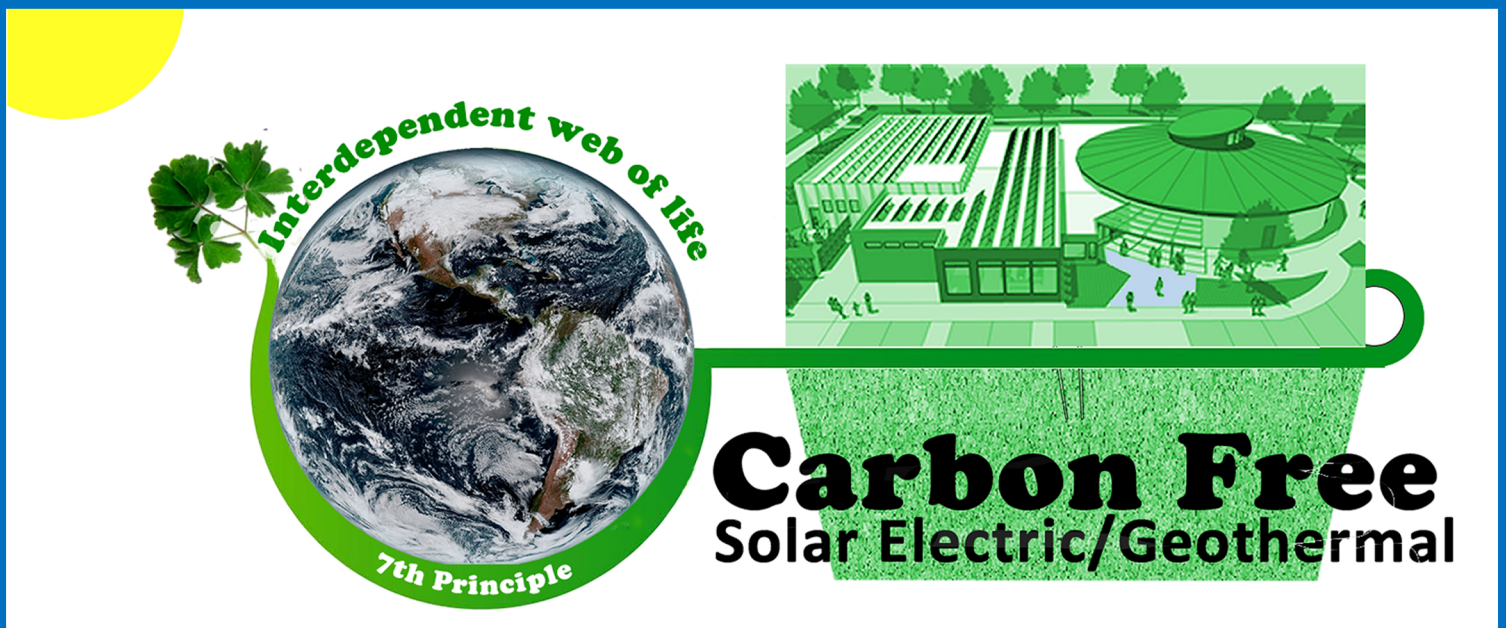


FROM THE GROUND UP

TRANSITIONING A FAITH-BASED FACILITY TO SUSTAINABLE ENERGY
USING SOLAR ELECTRIC AND GROUND SOURCE HEATING & COOLING



UNABRIDGED CASE STUDY: FIRST UNIVERSALIST CHURCH DENVER, COLORADO

ASSEMBLED AND REPORTED BY:
MILT HETRICK

FROM THE GROUND UP


Transitioning a Faith-based Facility to Sustainable Energy
Using Solar Electric / Ground Source Geothermal Heating & Cooling

Unabridged Case Study: First Universalist Church, Denver Colorado

Assembled and Reported by:

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Dedication

To all those who shared their experiences to help make this vision a reality,
To indigenous peoples who teach us how to lived connected to Mother Earth,
To all those who have gone before, whose wisdom poured our foundation.

“Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it's the only thing that ever has.”

...Margaret Meade

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“The most difficult transition to make is from an anthropocentric to a biocentric norm of progress.

If there is to be any true progress, then the entire life community must progress.

Any progress of the human at the expense of the larger life community must ultimately lead to a diminishment of human life itself.”

...Thomas Berry, “Bioregions: The Context for Re-inhabiting the Earth,” in *The Dream of the Earth*,

Preface

This book describes a recent renovation project where a medium size church transitioned from burning unsustainable fossil fuel to harvesting sustainable energy from inexhaustible sources (solar and ground source geothermal). To make that outward physical change in the facility, an internal change first had to take place within the congregation.

This multi-year project generated numerous emails, analysis reports, presentations, pamphlets, flyers, etc. along the way. This book simply extracts some of those records to tell the story of how one faith-based congregation set out on their transitional journey from fossil fuel to sustainable energy sources. What they encountered was unexpected.

The First Universalist Church Denver, founded in 1891, is one of over a thousand congregations embedded in the larger Unitarian Universalist Association of Congregations (UUA).¹ The First Universalist congregation consists of around 400 adult and 200 youth members.

For full disclosure, the reporter is a member of the First Universalist congregation and was involved in this energy transition project. By stepping outside the effort, it was possible to become a “scribe” and document some of the key events and ‘lessons learned’ that may be of use to others wanting to replicate similar goals.

This energy conversion project was partially embedded within a larger remodeling project of the church facility called ‘Building for the Future (BFF).’ The ‘Lessons Learned’ described in this book could also apply to a stand-alone energy transition project for other non-profit organizations since the funding for the new energy system ended up being independent of the main remodeling effort.

Frankly, looking back, even the scribe is utterly amazed this project actually took place. There were numerous times where hurdles and obstacles seemed to be insurmountable and the goal posts seemed to be always moving. However, during these difficult times, there was combined human energy that seemed to create a force that held the project together and enabled the team to find “workarounds.” Perhaps the impartial reader can see what happened more clearly than the scribe.

The story is real. The church is real. The people are real, but their names have been masked to protect personal privacy. The story documents the unavoidable conflicts that occurred among the diverse & passionate parties involved and how these differences were generally resolved.

To assure authenticity, the reporter includes excerpts from actual project documents and email correspondence (thinly veiled to protect the privacy and lightly edited for brevity) to help tell the story as it actually unfolded.

To orient the reader, there were several “groups” of people involved. Each group is defined by the bond (relational attraction) that held them together.

The Church. Groups involved in the internal transformation include:

- the congregation at large (church members and friends),
- the church leadership consisting of the Ministers, staff and a Board of Trustees,
- a building committee known as the ‘Building for the Future’ (BFF) committee plus several subcommittees including a three-person “Sustainability Subcommittee,” an ad hoc committee that functioned for about 4 critical months called the Renewable Energy Working Group (REWG), and
- a small social justice group referred to as the Green First Task Force, and
- a relatively small group of members (7%) who provided the capital required to purchase the new energy equipment (solar and geothermal).

The Contractors. Under the direction of the BFF Committee, the external change in the physical facility was implemented by professional contractors and building inspectors:

- the architectural design team (Barrett Studio Architects and DMA Mechanical Design)
- the construction team (Faurot Construction and their subcontractors) and
- an energy system commissioning consultant, Iconergy.

The Social System. In the process of telling this story, it becomes obvious the “Church” and “Contractors” are embedded in and influenced by a ubiquitous social structure including:

- a city building department, its codes, its permits, and its inspectors intended to protect and preserve public health and safety, and
- a complex social system consisting of multiple sectors (i.e. political, economic, legal, informational, ethical, and other subsystems) intended to assure a civil society and form a more perfect Union. This ubiquitous social

Preface

system is intended to influence its members/citizens in a way that creates a civil society. During the course of this project, it became obvious that currently the social system is not designed to influence citizens to make sustainable choices so new ways of thinking were employed. Examples are provided.

In general, the current social system did not prohibit the energy transition project; nor did the system encourage or expedite the project. So in this book, we ask, “What needs to change in our social structure to encourage rather than deter the transition to sustainable living so that we avoid the imminent sixth mass extinction we are currently bringing on.”

This somewhat mundane remodeling project turned out to be more than putting solar panels on the roof and changing out ten natural gas burning furnaces with geothermal heat pump furnaces. It provided insight into aspects of our social system that are in “Right Relationship.” It also identified insidious aspects of our social system that are influencing us to make harmful/ecocidal decisions. These destructive forces within our civil society will have to be identified and subjugated soon if homo sapiens are to survive and thrive beyond the 21st century.

Our tiny little project tucked away in the southeast corner of the City & County of Denver, Colorado, United States of America, is just a microcosm of a global existential issue, but it serves to uncover what is right and what is fatally flawed in our U.S. social system today.

By documenting key events associated with the funding and installing a 21st-century energy system

during this renovation endeavor, it is possible to identify some of the hurdles /challenges the church had to overcome as well as some of the successes they were able to celebrate.

As this story unfolds, we identify and maintain an awareness of these opposing external forces that were influencing our decision-making process. Although our current social system in the U.S. attempts to financially incentivize and thereby encourage homeowners and business owners to invest in sustainable/renewable energy, there are few if any such incentives for the non-profit sector. We discuss techniques to level the playing field for churches and other groups unable to benefit from tax-based financial incentives – including proposed federal legislation.²

Let there be no doubt, this project could not have been completed without the combined effort (human energy) of a significant number of people working toward a common purpose.

Finally, although this story involves a specific faith-based community that has its roots in the Judeo-Christian framework, it is based on a general “creation care” principle embedded in most world religions. Other religious communities can replace the UU Seventh Principle³ with their own creation story and sense of stewardship for Earth. But it is essential to find a common thread (i.e. a set of values) that can be used to bind the group together as they encounter the inevitable conflicts on this journey to live more sustainably.

Executive Summary

After approximately a year of internal discussion and dissension, conflict and compromise, a plan emerged to replace the fossil fuel energy system of First Universalist Church with a renewable energy system (using solar electric and ground source geothermal heating and cooling).

On 6 Nov 2016, the congregation voted unanimously to approve the plan and proceed with the installation of this new energy system.

Financing for the new equipment was arranged internally through member donations and low-interest member loans. The operating budget remained unchanged. Instead of writing monthly checks to a 'for-profit' utility company (Xcel Energy) for electric and natural gas, monthly 'utility payments' are now

used to repay the member loans over a 15-year time frame.

The church was closed for remodeling in August of 2016 and partially reopened for the Christmas Eve program 2017. Installation of the rooftop solar system was completed in March 2018. The new energy system became fully operational in June 2018.

The sustainable energy system has zero carbon emissions and avoids dumping 100 tons of CO₂ into the atmosphere annually. In addition, this new system saves about 150,000 gallons of precious western water annually.

Instead of buying and importing energy from the local utility company, the church now harvests energy that is already onsite (solar energy incident on the roof and thermal energy under the north parking lot) to operate the facility.

Transitioning to a solar and geothermal energy system is expected to reduce the 20-year life cycle operating cost for energy by over \$150,000 compared to an obsolete ecocidal fossil fuel based system.

Prolog – An Emergence?

“What is happening?” asked the Scribe.

“Emergence” replied the Sage.

“Emergence?” questioned the Scribe.

“Yes. Emergence, the creation of ‘something more’ from ‘nothing but.’” the Sage explains.

November 6, 2016

On this day, November 6, 2016, a dedicated group of people, members of a specific religious association in southeast Denver, Colorado voted unanimously to set into motion the creation of ‘something more’ (more capable, complex, and congruent with Nature) from ‘nothing but’ (things that already exist.) – Namely a Sustainable Energy System for their brick & mortar facility.

Because of their decision, just over a year later, a newly renovated church facility emerged that by design:

- Fixed a leaky roof,
- Accommodates more people in a larger Sanctuary,
- Provides more classroom space,
- Replaces aging equipment,
- Is more energy efficient,

AND the newly renovated facility

- Utilizes a sustainable energy system that harvests energy from the Sun for 100% of the electrical power and exchanges thermal energy with the Earth for 100% of the heating and cooling needs.
- Operates with zero greenhouse gas emissions and stops doing harm to future generations.⁴

As is often the case with emergence, unexpected unpredictable things are still unfolding, such as:

- A renewed sense of enthusiasm (and human energy) for the work of the church,
- The pride that the renovated facility reflects the core values of this spiritual community, and
- Relief that the church facility is no longer doing harm to the future of our children and their children

The reporter of this case study has chosen to borrow the concepts of ‘emergence’⁵ and “Ecomorality: the ethics of Sustainable Living” from biologist and Religious Naturalist Ursula Goodenough and use them as a unifying structure for this story. Dr. Goodenough points out that creating ‘something more’ from ‘nothing but’ something that already exists can be

observed throughout the entire Universe Story beginning with the Big Bang.⁶ In fact, emergence seems to be inherent in the evolution of all living systems. Homo sapiens themselves can be considered as another emergence along the path of evolving consciousness.

Dr. Goodenough’s concept was extended slightly:

Sustainable Emergence is the creation of ‘something extraordinarily’ [complex and congruent with Nature] from ‘nothing but’ that which already exists [by forming ‘new relationships’ that are brought together by an ‘external source of energy.’]

By extending the idea of emergence in this manner we acknowledge the ‘new relationships’ that have been formed as part of this project. In telling the story we will try to become more aware of the ‘external sources of energy’ and the forces involved in this latest emergence.

How Did This Emergence Happen?

Q: “How did the church transition to solar and geothermal sources of energy and stop doing harm?”

A: It is complicated. Details are in this book.

Q: “Can this energy transition project be replicated by other faith-based or non-profit organizations?”

A: Yes. Generic “Lessons Learned” that can be used by other ‘non-profit’ organization are woven into this story.

Q: Was there a guiding light for this project?

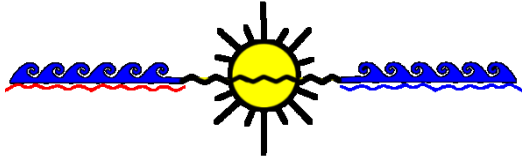
A: Yes. It was a multi-color light emanating from faith-based values, scientific awareness, evolving technology and even wisdom borrowed from distant cousins in the phylogenic tree of life - the interdependent web of life.

Q: So was biomimicry involved?

A: Indirectly. The value system of the people involved in this project included deep respect for Nature and its interdependent web of life – the Unitarian Universalist version of creation care.

That the proposed sustainable energy system for their facility was humbly (albeit crudely) mimicking the energy system of a plant was not lost to the people involved.





Introduction

“Storytelling is the oldest form of education.”

...Terry Tempest Williams

The story teller is faced with the question
“Where does this story begin?”

Everybody’s Story

With today’s scientific awareness, “Once upon a time” can now take our mind back 13.7 billion years along a continuous golden thread of connectedness that is “Everybody’s Story.”⁷

To be alive today and able to reach back that far into the past is a profound historical privilege never experienced by previous generations. Thanks to brilliant minds who peered outward through the Hubble Telescope and meticulously observed what they can still see, we have a better understanding of not only our origin but also where we are headed. Hubble seems to have made time deeper and ironically irrelevant. Within its field of view, we can now see examples of our own star in the past, present, and future. We can now see innumerable examples (there are an estimated 100 billion galaxies each containing as many as 100 billion stars/solar systems) of our Mother Star who gave birth to our solar system (and billions of others experiments in a broad range of sizes).

We know our Mother Star was at least in the supernova class because our solar system and planet contain elements beyond iron in the periodic table. Elements heavier than iron were formed at the end of her life as she collapsed, and then exploded. The extreme conditions created during the explosion formed species more complex (heavier) than iron. As the star stuff blasted out in all directions, a small portion of this matter reformed into a new gravitational system we call our Solar System. At the center of this next generation gravitational system, a much smaller star was born we call our Sun.

Thanks to telescopes like Hubble, we extended our ability to see nearly to the edges of the Universe. Now we can see likenesses of our Sun being born, living and dying and know that our Sun is in its mid-life. Someday, about 5 billion years from now, it too will join the ranks of the other red giants and white dwarfs we can see throughout the Universe.

For a fleeting moment, one can sense an empowering connection with the entire expanding Universe. After all, we living systems on Earth are but ingenious arrangements of the same star stuff observed throughout the Universe and held together by the same four forces of nature⁸.

When we turn our telescopes around and use them as microscopes, we can see paleontological and biological evidence of a 3.8 billion year journey of Life on Earth up to the present moment.

In the relative calmness and coolness provided by the crust of planet Earth, we can see continuous threads of evolving complexity of diverse arrangements of basic star stuff.⁹ Sharing the planet with us today are now more than 2 million unique living species. Astonishingly, species living today are a mere 1% of all the species that once lived and gone extinct. We, homo sapiens and our extended family of distant cousins alive today are the descendants of those uncommon species able to survive 5 known mass extinctions recorded in the deep history of our planet.

We have evolved to be a miraculous functional species powered indirectly by the energy of our star aka Sun. We are now aware in the language of science that without a continuous connection to an external source of energy, living systems on Earth simply return to a pile of stardust. We can also observe that the preferred source of energy for complex eukaryotes can be traced back to sunlight – solar energy - the electromagnetic energy that emerges from a continuous fusion of hydrogen at a relatively safe distance of 93 million miles (150 million kilometers)¹⁰ away.

But there is more to our story. To be alive today is a profound historical privilege never experienced by previous generations because brilliant minds can now look inward with the electron microscope. Computer visualizations allow us to read our personal “How to Assembly” instructions written in the language of DNA. We now have phylogenetic evidence that all living systems have a last universal common ancestor (LUCA) dating back billions of years. In the language of science, all living species on Earth are connected by remarkably similar DNA and appear to share a common ancestor

Introduction

that lived 3.5 to 3.8 billion years ago.¹¹ One of the more delightful, easy-to-understand discussions of our evolutionary path can be found in a brilliant book “Your Inner Fish: A Journey into the 3.5 billion-year history of the human body” by Neil Shubin, a paleontologist, and professor of anatomy at the University of Chicago. Shubin states that the best road maps to human bodies lie in the bodies of other animals because *“the bodies of these creatures are often simpler versions of ours.”*

This is everybody’s creation story.



Responding to Everybody’s Story

Upon hearing the creation story expressed in the language of science, some of us may avoid the feeling of insignificance and isolation in such a vast Universe by emotionally connecting with our interdependent web of life. We can then sense our significance knowing that we each play a unique role within that web. We seemed to have evolved with an insatiable curiosity that has expanded our awareness of the Universe. As a result, humans have become a miraculous system of star stuff that allows the Universe to look back upon itself.

Some of us may respond with a sense of gratitude, even pride, to know that we are survivors of at least five mass extinctions since life began on our planet. Somehow, our primordial ancestors adapted to those previous extinction events created by forces beyond their control and found a way to survive those precarious times. We, along with our current living cousins, are the new growth on the outer branches of the phylogenic tree of life.

Considering Homo sapiens walked out of Africa around 200,000 years ago, it was like yesterday that we began to become slowly aware of an existential issue of global warming caused by the behavior of an exploding population of now over 7 billion people.

Let us be clear, there is nothing wrong with the Universe or our solar system that is the root cause of today’s climate change. The Universe has provided everything needed for life to thrive on planet Earth in the foreseeable future. We can observe that all living systems require an external source of energy – and our Sun, now in its midlife, has provided life-sustaining energy for the past 5 billion years and appears to have enough hydrogen fuel for another 5 billion years. In fact, life scientists have described Earth as a Goldilocks

planet, i.e. it is “just right” for life to evolve and thrive. (Especially diverse complex living systems.)

Let us be clear, the root cause of today’s climate change is ecocidal human behavior. Despite unheeded warnings of climate scientists around the world, we continue to extract and burn ancient hydrocarbons as our primary source of energy to operate out the technology. The combustion process that releases energy in the form of heat (thermal energy) also dumps CO₂ and other GHG into our atmosphere. As we watch the Keeling Curve shown in Figure 1 is updated on a daily basis by the Mauna Loa Observatory¹², we can see the level of CO₂ in our atmosphere continues to increase relentlessly over the past 6 decades. This upward trend must stop, level off, and start to decline within the next decade if we want to have hope for a habitable planet for complex land species in the future.

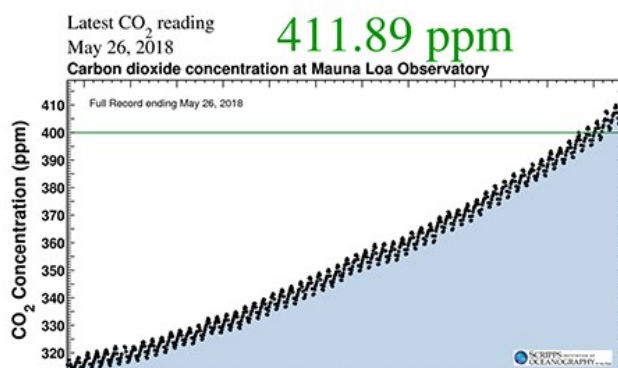


Figure 1 Global CO₂ Levels Continue to Increase

The laws of nature have been benevolently constant as far as we can tell day after day for the past 13.7 billion years. The good news is that today, thanks to meticulous observations of our natural world integrated by reason and logic, we collectively know what most of these natural responses (laws of nature) are. These natural responses have been captured and cataloged (e.g. Newton’s laws of motion) in the language of physics and mathematics. So with modern computers, advanced instrumentation, physical & mathematical models of nature, we can now replicate what has happened in the past (to verify the models), update the information using what is now, and begin to predict what is most likely going to happen in the future.

As we look ahead, there are some ominous predictions if we continue on the current path.



Acknowledging the effects of human behavior

There is no question that understanding how seven billion people are affecting/changing our planet is the most complex task humans have ever undertaken. To fully understand Gaia's complex dynamic systems sufficiently to be able to predict the future requires an awareness of, a physical & mathematical understanding of, and an ability to precisely monitor/measure nearly every natural phenomena that can affect the habitability of this planet – not to mention the recently acknowledged anthropogenic effects.

Within the past 50 years, we began to realize that burning more of the buried reserves of ancient hydrocarbons (aka coal, oil, natural gas, tars oil, shale oil) is ecocidal behavior. Slowly we began to compile convincing scientific evidence that our burning behavior was changing the levels of greenhouse gas (GHG) in our planet's atmosphere. We became aware of irrefutable evidence that the levels of GHG were increasing precipitously. The basic laws of thermodynamics such as the Conservation of Energy predicted that we were causing a significant energy imbalance with our Sun by dumping enormous amounts of invisible CO₂ and other GHG gases - around 40 gigatonnes (40 billion tons) into the atmosphere each year.



Responding to Global Warming

It was at a global family reunion in December of 2015, known as COP 21, that the world community acknowledged this imminent danger and agreed to limit global warming to 2 deg C with an effort to keep warming to below 1.5 deg C. This means that GHG emissions must be eliminated, stopped, go to zero within 15-20 years to limit warming to 1.5 deg C. and within 20-30 years to limit warming to 2 deg C.

As a religious denomination, the Unitarian Universalist Association (as well as a number of other denominations) has expressed its concern about global warming so the story describes some of the early UUA initiatives (General Assembly Resolutions in 2006, 2014, 2015) and the sponsorship of the UU Ministry for Earth (UUMFE).

The story continues and focuses specifically on First Universalist and their formation of the Green First

Task Force, that lead to its Green Sanctuary Certification in 2011.

It was about that same time that the Green First Task Force began to advocate for the installation of rooftop solar in response to the ever-rising levels of CO₂ caused by burning ancient hydrocarbons to generate electrical power.

We find a several year hiatus in the story while the church is deciding what to do about renovation, etc.

The story then begins to get more specific, requests are made, agreements are made, bent and broken, goals are set and moved, skepticism, fiduciary responsibility, values, UU purpose, and principles are re-examined, conflict arises and managed if not resolved, BUT eventually, a congregational level response emerges. And that's the story.

It not clear how it actually came together; but in the end, the renovated church facility made the transition to a sustainable energy system. By using solar energy and ground source geothermal energy instead of burning hydrocarbons, the church facility no longer does harm to the planet or the future of its youth.

"The best way to predict your future is to create it,"

....."Inventing the Future" by Dennis Gabor, 1963

Existential Issue - Unsustainability

As we move through this case study, we attempt to point out the external factors that are preventing our church and other non-profits from transitioning to renewable energy. We identify aspects of our social system that are influencing us humans to make choices that are unsustainable.

It is obvious that as these human-created laws and principles and practices evolved, they did so with limited consideration of the effects of human behavior on the habitability of the planet. We are now more aware that humans are foiling their nest. It is way past time to use this new found awareness to update our social system so that influences us to avoid ecocidal behavior. We can only point out what is wrong and suggest a few possible changes. It is up to civil society as a whole to develop changes consistent with our diverse cultures.

This is also the guiding spirit of the 2015 Papal Encyclical in which Pope Francis states:

Introduction

"I would like to enter into dialogue with all people about our common home... since the environmental challenge, we are undergoing concerns and affects us all."

Ref: Encyclical Letter Laudato Si' of The Holy Father Francis on "Care For Our Common Home."

http://w2.vatican.va/content/francesco/en/encyclicals/documents/papa-francesco_20150524_enciclica-laudato-si.html

What this story is about

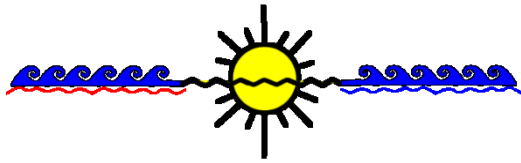
In this story, we can see how a fuzzy vision of 'what might be' transform into a physical reality of 'something new that is.' We see how this 'something new' emerges that better reflects the values/ethics/morality of this faith-based community. We see another example of how we can borrow star stuff from Earth and mindfully fashion these natural resources into a meeting place that no longer does harm to our interdependent web of Life.

End Result

Although it was a bit of a struggle to get there, the Congregation seems pleased that their new energy system allows them to operate their worship facility without doing harm linked directly to burning ancient hydrocarbons. The church no longer imports energy for operations. The new energy system allows them to honorably harvest the energy that is already onsite. Using 21st century equipment, the facility can:

- harvest sunlight and generate all the electrical power needed by using a rooftop solar photovoltaic (PV) system, and
- exchange thermal energy (heat) with the Earth (and/or surround air) for all the church's heating and cooling needs by using air and/or ground source heat pumps, and
- heat their domestic hot water (DHW) using solar electric augmented with an air-source heat pump.

Fossil fuel derived energy is no longer needed to operate their facility.



Part I: An Awakening- a Growing Awareness- an Evolving Collective Consciousness (Pre 2007)

"The most remarkable feature of this historical moment on Earth is not that we are on the way to destroying the world... It is that we are beginning to wake up, as from a millennia-long sleep, to a whole new relationship to our world, to ourselves and each other."

-- Joanna Macy

We have divided our story of transition from a fossil fuel based energy system to a renewable energy system into six chronological segments. Part I recalls some key events in recent human history that set the stage for this project.

For those, past and present, who contributed their human energy to support this project, we acknowledge and honor their awakening. Today our collective consciousness, our environmental awareness is the accumulation of heroic efforts by those who have gone before. Therefore, it is appropriate to trace our environmental awakening and source of motivation back in time.

To set the stage for our story, we cite a few 20th-century historical environmental milestones.

Rachel Carson's Silent Spring (1962) – an early milestone in our awakening

"... books have at times been the most powerful influencer of social change in American life. ... Rachel Carson's **Silent Spring**, which in 1962 exposed the hazards of the pesticide DDT, eloquently questioned humanity's faith in technological progress and helped set the stage for the environmental movement."

- Excerpt from the Natural Resources Defense Council (NRDC) Website
[<https://www.nrdc.org/stories/story-silent-spring>]



EarthRise – Apollo 8 (December 24, 1968) – a



Figure 2 Earth as Seen from Lunar Orbit December 1968
profound awareness of Spaceship Earth

Like books, images can have a profound impact on our evolving consciousness.

Apollo 8 astronauts Borman, Lovell, and Anders provided the profound visual perspective seen in Figure 2 during a live broadcast from lunar orbit on Christmas Eve 1968. They photographed the Earth and Moon as seen from their spacecraft window.

Said Lovell, "The vast loneliness is awe-inspiring ... you realize just what you have back there on Earth."

"Vast loneliness" acknowledges we earthlings are alone in the vastness of space and we are all in this together.

The "vast loneliness" of the Earth Rise photo reminds us there are no power lines coming to us bringing electricity. There are no pipelines bring us oil or gas from outer space. There are no water pipes bringing us potable water. There are no trucks, trains or planes from outer space bringing us food to eat. There are no sewer lines to carry away our human-created toxic wastes. Nor should we ever expect any.

"Vast loneliness" acknowledges our planet is neither flat nor is it round (as a circular shape cut from a piece of paper). As shown in the Earth Rise photo, our planet is spherical and finite – as are all of the resources we require to sustain life. Learning how seven billion homo sapiens can live sustainably on such a finite planet has become one of today's foremost existential issues.

Part I An Awakening (Pre 2007)

“Vast loneliness” acknowledges that the barren lunar landscape in the foreground of Figure 2 is obviously unable to sustain life as is. Although our Moon is a faithful orbital companion that adds stability to an otherwise wobbly rotation, our Moon is no green Garden of Eden teeming with diverse forms of life nor is it a ready source of basic resources (such as water and oxygen) to support human life. Nor are the first, second and fourth rocks from the Sun.

Having landed several spacecraft and roving scientific vehicles on that fourth rock, we now know living conditions are not so good on Red Planet Mars.¹³ Earth is pretty much where life in our solar system thrives today. Earth appears to be the preferred place for us to thrive and expand our consciousness. There is no Planet B within our current reach.

Granted we have many distractions. We are surrounded by a rising tide of ecocidal behavior at the moment. This realization became a source of motivation to take on the church’s sustainable energy system project described in this document.

Bringing any form of life, as we know it, to an end by continuing our unsustainable behavior is inconsistent with our core values. As a species, we are awake enough to know our current behavior is ecocidal. Fortunately, we are conscious enough to know the Universe (and human creativity) have provided viable sustainable alternatives.

Not shown in Figure 2 (because it is about 93 million miles above and to the right of this photo) is our Sun that continuously envelops our planet in life-sustaining energy. This existential gift is often something we “take for granted.” Perhaps because of overfamiliarity, we fail to appreciate properly the daily gift of energy that supports the interdependent web of life on planet Earth. As living systems turn to face the Sun each morning, they are offered this gift; what they do with their gift of Sunlight is their choice. They can harvest this daily energy (as do 2 million other documented living systems) to enhance their lives. Or ignore it and continue to waste this life-supporting energy from our Sun – and instead continue to scratch, drill and dug into Mother Earth for her finite reserves of ancient sunlight transformed into ancient hydrocarbons for storage.

To be more specific, the church lot receives around 12,000,000 kWh of free energy from our Sun each year.¹⁴ Approximately 242,000 kWh were needed before the renovation project to provide electrical power and heat for the church facility. So operating the

church requires around 2% of the solar energy it receives from the Sun each year. There is no reason to insist on burning the world’s precious finite supply of ancient hydrocarbons as a source of energy for operating the church facility. Up until Mar 2018, most of the free energy incident on the church roof (and in the parking lots) was converted into waste heat. By burning ancient hydrocarbons, the church became responsible for dumping 100 tons of GHG into the atmosphere each year. Secondly, they do harvest a small portion of the Sun’s energy with a few trees, some flowers, grass and other plants around the building that in turn convert some of this solar energy into biomass. An outside observer might have concluded this was not a very grateful acknowledgment of a precious gift of life-sustaining energy – but that is about to change if new sustainable energy can be financed.



Blue Marble-Apollo 17 (Dec 1972)

Later ventures into space have since captured images of the entire Earth’s surface – as seen in daylight (Figure 3) and as seen at night (Figure 4).

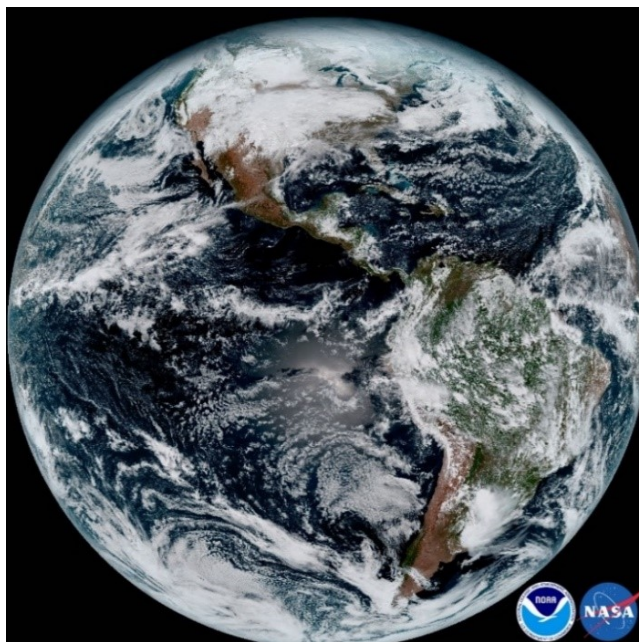


Figure 3 Earth by Day

What our eyes see in the photo ‘Earth by Day’ is actually ‘current sunlight’ reflecting off various areas of our planet often called albedo. It is easy to forget that the source of energy for life on planet Earth comes to us daily as a gift from a source 93 million miles away.

Part I An Awakening (Pre 2007)

In contrast, the 'Earth by Night' photo is predominately "light from antiquity."

Around 300 million years ago, ancient Sunlight was stored as biomass called coal (chemical energy in the form of hydrocarbons). Today, the fossil fuel burning industry is extracting these ancient hydrocarbons at a frenzied pace from deeper and deeper within the Earth.

When these ancient hydrocarbons ignite/burn they produce fire and heat for making steam to generate electrical power or to drive our internal combustion engines. Some of that electrical power is then transformed back into the light we see in photo "Earth by Night." This is light from antiquity. The lights seen from space at night leave no doubt where human technology (and energy consumption) currently abounds.



Figure 4 Earth by Night – Human Created Light

Today everyone knows that burning hydrocarbons produces the greenhouse gas CO₂. In fact, we know that burning 1 pound of carbon produces 3.67 pounds of CO₂¹⁵ Mining coal has been known to be a dangerous, debilitating and potentially lethal occupation. As it turns out, burning coal is also dangerous, unhealthy and potentially lethal for all life on the planet. Continuing to burn carbon as a fuel because it is cheaper based on a broken economic measuring stick defies reason and logic.

Because humans cannot "see" CO₂ with the naked eye, deniers, who refuse to use modern instruments to enhance their "seeing," can persist among us. Paradoxically, these deniers are often self-blinded by

profit, greed and dark money that obscures their moral vision.

The ramification of continuing to burn these ancient hydrocarbons is that the amount of CO₂ in our common atmosphere continues to increase. During the lifetime of the reporter, the concentration of CO₂ has increased from less than 300 ppm to over 400 ppm and is steadily rising. Other greenhouse gases linked to the extraction, transportation, and combustion of ancient hydrocarbons are also increasing steadily.

Basic physics known since the mid-1800s tell those willing to listen that this increase in greenhouse gas (GHG) in our atmosphere is trapping more and more thermal energy on planet Earth. The natural law referred to as "the conservation of energy" is as well known and verified as the law called "gravity." We can see the apple fall from a tree, but we cannot see thermal energy with just our eyes. However, human creativity has extended our vision by using technological instrumentation (such as infrared cameras). Using infrared cameras in space, it is possible to actually see the electromagnetic radiation (infrared light) coming from our planet is indicated in Figure 5. The colors relate to the temperature of the surface that is radiating this energy.¹⁶

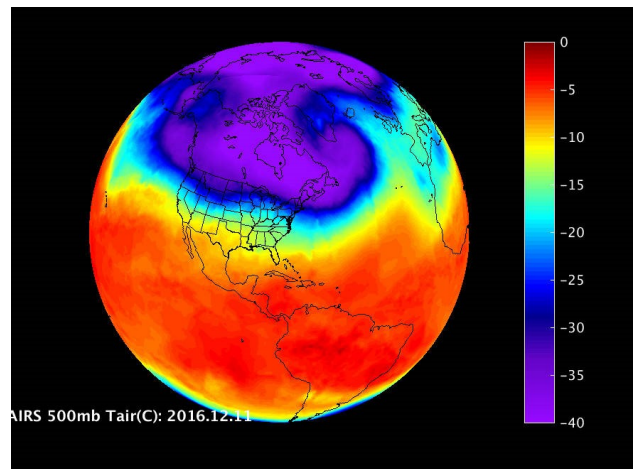


Figure 5 Earth's Actual "Light" as seen by the AIRS Instrument on NASA's Aqua Satellite (11/12/2016)

What will the 'Earth by Night' look like in 100 years? The answer actually depends on whether or not this case study (and others like it) are replicated to reduce GHG emissions to zero within the next 10-20 years.



Limits to Growth (1972)

The Limits to Growth was published by Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III in 1972. The authors documented their use of computers to simulate exponential economic and population growth on a planet with finite resources.¹⁷ This computer modeling project was commissioned by the Club of Rome, it simulated^{18,19} the consequence of interactions between the Earth's and human systems.

This was probably one of the first attempts to quantify the complex interaction between Earth's systems and human activities. The results/predicted trends were at best sobering and the origin of a renewed awakening.

The original version presented a model based on five variables: world population, industrialization, pollution, food production, and resources depletion. These variables are expected to grow exponentially, while the ability of technology to increase resource availability is only linear.²⁰ The authors intended to explore the possibility of a sustainable feedback pattern that would be achieved by altering growth trends among the five variables under three scenarios. They noted that their projections for the values of the variables in each scenario were predictions "only in the most limited sense of the word," and were only indications of the system's behavioral tendencies. Two of the scenarios saw "overshoot and collapse" of the global system by the mid to latter part of the 21st century, while a third scenario resulted in a "stabilized world."²¹

The book continues to generate fervent debate and has been the subject of several subsequent publications. The most recent updated version was published on June 1, 2004, by Chelsea Green Publishing Company and Earthscan under the name *Limits to Growth: The 30-Year Update*. Donella H. Meadows, Jørgen Randers, and Dennis Meadows have updated and expanded the original version.^{22, 23, 24}

UU Ministry for Earth (UUMFE) (1989)

A separate non-profit organization with close ties to the UUA focuses on environmental issues, called the **UU Ministry for Earth**.

(Excerpts from www.UUMFE.org website) (<http://uuministryforearth.org/>)



Figure 6 UUMFE is an adjunct of the Unitarian Universalist Association of Congregations.

"Although the UU Ministry for Earth has close ties to the UUA, it is a separate not-for-profit 501(c)3 organization with an independent Board of Directors. As an independent non-profit organization, most of UUMFE's funding comes from memberships, donations, grants, and resource sales. As a result, the UUMFE resources are available to each member congregation.

About UUMFE

Connecting and inspiring an active community of UUs for environmental justice, spiritual renewal, and shared reverence for our Earth home.

The UUMFE Vision:

We envision a world in which reverence, gratitude, and care for the living Earth are central to the lives of all people. Our purpose is to inspire, facilitate, and support individual, congregational, and denominational practices that honor and sustain the Earth and all beings. We affirm and promote the principles of the UUA, including the UU Seventh Principle "Respect for the interdependent web of all existence of which we are a part."

UU Ministry for Earth History

Part I An Awakening (Pre 2007)

The concept began in 1989 with discussions about how to make the Seventh Principle of the UUA more central to members, congregations, and the Association. The Seventh Principle Project was formed and the first edition of the **Green Sanctuary Handbook** was published in 1991 blending religious celebrations, education, administration, and community action. In 1999, Rev. Fred Small inspired a national environmental program. In 2002, The Seventh Principle Project incorporated and the Green Sanctuary program began accrediting congregations. In 2005, the organization changed its name to Unitarian Universalist Ministry for Earth.

UUMFE was instrumental to the passage of the landmark 2006 Statement of Conscience on the Threat of Global Warming/Climate Change. In 2008, UUMFE gave the Green Sanctuary program to the UUA to administer and began refocusing on environmental justice while still providing support to congregations with their Earth ministry.

NOTE: First Universalist Denver completed certification as a Green Sanctuary in 2010 (Thanks to the work of Tom Abood and many other members of the Green First Team).

The Green Sanctuary Program

The Green Sanctuary Program provides a path for congregational study, reflection, and action in response to environmental challenges. The Green Sanctuary Program, now in its sixth edition, partners with congregations to address climate change and environmental justice. Congregations that complete the program are accredited as Green Sanctuaries in recognition of their service and dedication to the Earth.

This program provides a structure for congregations to examine their current environmental impacts and move towards more sustainable practices in ways grounded in Unitarian Universalism. The program has four focus areas:

Environmental Justice²⁵ acknowledges that marginalized communities are often hit first and hardest by environmental crisis. In partnering with these communities we are able to address human and environmental needs at the same time. Environmental Justice emphasizes a shift from providing charity to working in solidarity with the communities most affected by climate change.



Worship and Celebration²⁶ is the heart of Unitarian Universalism. As we work together towards a cleaner, more just and sustainable world, worship enables us to stay connected to each other and to celebrate the work we have accomplished.

Religious Education²⁷ shapes more than just minds. It shapes attitudes and practices.

Sustainable Living²⁸ requires us to treat the world more gently by using fewer resources and being mindful of the choices we make.



Commit2Respond

Excerpts from their website:
(<http://www.commit2respond.org/>)

THE WORLD IS HURTING. HOW WILL YOU RESPOND?

We are facing a climate crisis. Climate change is already causing suffering for peoples around the world every day. Recognizing the interdependence of all life, we are called as people of faith and conscience to heal and sustain the planet we call home.

What is COMMIT2RESPOND?

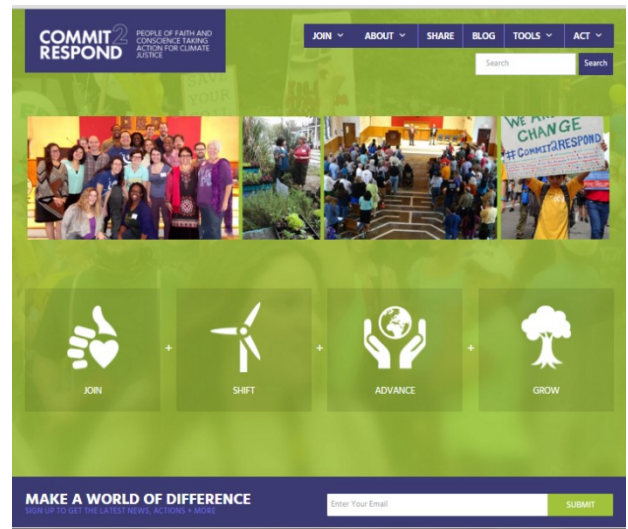


Figure 7 Commit2Respond is a coalition of Unitarian Universalists working for climate justice.

Commit2Respond is a coalition of Unitarian Universalists and other people of faith and conscience working for climate justice.

Unitarian Universalists and other people of faith and conscience have been on the frontlines of

Part I An Awakening (Pre 2007)

environmental justice for decades. United in collective action, connected through partnership, we will change the world.

We are diverse in spiritual belief, yet united in faith that a better world is possible and that our collective power can create change.



Interfaith Power & Light – Creation Care (1992)

The Abrahamic religions (Judaism, Islam, Christian, Mormonism) generally trace the origin of Creation Care to Genesis 2:15. Other world religions, including the belief system of native/indigenous peoples, also have creation stories that include acknowledgment, respect, and even reverence for all forms of life and elements of our natural world.

(Excerpts from the website: <http://www.ipl.org/>)

Fifteen years ago [1992] Rev. Sally Bingham and the Rev. Ben Webb founded The Regeneration Project (TRP), with a mission of deepening connections between ecology and faith. TRP is now situated all over the country, sponsoring specific initiatives to slow climate change and persuade people of faith to reduce energy use and embrace conservation. We do this under the catchy name of Interfaith Power and Light. TRP organizes and maintains an affiliated network of Interfaith Power and Light programs across twenty states. We educate not only with tools and ideas on energy conservation but spell out the moral reasons too....

People are seeing, hearing, and feeling the consequences of global warming -rising seas, more severe storms, and changing weather patterns. Ice is melting even faster than predicted in the Antarctic and at both poles.

As people awaken to the problem and make changes in their own lives -and laws on the horizon curb greenhouse gases -I cannot hold back my optimism. We may well be on the way to saving our children and grandchildren from potential catastrophe. We may well show that we do, in fact, love our neighbors and are willing to show it by investing in a clean-energy future to secure a healthy environment for generations to come.

Congregations that join our state-level Interfaith Power and Light programs agree to make their

buildings more energy efficient, practice conservation, and, where possible, use renewable energy -and serve as an example to their individual members.

The religious leaders of a state Interfaith Power and Light program become public advocates for weaning America off its dependency on fossil fuels. In our work to influence public opinion and policy, we write letters to decision makers, publish high-profile ads in newspapers, and visit legislators to discuss the moral reasons for addressing the climate crisis. We have gained considerable media attention; many of our congregations have been featured in local newspaper articles, seen on television, or heard on NPR.

Currently, about 4,000 congregations participate, each of which showed the film *An Inconvenient Truth* to congregants in October 2006. This film gave the scientific evidence that people need to put their faith into action. Collectively the Interfaith Power and Light state groups have purchased and installed thousands of compact fluorescent light bulbs and hundreds of Energy Star appliances influenced Renewable Energy Standards and Clean Car legislation and lobbied for numerous greenhouse-gas-reductions bills now in Congress.

We hold an annual conference so all the leaders of IPL programs can share best practices and the religiously rooted reasons for accomplishing our goals. We work with evangelicals, Jews, Catholics, mainline Protestants of all denominations, Buddhists, and Muslims.

The religious voice has always been important in the history of reform in America, shaping the debate on abolition, women's right to vote, and the civil rights movement. We hope to lead again as agents of change so that this nation will never be in conflict with other countries over scarce oil supplies. A transition to clean and healthful paths of creating energy is not only a way to create jobs and save money, but also an essential part of saving creation.

To join or start a program in your area, go to www.theregenerationproject.org .Once there click on your state to see if there is an existing program. The site will walk you through the steps it takes to join. Or call our office at (415) 561-4891 in San Francisco.

Ref: Reflections, Spring 2007, Volume 94, #1

Part I An Awakening (Pre 2007)

Interfaith Power & Light

Mobilizing Faith Communities to Care for Creation

Our Mission and Vision

IPL embraces being “all in” on the Paris Agreement, transitioning by 2020 to limit global warming to “well below 2°C” (by which we mean no more than 1.5°C). We believe that **communities of faith need to lead the climate response**, just as they led the Civil Rights movement.

In 2017, National IPL founder Rev. Sally Bingham announced a set of priority areas as part of a co-authored paper with Christiana Figueres in the scientific journal, *Nature*.

1. Decarbonize electricity by 2020, with a focus on our local electricity systems.
2. Fully decarbonize cities and states by 2050
3. Implement a preference for EVs in new purchases by 2020 (ultimate phase out of gas/diesel vehicles).
4. Assure equity so that all sectors of society make these transitions on the same schedules, subsidizing the energy poor in order to achieve the common good of addressing climate change.

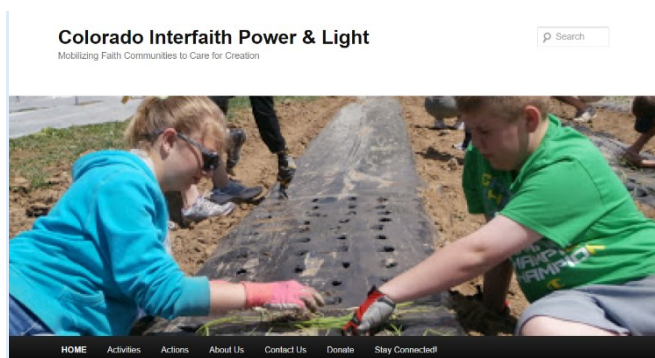


Toward System Change not Climate Change - 22 Sept 2018

2

Colorado Interfaith Power & Light, Mobilizing Faith Communities to Care for Creation

<http://www.coloradoipl.org/>



Our Mission and Vision

Our mission is to educate and energize Colorado’s diverse faith communities to care for God’s creation.

We focus on climate change as one of the most pressing threats to our planet.

We believe that communities of faith need to be and will be in the leadership of caring for God’s creation by educating their communities about the causes and consequences of climate change; discovering and implementing ways to improve their own creation stewardship and reducing their carbon footprint; and advocating with government representatives for public policies that will move the world away from its harmful dependence on fossil fuels and toward healthier, more sustainable ways of producing and using energy.

Colorado Interfaith Power & Light is part of a nationwide Interfaith Power and Light movement, with 40 other state organizations and a national [Interfaith Power and Light](#) organization based in San Francisco.

After several years of supportive sponsorship and guidance by the Green Heart Institute, in 2009, CoIPL moved under the fiscal sponsorship of the Colorado Nonprofit Development Center, a Colorado-based 501c3 that provides services to help Colorado nonprofits grow and become independent.

Washington Interfaith Power & Light

<http://earthministry.org/about/>

Earth Ministry actively engages people from a variety of faith traditions on climate and energy issues through our Washington Interfaith Power & Light (WAIPL) project. WAIPL is part of the 14,000 congregation-strong Interfaith Power & Light national network, now active in 40 states across the country. We host interfaith workshops, worship services, training, and advocacy opportunities in partnership with a diversity of Jewish, Christian, Muslim, Buddhist, and other faith communities across the state.

GreenFaith (1992)

(Excerpts from the website:

<http://www.greenfaith.org/about/history-1>)

“GreenFaith was founded in 1992 under the name **Partners for Environmental Quality** by Jewish and Christian leaders who believed the religious community needed an organization to connect diverse religious traditions with the environment. “

“In the late 1990s, Jewish and Episcopal Communities in Newark began promoting the use of renewable energy by religious institutions and people of faith. In the early 2000s, we focused our efforts on energy conservation and the use of renewable energy in religious institutions. Since 2003, in partnership with Sun Farm Network, GreenFaith launched Lighting the Way, a program that has installed 25 solar arrays on religious institutions around the state.”

One of the more recent GreenFaith projects was to partner with Climate Outreach in a study of climate change communication among the various world religions – a summary document was published that helps climate advocates select the appropriate terminology for most effective communication within each of 5 faith communities. Jewish, Christian, Muslim, Buddhist, Hindu. “Faith & Climate Change: A Guide to Talking with the Five Major Faiths,” George Marshall.

Faith shapes the values and behavior of billions of people. In 2015 there was a surge in action on climate

Part I An Awakening (Pre 2007)

change from faith groups - and with more than 8 in 10 people worldwide identifying with faith, we need to keep that momentum going. For climate communicators both within and outside faith communities, there is a need to better understand the language that works when trying to lift up the desire for action from the world's people of faith.

“This guide is intended to provide **practical guidance for climate communicators, both inside and outside faith communities**, about what language works well and – crucially – what language might pose an obstacle for communicating with any specific faith group.

In April 2015, GreenFaith asked Climate Outreach to develop and test language around climate change that could mobilize activity across **five main faith groups (in alphabetical order: Buddhism, Christianity, Hinduism, Islam, Judaism)** in the run-up to the 2015 world climate conference in Paris.

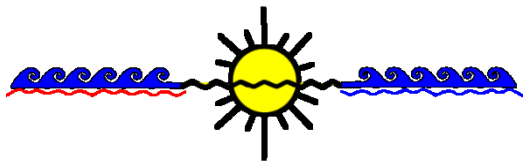
This research may be the first of its kind: **not only does it seek language that works with each of the faiths, but it also seeks language that works across all of them.**”

A new guide, produced in partnership with international interfaith group GreenFaith, is based on pioneering international social research. This practical guide not only presents language that works with each of the world's 5 main faith groups (Buddhism, Christianity, Hinduism, Islam, and Judaism) but also a language that works across faiths - and language that doesn't work.

Five (5) narratives that work across faiths:

- **Earth care - a precious gift**
- **Climate change is a moral challenge**
- **Climate change is disrupting the natural balance**
- **We live our faith through our actions**
- **I take a personal pledge “**





Part II Pre-BFF Period (2007 to May 2014)

“Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it's the only thing that ever has.”

...Margaret Meade

This story of transition from a fossil fuel based energy system to a renewable energy system has been divided into six chronological segments. Part II describes related activities and events that occurred before the major “Building for the Future” (BFF) remodeling project was officially initiated in May 2014.

The idea to transition from a fossil fuel based energy system to a sustainable renewable energy system began several years before the BFF Remodeling Project formally started. It is not known how much, if any, of the early “environmental awareness” activities, had an influence on the transition to a new energy system, but these related “Pre-BFF Project” activities are included as background for the story.

Those involved in this project are aware they built upon the foundation laid down by others. If there is any hope to replicate this project by other groups in the future, it is important to understand the key aspects of that groundwork. To replicate this project, it is also important to understand the motivation – the source of human energy – that initiated the project and kept it moving toward completion.

Green First Task Force (2007)

As a subset of First Universalist Social Justice ministry, the Green First Task Force was formed in 2007 by a small group of church members who were passionate advocates of sustainable living. Green₁ chaired monthly meetings until August 2012 when Green₂, the current chairperson, assumed the Green First leadership role.

As documented in this Case Study, the human energy from this small group of a half dozen people provided the initial spark to create ‘something more’ from ‘nothing but’ – in this case, study, their goal was to see the emergence of a sustainable energy system for their church facility.

The handful of advocates for a sustainable energy system realized that for this project to move forward, several dozen more people in decision making roles would have to become enthusiastically involved - including members of a building committee, the Board of Trustees and the Church Staff. Eventually, the entire church membership would have to approve the project.

Green Sanctuary – First Universalist (Nov 2010)

A pre-existing “environmental awareness” program had preceded this energy transition project. This consciousness-raising program was called the Green Sanctuary Program discussed in the previous section that can be traced back to the UUMFE also described in an earlier section.

The Green Sanctuary Program provides guidelines for congregational study, reflection, and action pertaining to today's environmental challenges - including climate change and environmental justice.

Successful completion of the Program results in Green Sanctuary accreditation: formal recognition of a congregation's service and dedication to UU values, specifically the Seventh Principle: “Respect for the Interdependent web of all existence of which we are a part.”

First Universalist Denver completed this environmental awareness program and became an accredited “Green Sanctuary” in November of 2010 several years prior to this remodeling project.

Congregational Vote:

On May 23, 2010, in a Congregational meeting, the members of First Universalist unanimously voted to apply for accreditation as a Green Sanctuary and adopted the following Covenant:

GREEN SANCTUARY COVENANT

We the members of First Universalist Church of Denver and participants in the Green Sanctuary Program:

- Recognizing the vulnerability and interdependence of Earth and all living things;
- Recognizing the need to protect and maintain the quality of our common natural resources;
- Recognizing the need to act individually, as a congregation and to join with others to promote environmental justice and to create a sustainable society based on love and respect for our Earth and its diversity of life and resources; and
- Recognizing our universal human rights to a clean environment

DO COVENANT:

- To engage in ongoing activities and projects and to encourage each other in a personal and congregational commitment to living this promise through our Unitarian Universalist Principles, including the Seventh Principle, "Respect for the interdependent web of all existence of which we are a part.";
- To incorporate the Seventh Principle values and practices into our worship services, celebrations, and religious education programs;
- To live lightly on the Earth and strive to continually improve our environmental impact; and
- To affirm and promote programs to raise the awareness of human behaviors and actions that affect the health and sustainability of our living Earth and humanity.



Solar Christmas lights (Dec 2010)

Everyone involved in this story has their own personal experiences that provided motivation to get involved in this transition project. One member of the Green First Task Force volunteered this story.

Christmas of 2010. Weeks before Christmas, our daughter-in-law pointed out she had seen solar-powered Christmas lights at Target.

We tucked that tidbit of information away. As we got closer to Christmas we found ourselves at

a Target store. Sure enough, in the far corner of the store, where the milk is strategically located in a grocery store, we found the outdoor Christmas decorations – including short strings of lights with no plug at either end of the string – just a small solar cell (three-inch square) and an enclosed AA battery.

The solar collector was just a few square inches, but the lights were the highly efficient LEDs that could be set to flash intermittently apparently to draw attention to themselves. So we had fun that Christmas with our new solar toys. Actually, we returned to Target to get a couple of other strings including one with four LED-lit plastic 'snowflakes' the size of your head.

Nothing says Christmas better than plastic snowflakes on steroids illuminated by solar power. In addition to Jingle Bells, Solar Cells were on our mind that Christmas.

As we turned our calendar to a new year that same winter, with solar still on our mind, we attended the 2011 National Western Stock Show in Denver. Once inside the aging arena, we were being swept along by the river of Stock Show enthusiasts and mesmerized by the diverse display of western hats, shirts, belt buckles, and boots when we spotted a lone table piled with pamphlets bearing a banner "Simply Solar." We had to stop.

The lonely young salesperson behind the table was eager to get our name, phone number, email address and set up a time to come out and provide a cost estimate for a rooftop solar system - and that is how our new appreciation for the Sun began.

In mid-2011, a solar PV system was installed on our roof to sustainably generate 100% of our electrical needs.

From Stock Show to Solar.

(Reporter: The story goes on to describe how excess solar electric was then used to eliminate other uses of fossil fuel. A natural gas furnace became a geothermal heat pump powered by solar electric, and a gasoline powered car was replaced with an electric vehicle charged by solar electric.)

This positive experience of transitioning to renewable energy was discussed months later at a Green First Task Force meeting at church. At the urging of several other Green First members, the experience was

Part II Pre-BFF Period (2007 to May 2014)

documented in a small book²⁹ that helped illustrate the practicality and simplicity of transitioning from burning ancient hydrocarbons to harvesting solar and geothermal energy.



“Agenda for a New Economy: From Phantom Wealth to Real Wealth,” David Korten (2010)

After the economic meltdown of 2008, David Korten, among other courageous outspoken critics of Laissez Faire Capitalism, began pointing out fatal flaws in portions of our economic system we call Wall Street.

“The Wall Street economy we have is highly effective and efficient at converting real living wealth to phantom financial wealth to make rich people richer. It is a path to collective suicide. Our future and that of our children depend on replacing the values and institutions of the Wall Street economy with the culture and institutions of a New Economy designed to provide an adequate and satisfying livelihood for all people in balanced relationship to Earth’s biosphere.”

The insight into an awareness of how Wall Street operates provided by David Korten, Joseph Stiglitz, and others had an influence on how the energy transition project was financed.



Occupy Wall Street (Fall 2011)

Sept 17, 2011, marked the beginning of the Occupy Wall Street movement.³⁰ The primary take away from the short-lived occupation of Zuccotti Park, located in New York City’s Wall Street financial district, was the global attention focused on social and economic inequality worldwide. Occupy tent camps sprung up in cities around the country, including Denver. Participants in the Occupy movement self-educated themselves about the existing economic system and identified the abuse, corruption, and injustice that had crept into the economic system. During this brief movement, many people became aware that 1% of our population was hoarding 50% of the country’s wealth and each year this 1% received 50% of the nation’s income. During this brief movement, many people became aware that economic inequality was contributing to political inequality and environmental injustice.

It was the “Occupy” movement that informed us of how Wall Street was actually operating. *Rolling Stone* writer Matt Taibbi asserted, “These people aren’t

protesting money. They’re not protesting banking. They’re protesting corruption on Wall Street.”³¹

As this story unfolds, you will see that avoiding Wall Street’s commercial usury rates was a key element in making this project possible.



UUA General Assemblies: Ethical / Moral / Spiritual Issues (2006, 2014, 2015)

Has the Unitarian Universalist Association Documented a Position on Sustainable Energy Issues?

Yes. In 2006¹ and again in 2014² and 2015³, the Unitarian Universalist Association (UUA) General Assembly (GA) has democratically voted and passed Resolutions pertaining to Energy, Climate Change and Divesting from Fossil Fuels.

A few excerpts are provided:

Statement of Conscience: 2006 UUA General Assembly (Slide 2006.1)

Slide 2006.1

2006 UUA General Assembly: Statement of Conscience

Earth is our home. We are part of this world and its destiny is our own. Life on this planet will be gravely affected unless we embrace new practices, ethics, and values to guide our lives on a warming planet.

As Unitarian Universalists, we declare by this Statement of Conscience that we will not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grandchildren.

We as Unitarian Universalists are called to join with others to halt practices that fuel global warming/climate change, to instigate sustainable alternatives, and to mitigate the impending effects of global warming /climate change with just and ethical responses.

As a people of faith, we commit to a renewed reverence for life and respect for the interdependent web of all existence.

Congregational Actions

- Celebrate reverence for the interdependent web of existence in all aspects of congregational life;
- Treat environmentally responsible practices as a spiritual discipline;
- Seek certification through the Green Sanctuary Program of the Unitarian Universalist Ministry for Earth;

Part II Pre-BFF Period (2007 to May 2014)

- Educate ourselves, our children, and future generations on sustainable ways to live interdependently;
- Seek U. S. Green Building Council Leadership in Energy and Environmental Design (LEED) certification for all new congregational building projects and **use LEED guidelines for renovation projects;**
- Use congregational financial resources to positively address the global warming/climate change crisis;

Fossil Fuel Divestment - Business Resolution: 2014 UUA General Assembly (Slide 2014.1)

Slide 2014.1

2014 UUA General Assembly: Fossil Fuel Divestment - Business Resolution

WHEREAS, Unitarian Universalist congregations covenant by our Second and Seventh Principles to affirm and promote justice, equity, and compassion in human relations and respect for the interdependent web of all existence of which we are a part; and

WHEREAS, the climate crisis threatens Earth systems through warming, destabilization of the atmosphere and climate, sea level rise, and the acidification of the oceans, of which the brunt of the burden has fallen and will fall on the poorest people in the world, who are least responsible for the crisis; and

WHEREAS, the 2006 Unitarian Universalist Association (UUA) General Assembly approved a Statement of Conscience on the Threat of Global Warming/Climate Change declaring “that we will not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grandchildren;” and

WHEREAS, member congregations have demonstrated their commitment to environmental and climate justice by seeking Green Sanctuary accreditation, forming Climate Action Teams, divesting from fossil fuel companies, or other efforts; and

WHEREAS, if all known fossil fuel reserves are burned, they will produce five times the amount of greenhouse gas emissions required to raise global temperatures beyond 2°C, the level that leaders of 167 countries (including the United States) have agreed represents a threshold beyond which there would be dangerous human-caused interference with the climate system; and

WHEREAS, we have a moral responsibility to Earth, to all beings, and to future generations **to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy;** and

WHEREAS, a global and growing movement is calling upon universities, pension funds, public entities, and religious institutions to divest their holdings in the 200 major fossil fuel companies listed by the Carbon Tracker Initiative (CT200), which together control 26% of known reserves, in order to break the hold of fossil fuel corporations on markets and governments; and

WHEREAS, the Unitarian Universalist Association is a leader among religious institutions in shareholder activism to halt climate change by ending the use of fossil fuels and, in concert with global investors organized by Ceres and Carbon Tracker, is pressing fossil fuel companies to divest their most carbon-intensive operations and reinvest in lower-carbon energy sources; and

WHEREAS, the guidelines for socially responsible investment of the UU Common Endowment Fund (UUCEF) state that “The UUA seeks to avoid companies that... contribute in significant ways to climate change;” and

WHEREAS, the 2013 General Assembly overwhelmingly passed an Action of Immediate Witness for congregations to “Consider Divestment from the Fossil Fuel Industry;”

THEREFORE BE IT RESOLVED that this General Assembly calls upon the UUA to cease purchasing securities of CT200 companies as UUCEF investments immediately; and

BE IT FURTHER RESOLVED that this General Assembly calls upon the UUA to continue to divest its UUCEF holdings of directly-held securities of CT200 companies, reaching full divestment of these companies within five years; and

BE IT FURTHER RESOLVED that this General Assembly calls upon the UUA to work with its current and prospective pooled-asset managers for the purpose of creating more fossil fuel-free investment opportunities, with the objective of full divestment of UUCEF indirect holdings in CT200 within five years; and

BE IT FURTHER RESOLVED that this General Assembly calls upon the UUA to invest an appropriate share of UUCEF holdings in securities that will support a swift transition to a clean energy economy, such as renewable energy and energy-efficiency-related securities; and

BE IT FURTHER RESOLVED that, notwithstanding any provision above, the UUA may retain investments in CT200 companies in which it is engaged in shareholder

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activism seeking environmental justice or transition to clean and renewable energy; and

BE IT FURTHER RESOLVED that, notwithstanding any provision above, the UUA may purchase the minimal shares of CT200 companies necessary to permit the introduction of shareholder resolutions seeking environmental justice or transition to clean and renewable energy; and

BE IT FURTHER RESOLVED that, notwithstanding any provision above, the UUA shall not take any action inconsistent with its fiduciary duty or that is incompatible with the principles of sound investment; and

BE IT FURTHER RESOLVED that the President and the Treasurer of the UUA shall report to each General Assembly from 2015 through 2019 on our Association's progress on the above resolutions; and

BE IT FINALLY RESOLVED that this General Assembly encourages Unitarian Universalist congregations and Unitarian Universalists to ...to take action to end climate change, such as investment in renewable energy and conservation.

Act for a Livable Climate: Support a Strong, Compassionate Global Climate Agreement: 2015 UUA General Assembly (Slide 2015.1)

Slide 2015.1

2015 UUA General Assembly: Support A Strong, Compassionate Global Climate Agreement In 2015: Act For A Livable Climate

2015 Action of Immediate Witness

WHEREAS, global climate change is fundamentally a moral and ethical crisis induced and exacerbated by human activity that can and must be modified to maintain a livable world for ourselves, our descendants, and other species;

WHEREAS, looming ecological catastrophes impacting food, water, and disease threaten the vulnerable and our descendants with mass suffering;

WHEREAS, Peter Morales (UUA President) and Bill Schulz (UUSC President and CEO) recently wrote that "The crisis of climate change is the gravest threat facing our world today";

WHEREAS, we can act to limit the harmful consequences of climate change by effective risk management (adaptation and mitigation, including emission reductions, development of renewable

energy, etc.), with sufficient motivation, persistence, optimism, and will;

WHEREAS, our Principles impel us to act on climate change: The web of life is threatened: climate catastrophes (in near and long term) disproportionately impact the poor, disadvantaged, elderly, women, and children; issues of equity, justice, democracy, speaking truth, and defending the right of conscience are associated; and our descendants are threatened, raising intergenerational equity issues;

WHEREAS, Unitarian Universalists overwhelmingly voted to adopt a Statement of Conscience on the Threat of Global Warming and Climate Change in 2006, calling Unitarian Universalists into action to mitigate climate change;

WHEREAS, there can be no long-term solution to many social justice issues with which Unitarian Universalists are concerned without a viable solution to the climate problem; and

WHEREAS, we are responsible as people of faith to mitigate, avert, and limit the potential catastrophes of climate change, standing with other faith traditions caring for our common home;

WHEREAS, Unitarian Universalists have made a commitment to climate justice and stand in solidarity with first nation peoples, who are disproportionately affected by climate disruption;

WHEREAS, an international climate agreement is critical for reducing the risk of the myriad severe climate impacts and also increasing positive opportunities for all people; and

WHEREAS, an December 2015, many nations of the world will gather in Paris for their last opportunity to negotiate the most important climate agreement in history;

THEREFORE, BE IT RESOLVED that the 2015 UU General Assembly calls on Unitarian Universalists to unify and provide ethical and moral leadership for climate action and to do so within our congregations and within our multi-faith communities;

BE IT FURTHER RESOLVED that Unitarian Universalists will support local actions such as the Lummi Nations' opposition to the Gateway Pacific Coal Terminal on sacred lands;

BE IT FURTHER RESOLVED that Unitarian Universalists will participate in and support mobilizations nationally such as the Moral March for Climate Justice in September 2015 during the Papal visit to Washington DC, pressing our government to act urgently and responsibly; and

BE IT FURTHER RESOLVED that the 2015 UU General Assembly endorses a Unitarian Universalist delegation to the UN Climate Agreement Talks in December 2015 to support a strong, compassionate, fair, ambitious, binding, and enforceable international climate agreement. Without a global climate agreement, the climate crisis will not be sufficiently addressed, and many social justice issues will continue to magnify.

It should be mentioned that the above UUA statements about ‘creation care’ have related counterparts in all of the world’s religions.³²



Church Solar – Green First Task Force Initiatives

The first documented reference of interest in installing a solar electric system on the church was at a Green First Task Meeting held on Oct 4, 2011. One of the Green First members was involved in the then rapidly changing solar installation industry and was keeping the church staff informed of local incentives and current Xcel Energy SolarReward™ Rebate Programs. The primary focus at that point in time was finding a third party who could take advantage of tax incentives and pass some of those cost reductions back to the church.

Reporter’s Note: To respect the privacy of the individuals involved, but maintain identity of their role on the overall effort, we use the following nomenclature: A member of the Green First Task Force is given the label “Green” with a subscript number. e.g. Green₃ Green_{1,5,6} would denote three members of the Green First team. A member of the BFF Building Committee is given a label BFF₂ A member of the Board of Trustees would be Board₁ and so on.

Challenges and Opportunities for Installing Solar on the Church (4 Oct 2011).

Green First Task Force Meeting Minutes (Excerpts)
Chalice Lighting
Introductions –Green_{1,2,3,4,8,9}

Green₄ then reported on the challenges and opportunities for installing solar on the church.

- One challenge for non-profits is that they cannot take advantage of tax incentives. One solution is for a 3rd party to own the energy system to get tax incentives and sell power to the church (commonly referred to as Power Purchase Agreements or PPAs). That makes sense for larger systems and residential systems but not necessarily for a system sized appropriately for First Universalist Church Denver.

- Pristine Sun from Wyoming is one company that does PPAs for mid-sized systems. They proposed to install a system on the Church. There would have been a 4-6 week design phase after which both Pristine and First Universalist would have had the option to continue to construction. That proposal is no longer available because the Excel Energy incentives have run out and there are not expected to be other incentives for several months.

- Green₄ brought the Pristine Sun proposal to the Board of Trustees and they responded by asking the Green First Task Force and other groups to make a broader investigation of solar. The key questions to prepare a response to the Board are:

- Why do Solar? - Green₂
- What to look for in a contract? – Green₁
- What are the best solar options for us? – Green_{3,4,8}

- Green₄ expressed the desire to establish parameters that would make solar a good choice for the church.

Minutes by: Green₂



About a week after the 4 Oct 2011 Green First meeting, another member of the Task Force, Green₅ who had just successfully transitioned their home to solar and geothermal renewable energy (solar electric and ground source geothermal heating and cooling), sent a note to the Green First Team supporting the addition of a solar PV system on the church. Key points include:

- Links to a more detailed description of the process of adding solar and geothermal
- further discussion of the moral/ethical basis for transitioning to renewable energy,

Part II Pre-BFF Period (2007 to May 2014)

- discussion of including both solar electric and geothermal heating and cooling in this transition to become carbon-free
- observations about our current broken economic system for comparing fossil fuel vs renewable energy options, and
- consideration of a third party that can take advantage of the public incentives for transitioning to renewable energy.

Comments on the moral/ethical basis as well as the financial rationale for transitioning to renewable energy. (10 Oct 2011)

From: Green₅

Date: Monday, October 10, 2011

To: Green_{2,et. al.}

Subject: RE: Green First Meeting Minutes-Oct 4 - Great Job!

Green₂,

Thanks for forwarding the minutes of your meeting - the work of the Green First group is very impressive.

As a long-time member of First Universalist, I would like to support your efforts however I can - especially the initiative to explore adding solar photovoltaic panels at the church.

As Green₁ knows, I too am an advocate of doing what we can to put together a proposal to the Board they can't refuse.³³ Harvesting current sunlight for our energy needs is the responsible, ethical (and sustainable) thing for us UUs to do, particularly now that we all are aware of what it means to continue to burn fossil energy.

As background info, we installed 24 panels on our home in Centennial this past spring using a company from Boulder (they are now in the process of going out of business since Xcel Energy backed off on their SolarRewards™ rebate program). For more information on our personal challenge to install solar, you might see our blog entries

1)

<http://www.nowforourturn.org/CosmicReflections/2011/06/15/sustainable-energy-phase-i-our-new-solar-system/>

2)

<http://www.nowforourturn.org/CosmicReflections/2011/07/15/sustainable-energy-phase-i-%e2%80%93-sun-farming-one-month-later/>

In a note sent to Green₁ before your meeting, we mentioned that based on the emerging **Ecomorality: the Ethics of Sustainability**, we are now aware that it is unethical to consume fossil energy with no intention of paying it back (to Planet Earth and future

generations). Over the past 3.5 billion years that life has been evolving on this planet, sustainable evolution has selected species that find a way to live off current Sunlight (directly as autotrophs or indirectly as heterotrophs). It is only the human species that recently (since the 1700s) insists on burning and eating and living off the stores of Ancient Sunlight (coal, oil, natural gas, tar sands, etc.) instead of living off current sunlight like all other living species.

We as a congregation of supposedly aware humans still heat our church with natural gas and consume power generated by burning coal and natural gas. This is now known to be unethical (if not immoral), yet we consider ourselves "Green."

There are alternatives. Installing solar panels to provide our electrical power needs is a good start. Sizing the system to later accommodate the power required to operate compressors for a sustainable ground source Geothermal Heat Pump heating and cooling system would be wise. We would then be carbon free. Boreholes for a vertical closed loop system could easily be drilled adjacent to the building or even in the parking lot (and covered back over) to accommodate the necessary ground loops needed to exchange energy with the earth for our year-round heating and cooling needs. Anything less than a complete transition to renewable energy is unethical.

As Bill McKibben and David Korten point out, people (including our Board who must be responsible from a fiduciary perspective) will immediately want to use today's (invalid) economic models to evaluate these alternative energy systems and say that a "payback" of 10-15 years is not a good investment. And they would be right if we play in their sandbox and use Wall Street's irresponsible economic model that places no intrinsic value on coal/oil/natural gas (- i.e. assumes it is free for the taking as we do now) and does not take responsibility for the ignored cost (externalities) of waste products generated by burning. But as we know, Ancient Sunlight (aka coal, oil, natural gas) is not valueless - it is a one-time only resource for the planet for the next 500 million years or more. Like every other resource on the Planet, it should be borrowed and paid back/returned /recycled for future generations (Cradle to Cradle concept) according to the ethics of sustainability.

Currently we "borrow" fossil energy with no intention of ever paying this resource back for later use by future generations. Future generations will look back at us as being highly unethical, particularly after we became

Part II Pre-BFF Period (2007 to May 2014)

aware of what we were doing to the planet in the late 20th century and early 21st century.

A more accurate (sustainable) economic model would place a value on coal, oil, etc. that includes not only the cost of extraction, refining, etc. but also the cost of sustainably generating an equivalent amount of energy (generated by renewable sources/current sunlight) and storing it for future generations. A valid economic model would also include the cost of properly recycling all the waste generated in consuming the fossil energy (re-sequestering CO₂, disposing of the mercury, sulfur, ash, etc.,). When these additional "costs" of borrowing coal, oil, etc. are included in a valid economic model, then wind, solar, geothermal heat exchange, hydro will always come out on top as the least expensive option and as the obvious rational solution for a conscious humanity that wishes to be sustainable rather than suicidal.

Green₄ is correct in reminding us that being a non-profit is a game changer when we use today's economic model. So it does seem that the 3rd Party developer is the best way to go since they can at least benefit from the 30% federal tax credit. If Xcel Energy is going to start up rebates again, that would even be better.

If the Wyoming group or Solar City in Boulder, etc. can't provide a reasonable third party proposal, I would suggest we even think about the possibility of forming our own third-party development company for this one project. It may be there are a number of members would be willing to take some of their 401K out of Wall Street investments and invest in a local sustainable venture. It seems the financial gains from Wall Street investments are being drained away into the accounts of overpaid CEOs in the financial sector.

I personally would much rather lose money in a local "investment" that benefits the church than one that benefits Wall Street like I'm doing today. Although I don't believe there is any real risk in investing in this project involving the church - the return on investment may take a bit longer but we expect the church will still be around 20 years from now even if we aren't. Based on the number of recently laid off solar installers that are looking for jobs today, together with the existing resources in our membership, it would seem possible to assemble the electrical and mechanical talent for installing this one system for the church - if we could get it designed.

Anyway, Green_{1,2,4} thank you for taking on this admirable initiative - it's the right thing to do. We just have to figure out how to make it work with today's broken/obsolete economic model that most people still

use for making financial decisions (and the Board is obligated to use legally).

Let me know if there is anything I can do to help.

Best wishes,

Green₅

Excel Energy solar rebates are currently "on hold", according to Green₄. However, a sister church, JUC, added two small solar PV systems anyway.

Ignore the inability to capture tax benefits or depreciation. Just do it. (11 Oct 2011)

From: Green₄

Date: Tue, Oct 11, 2011, at 11:48 PM,

To: Green₅

Subject: Thanks Green₅ for the supportive thoughts.

In Colorado, all of solar above 10kW is on hold right now for many more months. Nonetheless, I am confident we will be able to find a sensible and practical way to get solar on our building. Maybe even a 10kW project to get going in the near term.

One story I like to tell is that our cousin church, Jefferson Unitarian, has put two small systems on their building in 4 years. In both cases, they simply **paid the price and ignored the financial downside of not being able to capture tax benefits or depreciation, etc.** While I do not advocate that for our church, I can tell you there are church members there "young and old" that virtually "click their heels" each time they walk through the door because they are happy and proud of what they have done. And I look forward to the day ...³⁴

Best, Green₄

A church staff member enthusiastically requested a game plan from the Green First Task Force for adding solar to the church.

Let's put together a proposal (for solar) the Board can't refuse? (12 Oct 2011)

From: Staff₂

Date: Wed, 12 Oct 2011

To: Green₄

Subject: Re: Green First Meeting Minutes-Oct 4 - Great Job!

Green₅,

Part II Pre-BFF Period (2007 to May 2014)

I am inspired by your ideas and "can do" attitude. Green₄, thanks for forwarding.

I would love to get a game plan going for how we can "put together a proposal to the Board they can't refuse." How do we proceed? If the first things are first... what is first?

Staff₂

First Universalist Church of Denver



Although the Green First Team did not appreciate how important it was at the time, involving the staff and at least a few Board members early in the project is essential. So within a few days, the Green First Team responded to the Staff with an initial top-level four (4) step game plan to continue the discussion.

Church Vision Statement for Renewable Energy - Example (17 Oct 2011)

From: Green₅

Date: Mon, 17 Oct 2011

To: Staff₂; Green₄

Subject: RE: Green First Meeting Minutes-Oct 4 - Great Job!

Staff₂/Green₄,

We've enclosed some thoughts in response to your question, "What's first?" ... this is how we might start further discussions. (See Enclosure.)

Green₅

Enclosure:

Church Vision Statement for Transitioning to Renewable Energy (4 Step Approach)

Let us start by saying that the Green First Task Force and the church staff embraces the concepts of *Ecomorality: The Ethics of Sustainability*. It is very impressive to see all the changes that have been made to our religious community can be in Right Relations with the Planet and the interdependent web of life...

... let us describe a possible vision that hopefully, we can make a reality soon.

Step 1. The Vision

Let our first draft and agree upon a simple Vision Statement. Some examples are:

Whereas we know that, the consumption of Ancient Sunlight (coal, oil, natural gas, oil from tar sands and shale) without any intention of "paying it forward" for future generations is unethical:

Be it resolved that we the members of First Universalist Church intend to operate our church facility without consuming fossil energy, and further,

Be it resolved that we will immediately begin the transition to renewable energy.

Or our common Vision Statement might be:

Our goal is to operate First Universalist Church in Right Relations with the interdependent web of life, without consuming any additional fossil energy and without causing further damage to our Planet by the introduction of fossil energy waste products from the extraction and combustion of coal, petroleum products or natural gas into our atmosphere, water, or soil. Our goal will be accomplished by transitioning to renewable energy technology. This solution will be justified using an updated economic measuring stick (e.g. see David Korten) that replaces our current invalid economic model.

Or you can defer any reference to spiritual principles and personal values and use a simple Vision Statement such as:

Provide all electrical power, hot water, as well as heating and cooling from renewable energy sources only.

In any case, it is important, to begin with a shared Vision that will serve to bind together all (or most of) the future stakeholders.

Step 2. The Concept (Conceptual Design)

From that general vision statement, the Team could put together a list of options on how to accomplish this goal. From that list, we could recommend a preferred approach. The approach options include:

Approach #1: Hands On. Take an active role in developing real solutions with real hardware, or

Approach #2: Third Party. Have someone else develop pseudo-solutions. Transfer the issue and responsibility to another party.

[e.g. pay Xcel more money each month to pretend that our energy is coming from a yet to be built wind farm in the state of]

For individuals, with a limited background in renewable energy alternatives, Approach #2 may be more appropriate.

For the church with a diverse array of interests and experience, Approach #1 may be more appropriate – e.g. some members of the church already have installed renewable energy systems at home or at work.

Obviously, we prefer and recommend Approach #1 – where we assume responsibility for our own behavior so the transition to a sustainable operation is clearly visible. Then we can actually see that we are harvesting the sunlight incident on our roof and see that we are generating the energy we consume.

a) Electrical power generation.

Green₄ and others on the Team can size a PV system based on last year’s usage of electrical power. But the system will need to be oversized a bit (10-20%?) because the proposed vision also eliminates the consumption of natural gas. Thinking ahead 5-10 years, it would be nice to envision a system that could be extended later to accommodate power for members who come to church in their electric vehicles and may want to plug in during the service...

The latest solar panels with micro-inverters (e.g. Enphase) that Green₄ is familiar with allows the owner to easily add to the system later if needed, assuming the electrical system is installed initially with some later expansion in mind.

Side note: There is a fun aspect of the Enphase system for geeks. Any member could go online and see how the panels are performing and how much energy (MW hours) they have generated to date. There is also an estimate of the environmental benefits (e.g. tons of Carbon offset by using the solar PV panels instead of burning coal and the equivalent number of trees one would have to plant to have the same benefit as the panels.)



b) Heating and Cooling, Hot Water.

The type of ground source (Geothermal) Heat Pump heating and cooling system I’m familiar with (the type we had installed at home this summer) allows us to exchange (withdraw & deposit) thermal energy with the Earth. This type of geothermal system requires the normal furnace electrical power (or a bit less because it may use more efficient DC motors than we are currently using) PLUS some additional electrical power for the heat pump compressor and a small amount of power for the water pumps that circulate the water in the heat exchange ground loop. So to replace the natural gas, we will need some additional electrical power to drive the heat pump. For more information about this geothermal technology, see the Department of Energy web site.

http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm?mytopic=12640

According to DOE,

“Even though the installation price of a geothermal system can be several times that of an air-source system of the same heating and cooling capacity, the additional costs are returned to you in energy savings in 5–10 years. System life is estimated at 25 years for the inside components and 50+ years for the ground loop.”

This same geothermal technology was installed by IKEA for heating and cooling their new store in Centennial, CO.

Based on our limited knowledge of ground source geothermal heating and cooling systems (that can also provide hot water), the design would require drilling perhaps a dozen boreholes about 5” in diameter 200-400 feet deep and 15-20 feet apart – probably in one of the parking lots. Each hole takes a couple of hours to drill. Black plastic tubing is inserted in each hole to make up the ground loop and grouted in place with environmentally friendly bentonite clay (they call it geothermal grout) to provide efficient exchange energy with our Earth. Although water circulates through the tubing, it is a closed system – the tubing is expected to last for 50-200 years. The ground loop tubing is routed into the basement and connected to the Heat Pump Furnaces. The old gas furnaces are replaced with the new Heat Pump Furnaces (that have no combustion). The new heat pumps operate by using the electrical power generated by our PV panels.

There are numerous contractors who specialize in installing Geothermal Heat Pumps and they would put together a detailed concept.

At the end of this Conceptual Design Phase, the Team will have a sense of the real estate/area required to harvest enough sunlight for the power, and where we could locate the heat exchange ground loop(s)

I am assuming there will be no real physical constraint to prevent the installation of a complete system that uses renewable energy. In other words, we will be able to envision enough east, south, or west roof area or as Green₄ mentioned possibly elevated carport-like roof area in the parking lot for the panels. Because the boreholes are only 5 inches in diameter to drill and actually the ground loop is buried 5-6 feet underground and covered over so nothing shows above ground. The ground source geothermal heat pump furnaces are the same size as traditional gas furnaces, so there should be no problem locating space for a new heating and cooling system.

The above scenario is one of several technology alternatives that will allow us to operate our facility using only the Sun as our source of energy – no further consumption of precious fossil energy, no combustion, no emissions (e.g. CO₂, sulfur, mercury, etc.) because we are taking responsibility for harvesting current sunlight to meet our energy needs.

Step 3. Preliminary Design / Cost Assessment

This is where it will get challenging. And we can't see very well this far ahead. So the Team has to work on Steps 1 & 2 to be able to see Step 3 more clearly.

At this point, the sizing and list of equipment will be known to get some cost estimates from several outside parties. It appears that the Team has enough expertise to do its own cost estimating of the hardware to see if the idea makes any sense.

As Green₄ has pointed out, being a non-profit makes the financial story more complicated. Not sure the "third party" concept will work for the heating and cooling system because we don't know of any existing funding models for such an approach. But there is a 30% federal tax credit for the Geothermal System as well as for the Solar PV System if we could figure out how to leverage that opportunity to our advantage.

Since it appears Xcel Energy is suspending their rebate program for PV systems, we can look at the options:

- a) Postpone installation hoping the Colorado legislature will reset the goal posts for Xcel and the rebates will resume
- b) Assume there will be no Xcel Energy rebate and take on the complete cost alone.

So when we run the numbers using the existing economic models, **Be prepared for a shock.** Without rebates and tax credits or non-profit discounts, the traditional payback period from the current invalid economic model that most people use could be between 10-20 years. More on that later.

Then we start brainstorming with more facts and get a better idea of what we have to work with.

A) We can approach the financing by implementing the transition solution incrementally at a rate that accommodates a more reasonable cash flow, or

B) We can take on the whole project and figure out creative ways to finance the build. The Board will remind us that they do not have any money to take on this project even though it may be "the right thing to do."

i) We may find the Board is receptive to allowing us to conduct a special fundraising campaign just for this project.

ii) We may be able to come up with some in-house third-party solutions that can leverage the federal tax credits at least, even if the Xcel Energy rebates are off the table.

Setting up a third-party development /investor group could be a hassle to assure the in-house investors were protected legally. But the reason I'm mentioning this option is that I personally would love to withdraw investments now in Wall Street and bring that money back into the local community –what better than to "invest" in a sustainable project for the church. So we can leave this option on the table for consideration.

iii) In any case, we may want to drag out a more valid economic model (that some refer to as the Korten economic model because it identifies the "subsidies" of the current fossil energy industry as well as the hidden costs that are not reflected in the cost of their products.) Using an updated economic model that reflects today's awareness of externalities, renewable energy will be found to be better financially than fossil energy every time.

Step 4. Detail Design and Installation.

Assuming the conceptual design has been properly approved by the board and the congregation AND there is financing, we can submit requests for proposals to design/install the solar & geothermal

systems. There will likely be two separate contractors/contracts.

Schedule. Because we are in a recession, and people are looking for jobs, we will probably find that contractors will give the project their full attention and quick response. All equipment should be in existing inventory and available within a month. Green⁴ would know better, but after the designs are complete and the permits are in place, etc. the actual installation of the panels should take around a week or two. We'd guess the ground loop installation would be about 1-2 weeks, and the furnace work a couple of weeks.

Renewable Energy Systems - Local Examples

During the course of this project, it was important to be able to identify (and even visit) examples of existing applications of the proposed solar and ground source heat pump/geothermal technology. Learning about and even seeing other working examples of viable alternatives to our existing fossil fuel-based energy system was essential to growing support for the project.

Church Members with Rooftop Solar

Most everyone was familiar with rooftop solar systems and a few members had already installed solar PV on their homes (or invested in community solar gardens.) As a result, there were few objections to installing a rooftop solar system on the church. At the time, the "industry standard" was to install a system that provided around 80%-90% of the annual electrical power needs, generally not 100%. Colorado statute prevented the installation of a solar PV system that would produce more than 120% of the last 12 months of actual usage. For new construction with no history, the local utility company provided a formula based on the square footage of the building.

We found that the most resistance to a completely renewable energy system (one that stopped burning ancient hydrocarbons completely) was over the use of geothermal technology. To our knowledge, there was only one church member who used a ground source heat pump heating and cooling system and another member whose brother (in Sweden)³⁵ used geothermal heating and cooling in his home for years. As a result, there was significant resistance to including geothermal technology at the beginning of this project – particularly when the financing seemed to be too challenging, the geothermal system was the first to be deleted. Geothermal is "High

Risk" technology and "Too Expensive" were common arguments by skeptics from the beginning.

Church Member with Ground Source Heating and Cooling.

It was helpful to have one church member who used a geothermal heating and cooling system in their home and could speak to its effectiveness, comfort, reliability, etc. and had actual cost data for a residential application. At least a dozen other church members visited the home and were underwhelmed by the geothermal heat pump furnace. It looks just like a natural gas furnace until you read the "geothermal" label. The primary difference is that there are two 1¼" diameter black plastic pipes connected to the furnace that circulate water for exchanging thermal energy with Earth instead of a natural gas pipe to the furnace. There is no natural gas line and there is no burning involved.

IKEA - Rooftop Solar / Geothermal Heating & Cooling

Two members of the Green First Team had an opportunity to take a tour of a local IKEA store as a part of Sierra Club renewable energy tour. They took an elevator to the top floor of the store and then ascended a steep ladder to emerge on the roof of the store. There they saw a sea of solar modules – the entire roof was blanketed with ballasted solar modules – held in place on the rubber roof membrane by weights rather than fasteners that would penetrate the water membrane and possibly cause future leaks.

So when folks take the position that "Geothermal is too risky" or say, "Geothermal might work at a residential level, but what about a larger application like the church?" one can always cite IKEA stores.

IKEA has pledged to be 100% renewable worldwide by 2020.

Jefferson Unitarian Church, Golden, CO

A sister church, Jefferson Unitarian Church (JUC), installed solar modules and ground source heating and cooling system on their Mills building during a major renovation project several years ago. Although their system has only been in operation for just a few years, JUC members seemed to have no regrets. They are happy they made the transition to renewable energy.

Why install Solar Panels at First Universalist?

It would help the environment.

Our modern society consumes products and burns fossil fuels at such a fast pace that greenhouse gases are warming the planet and other toxic emissions damage the health of humans and other creatures. By harnessing the sun's energy, the church would reduce the damage to the earth's atmosphere.

It is a financially sound investment.

Electrical costs are rising as fossil fuels become more scarce and demand for them increases in the rest of the world. Opportunities to lease solar panels or purchase energy produced by solar panels would allow us to mitigate the risk of increasing prices by locking in a constant, low rate increase for electricity.

It is consistent with our values.

One role of a church is to support its members as they strive to put their beliefs into action. Our seventh principle is to respect the interdependent web of all existence. Switching to solar energy would put that principle into action allowing the church and its members to consume energy without damaging the interdependent web.

It would inspire pride in the church membership.

By working together to achieve the worthy goal of reducing the church's environmental impact, the members of the church could feel a greater sense of commitment to the organization.

It would announce our environmental commitment to the community and potential members.

Drivers on Hampden and Colorado Boulevard could see the solar panels on our building. Without reading a word about us in the paper, or hearing a sentence about UU on the radio, those people would understand that we strive to live sustainably and invest in what we believe is right. Like-minded observers might be more likely to attend a service to find out more about our church.

Mount Vernon UU Church Completes Innovative Energy Project – A positive example. (11 Nov 2011)

From: Green₅

Date: Fri 11/11/2011, 12:12 PM

To: Green First Task Force

Subject: Church Solar-Geothermal Example

Staff₂/Green₄,

I'm sure you've seen this article in the *UU World*, but thought I'd send it along.

Just an interesting point to add to the story. The current minister at Mount Vernon is Kate Walker. Kate has family connections in Colorado, served as one of our interns and was ordained at our church. So if we have questions about the Mount Vernon energy project, I'm sure Kate would put us in touch with some good contacts...

Best wishes,

Green₅

Post Script: Shenandoah Sustainable Technologies filed for bankruptcy and the Mount Vernon church ended up

SHELTERING THE FAITH

Virginia church completes innovative energy project

Leaders of Mount Vernon Unitarian Church in Alexandria, Va., recently threw the switch to make their new sustainable energy project fully operational. The project combines use of 110 high-output solar panels to generate electricity with four new geothermal heat pumps for heating and cooling the building.

Because the geothermal units will use much less energy than the conventional units they replaced-about as much as the panels contribute to the electrical grid-the building is expected to have "net-zero" energy consumption.

The project was made possible by an offer from the contractor, Shenandoah Sustainable Tech-



Solar panels have been added to the roof of the Mount Vernon Unitarian Church in Alexandria, Va.

nologies, to pay the entire cost of purchasing and installing the equipment. In return, for 20 years the church will pay SST a monthly fee of approximately what it had been paying for conventional energy .•

as the owner of the entire solar/geothermal system.

Other members of the Green First Team documented their reasons for adding solar panels.

Why install Solar Panels at First Universalist? (15 Nov 2011)

From: Green₂

Date: Tue 11/15/2011, 9:40 P

To: Green First Task Force

Subject: Church Solar-Geothermal

Attachment: Why install Solar Panels at First Universalist?

Here is my first shot at answering the question "**Why do solar?**" I'd love to hear and incorporate any other ideas or thoughts you have on this topic. Thanks,


Green₂

These small sparks of energy from the Green First Task Force did not initiate any further reaction at this time. Other more pressing issues would inadvertently throw water on the Green First Team suggestions. The roof was leaking, we needed more classrooms and space in the Sanctuary, etc.

The Board of Trustees was trying to decide what to do about the church facility in general. Several options were being evaluated:

- Sell the building and move to another location; or
- Scape it and build a new facility; or
- Remodel the existing structure.

Proposing to add solar panels or ground source geothermal heating and cooling to the existing structure was inappropriate at that point in time.




Hiatus in Energy System Upgrade Advocacy (Dec 2011 - Jun 2014)

As the year 2011 ended, efforts to transition the church to a renewable energy system were put on hold because the church was wrestling with a bigger concern – what to do about the entire facility.

The Green First Task Force remained active in other areas and members continued to participate in the Ministry for Earth as well as other environmental advocacy groups and promote respect for our interconnected web of life.

The Green Force team advocates tried to keep the issue alive – or at least on life support as the fate of the building was being determined.



While waiting for a decision by the Board of Trustees on which renovation path the church would take, members of the Green First Team focused on other social justice and environmental areas including recycling/zero waste; ethical eating; and affordable housing through Habitat for Humanity.

Individual members of the church continued to support other environmental groups such as 350.org, Citizens Climate Lobby, Sierra Club, Slow Money, etc. and they make this new awareness available to church members. A few examples are provided below.

Green First Flyer based on CCL Information (Oct 2013)

The following flyer used by the Green First Team was created using information extracted from published materials of a national group called **Citizens Climate Lobby**.

So How Do We Transition from Fossil Fuel to Renewable Energy?

“As long as carbon fuels are (perceived to be) cheap, we will continue to use them.”

... Dr. James Hansen, NASA Climate Scientist

Conservative Economists are suggesting a revenue-neutral **Carbon Fee-Dividend** program can be implemented to correct the market and help Americans transition to renewable energy.

Issue. Our current economic system allows the fossil fuel industry to “externalize” (i.e. ignore) social costs (e.g. pollution, climate change, mercury contamination, etc.) associated with their products. As a result, the American economic system makes it appear that fossil fuels are the cheaper (best) choice when compared to renewable energy alternatives.

Over 100 years ago, economist Arthur Pigou recognized a basic flaw in economic systems and recommended that when a “producer” ignores or externalizes “incidental uncharged disservices,” the people (e.g. via their government) should add a fee to that product to internalize this social cost and correct the market. Today, this correction is called a Pigouvian correction/fee/ tax. Over a dozen countries have successfully initiated a Carbon fee/ tax – including Canada. Using a carbon tax, British Columbia reduced their dependence on fossils fuels by 18% in the past 4 years – with no ill effect on their economy.

Proposed Solution. Greg Mankiw, the conservative economist, initiated the Pigou Club, an “elite group of economists and pundits” in favor of a Pigouvian tax on emissions from burning carbon. The Club now has over 50 members. **Citizens Climate Lobby**, a grassroots organization (see www.CitizensClimateLobby.org) is also advocating legislation to initiate a market-based revenue-neutral carbon fee-dividend program.

The carbon fee program would be market-based rather than regulation-based. The program would be revenue-neutral so all revenue is equally distributed as a dividend to all taxpayers. There prevents any growth in government. An average carbon user breaks even at the end of the year. People who insist on driving a Hummer can do so – they will just pay more in carbon fees at the gas pump than they receive in their dividend check at the end of the year.



Another article by a Green First member that was based on Citizen Climate Lobby materials was published in the church’s Social Justice Newsletter, **Social Justice Matters**), Vol. 2, November 5, 2013. Whether or not keeping the issue of climate change “out there” during the 2 ½ year hiatus contributed to raising the consciousness of church members is impossible to know.

It’s about Isabella and a Price on Carbon Pollution. (Nov 2013)

It’s about Isabella and a price on carbon pollution.

My (step) Great Granddaughter, Isabella was born on 10 Sept 2013, the 7,141,518,710th human soul³⁶ currently living on planet Earth.

As a Unitarian Universalist, I’d be remiss not to ponder one of the inevitable questions Isabella will learn to ask when she gets to elementary school:

“Epa, are you leaving Earth a better place than it was when you were my age?”

I know full well that any answer other than an unequivocal “Yes” is a social injustice to her and all future generations.

She might ask, “Did you know back then we would run out of fossil fuel to burn during my lifetime?”

My reply, “Yes, I could do the math.”

She’d then say “And did you know that all that burning was changing our climate?”

My reply, “Yes I did, but Izzy, you don’t understand. Sure there were a lot of social injustices including climate change happening around the time you were born in 2013, but there were also a lot of distractions and displacement issues back then.

Our political system had ground to a halt. Our economic system was redistributing the country’s wealth to the 1%. Our legal system was treating corporations as if they were people and had human rights but no human responsibilities. Our educational system was crumbling and failing the majority of our minorities. Our health system was becoming motivated by profit instead of compassion and the pursuit of wellness. Our foreign policy was centered around projecting strength by bombing people around the world.

And that Fall of 2013 when you were born, the Denver Broncos started their season 6 and 0; Manning was breaking records every week.

There really wasn’t time to think about updating our human-created political /economic /legal/ educational system so that it would influence us to make sustainable choices – like transitioning to inexhaustible sources of energy such as solar, wind, geothermal, etc. We weren’t concerned that your generation would run out of oil, gas, and coal.”

Note to Self: If I feel a passion about a specific injustice, there is probably someone else in the UU community or beyond that shares that same concern. So personally, I’m going to focus on helping update our U.S. economic system so it influences us to transition to inexhaustible energy sources rather than fossil fuel. Have you heard of a market-based revenue-neutral carbon fee-dividend program?

That story is coming to the First Universalist Community Forum and the Social Justice Matters Newsletter soon. When we stop burning carbon-based fuels and turn to the inexhaustible alternatives that already exist (solar, geothermal, wind, hydro), there are many human--created problems that just simply go away – including climate change.

After all, it is about all the Isabellas.

During the three-year hiatus (between 2011 and 2014), when the Green Team was not actively advocating for solar or geothermal to be installed at the church, other things emerged that may have influenced the background for the upcoming project. We will mention a few.

Climate Change Educator and Church Member (Green₆)

A member of the church and retired NASA scientist, Green₆ tells a story later in this book about how he became convinced climate change was real, human-caused and how he decided to do something about it.

Applying his expertise in physics, Green₆ became an adjunct professor at the University of Denver where he taught upper-level students about the physics of climate. He also taught an eight-week course about climate change at a local Academy for Lifelong Learning. A number of people involved in the church energy transition project attended Green₆'s science-based classes at the Academy. Academy attendees learned about the evidence that indicates human behavior (i.e. over a century of burning ancient hydrocarbons as an energy source) was introducing greenhouse gases into the atmosphere at a rate that was altering the heat balance of our planet – more so than any other natural phenomena such as volcanos, Sunspots, Earth's wobble, etc. As a result of this balanced presentation of scientific knowledge, attendees independently became convinced climate change/global warming was truly an existential issue of our day. Those who attended Green₆'s classes or seminars were better equipped to evaluate misinformation and illogical arguments of climate change rejecters.

As a member of the Green First Team, Green₆ helped communicate the technical and financial details of the proposed renewable energy system project to the building committee and Board of Trustees with an added amount of credibility.

As a member of First Universalist Denver, Green₆ also coordinated a monthly "Science Discussion" forum that featured keynote speakers on a diverse range of science-related topics. Some of these topics touched on climate change evidence - such as a tour of the U.S. National Ice Core Laboratory³⁷ at the Denver Federal Center in Lakewood, Colorado. Air bubbles trapped in ice

thousands of years ago confirm that the modern increased CO₂ levels in the atmosphere are unprecedented.

When the energy transition project was later being considered and evaluated by a larger circle of stakeholders, Green₆ invited a fellow scientist to present a science-oriented discussion/assessment of the proposed energy system. (That science presentation is provided later in the case study book)

"Living Without Fire – Just the Sun and Earth" (2013 - June 2014)

One member of the Green First Task Force had installed a rooftop solar PV system and a ground source geothermal heating and cooling system at their residence in 2011. It was a successful 100% transition from fossil fuel to renewable energy. Thanks to encouragement and advice from several other Green First members in 2013, this transition to solar/geothermal was documented in a small self-published 100-page book. After seeing the first draft, the author was advised to re-write the technical report more as a personal narrative to make it a bit more readable. Another sound piece of advice was to reshape the story so it was teach-y but not preachy.

As a result, the book "*Living without Fire*" provides an actual example, with real data, of what an individual can do to transition from being a part of this environmental calamity to being part of its solution.

Admittedly, the author's transition from finite supplies of fossil fuel to inexhaustible energy sources was motivated by the emerging influence of "Ecomorality: the Ethics of Sustainable Living" rather than pure financial incentives. Nevertheless, after re-examining our current broken economic system, the author still concluded it makes logical sense (as well as dollars and cents) to move beyond burning ancient hydrocarbons - for the sake of future generations and all life on our planet.

Since making the transition to solar and geothermal energy, the author no longer buys electricity made from coal or natural gas; the author no longer buys natural gas to heat his home; the author now drives an electric vehicle and no longer buys gasoline for local travel.

This Colorado home is now celebrating seven years of freedom from hydrocarbon energy sources thereby demonstrating it is possible to 'Live without Fire' - quite comfortably and economically it seems.

As it turned out, the documentation of this personal experience with solar and geothermal technology proved to be useful on a number of occasions as the Green First

Part II Pre-BFF Period (2007 to May 2014)

Team pursued its campaign to install solar and geothermal systems for the future operation of the church.

“This Changes Everything: Capitalism vs The Climate”, Naomi Klein (2014)

It was in 2014, that Naomi Kline published *“This Changes Everything”* - an emotionally difficult but necessary book to read. In one case, members of the Green First Team formed a small support group to help process the powerful message conveyed by Kline. The book was even a topic of the First Universalist Community Forum that was attended by a broader church audience. There is no question that *“This Changes Everything”* had a profound impact on a number of Green First Team members as it reframed “capitalism.” As a result, the Green First Team was given permission to pursue new approaches for raising the capital required to finance the new energy system of the church. We describe this later in the book.

“Since *‘This Changes Everything’* was published, Klein’s primary focus has been on putting its ideas into action. She is one of the organizers and authors of Canada’s [Leap Manifesto](#), a blueprint for a rapid and justice-based transition off fossil fuels. **Leap** has been endorsed by over 200 organizations, tens of thousands of individuals, and has inspired similar climate justice initiatives around the world.”³⁸

“This Changes Everything” ... is the most momentous and contentious environmental book since “Silent Spring.”

... Rob Nixon, The New York Times Book Review

Some excerpts from Rob Nixon’s The New York Times Book Review are included below.

“Every inhabitant of this planet must contemplate the day when this planet may no longer be habitable.” Thus spoke President Kennedy in a 1961 address to the United Nations. The threat he warned of was not climate chaos — barely a blip on anybody’s radar at the time — but the hydrogen bomb. The nuclear threat had a volatile urgency and visual clarity that the sprawling, hydra-headed menace of today’s climate calamity cannot match. How can we rouse citizens and governments to act for concerted change? Will it take, as Naomi Klein insists, nothing less than a Marshall Plan for Earth?

“This Changes Everything: Capitalism vs. the Climate” is a book of such ambition and consequence that it is almost unreviewable. ... Her strategy is to take a scourge — brand-driven hyper-consumption, corporate

exploitation of disaster-struck communities, or “the fiction of perpetual growth on a finite planet” — trace its origins, then chart a course of liberation... she arrives at some semi-hopeful place, where activists are reaffirming embattled civic values.

To call “This Changes Everything” environmental is to limit Klein’s considerable agenda. “There is still time to avoid catastrophic warming,” she contends, “but not within the rules of capitalism as they are currently constructed. Which is surely the best argument there has ever been for changing those rules.”

On the green left, many share Klein’s sentiments. George Monbiot, a columnist for The Guardian, recently lamented that even though “the claims of market fundamentalism have been disproven as dramatically as those of state communism, somehow this zombie ideology staggers on.” Klein, Monbiot and Bill McKibben all insist that we cannot avert the ecological disaster that confronts us without loosening the grip of that superannuated zombie ideology.

That philosophy — neoliberalism — promotes a high-consumption, carbon-hungry system. Neoliberalism has encouraged mega-mergers, trade agreements hostile to environmental and labor regulations, and global hypermobility, enabling a corporation like Exxon to make, as McKibben has noted, “more money last year than any company in the history of money.” Their outsize power mangles the democratic process. Yet the carbon giants continue to reap \$600 billion in annual subsidies from public coffers, not to speak of a greater subsidy: the right, in Klein’s words, to treat the atmosphere as a “waste dump.”

...

Klein diagnoses impressively what hasn’t worked. No more claptrap about fracked gas as a bridge to renewables. Enough already of the international summit meetings that produce sirocco-quality hot air, and nonbinding agreements that bind us all to more emissions. Klein dismantles the boondoggle that is cap and trade. She skewers grandiose command-and-control schemes to re-engineer the planet’s climate. ... She reserves special scorn for the partnerships between Big Green organizations and Immense Carbon, peddled as win-win for everyone, but which haven’t slowed emissions...

In democracies driven by lobbyists, donors, and plutocrats, the giant polluters are going to win while the rest of us, in various degrees of passivity and complicity, will watch the planet die. “Any attempt to rise to the

Part II Pre-BFF Period (2007 to May 2014)

climate challenge will be fruitless unless it is understood as part of a much broader battle of worldviews,” Klein writes. “Our economic system and our planetary system are now at war.”

...The divestment movement against Big Carbon is gathering force. While it will never bankrupt the mega-corporations, it can reveal unethical practices while triggering a debate about values that recognizes that such practices are nested in economic systems that encourage, inhibit or even prohibit them.

... Klein’s adversary is neoliberalism — the extreme capitalism that has birthed our era of extreme extraction. Klein is smart and pragmatic enough to shun the never-never land of capitalism’s global overthrow. What she does, brilliantly, is provide a historically refined exposé of “capitalism’s drift toward monopoly,” of “corporate interests intent on capturing and radically shrinking the

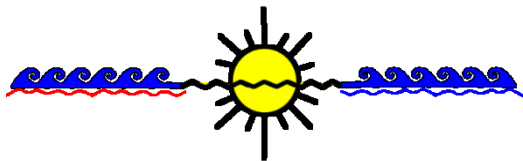
public sphere,” and of “the disaster capitalists who use crises to end-run around democracy.”

...Yet “This Changes Everything” is, improbably, Klein’s most optimistic book. She braids together the science, psychology, geopolitics, economics, ethics, and activism that shape the climate question. **The result is the most momentous and contentious environmental book since “Silent Spring.”**

<https://www.nytimes.com/2014/11/09/books/review/n-aomi-klein-this-changes-everything-review.html? r=0>

A version of this review appears in print on November 9, 2014, on Page BR12 of the Sunday Book Review with the headline: Force of Nature.





Part III Building for the Future (BFF) Project Capital Campaign (May 2014– Mar 2016)

“The best way to predict your future is to create it,”

.... Dennis Gabor, *“Inventing the Future,”* 1963



The Building for the Future (BFF) remodeling project was launched in May 2014 by congregational approval.

Green₄, a solar energy advocate, was one of the original members of the BFF Committee, so he incorporated sustainable design objectives (e.g. conservation, efficiency & solar PV) in the remodeling goals of the BFF project.

A solar photovoltaic (PV) system was considered to be a “no cost add-on” that would be financed by a third party lease (power purchase agreement). The church would then buy electricity generated by the third party system for the period of the contract (TBD). As a result, the BFF committee did not include the cost of a solar system in their budgetary considerations.

As soon as the request for member input to the BFF project was announced in June 2014, a broader vision for a sustainable energy system was conveyed to the BFF committee that added ground source/geothermal heating and cooling to the previous sustainability goals.

Green First members submitted their request for solar/geothermal/ energy efficiency/sustainable construction materials, etc.



BFF Request for Input - Strategic Planning and Programming for Church Expansion (24 Jun 2014)

From: Green₄

Date: Tue 6/24/2014 10:13 PM

To: Green First Task Force

Subject: Meeting this Sunday Regarding Strategic Planning and Programming for Church Expansion

Green First Team, I wanted you to know that we just had to change the date of a meeting that I will lead regarding the new building process to this Sunday at 11:15. Am hoping you can join to discuss strategic areas of interest and needs for a building expansion.

The Architects describe an important planning step as Programming. This means we need to communicate needs and wants for expansion and improvement of the facility so that we are comfortable that we have not overlooked anyone’s input if they want to weigh in.

This will take some thought both about those actual ideas but also the best process to engage congregation groups. It should not result in volunteer workload for anyone at this stage, just looking for thought leaders to discuss...

Hope you can join.

Best, Green₄

BUILDING FOR THE FUTURE

All Hands on Deck!

Planning is beginning on our exciting building project. There will be many opportunities for input throughout this process. You are invited to bring your ideas to planning sessions in three areas:

COMMUNICATIONS – Sunday, June 29 at 11:15, Room 4

Internal and external information flow, surveys, print, electronic and social media, etc.

Interim Lead: Staff₃

STRATEGIC PLANNING – Sunday, June 29 at 11:15, Room 3

Matching mission to program needs

Interim Lead: Green₄

BUILDING PLANS AND CONSTRUCTION – Sunday, July 20 at 11:15, Room 4

Oversight, coordination, documentation of planning and construction

Interim Lead: BFF₃



An online questionnaire/survey was prepared to solicit input from members of the congregation.

Building Vision

The Draft Vision

Please review the draft vision statement below ...

---DRAFT FOR CONGREGATIONAL REVIEW –
September 1, 2014---

BUILDING FOR THE FUTURE VISION STATEMENT

First Universalist envisions a transformation of our building that celebrates our principles, reflects our values, inspires our spirit and stirs our actions.

- The building will invite people to experience joy, awe, reverence, inspiration, and connection through abundant light, beautiful color, and vibrant sound, with a feeling of spaciousness, and connection to the natural world.
- The building will speak of who we are and will support the work we do: love as a covenant, wisdom for life and compassion in action. It will welcome newcomers, encourage radical hospitality, invite participation and engagement, connect people within and across the generations, and reach out to create a diverse community within our walls and beyond. It supports our invitation for people to gather with us, grow with us, and serve with us.
- The building will be a functional, clean, safe, user-friendly space for our community. **It will incorporate sustainable building practices in the use of energy, building materials, and ongoing maintenance.** Its flexible design anticipates change, growth, multiple purposes, and continuous renewal.
- The design of the building will reflect **our concern for the environment, connection with our surroundings, love of life, and our deliberate commitment to learning and reinvention.** The building and the process of its creation will open a path for new growth and will be a catalyst for creating new connections with the broader community in line with our mission to offer a

community for connection, renewal, and transformation.

Although the “Building Vision Statement” was very general and made no specific mention of transitioning to solar or geothermal energy, the environmental advocates and the Green First Task Force were pleased. They felt visible and believed their Ministry for Earth was being respected by this draft vision statement – particularly the portion that is in bold text for emphasis.



Social Justice Matters Newsletter.

An article reporting a recent UUA Resolution “Divestment of Fossil Fuel Holdings.” (Sep 2014)

The following appeared in the First Universalist “Social Justice Matters” Newsletter.

Several Green First Task Force members attended the UUA General Assembly during the summer of 2014 in Providence, RI. It was during that conference that the UU delegates approved a resolution encouraging divestment of all fossil fuel holdings. (Ref: The detailed description was provided earlier as “Slide 2014.1”). It seemed appropriate to seize the moment and apply this resolution to the early planning that had just commenced for renovating the church. An article about the new UUA resolution was prepared for publication in the Social Justice Newsletter.



Social Justice Matters Newsletter, Vol. 7, September 2014

First Universalist Church of Denver

Welcome to our seventh edition of Social Justice Matters. It begins with a reporting on our congregations generous giving for Compassion in Action. It includes articles from Green First, Gun Violence Prevention, World Gift Market, Habitat for Humanity, Homeless Project and Six Words about Race.



**Green First Task Force:
Divesting in the Fossil Fuel Industry**

May I say that I am proud to be associated with a religious organization that walks its talk.

On June 28, 2014, our UU General Assembly delegates overwhelmingly approved a resolution that the Unitarian Universalist Association divests of any holdings in companies that produce or process ancient hydrocarbons (oil, natural gas, and coal) for the purpose of burning these finite one-time-only resources.

Here are a few excerpts from this Unitarian Universalist Association 2014 Business Resolution entitled: Fossil Fuel Divestment

Our talk

WHEREAS, we have a moral responsibility to Earth, to all beings, and to future generations to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy...

Our Walk

BE IT FINALLY RESOLVED that this General Assembly encourages Unitarian Universalist congregations to review their congregational and personal investments with a view to taking action to end climate change, such as:

- ***public divestment of their holdings in fossil fuel companies, and***
- ***investment in renewable energy and conservation.***

“Total Divestment” takes on several forms. In addition to not buying “stock” in an enterprise that engages in less than moral behavior, we also stop buying their “products and services” and instead buy/ invest in viable alternatives.

With this example and encouragement from the 2014 General Assembly of UUs, we at First Universalist can apply this Resolution as we shape our future and consider any new building projects or operational changes that involve our use of energy.

Example #1: We at First Universalist need to replace our old natural gas burning furnaces. It would be egregious to invest in new gas-burning furnaces when alternatives such as geothermal heat pumps (that consume no fossil fuel) are

sustainable alternatives for our heating and cooling needs.

Example #2: We plan to alter our roof configuration. This is a great opportunity to add solar photovoltaic panels to our rooftop to avoid burning coal or natural gas for our electrical power needs.

As the 2014 UUA Resolution reminds us, with the consciousness we have today, “Divestment” of fossil fuel holdings is a moral issue as well as an opportunity for us Unitarian Universalists to walk our talk.

Green5, Green First Task Force, Sept 2014
Past Moderator, '84-'85



Newsletter Editor: Dan M. with assistance from Mimzy T.-M., and Rev. Senior Minister

Not to put too fine a point on the UUA Fossil Fuel Divestment Resolution of 2014, a “memo” was sent directly to the co-chairs of the renovation building committee [referred to as the Building for the Future (BFF) committee] in the event they might have missed the Social Justice Newsletter article. In addition to advocating for a fossil-free church, an attachment to the memo included a conceptual idea of what a fossil-free church might look when described as an ‘Energy Vision Statement.’

Draft Vision Statement - Additional Comments (12 Sep 2014)

From: Green5
Date: Fri 9/12/2014, 11:20 AM
To: BFF_{1,2}
Subject: Church Solar-Geothermal
Attachment: Building for the Future: Energy Vision

BFF_{1,2}

Thank you for all the effort you and the members of your committee are putting in to assure that any church remodeling incorporates member expectations. I did fill out the online survey as you encouraged us to do.

Part III Building for the Future Capital Campaign

You may have seen the latest issue of "Social Justice Matters" (Vol. 7, Sept 2014) and are aware of my input that relates to the Draft Vision Statement.

Nevertheless, I wanted to add a bit more detail for the record.

From my perspective, it would be unconscionable for the architect to propose a plan for a new building upgrade that continues to rely on fossil fuel for our energy needs based on today's consciousness. Viable alternatives are now available.

For the sake of the young people in our RE program, for the sake of all future generations (and all other forms of Life on our shared planet), we must view this next step in our church history as an opportunity to transition away from burning ancient hydrocarbons and to begin harvesting our own sunlight for all our energy needs.

Although I am not aware of any UU churches in our area that have made this transition completely, it certainly is possible and is being done elsewhere. For example, the Mount Vernon Unitarian Church in VA installed solar and geothermal heat pumps for heating and cooling several years ago. (Their minister, Rev. Kate Walker, was ordained at First Universalist in 1998). For an excellent discussion of a geothermal heat pump application to a church facility, see their website: <http://mvuc.org/social-justice/our-solar-geothermal-energy-program/>.

We know that solar PV plus geothermal heat pumps work on a large scale. For example the IKEA store in Centennial, CO has covered its entire roof with solar PV. During construction of their building, IKEA put in geothermal boreholes to exchange thermal energy with the earth for their heating and cooling needs - IKEA does not burn any natural gas (and has zero carbon emissions).

We also know that solar PV and geothermal heat pumps work on a small scale for residential applications. For example, three years ago we added solar PV to our rooftop and then replaced our natural gas furnace with a geothermal heat pump. So we have not required or purchased any fossil fuel for our home for the past three years. Eight of our solar PV panels provide enough electrical power to drive our plug-in hybrid 10,000 miles/year without burning any gasoline. For more details see: "*Living with Fire - Just the Sun & Earth*"³⁹

The energy needs of First Universalist are somewhere between IKEA and a residential application. There is no question First Universalist could stop burning fossil fuel now. The enclosed document illustrates a few concepts to begin to illustrate the feasibility of transitioning away from fossil fuels.

What a great story (and positive example) this transition would be to weave into our youth RE program. They could proudly explain to their peers that their church runs solely on the sun and does not contribute to climate change/global warming.

Although the following is too detailed for your general Vision Statement "It will incorporate sustainable building practices in the use of energy," I offer it as a lower level of detail:

Energy Vision for First Universalist:

- To walk our talk and provide all electrical power, heating, and cooling, as well as hot water from renewable/inexhaustible energy sources only.
- First Universalist will divest completely from fossil fuel (we will stop buying fossil fuel industry stock, bonds, products, and services) as encouraged by the June 2014 Fossil Fuel Divestment Resolution adopted by the UUA General Assembly.

Thanks again for all your effort

Respectfully,

Green₅

Attachment

Building for the Future: Energy Vision (9/12/2014)

Introduction - Vision

We can envision a future rooftop that is green in the sense that it harvests sunlight for our electrical power needs. As a result, there is less valuable sunlight wasted (i.e. the zero waste solution).

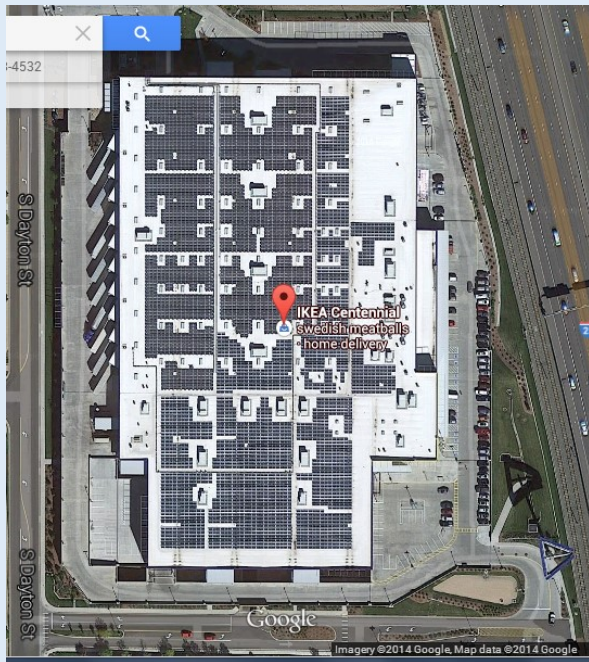
For our heating & cooling requirements, our future building can exchange thermal energy with Mother Earth using heat pumps powered by some of the solar-generated electrical energy. We can tell our youth that their church no longer contributes to climate change.

Rooftop Solar Example – IKEA Centennial, CO

Most of the available roof area of the IKEA store in Centennial, CO is covered with solar PV modules.

The individual modules are mounted on a framework that is “ballasted” in place on the roof.

This eliminates the need to penetrate the roofing membrane with holes for fasteners that in turn become potential leak paths for standing water on the roof. The amount of ballast/weight required to hold the modules in place was determined by calculating the weight required to withstand wind loads.



Heating and cooling of the IKEA building use geothermal heat pumps – no natural gas is burned.

IKEA’s goal was to harvest all their energy using solar PV and geothermal heat pumps. They seem to have accomplished that goal.

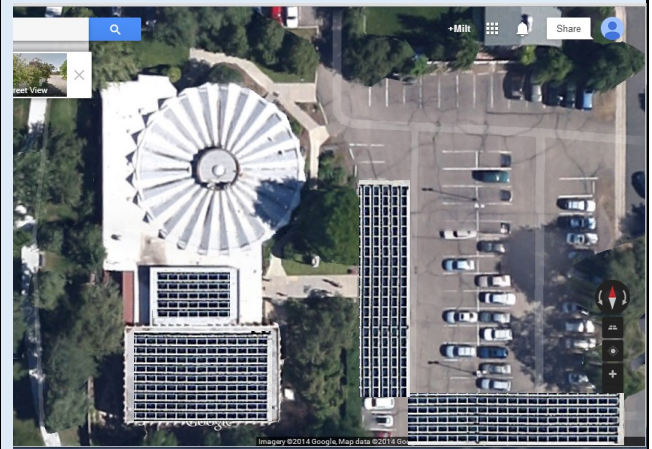
Conceptual Solar Layout for First Universalist

Using the IKEA flat rooftop approach, we can get some conceptual idea of how that would look on our present roof area. What the future roof will look like is “to be determined.”

Solar Modules on Existing Primary Structure

The amount of electrical power that could be generated on our existing flat room can be approximated (assuming south facing modules; 10 deg tilt, 250 W/module, 150 modules)

$$38 \text{ kW} * 1459 \text{ kWh /KW} = 55,442 \text{ kWh/year}$$



Solar Garden (Car Ports with Solar)

Green₄ has also suggested that we might consider the idea of a third party Solar Garden. As an alternative, we show two carports structures in the existing east parking lot as an example of the potential for harvesting additional sunlight on site. This illustrates there is space for at least an additional 210 solar modules bringing the total annual power generation up to around 131,310 kWh/year. (We currently use about 72,000 kWh)

The annual value of 131,310 kWh using today’s retail of \$0.12/kWh would be about \$15,757/year.


Typical Commercially Available Solar Carports

Solar carports are commercially available. A few of the options are shown below.

Residential Grid-Tie Solar Carport System Information		
 <p>Schletter Residential Solar Carport</p> <p>Schletter Residential Solar Carport Features</p> <ul style="list-style-type: none"> • Pre-fabricated solar carports • Small home carports to large car parks • Solar carport design available • On-site project management available • Made in the USA 	 <p>Baja Construction, Inc.</p> <p>Baja Construction Solar Carport Features</p> <ul style="list-style-type: none"> • Family-owned company. Made in USA • Pre-fabricated and custom solutions • Home solar carports from 20'x10' • Stamped engineering reports available • Carport design assistance available 	 <p>Orton Scalable Solar Carport</p> <p>Orton Residential Scalable Carport Features</p> <ul style="list-style-type: none"> • Available in all sizes large to small • Solar carport charging station option • Pre-fabricated or custom design • Low-cost solar carport • On-site project management available • Installation service options

Recharging Stations for Electric Vehicles

Charging stations to recharge electric vehicles are also becoming more popular. These can be set up as “pay as you charge” stations (e.g. ChargePoint) so the church would not incur any significant expense but simply provide the charging station.



Sun Pumps
1:57

Have an electric car? Visit one of the electric vehicle charging stations in our main parking lot! Our charging stations are green-powered by on-site solar facilities.

<http://www.chargepoint.com/>

Financing of Solar PV System

There are many options available for financing the primary solar PV system. The system can be owned or leased.

Ownership. There are a number of ways to finance the purchase of solar equipment. It could be included in the overall cost of the building renovation/mortgage or we could initiate a special capital campaign specifically for the solar equipment.

Leasing the system involves a third party who is willing to invest the capital for the equipment. The church would then sign a contract to make their utility payments to the third party knowing their electrical power was being generated sustainably.

Local Community Garden

The solar garden/carport system would provide another option. Members who are unable to add solar to their own rooftop (e.g. because they live in an apartment, condo, or retirement center, etc.) would be able to purchase additional portions of the solar garden system to offset their electrical energy usage. This allows members to assume responsibility for harvesting the energy they use in their lifestyle by placing their solar PV modules in the church parking lot.

Currently, there are a limited number of third-party organizations allowed by Colorado statute to offer solar gardens, but that could be added to the list of needed social system changes for more sustainable living.

From the Scribe's perspective, it seems that at this point in time, there were only two members of the Green First Team that were vocal advocates for the new energy system vision. That was all there was at the time – merely a vision. The vision was not yet defined enough to even become a dream.

But then a significant event occurred. A third member of the Green First Team (Green₆) "piled on" adding more human creative energy to the "Energy System Vision." Although the number of staunch advocates only increased from 2 to 3 (a 50% increase), the effectiveness of the small group seemed to increase dramatically – not in a linear way as $1+1+1 = 3$, but rather in a factorial manner as $1 \times 2 \times 3 = 6$.

Green₆ then contacted other members of Green First Task Force to garner their support.

Expanding the circle at First Universalist (14 Sep 2014)

From: Green₆
Date: Mon 9/14/2014, 10:13 AM;
To: Green First Task Force
Subject: Church Solar-Geothermal

Green₃ and Green₁, where is First Universalist going on this?

(This was sent to BFF_{1,2} and copied to me by Green₅. I have redacted the personal message portions.)

Green₆.

Re: the recent "Divestment Resolution" passed by the UUA General Assembly this year: (See Attachments)

... WHEREAS, we have a moral responsibility to Earth, to all beings, and to future generations to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy ...

There are several ways we UUs can "divest" - at the Association Level, at the level of individual Congregations (i.e. First Universalist) and at the personal level. Seems that divesting can be carried out in a number of ways. We can stop buying "stock" in fossil fuel extraction/burning corporations AND we can stop buying their "products and services." We can buy viable alternatives instead.

Obviously, with the consciousness we have today about the morality of burning more ancient hydrocarbons, if we need to replace old natural gas burning furnaces, it would be egregious to buy new gas burning furnaces when alternatives such as ground source geothermal heat pumps are sustainable alternatives.

Likewise, it would seem to be hypocritical for UUs to construct any new roof area that simply transforms valuable incident solar energy into waste heat. Alternative roof design will allow us to harvest a portion of this energy and convert it into electrical power to offset our needs (for amplifying sound and

music and operating our office computers and copiers, etc.)

Whether it was intentional or fortuitous is not known, but this additional endorsement helped open the flood gates for a growing wave of support. The "Energy System Vision" had now acquired a legitimate status at First Universalist.

There seems to be nearly a 6-month hiatus at this point. Then the correspondence related to the energy system resumes the following year. But 2015 was a year of significant events that contributed to this transition project.

About midyear, a member of the Building for the Future (BFF) remodeling committee contacted a member of the Green First Team for more information about geothermal heating and cooling.

BFF Committee Inquiry into Geothermal Heating and Cooling (May 2015)

From: BFF₃
Subject: Re: First Universalist Roofs and Drains, and Geothermal
Date: Fri, 29 May 2015
To: Green₅

Hi, again Green₅,

Another area of the church remodel I am looking at is the heating, ventilating, and air conditioning. BFF₂ told me recently, that you have an interest in the church using geothermal, and also some experience with it! I would very much like to talk to you about this. It is something we have discussed with the architects and would like to incorporate into the design, if possible. We need to know more about it.

I am hoping you are available to talk sometime. Either by phone at your convenience or, if you would like, to get together for coffee.

Thanks,

BFF₃

And of course, the Green First Team responded quickly.

From: Green₅

Sent: Sunday, May 31, 2015

To: BFF₃

Subject: RE: First Universalist Roofs and Drains, and Geothermal

Hi BFF₃,

BFF₂ is correct. I am very much interested in geothermal heat pumps for heating & cooling - having replaced our natural gas furnace with a geothermal heat pump about 4 years ago.

I'd be happy to meet sometime and discuss my experiences with geothermal (95% good).

There are several meeting options... Let me know what works best for you. This coming week looks pretty open either during the day or early evening.

Green₅

From: Green₅

Sent: Monday, June 1, 2015, 2:50 PM

To: BFF₃

Subject: RE: First Universalist Roofs and Drains, and Geothermal

BFF₃,

I've lined up a geothermal "expert" to accompany us on our tour of the furnaces - but he is out of town until Thursday night and could meet with us Friday or Saturday if either would work for you - or next week. His name is Al W. and he was the contractor who installed the geothermal heat pump in our home. He understands we are just in the exploratory phase but is willing to take a look at our situation and offer suggestions/comments.

Let me know if either Friday or Sat would work for you and I can get back to Al.

Green₅

From: BFF₃

Subject: Re: First Universalist Roofs and Drains, and Geothermal

Date: Mon, 1 Jun 2015

To: Green₅

Hi Green₅,

Meeting at church would be great. We could look at the furnaces and how they could be updated with

geothermal. As you probably remember, they are all over the place! ... I also have a key, so we could meet there anytime that it is convenient for you.

Thanks,

BFF₃

The meeting was set up. The geothermal contractor visited the facility and confirmed the feasibility of replacing the ten natural gas furnaces with geothermal heat pump furnaces. He observed that a good place to install the ground loop heat exchanger system would be in the north parking lot. Plenty of space. With ten furnaces, the contractor estimated the church would need at least 18 boreholes 300 feet deep = 5400 total feet. Drilling costs at that time were around \$15/feet. So the ground loop was estimated to cost around \$81,000. The contractor indicated the ground loop cost is about 1/3 of the total cost of a geothermal system, so a rough estimate of the total geothermal system cost was in the ballpark of \$250,000. The contractor's comments were summarized in a memo to the BFF building committee on 6/5/2015 (see Appendix B.).

For some unknown reason, the BFF committee came up with a cost estimate of \$600,000 to add geothermal for budget considerations. This inflated cost obviously introduced a significant negative bias for a geothermal system into their renovation budget.⁴⁰

While the architects and the building committee were preparing preliminary concepts for the church remodeling effort, the Green First Task Force and environmental justice advocates continued their Ministry for Earth in other areas. For example, they wrote and published a series of pamphlets on "Sustainable Living" for church members.

Green First Task Force "Living Our Values" Trifold Pamphlets (Jun 2015)

As part of the environmental education program for sustainable living, the Green First Task Force published six 8.5"x 11" tri-fold pamphlets on the following topics:

- Solar
- Geothermal
- Climate Change
- Electric Vehicles
- Divestment
- Food

The intent of the pamphlets was two-fold: 1) provide basic information about choices we have today that are consistent with sustainable living and 'Living our UU values,' and 2) identify a local "Go2 Green Guide" (also a member of the church) who can answer questions about the topic. Examples of the "Solar" and "Geothermal" pamphlets can be found in Appendix C.

The Spirit of America and the Challenge of Climate Change – Sunday Program (5 Jul 2015)

From their very beginnings, Unitarian Universalists tend not to shy away from the important challenges of each historical moment. The critical issue of today's era is the climate crisis. What might this crisis be challenging us to do, both personally and collectively? Why not introduce the existential issue of 'creation care' into a Sunday service?

Green₇, a member of the Sunday Morning Program Committee, took responsibility for planning and coordinating a Sunday morning service focused on the topic of climate change/global warming. Green₇ lined up two speakers who were passionate about raising awareness of what UU's can do to respond to climate change. Speaker #1 was a retired UU minister, Green₁₁, and speaker # 2 was a retired NASA scientist, Green₆, now an adjunct professor at the University of Denver teaching a course on the Climate Physics. Together, they constructed an Order of Service.

Documentation of this Sunday morning service and sermon that centered around climate change is provided below. The goal of this service, of course, was to raise awareness of climate change and the urgency to do something about it.

Order of Service



Order of Service (Abridged): July 5, 2015, 10:00 am

Theme: The Spirit of America & the Challenge of Climate Change

Bell Sound

Announcements

Rev. Senior Minister: Welcome to First Universalist. For the service, we ask that you silence your cell phone.

Rev. Senior Minister: We welcome the Rev. Guest Speaker to the pulpit this morning. Rev. Guest Speaker is a retired UU minister and an accredited interim minister for our denomination. She has served eight UU congregations, including nearby Colorado Springs. Rev. Guest Speaker is also a published author, with five books to her credit. She lives in Las Vegas and spends summers here in the Denver area with her partner, a member of our congregation.

Invitation to Community: Rev. Senior Minister

Prelude: *Who'll Stop the Rain?*

Opening Words: Green₇, Worship Associate

Rev. Jacob Trapp writes:

To worship is to stand in awe under a heaven of stars;

Before a flower, a leaf in sunlight, or a grain of sand.

To worship is to be silent, receptive,

Before a tree astir with the wind,

Or the passing shadow of a cloud.

To worship is to sing with the singing beauty of the earth;

It is to listen through a storm to the still small voice within.

Hymn *Mother Earth*

Chalice Lighting: Green₇

Love is the spirit of this church, and service is its law.

This is our covenant: to dwell together in peace, to seek the truth in love, to serve human need, and to help one another.

Sung Response #123 *Spirit of Life* by Carolyn McDade (remain seated)

Spirit of Life, come unto me. Sing in my heart all the stirrings of compassion.

Blow in the wind; rise in the sea; move in the hand, giving life the shape of justice.

Roots, hold me close; wings, set me free; Spirit of Life, come to me, come to me.

Words of Welcome/Meeting & Greeting: BFF₅, Board of Trustees

Offering: Compassion in Action

Readings from the Common Bowl

Green₇: "The Great Work of our era is to carry out the transition from a period of human devastation of the Earth to a period when humans will be present

to the planet in a mutually beneficial manner." *Father Thomas Berry*

Rev. Senior Minister: "We will never have a perfect world, but it's not romantic or naive to work toward a better one." *Stephen Pinker*

Green₇: "We stand now where two roads diverge. But unlike the roads in Robert Frost's familiar poem, they are not equally fair. The road we have long been traveling is deceptively easy, a smooth superhighway on which we progress with great speed, but at its end lies disaster. The other fork of the road/the one less traveled by/offers our last, our only chance to reach a destination that assures the preservation of the earth." *Rachel Carson*

Rev. Senior Minister: "Climate change is ... a moral issue. It requires us to consider what it means to walk justly in relationship with...the human family with future generations, and with the whole community of life." *Rev. Sharon Delgado, United Methodist minister, Founder and Executive Director of Earth Justice Ministries*

Green₇: "We're dumping carbon dioxide into the atmosphere at a rate the Earth hasn't seen since the great climate catastrophes of the past, the ones that led to mass extinctions.... The dinosaurs never saw that asteroid coming. What's our excuse?" *Neil deGrasse Tyson*

Rev. Senior Minister: "No longer is caring for oneself, one's family or community enough. Even caring for our nations, as we have done over the last 300 years is far too narrow. The crisis of global warming means we have to now care for a whole planet, and for every species of life we share it with." *John Croft, co-founder of the Gaia Foundation in Western Australia*

Green₇: "As human beings, we are vulnerable to confusing the unprecedented with the improbable. In our everyday experience, if something has never happened before, we are generally safe in assuming it is not going to happen in the future, but the exceptions can kill you and climate change is one of those exceptions." *Al Gore*

Rev. Senior Minister: "One of the big questions in the climate change debate: Are humans any smarter than frogs in a pot? If you put a frog in a pot and slowly turn up the heat, it won't jump out. Instead, it will enjoy the nice warm bath until it is cooked to death. We humans seem to be doing pretty much the same thing." *Jeff Goodell*

Green₇: “The biggest barrier to dealing with climate change is us: our own attachment to habits that are hard to shift, and our great ability to park or ignore uncomfortable choices.” *Geoff Mulgan*

Rev. Senior Minister: “Earth is our home. We are part of this world and its destiny is our own. Life on this planet will be gravely affected unless we embrace new practices, ethics, and values to guide our lives on a warming planet. As Unitarian Universalists, how can our faith inform our actions to remedy and mitigate global warming and climate change?” *UUA website, Global Warming/Climate Change page*

Candles in Community: Rev. Senior Minister:

Rev. Senior Minister: As we gather together each week, we hold one another in loving community. If you would like to light a candle and share a personal joy or sorrow, please come now and light a candle, then form a line here. As we listen to all that is spoken, we are embracing our world, our congregation, and one another.

Exploration I *Awakening to Climate Change*
Rev. Guest Minister

Exploration II *Awakening to Climate Change*
Green₆

Music *America the Beautiful*

Exploration III *Responding to Climate Change*
Rev. Guest Minister

Hymn #187 *It Sounds Along the Ages*

Extinguishing the Chalice: Green₇

We extinguish this flame but not the light of truth, the warmth of community, or the fire of commitment. These we carry in our hearts until we are together again.

Closing Words: *(by Robert Doss; adapted & expanded by Kirk Loadman-Copeland)* Rev. Senior Minister:

I close with these words:

To those who came here seeking the holy,
May the holy go with you and in you.

To those who came here seeking to embrace life,
May life return your affection.

To those who came here seeking a better way,
May you find that way

And the patience and courage to take it to step by step.

To those who came here seeking a better world,

May we make it so by the loving work of our hands and our heart.

Postlude: *Big Yellow Taxi*

Exploration 1: Awakening to Climate Change: Rev. Guest Speaker and Dr. Green₆

Rev. Guest Minister Pt1

Good morning! It is so good to be in your pulpit again! I was first here back in 1998 when you ordained your intern Kate W. into the Unitarian Universalist ministry.

How many of you were here then? Kate and I were classmates at Starr King School in Berkeley, and when I was driving across the country to begin my internship south of Boston, and Kate was beginning hers here, she took me into the high country on a hike to find wild columbine.

Now the blue columbine that is your state flower is so called because Columba is Latin for Dove. Can you see the dove in the flower?

In the spring of my first year of seminary, I placed a pot of Columbine on the windowsill of my dorm room.

Its pale pink blossom flying high on its singular stem kept me mindful that, in ancient times, the image of a dove being born from the mouth of a dolphin (Delphos: womb) symbolized women’s rebirth journey. For a woman’s spiritual task is to give birth to her whole self out of her ego self.

Then, as I prepared to go home that summer to close out my old life there, I took the pot to the gardener at Starr King School and asked her to plant it somewhere. She did: right beneath an enormous tree in the front of the school.

All that seminary second year, as I struggled to live in the liminal space between the familiar security of the old life and the as-yet-incomprehensible new one, I looked forward to the columbine’s reappearance in spring.

But when it finally bloomed, it was small, close to the ground, and red with a yellow center. Stunned, I sought out the gardener: what happened to my gorgeous pink columbine?!

She looked at it and declared, “It reverted to its original self. All nursery grown columbine are hybrids, cultivated to be showy. This one simply became its authentic self again.”

Now there was a perfect metaphor for becoming a minister, and beginning a new life from my authentic Self!

So when Kate invited me to participate in her ordination into ministry, I was delighted to find a Columbine on the cover for the service! I even used the columbine in my charge to your congregation. I was even wearing this same columbine covered stole!

Now I bring another charge to you this morning.

Forgive me, but the columbine is insisting upon it!

For you see, these summers when I hike up to the high country to commune with them, what I find is that your state flower is fading and thinning...exactly as predicted by a Berkeley researcher who did his summer fieldwork in your mountains. Over several years, he observed what happened when he simulated the conditions of global warming in an alpine meadow. Sage crept up the slope and replaced the columbine.

I can't stand that! And I can't let that stand.

So here I must make a stand.

In part two this morning I shall share just what I have been doing in order to keep that commitment.

Meanwhile, my path to climate awareness clearly parallels our first source:

"Direct experience of that transcending mystery and wonder, affirmed in all cultures, which moves us to a renewal of the spirit and an openness to the forces that create and uphold life."

Your journey may well be predicated on another source.

For instance, another approach might be through the Fourth Principle:

"A free and responsible search for truth and meaning,"

and/or the Sixth source:

"Humanist teachings which counsel us to heed the guidance of reason and the results of science, and warn us against the idolatries of the mind and spirit."

So to share his journey into climate awareness through that lens, here is our scientist friend, Green₆

My journey by Green₆

It was 1957. I'd just started college and that fall the Soviet Union launched Sputnik, frightening the Nation. My patriotic duty was to study physics and

contribute to the Nation's need for technical talent. I went to graduate school in physics, learned about space, and invisible energetic particles there that were dangerous for humans.

I got a job at NASA and started my research in the late sixties. I didn't support the Vietnam War. National leaders I agreed with were being shot. I started to wonder. What was the value of my research to the human condition? It didn't feed the hungry, provide jobs for the unemployed or stop inhumanity to man or woman.

The research was exhilarating. New satellites were revealing new secrets on a regular basis. Growth of population and the economy was phenomenal, driven by inexpensive energy. Astronauts landed on the moon and took pictures of Earth from space. Love of nature and awareness of the Earth as a whole grew as images began to pour in.

By the 1990s I became privy to some of the earliest warnings about global warming. Jim Hanson stood nearby and gave the first dire warning I heard. Carbon dioxide and other greenhouse gases were going to have a serious impact on our climate. I heard briefings on the probable health impacts. I became friends with scientists who were studying these effects.

When I retired, I resolved that I had to become more directly involved in the problem of climate change. I listened to those who didn't accept the growing consensus. A good scientist does not accept without the evidence. I spent the next few years studying and learning and became convinced. I learned about peak oil, the exponential growth of our population, and the relationship between energy use and affluence.

I got depressed. I decided the confluence of problems was insurmountable. I eventually learned that the only escape from an emotional backwater is by doing something. I started giving talks and teaching about the climate. I have the advantage of training to understand the effects of things I cannot see or experience directly (carbon dioxide, temperature, energy, stuff like that).

So what now? I have come to see no point in butting heads with deniers, and those who are indifferent. Most of those who want to know about climate change already know. Of course, I am delighted to talk with those who are open-minded and willing to listen and learn. I have realized that this is a privileged person's problem and I believe we scientists

are morally obligated to take the lead in solving it. I have learned that the problem is serious but fixable. While the inaction is frustrating, it is clear many people are involved and something is being done. It is not hopeless.

As I approach the twilight of life, I may not have many years to better align my values with my actions. So now, I am trying to figure out how to make this work in practice. I am seeking association with those who are convinced and are already doing something, and I am finding that there are a lot of them and that I like them a lot. I am doing something.

Rev. Guest Speaker – Pt2

For the next few minutes, I invite you to ponder the words of America the Beautiful, with its evocation of our spacious skies and waves of grain and majestic mountains and shining seas....which of these speaks especially unto you?

And how do YOU feel about oil spills along our coasts, the tops of our mountains blasted off for coal and the hundreds of thousands of natural gas wells that preside over the plains...

all of which are contributing to the release of CO₂ into our skies, so that now our global atmosphere contains 400 parts per million, a condition not seen since the time of the dinosaurs and the last mass extinction. In fact, we the people are already bringing about the Sixth Great Extinction.

How does that reality line up with our Unitarian principle that urges, "respect for the interdependent web of all existence of which we are a part"?

Exploration 2: Responding to Climate Change:

Rev. Guest Speaker

I grew up in MA, where car license plates say Spirit of America. And why not? From Bunker Hill to Lexington Green, from Concord Bridge to Boston Harbor where the original 'tea party' took place, the prevailing attitude toward major issues has been to stand up and face it head-on.

My affinity for this history is why, after adulthood of living mostly elsewhere, I chose to do my parish internship south of Boston. And I was indeed ordained by the people of Old Ship, First Parish in Hingham, wearing this columbine stole and graced by bouquets of columbine and roses on the altar.

The church itself sat across the street from the Lyceum, where Emerson had lectured a century and a

half earlier. A Unitarian minister, Emerson resigned from his Boston pulpit and moved to rural Concord, where he could cultivate his inner Spirit. There he helped start the Transcendentalist movement.

The majority of the Transcendentalists were Unitarian ministers, and Nature became the vehicle through which they cultivated their whole Selves, the Divinity within.

But their inner awareness demanded outward action.

The ethical consequences of the Transcendentalists' ideals impelled them into a wide range of causes, from the educational reforms of Bronson Alcott and Elizabeth Peabody, to the Christian socialism of William Henry Channing, Margaret Fuller's feminism, Thoreau's civil disobedience, George Ripley's Brook Farm, and Theodore Parker's commitment to abolition.

And then there was Thomas Starr King, for whom our seminary in Berkeley is named. Starr King was a Universalist minister in Boston who hung out with Emerson's crowd until he was called to serve the Unitarian Society of San Francisco in 1860. At that point in time, the nation was in turmoil, with the southern states threatening secession out of fear that the balance of power in Congress would tip towards the abolition of slavery as new states were added to the union.

California had been a state for 8 years when Starr King arrived, and he is credited with keeping California in the Union.

Sometimes referred to as 'the orator who saved the nation,' Starr King was honored by being one of the two statues from California to be displayed in statuary hall in the U.S. Capitol...until he was replaced by Ronald Reagan's in 2006.

Yet, ever the Transcendentalist, and an avid naturalist, Starr King's was also an important voice in convincing Lincoln to designate Yosemite and Mariposa Grove as the country's first major environmental preserve....the earliest natural place to be expressly set aside for the public to enjoy.

But when you spend time in Nature and come to know it as something beyond your small ego-self, you must fight for its well-being, which is why I am here this morning on behalf of your CO columbine that is being impacted by climate change.

I vividly recall an insight I had while doing an interim ministry year at the Unitarian Church in Charleston, S.C. Driving beneath a billboard advertising a newly opened slave museum, I looked up at the image of a dark-skinned man in chains and it hit me: this is exactly what we are doing to the earth: enslaving it for our pleasure, power, and profit.

And in the process, we are changing the climate and contributing to the next mass extinction!

Yet our English words ecology and economy both come from that singular root *oikos*, which is Greek for home.

So I submit unto you that any economic activity that threatens the ecosystems on our home planet is insane, immoral and ought to be deemed illegal.

For just as the cotton-based economy of the civil war era did not justify slavery, the fossil fuel based economy of today does not justify enslaving the living Earth.

Yet the fossil fuel industry is determined to dig up, frack for, drill down to and burn every last ounce of CO₂ releasing coal, oil, and natural gas in order to max out its bottom line.

But the real bottom line is this: we need to start leaving the rest of the reserves in the ground. We can't burn any more gas, oil, or coal and still have any hope of a viable planet.

Yet thanks to the fossil fuel lobby, Congress won't act.

So we people must. And we are. Ordinary people, non-corporate people, we the people are taking action:

We are banning fracking,

We are blocking pipelines,

We are lobbying Congress for a carbon tax,

We are divesting our personal and professional portfolios from fossil fuels, and demanding our churches and colleges do likewise.

But this involves more than saying no to fossil fuels; it means finding fossil freeways of living in the world....so

We are changing our light bulbs

AND we are changing our life ways

by installing rooftop solar to power our homes and electric cars and sinking geothermal loops for our heating and cooling...

We are growing and/or eating local, organic foods,

We are driving fuel efficient cars and/or biking.

You can find information on all of these people-powered efforts at the Green First Kiosk after the service this morning, and then join us on August 15 for a workshop that will help you plan your personalized response to climate change.

Do you doubt that you can make any difference in the major challenge of our time? Let me lift up my own story, one in which my small actions were but part of the larger narrative:

As a student nurse, I met and then married an intern from India, whose brown skin put me in touch with and made me part of the Civil Rights movement that was happening at the same time. When my non-U.S. citizen husband was drafted during the Vietnam War, I worked on peace issues as a military spouse for 23 years, helping to establish the U.S. Institute for Peace that now sits across from the state department in D. C.

As the mother of two daughters, I got involved with the Women's Movement in order to make sure that they would have more opportunities than I had growing up in this country.

As a minister whose spiritual life is grounded in the natural world, I have always preached and practiced ecological awareness and environmental action.

And now, as a non-fiction writer, naturally I am involved in the climate movement that is blossoming around us today!

And I/we are in good company. The Pope has just come out with a sweeping Encyclical on Climate. I encourage you to download it in PDF file and read it. Of its 184 pages, barely a handful is overtly Catholic...he is talking to us all...which is why I pulled seven excerpts for you to reflect on during the coming week, as you live into questions about climate change.

Be assured that people of all faiths are stepping up and taking action. From the Parliament of World Religions to our own Unitarian Universalist Association, we are joining forces against the powers and principalities behind ecocidal practices.

Make no mistake: the power of the people is on the move. It is a part of who we are as Americans. Whenever there is a problem, we fix it. The continuation of our national epic demands it; our natural landscapes command it.

And more: the fate of the very planet depends upon our response to and responsibility for this human created a crisis.

I grew up in an evangelical protestant Sunday School singing “He’s got the whole world in his hands.....” But today, it is we who have the whole world in our hands.....

May we act with courage and clarity, commitment and wisdom.

To put that into perspective, let me invite you to stand:

Using your body to measure our planet’s time within the 14 billion years since Time began,

- your feet planted on the ground mark the beginnings of the earth at the birth of our solar system 4.5 billion years ago,
- the first living cell appears at your ankle (3.8 bya),
- life’s common ancestor (LCA) is at calf level (3.5 bya),
- multiple cellular life emerges at your knee (3 bya),
- DNA exchange comes into being at hip level (2 bya),
- plants and oxygen come about at shoulder height (1 bya).

Now, raise up your arms:

- the largest explosion of life is at your elbow (500 mya),
- dinosaurs come and go just below your wrist (70 mya),
- at your wrist’s bone is when humans appeared (2 mya).
- In the span of Time represented by the wrinkle in your skin at your wrist, modern humans walked out of Africa 200,000 years ago and landed on the Moon.

The distance from your wrist to your outstretched fingertip represents 500 million years to go that our planet should/could/would support life. That future is now in the palm of your hand.

Now, please sit down, and with your hands open upon your lap, see your personal lifeline etched on one; across the other is the whole arc of evolution.

Yet the continued viability of that narrative now lies in human hands.....your human hands.

May you act with courage and clarity, commitment and wisdom.

The Order of Service included **Daily Reflections: Quotes from the Pope’s Encyclical on the Environment and Climate**

Monday: *“Although change is part of the working of complex systems, the speed with which human activity has developed contrasts with the naturally slow pace of biological evolution. The earth, our home, is beginning to look more and more like an immense pile of filth.”*

Pope Francis

Tuesday: *“The human environment and the natural environment deteriorate together; we cannot adequately combat environmental degradation unless we attend to causes related to human and social degradation. The warming caused by huge consumption on the part of some rich countries has repercussions on the poorest areas of the world.”*

Pope Francis

Wednesday: *“Humanity is called to recognize the need for changes of lifestyle, production, and consumption, in order to combat global warming or at least the human causes that produce or aggravate it. For such effects will continue to worsen if we continue with current models of production and consumption.”*

Pope Francis

Thursday: *“Nobody is suggesting a return to the Stone Age, but we do need to slow down and look at reality in a different way, to appropriate the positive and sustainable progress which has been made, but also to recover the values and the great goals swept away by our unrestrained delusions of grandeur.”*

Pope Francis

Friday: *“Human beings and material objects no longer extend a friendly hand to one another; the relationship has become confrontational. This has made it easy to accept the idea of infinite or unlimited growth, which proves so attractive to economists, financiers, and experts in technology. It is based on the lie that there is an infinite supply of the earth’s goods, and this leads to the planet being squeezed dry beyond every limit.”*

Pope Francis

Saturday: *“The fact is that contemporary man has not been trained to use power well, because our immense technological development has not been accompanied by a development in human responsibility, values, and conscience.”*

Pope Francis

Sunday: *“Today, in view of the common good, there is an urgent need for politics and economics to enter into a frank dialogue in the service of life.”*

Pope Francis



Near the end of Summer, several members of the Green First Task Force facilitated a workshop on 15 Aug 2015 with the theme **“Responding to Climate Change: A Personal Planning Workshop.”**

The workshop facilitators had themselves responded personally by divesting in fossil fuels, installing rooftop solar, driving plug-in vehicles, and investing slow money in local farming and other sustainable enterprises. So they were able to convey some of their personal experiences to the attendees.

Much of the workshop material is presented below. It is not clear if or how the workshop contributed to the surprising attendee response during the Question & Answer segment at the end.



Responding to Climate Change: A Personal Planning Workshop (15 Aug 2015)

The Green First Task Force sponsored a half-day long workshop to assist attendees in **preparing a personal plan of action in response to climate change.** The flyer announcing the workshop indicated this was not an event for climate change deniers or liars.



Background / Prerequisites for Workshop:

- OK, climate change is real and humans are causing it. So now what? What can I do?
- Climate change has become a moral issue requiring an ethical response by people of faith.
- So what’s my plan - individually and collectively (i.e. as part of a larger group)?

What to Expect from Workshop:

- Identify the growing number of options now available in the areas of energy, food, finance, and transportation that are climate-friendly and aligned with our personal values/ethics/principles.
- Craft your own personal plan of action based on your unique circumstances.

About 30 people attended the workshop; most were members of the church but several non-members participated as well.

Each attendee left with a three-ring notebook filled with all the workshop materials – including a personal plan for responding to climate change.

The primary goal of the workshop was to raise awareness of the urgency of the imminent climate crisis and help individuals develop their own personal plan to respond to climate change.

But at the end of the workshop, something totally unexpected happened that made the event a part of this Case Study.

Opening Worksheet: Preface

Global Climate Change is real and affects all Life. Humans are causing it by altering the amount of greenhouse gases in our common atmosphere. Greenhouse gases trap heat and make the planet warmer.

Human activities are responsible for almost all of the increase in greenhouse gases in the atmosphere over the last 150 years.

The largest source of greenhouse gas emissions from human activities in the United States is linked to burning fossil fuels for electricity, heat, and transportation. There are viable alternatives to fossil fuels for our energy needs that can minimize, even eliminate our greenhouse emissions.

The information presented and the worksheets provided are intended to help you evaluate today’s energy options and select those that are best for your personal circumstances and minimize harm to others.

*“The dinosaurs never saw that asteroid coming.
What’s our excuse?”*

--- Neil deGrasse Tyson

Responding to Climate Change:

A Personal Planning Workshop

August 15, 2015

Facilitators:

Green₁, Green₂, Green₁₁

Facilitator Bios (3)

(Personal Responses to Climate Change)

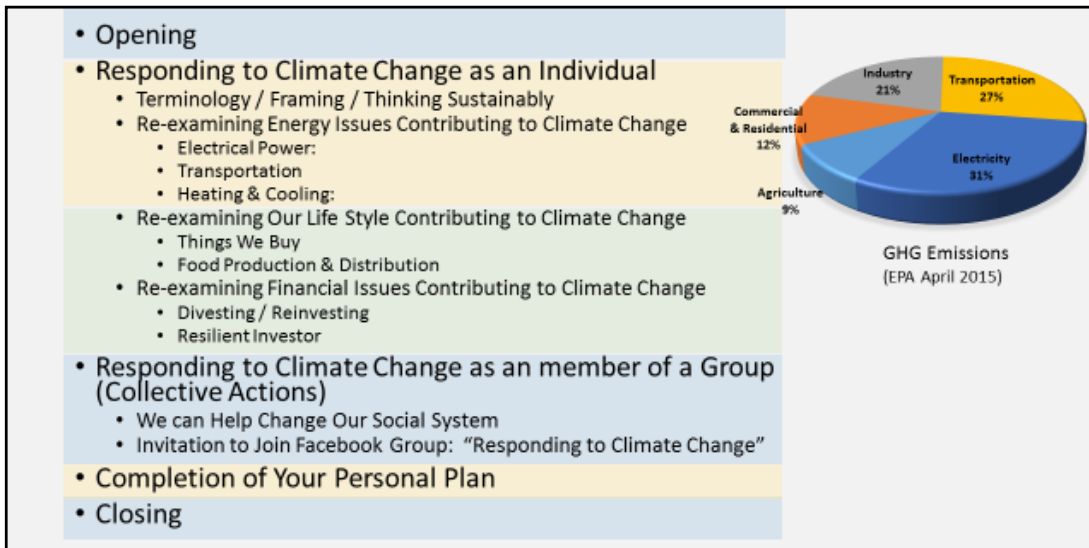
- 3 have solar PV on their roof,
- 2 drive a plug-in hybrid vehicle; 1 drives a regular hybrid,
- 1 replaced the natural gas furnace and water heater with a ground-source geothermal heat pump for heating and cooling,
- 2 aerobically compost organic material,
- 2 no longer grow grass,

- 1 has replaced grass with permaculture, a vegetable garden, and three beehives, 1 lives in the desert and only grows native plants;
- 3 have divested from fossil fuel enterprises,
- 1 is focused on local investing; 2 are starting to invest locally,
- 3 are members of groups comprised of like-minded people concerned about the climate crisis and living sustainably,
- 2 are members of First Universalist Church; 1 is retired clergy but not affiliated with any church.

As indicated in the Overview Chart below, the workshop was divided into three parts.

Part I explored how **Individuals** can respond to this climate crisis; Part II discussed ways to work as a member of a **Group** to respond to climate change, and Part III encouraged the attendees to envision their own **Personal Plan** that would include both individual action and collective action.

“Responding to Climate Change” Workshop Overview



Responding to Climate Change as an Individual

Based on the work of George Lakoff, noted linguist, to use a different kind of thinking, it can be

helpful to “reframe” the situation. Here are just a few examples of reframing.

If you frame this black stuff extracted from the Earth as a “fuel,” there is only one thing you can do with a “fuel” – you burn it. However, if you refer to this

black stuff as “ancient hydrocarbon,” you can immediately think differently and envision many other uses of this resource that are sustainable – as suggested in the chart below. Other reframing examples are provided in Appendix H.

“Burning Petroleum as fuel is akin to firing up a kitchen stove with bank notes.”

- Mendeleev, father of the periodic table, 1876

Energy Terminology – Reframing (Slide 2015.2)

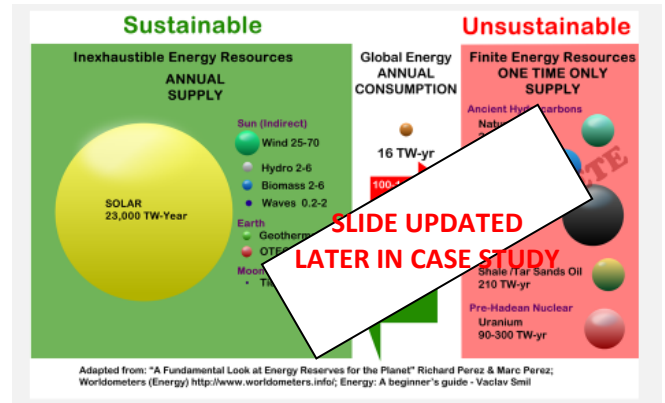
~~Fossil Fuels~~ ⇔ **Ancient hydrocarbons**

- Finite resources
- Burning is a one-time-only use
- No longer available to future generations
- Too valuable to burn/consume as a “Fuel” just to make heat
- There are viable alternatives
- Can be utilized sustainably (recyclable)
 - As carbon added to iron to produces steel. Steel can be recycled indefinitely.
 - Feedstock for manufacturing carbon fiber used to make lightweight materials (e.g. wind turbine blade, airplane structure, lightweight automobiles, etc.) that can be recycled.
 - Feedstock for petrochemicals/recyclable plastics. (One use only plastics are not sustainable.)

See Appendix J for additional examples of “reframing.”

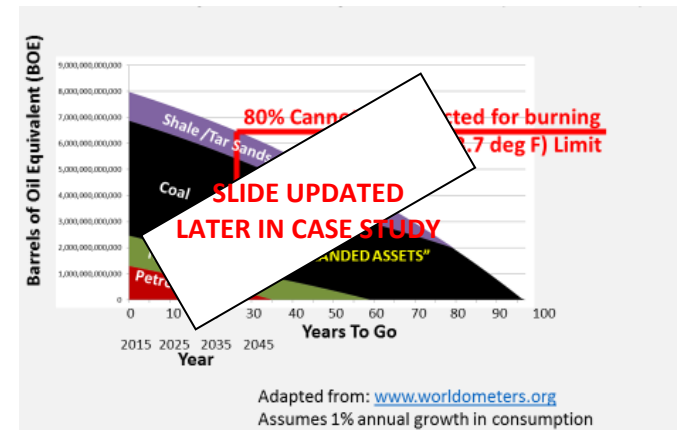
For those concerned about whether there are alternative sources of energy, the next chart graphically illustrates the enormous amount of solar energy (sunlight) available to Earth, 23,000 TeraWatt-Years, should we choose to use it.

Energy Perspective – How Much is There? (Slide 2015.3)

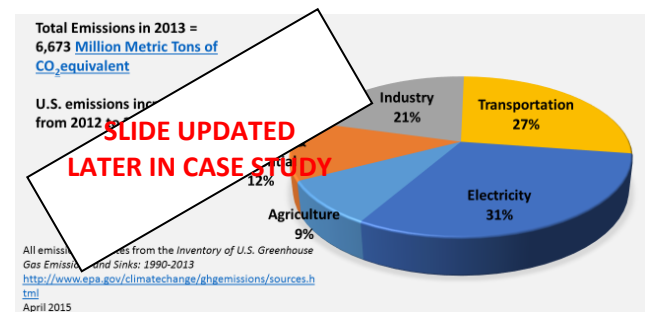


At the rate humans are consuming the finite supply of ancient hydrocarbons, these resources will be depleted within 100 years. Children being born today will live to see the practical end of oil, gas, coal and shale oil – unless we change our behavior.

Consumption of One-Time-Only Ancient Hydrocarbons (Fossil Fuel) (Slide 2015.4)



U.S. Greenhouse Gas Emissions by Economic Sector in 2013



31% of U.S. emissions are linked to Electrical power generation, 27% to Transportation, 12% to Building (Heating & Cooling). 70% of an individual’s GHG emissions are linked to three Sectors.

GHG Emissions linked to Electricity Slide 2015.3

POWER SUPPLY MIX—Energy sources used in power generation and purchase for all energy customers in the 2014 calendar year:

2014 Energy Mix, PSCO:

Natural Gas	25.3%
Coal	52.7%
Wind	18.9%
Hydroelectric	1.7%
Solar*	1.2%
Other**	0.2%

Includes solar energy generated by customer-owned systems through Solar Rewards.
 **Includes purchased biomass, oil and nuclear power.

2014 Average Cost of Generation by Energy Source, PSCo		GHG Emissions (Lbs/ kWh)
Coal:	4.8 cent per kWh	2
Wind:	4.7 cent per kWh	0
Hydro:	5.9 cent per kWh	0
Natural Gas:	8.5 cent per kWh	2.3 (Note #1)
Solar:	13 cent per kWh	0

Note #1: With zero methane leakage, GHG emissions from a natural gas plant are around 1.2 lbs/kWh. With 3% methane leakage, total emissions are 2.3 lbs/kWh (gas is worse than coal.) The Global Warming Potential (GWP) of methane (CH₄) averaged over 20 years is 86 times that of CO₂. The lifetime of a CH₄ molecule in the atmosphere is around 12 years.

At the time, Colorado legislation HB10-1001 regulated the ‘for-profit’ monopoly, Xcel Energy and required 30% of the power to be generated from renewable energy sources by 2020. By entering into long term contracts with wind farms, Xcel was well on the way to meeting these requirements with 19% from wind and 3% from solar and hydroelectric.

78% of the electrical power they sold was generated by burning ancient hydrocarbons and dumping GHG emissions into the atmosphere.

Xcel also published the cost of generating power from coal, wind, hydro, natural gas and solar in the 2014 timeframe. It is interesting to note that the cost to generate power from wind energy was 4.7 cents per kWh, less than from any other source.

At that time, customers could enroll in a Windsource® program and pay an extra \$0.02 per kilowatt-hour (i.e. instead of \$0.12/kWh, electric would cost \$0.14/kWh) to get their energy from wind-powered resources. This premium was reduced to \$0.015 per kilowatt-hour block beginning in 2017, making it more affordable for customers. It is worth pausing and thinking about this.

GHG emissions for the four sources of energy used to generate Xcel electricity are also included on the Slide. Although natural gas burning power generation plants are advertised as being “clean,” when methane leakage is considered, gas-fired plants can be dirtier than coal plants from a global warming perspective.

With this background and awareness of climate crisis and human causes, it is time to return to what can an individual do in response to climate change. What is about to be revealed is a mini-case study within the larger case study involving the church facility. This mini case study starts with a single-family home and describes the transition from fossil fuel thinking to sustainable energy thinking.

The storyteller is now an individual church member, one of a growing number of congregants who are exploring ways to respond to the climate crisis. Change is personal and that case unique – no plan fits all. Therefore, the workshop we are currently in is a Personal Planning workshop. Designed to provide tools and new ways of thinking that are necessary to find new solutions to the impending crisis.

A roadmap for this mini-journey is provided below. One metaphor that might be used to describe this mini-journey is the story teller’s experiment to explore “Total Divestment.” Spoiler alert. The storyteller describe their journey, they made some significant progress but get stuck at about 70 % reduction.

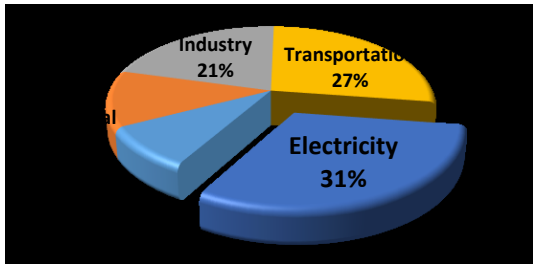
The following is extracted from and used with permission of the author “Living without Fire: Just the Sun and Earth: Illustrating a way to retrofit a 1974 home for more sustainable living,” by Milt Hetrick, 2014.

Slide 2015.4

Total Divestment: Personal Plan (Example)

- Divest/Sell fossil fuel industry stock or bonds.
 - Free up money to invest in Inexhaustible energy
- Stop Buying Fossil Fuel Products and Services (coal-generated electricity, natural gas, gasoline).
- Invest in inexhaustible energy.
 - Home Energy Use
 - Electrical Power
 - Heating and Cooling, Hot Water
 - Transportation Energy Use
 - Local Transportation

Step #1: Add Rooftop Solar PV – Stop buying electrical power



30 PV Modules on Rooftop of Primary Residence



10 PV Modules on detached garage/shop in the back yard



Space/Area Required for Solar PV

Panels for a 10 kW Solar PV system take up less than 5% of the typical city lot – see two areas outlined in white.

The blue lines represent the boundary of the 1/3 acre lot that is 155 feet from front to back.

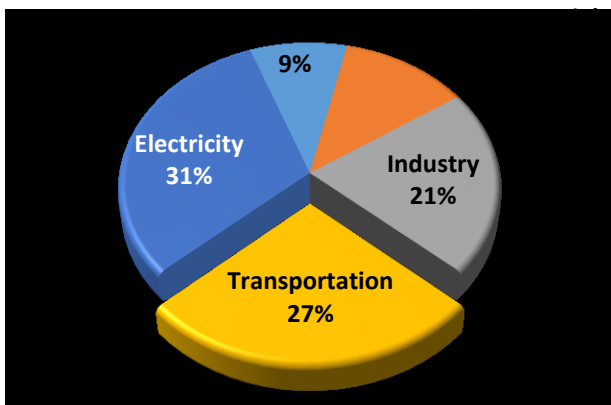


Enphase monitoring system graphically displays real-time performance. (Notice lower right-hand corner of the array is being shadowed by a tree.)

Rooftop Solar PV System Characteristics		
Number of panels	40	
System Rating	9.8	kW
Net Cost (After Rebates)	\$14,476 (See Note #1)	(\$1.48/W)
Annual Production (expected)	11392	kWh /year
Years of Operation (expected)	20+	years
Lifetime Production (expected)	227,840	kWh
Average cost/kWh for 20 years	\$0.06	/kWh
Added Investment in Home	5%	
Amount of lot covered by solar panels to meet energy needs (lot size = 1/3 acre)	5%	
Energy Source: Sun	Inexhaustible	(Several billion years)
Operating Emissions	Zero	
Water requirements	Zero	
Reuse /Recyclability (Theoretical)	100%	

Note#1: System installed in 2011 with existing costs and rebates at the time

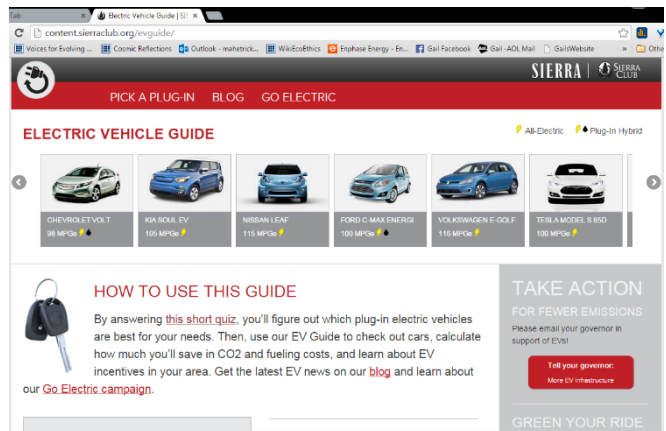
Step # 2 Buy a Plug-in Hybrid Vehicle – Stop buying gasoline (for local travel)



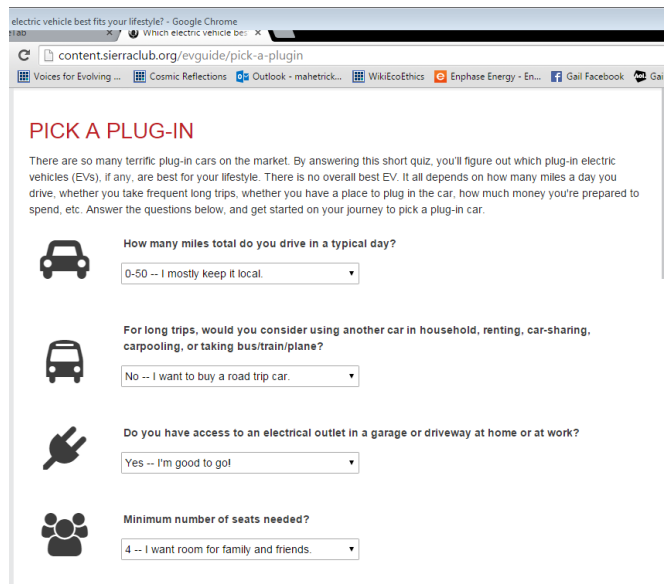
As indicated by the EPA GHG Emissions pie chart, an individual can reduce their personal emissions by 27% transitioning to an electric vehicle.

Back in 2012 when this Case Study took place, there were three electric vehicle options available in the U.S. (Tesla Model S, Nissan Leaf and the Chevrolet Volt).

In 2018, there were 44 different models available. To assist in evaluating the best option for you and your family, you might start with the Sierra Club Electric Vehicle Guide <http://content.sierraclub.org/evguide/>



By answering 4 basic questions about your transportation needs, the guide will select the options that meet your specific circumstances.



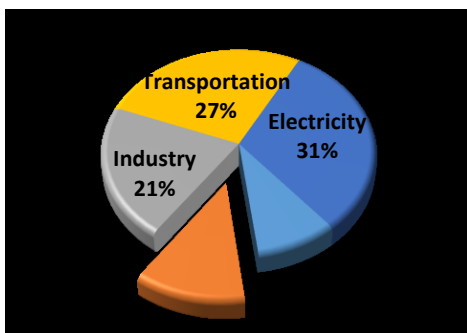
Part III Building for the Future Capital Campaign



Plug-In Electric Vehicle Characteristics	
Initial Cost (Tax, Registration)	\$43,569*
Federal & State Tax Credits	\$13,500
Net Cost	\$30,069
Operation (Warranted)	8 years (100,000 miles)
Energy Source:	8-10 solar PV modules provide the energy for 10,000 miles per year
< 40 mile trips: Sun - Solar PV	Inexhaustible
> 40 mile trips: Petroleum	~ 60 more years of petroleum reserves

* Base price dropped \$5,000 since this was purchased in 2012

Step # 3 Transition to Heat Pump Technology – Stop burning natural gas



Commercial & Residential Heating...

As indicated by the EPA GHG Emissions pie chart, an individual can reduce their personal emissions 12% by eliminating all natural gas appliances, furnaces, boilers, hot water heaters, etc. Today's heat pump technology, an extension of century-old refrigeration

technology, so it can be used for both cooling and heating as well as heating domestic hot water.

Replace the gas burning furnace with a Ground Source Geothermal Heat Pump and add a Ground Loop Heat Exchanger.



Drilling first 300' deep hole



Inserting the U- shaped black plastic tubing 300' down into the borehole



Trenching to add a manifold connecting the two boreholes



Trench backfilled. The ground loop now extends underground into a basement



Ground Loop in the basement with two circulation motors



Ground Source Geothermal Heat Pump Furnace
Replaces Unsustainable Natural Gas Burning Furnace

Geothermal Heat Pump Characteristics

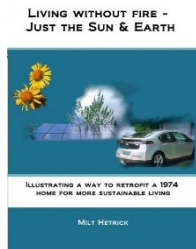
System Rating	4 Ton
Net Cost (after Federal Tax Credit)	\$19,199
Years of Operation (expected)	20+ years
Heat Pump Ground Loop – Vertical 300' deep(2)	50+ years
Added Investment in Home	6%
Energy Sources:	
Thermal Energy: Earth	Inexhaustible
Electrical Power: Solar PV	Inexhaustible

“Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it’s the only thing that ever has.”

...Margaret Meade.

Conclusions

- The 21st-century energy equipment that enabled the transition from burning ancient hydrocarbons to harvesting inexhaustible energy (that has zero GHG emissions) was installed by 2 contractors (3 people each) in just over one week of on-site work.
- The up-front investment in the transition process was equivalent to about 10% of the value of the home.
- As a result of this investment,
 - a) our energy-related utilities (electric and natural gas) have been prepaid for the next 20 years,
 - **Value: \$1500/year x 20 years = \$30,000**
 - b) our gasoline for 10,000 miles per year of local transportation has been prepaid for the next 20 years.
 - **Value: 250 gallons @ \$3 /gallon = \$750 x 20 years = \$15,000**
- More details are provided in “Living without Fire- Just the Sun & Earth”

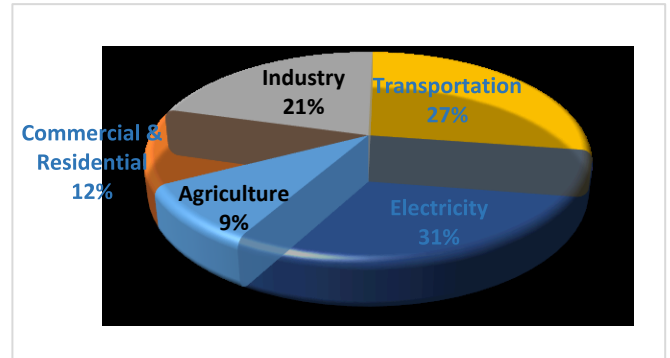


Conclusions – Total Divestment

- We no longer buy coal-generated electrical power from a utility company. (e.g. Xcel Energy)
 - We stopped financing industries that burn coal, oil and natural gas to generate electrical power.
- We no longer buy natural gas from a supplier (e.g. Xcel Energy)
 - We stopped financing drilling & fracking operations to heat our home.
- We no longer buy gasoline from a petroleum corporation for local transportation (e.g. Exxon Mobil)
 - We stopped financing drilling for petroleum (foreign & domestic), extracting tar sands and shale oil industry for our local travel.

We found we just don't need to buy most of these products and thereby support their unsustainable production practices.

However, we are not yet living sustainably. But it's a start.



Our food is not produced and transported to our local store sustainably. We do prepare the food sustainably using an electric cooktop and oven. We do store the food sustainably using refrigerator/freezer powered by solar electric.

The things we buy (books, appliances, clothing, etc.) are more than likely not manufactured sustainably.

The following was presented by Green₁ on Economics

AN EXPANDED/REDEFINED VIEW OF INVESTING
HOME/ FOOD/ FINANCIAL

What is your image of Investing?
Here's my story – how my image of investing has evolved.

My Evolutionary Journey. The serious disconnect between the Wall Street Global Casino investing and my values. What is my relationship with money, what is the purpose of money and how can I use my money to be truly of service to the world? How can I act on my deepest values through investing? How can I make a significant positive difference with my time, energy and money? Divested from Wall Street over 4 years ago.

Cree Prophecy: When all the trees have been cut down, When all the animals have been hunted, When all the waters are polluted, When all the air is unsafe to breathe, Only then will you discover you cannot eat money

In *The Soul of Money* by Lynne Twist, she states, *“We’ve made money more important than God or spirit. We’ve given it more power than the most powerful thing we know which is love, or spirit or relationship with one another.”*

Lynne Twist states, *“we are living under three toxic myths with relationship to money that has created many of the problems in our World and Economy:*

Toxic Myth #1: Scarcity-Creates competition rather than collaboration

Toxic Myth #2: More is better-we accumulate more than we need

Toxic Myth #3: That’s just the way it is and there’s nothing we can do about it.”

In *This Changes Everything-Capitalism v The Climate*, Naomi Klein writes:

“Climate Change pits what the planet needs to maintain stability against what our current economic model needs to sustain itself. The Climate Justice fight is not just an ecological fight. It is a fight for a new economy, a new energy system, a new democracy, a new relationship to our planet and each other, for land, water, and food sovereignty, for Indigenous peoples rights, human dignity, and rights for all.”

How do you Counter the above Myths, Respond to the Serious Climate and Economic Challenges and Create a New Economy and New World?

First, Expand and Redefine Your View of Investing: Investing is something we all do by directing our time, attention, energy or money in ways that move us toward our future dreams using a diverse range of strategies. *The Resilient Investor* by Hal Brill, Michael Kramer, and Christopher Peck. Also, see www.ResilientInvestor.com

Second, Rethink the Purpose of Investing. It should not just be about increasing your net worth and financial rates of return, but should also support the bigger and deeper and more profound purpose of life, improve our communities and build a better world.

Third, Consider Environmental and Social Factors as well as Financial Factors in Your Investment Decisions ...what is the impact of the investment to

all Stakeholders. Look for Triple Bottom Line businesses (People, Planet and Profits) certified by *B-Lab*. Businesses obtain the Certified B Corporation certification only after a rigorous assessment of the company’s entire operation and measure the positive impact of the company in areas of governance, employee engagement, community service, environmental impact as well the product or service the company provides. **Certified B Corporations** are using the power of business to solve social and environmental problems. (See www.bcorporation.net for more details)



YOUR HOME INVESTMENTS-THINK AND INVEST LOCALLY

Your Home is one of the most rewarding and enjoyable areas for making investments:

Energy Efficiency-- (insulation, doors, windows, attics, basements, lighting)

About Saving Heat www.aboutsavingheat.com

Lightly Treading www.lightlytreading.com

Renewable Energy

Namaste Solar www.namastesolar.com

An employee-owned cooperative based in Boulder and Denver

Transition to Xeriscape/Permaculture-Eliminate Lawns-Plant Edibles & Native Plants-Nurture Birds and Bees

Permaculture: a set of ethics, principles and a design process for successfully applying lessons from nature to the human realm.

The Wild Green Yonder (Adam Brock) Based in Denver www.wildgreenyonder.wordpress.com

Denver Botanical Gardens

Denver Water

The Stuff You Purchase for Your Home

The choices you make in purchasing products has a ripple effect impacting workers and communities, energy used in making and transporting and environmental consequences of production and disposal.

Buy locally made products from local businesses as much as possible...see

Mile High Business Alliance www.milehighbiz.org

The Story of Stuff www.storyofstuff.org

How we make, use and throw away our stuff

Your Money or Your Life by Joe Dominguez and Vicki Robbins. Scale back consumption and simpler living.

Green America's Responsible Shopper

www.greenamerica.org

Good Guide.... www.goodguide.com Ranks 250,000 products for health, environment and social impact

Sharing Economy... www.thepeoplewhoshare.com

Do you really need to purchase that product you will only use a few times per year... Examples of the Sharing Economy: Zip Car, Uber, Zagster, Time Banks



YOUR FOOD INVESTMENTS—THINK AND EAT LOCAL

Our highly industrialized, fossil fuel based, chemical-reliant, the globalized food chain is devastating the environment, undermining human health and destroying local economies. Food deserts, Obesity, Diabetes. The inhumane and cruel conditions for animals and farm workers. The indiscriminate use of antibiotics creating superbugs. The indiscriminate use of weed killer creating superweeds. (Round-up is no longer effective, recently the FDA approved 2,4-D which is a derivative of Agent Orange). GMOs, pesticides are killing our pollinator bees. The globalized food system burns 23% of all fossil fuels and contributes 31% of all greenhouse gas emissions. It is insane, unsustainable and unstable.

Nutritionist Ann Wigmore says, "The food you eat can be either the safest and most powerful form of medicine or the slowest form of poison."

Food is not a commodity, it is a connection with life, land, community, and health. We must recreate a food system that is Restorative, Regenerative, Democratic and Community based where all Stakeholders are considered and the goals are returns of Social, Economic and Environmental Capital for all.

Grow some of your own food....in your own yard or community garden.

The Urban Farm Company www.urbanfarmcolorado.com crafts custom vegetable gardens and will teach you how to grow your own food. Also, check with *Denver Botanical Garden and CSU Extension Master Gardener* classes to learn how to grow your own food.

Convert your yard into a farm. Contact *Agriburbia* at agriburbia.com for design and operation possibilities

Become a CSA (Community Supported Agriculture) member of a local farm, dairy or ranch. Get to know your farmer and visit the farm. For a complete listing of CSAs in Colorado go to www.coloradocsas.info

Shop at your local farmers' markets. Google *Colorado Farm Fresh Directory* for a listing of farmers markets in Colorado

- Eat fruits and vegetables that are in season.
- Learn how to can and preserve food for winter months.
- Patronize local restaurants that source local food.
- Check food labels and buy products from local farmers, artisans and food producers.
- Become a member of a food cooperative in your area.



YOUR FINANCIAL INVESTMENTS-THINK AND INVEST LOCALLY AND GLOBALLY WITH IMPACT

99% of the Dollars You invest in Wall Street are simply for trading and speculation. 1% goes to innovation and expansion. Almost nothing goes to local businesses. The Market is rigged and investors don't have a chance. The risk is with investors and taxpayers. Amy Cortese the author of *Locavesting*.

One of the Slow Money Principles is "We must learn to invest as if food, farms, and fertility mattered. We must connect investors to the places where they live, creating vital relationships and new sources of capital for small food enterprises."

Slow Money www.slowmoney.org Woody Tasch the founder of Slow Money asks, "What would the world be like if we invested 50% of our assets within 50 miles of where we live?"

WEANING OFF WALL STREET

Investor Definitions: In the United States you are either an **Accredited Investor** or a **Non-Accredited Investor**. For you to be defined as an **Accredited Investor**, you must have a net worth of at least one million US dollars, not including the value of your primary residence or have income at least \$200,000 each year for the last two years (or \$300,000 together with their spouse if married). If you don't

meet the above criteria, then you are a **Non-Accredited Investor**. **Accredited Investors** have many more opportunities to invest directly in privately held companies because of their status. It is estimated that only 2% of the US population are Accredited Investors which means that 98% of the US population are being denied many investment opportunities, especially to invest in their local communities. This presentation will focus primarily on those investment opportunities available for **Non-Accredited Investors** unless otherwise designated.

Move Your Money – Move all your day to day financial activities, including your checking, loans, credit cards, and mortgage, to a local bank or credit union. These institutions recycle their capital locally—so much so that even though local and regional banks account for only 20% of the assets of all banks, they provide more than half of all the loans to small business.

Pre-Purchase Local Goods and Services – Preselling is not regarded as security in Colorado, so businesses can raise capital by convincing their most loyal customers to make purchases in advance. Community supported agriculture, community supported restaurants, community supported publishing. [Credibles](#) is a pre-selling web site for small food businesses seeking to expand.

Sponsor Local Businesses – Web sites like *Kickstarter* and *IndieGoGo* have raised hundreds of millions of dollars for small businesses and projects. *Barnraiser* is a crowdfunding website geared to farmers and food producers. In these types of investments, you receive rewards or gifts instead of interest and the return of your investment, but you know that thousands of small contributors like yourself are helping to get a big idea off the ground. It is building a community of investors.

Tap Internet Lending Sites – *Kiva* and *Kiva Zip* facilitate peer-to-peer lending to microentrepreneurs overseas and in the US, though as a dot-org it only pays back the principal. *Prosper* and the *Lending Club*, both dot-coms, also pay interest. As a community, you might encourage your businesses to use these sites for loans and your investors to scour them for local business investment opportunities.

Invest in Local Funds—*The Calvert Foundation's Community Investment Notes* are a good way to move some of your money into social impact

projects such as affordable housing, microloans, etc. Here in Colorado, you can invest as little as \$20 in the Denver local economy through Community Investment Notes *Ours to Own Denver*...an initiative of the Calvert Social Investment Foundation, Urban Land Conservancy, Colorado Enterprise Fund, and others www.ourstown.org/denver

Join a Local Investment Group - Invest in Your Neighbors—Along the Front Range, we have three Slow Money related investment groups. One here in Denver called *Local Matters Investments, LLC*, one in Boulder called *Colorado Food Investments, LLC* and one in Fort Collins called *Living Soil Investments*. The mission of these investment groups is to support healthy and vibrant local economies and communities in Colorado by making small loans at competitive terms to farmers, producers, food-related entrepreneurs, and other entrepreneurs who advance healthy local food systems, environmental sustainability and more vibrant community. They are about connecting local investors with local businesses and educating all stakeholders as to the value of the local economy and community. Members pool their capital (approximately \$5,000 per member) and vote on making small loans to food producers and food-related businesses. Sometimes individual members will also make individual loans or invest in the businesses.

Check out the Slow Money website at www.slowmoney.org review its principles and mission and also check out www.slowmoneymaine.org which will provide information on the first Slow Money related investment club called No Small Potatoes.

Invest in Native Americans—Here in Colorado we have two institutions that you can invest in to support Native Americans.

The Native American Bank www.nabna.com is located downtown Denver and is a national bank serving all Native people and communities.

First Nations Oweesta Corporation www.oweesta.org is a Community Development Financial Institution (CDFI) that provides Native American Communities the tools and capital necessary to support job creation, business, real estate, and community development.

Colorado Crowdfunding Act became law on April 13, 2015, and will allow Non-Accredited Investors to

invest in privately held companies. There are certain rules and regulations that apply but this will be a significant and positive change to move capital into local businesses and the local economy.

Invest in Municipal Bonds—Be aware of when local municipalities are issuing bonds and invest in them. City and County of Denver recently issued \$12 million in bonds that sold out in less than one hour.

Socially Responsible Investing (SRI)—Also known as Sustainable and Responsible Investing, Impact Investing and a variety of other terms, we see SRI used more in the publically traded markets like Wall Street with publically traded companies, mutual funds, etc. The three pillars of SRI are:

1) *Screening*-both negative and positive screening, you can invest in companies that are aligned with your values. If you don't want oil and gas, or tobacco or fast food companies, etc. you can screen them out/divest from them;

2) *Shareholder Advocacy*—when investing in publically traded companies as a shareholder, you can propose Shareholder Resolutions to make positive changes in how the company operates—this is a powerful tool to make positive social change; and

3) *Community Investing*-which is what I discuss above with direct investing, moving money, etc. If you do invest in the publically traded markets, your investments should be SRI.

Financial Advisors- If you are looking for a financial advisor to help you navigate the public and private markets and SRI investments, you might contact one of the following investment firms: 1) *Natural Investments, LLC* at naturalinvestments.com (the principals wrote *The Resilient Investor*); or 2) *First Affirmative Financial Network, LLC* at firstaffirmative.com; and 3) *Principium Investments, LLC* at principium.co

Support Local Employee-Owned Businesses and Cooperatives

Support Year-Round Local Food Production through Controlled Environment Agriculture.....Veterans to Farmers www.veteranstofarmers.org

Cultivate community food systems/grow resilient local economies.....Re: Vision

www.revision.coop and the *Westwood Food Cooperative*

Support a 20,000 sq ft greenhouse/indoor farm and marketplace promoting food security and local economy GrowHaus www.thegrowhaus.com

MORE NATIONAL AND GLOBAL NON WALL STREET INVESTMENTS TO CHECK OUT

Self Help Credit Union

Self Help Federal Credit Union

RSF Social Finance—Based in California and inspired by the work of Rudolph Steinger, RSF believes money has a spiritual dimension. In their view, money is a form of energy that connects one person to another and strengthens the bonds of community

Cooperative Fund of New England

Root Capital (accredited investors)

Iroquois Valley Farms (accredited investors)

Investors Circle (accredited investors)

Equal Exchange CD-Invest in Fair Trade

Clean Energy Federal Credit Union—A credit union that is being planned by the *American Solar Energy Society (ASES)* to make loans strictly for renewable energies

ADDITIONAL MUST READ RESOURCES

Michael Shuman *Local Dollars/Local Sense* and *The Local Economy Solution*

Local Investing Resource Center www.local-investing.com

Green America Community Investing Guide www.greenamerica.org

ResilientInvestor.com....Click Go Deeper. Click on Zone you desire to research and there is excellent information available

Katherine Gustafson, *Change Comes to Dinner*

Hazel Henderson, *Ethical Markets*

Janine Benyus, *Biomimicry*

Marjorie Kelly, *Owning Our Future-The Emerging Ownership Revolution*

ADVOCACY

Public Banking- Support Public Banking in Colorado as an alternative to being controlled by the major financial institutions that are only concerned with their bottom line profits. A Public Bank will make affordable loans to small businesses, farmers, government entities and students; will save

taxpayers up to 50% on critical infrastructures like bridges, trains, and schools; will eliminate billions in bank fees and money management fees for cities; will support a vibrant community banking sector and will enable sustainable prosperity. Check out *Banking on Colorado*; the *Public Banking Institute* and *Be the Change*.

Overturn Citizens United—On January 21, 2010, the US Supreme Court ruled that “corporations are persons”; this decision has been disastrous to our political and economic democracy. Advocate overturning Citizens United. Check out *Move to Amend*; *The Center for Public Integrity* and *Represent US*.

Food Waste—More than 30% of food is thrown away...the single largest solid waste component in our landfills is food. An estimated 1.3 billion tons of food is wasted annually around the world. In every step of the food chain food is tossed out. It is estimated that \$165 billion of food is wasted by Americans every year. Compost, eat what you buy and support *Denver Food Rescue* denverfoodrescue.org is a nonprofit that redistributes food from grocery stores which would otherwise go to waste directly to Free Grocery Programs and they accomplish 75% of their deliveries on a bicycle.

GMO Labeling- Advocate for GMO (Genetically Modified Foods) labeling. We have a right to know what we are eating. Over 64 countries, including Russia and China, have GMO labeling laws and many European countries ban GMOs. Support *Right to Know Colorado*

Pollinators-- Advocate for our pollinators, the bees, birds, butterflies that are being decimated by pesticides. Support *Bee Safe Boulder*, *Bee Safe Neighborhoods*, *Friends of the Earth*

CLOSING

Judy Wicks the author of *Good Morning, Beautiful Business*, a co-founder of the *Business Alliance for Local Living Economies* and the founder and former owner of the White Dog Café in Philadelphia, comments on the New Economy, “Building a new economy, I came to realize, rests on a simple quality: our capacity to care—followed by our willingness to do what is necessary to defend and nurture what it is that we truly care about. Change begins in the hearts of the entrepreneur, the

investor, and the consumer. It’s the power of love and compassion that can bring transformative change and build an economy that is prosperous and strong, yet one where loving relationships matter more than profits. I had to move from a competitive mentality to one of cooperation in order to build that system. It takes a lot of capital to build a new economy, yet most people, even those who want to bring social change and see the need for a more nurturing economy, invest their savings in the stock market where it perpetuates the old exploitive economy.”

Personally, I have found divesting from Wall Street and pursuing the above path which aligns my Passions and Principles to all of my investments and actions to be significantly Enlightening and Empowering. May it be so for You!!



Resource materials were included in the back of the workshop notebook including a short list of groups committed to climate action. Attendees were encouraged to develop their own personal plan to transition from fossil fuel to renewable energy AND to join with others in an existing group to amplify their voice such as one listed in the table below:

Responding to Climate Change as a Member of a Group

Responding as a Group - Climate Change Actions in Process

UU Ministry for Earth (UUA)

<http://uuministryforearth.org/>

Connecting and inspiring an active community of UUs for environmental justice, spiritual renewal, and shared reverence for our Earth home.

We envision a world in which reverence, gratitude, and care for the living Earth are central to the lives of all people. Our purpose is to inspire, facilitate, and support individual, congregational, and denominational practices that honor and sustain the Earth and all beings. We affirm and promote the seven principles of the UUA, including: "Respect for the interdependent web of all existence of which we are a part."

350.org

<http://350.org/>

350.org is building a global climate movement. Our online campaigns, grassroots organizing, and mass public actions are coordinated by a global network active in over 188 countries. The number 350 means climate safety: to preserve a livable planet, scientists tell us we must reduce the amount of CO2 in the atmosphere from its current level of 400 parts per million to below 350 ppm.

Citizens' Climate Lobby

<http://citizensclimatelobby.org>

The purposes of Citizens Climate Lobby are to 1) create the political will for a stable climate and 2) to empower individuals to have breakthroughs in exercising their personal and political power. Their primary focus is legislation that corrects our economic system by putting a price on carbon pollution.

Climate Reality Project

<http://climateralityproject.org/>

True change happens when we embrace reality. Today, we know climate disruption is the biggest challenge humanity has ever faced. And we know carbon pollution is to blame. But at Climate Reality, we also know that solutions are right in front of us. We can create a healthy, sustainable, and prosperous future by making a global shift from dirty fossil fuels to clean, renewable energies like solar and wind.

Colorado Renewable Energy Society (CRES)

<http://cres-energy.org/>

To lead Colorado and its people to an energy-efficient (EE) and renewable energy (RE) economy through education, policy, and economic development.

Commit 2 Respond

<http://www.commit2respond.org/> (UUA)

Commit2Respond is a coalition of Unitarian Universalists and other people of faith and conscience working for climate justice. United in collective action, connected through partnership, we will change the world. We are diverse in spiritual belief, yet united in faith that a better world is possible and that our collective power can create change.

Conservation Colorado

<http://conservationco.org/>

Our mission is to protect Colorado's environment and quality of life by mobilizing people and electing conservation-minded policymakers.

Earth Guardians

<http://www.earthguardians.org/>

Earth Guardians is an organization of dedicated youth from around the world. We are committed to standing up to protect the Earth, Water, Air and Atmosphere so our generation, and those to follow, inherit a healthy, just and sustainable planet. We are focusing on weaving together the synergy of individual grassroots youth-driven projects around the globe, to create one international, intergenerational movement for effective change.

Earth Justice

<http://earthjustice.org/>

Earthjustice uses the power of law and the strength of partnership to protect people's health; to preserve magnificent places and wildlife; to advance clean energy, and to combat climate change.

Environmental Defense Fund

<http://www.edf.org/>

Environmental Defense Fund's mission is to preserve the natural systems on which all life depends. Guided by science and economics, we find practical and lasting solutions to the most serious environmental problems.

Greenpeace

<http://www.greenpeace.org/usa/en/>

We defend the natural world and promote peace by investigating, exposing and confronting environmental abuse, and championing environmentally responsible solutions

Idle No More

<http://www.idlenomore.ca/>

Idle No More (INM) calls on all people to join in a peaceful revolution, to honor Indigenous sovereignty, and to protect the land and water." INM has and will continue to help build sovereignty & resurgence of nationhood. INM will continue to pressure the government and industry to protect the environment.

Natural Resources Defense Council

<http://www.nrdc.org/>

Priorities include: Curbing Global Warming and Creating the Clean Energy Future; Reviving the World's Oceans; Defending Endangered Wildlife and Wild Places; Protecting Our Health by Preventing Pollution; Ensuring Safe and Sufficient Water; Fostering Sustainable Communities

Sierra Club

<http://sierraclub.org/>

Our successes range from protecting millions of acres of wilderness to helping pass the Clean Air Act, Clean Water Act, and Endangered Species Act. More recently, we've made history by leading the charge to move away from the dirty fossil fuels that cause climate disruption and toward a clean energy economy.

Our Children's Trust

<http://www.ourchildrenstrust.org/>

Our mission is to establish the legal right to a healthy atmosphere and stable climate for all present and future generations. By supporting youth plaintiffs in strategic atmospheric trust litigation, OUR CHILDREN'S TRUST empowers youth to lead a game-changing effort to hold the ruling generation accountable and to compel governments in the United States and abroad to adopt and implement enforceable science-based Climate Recovery Plans.

Rain Forest Network

<http://www.ran.org/>

Over the past year, RAN has been building a movement to stop dirty energy projects like the Keystone XL tar sands pipeline. We've trained volunteers who stand ready to deploy non-violent civil disobedience actions in over 130 cities to stop this carbon time bomb.

Responding to Climate Change

<https://www.facebook.com/groups/RespondingtoClimateChange/>

People who have committed to doing something about climate change. It is a continuation of a workshop that introduced and explored climate-friendly options now available in the areas of energy, food, finance, and transportation. Here we will support and resource one another's efforts to live according to our values, principles, and ethics around the challenge of the changing climate. This will also be our connection to what's happening in the wider world as personal actions lead to public

activism, for "the best way to predict your future is to create it" (Abraham Lincoln).

The Nature Conservancy

<http://www.nature.org/>

The Nature Conservancy is the leading conservation organization working around the world to protect ecologically important lands and waters for nature and people.

Wall of Women

<http://www.facebook.com/wallofwomen/>

Wall of Women is entrusted to protect the Earth for future generations. We support the children as they challenge those who choose profit rather than preservation.

Women's Earth & Climate Action Network, International (WECAN)

<http://wecaninternational.org/>

The Women's Earth & Climate Action Network is a solutions-based, multi-faceted effort established to engage women worldwide to take action as powerful stakeholders in climate change and sustainability solutions.

World Wildlife Foundation

<http://www.wwf.org/>

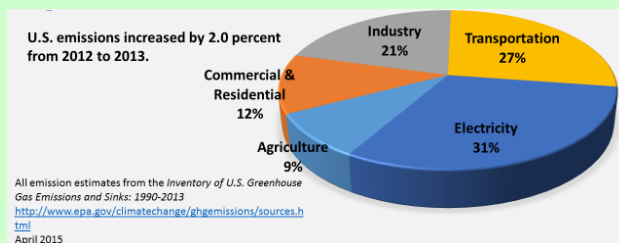
To build a future in which people live in harmony with nature.

After all this background information, workshop attendees were given a few minutes to sketch out their **Personal Plan** in Response to Climate Change.

Responding to Climate Change: Personal Plan

Preface:

Global Climate Change is real and affects all Life. Humans are causing this detrimental change by altering the amount of greenhouse gases in our common atmosphere.



The largest source of greenhouse gas emissions from human activities in the United States is linked to burning fossil fuels for electricity, heat, and transportation. There are viable alternatives to fossil fuels available to us today.

Introduction

As an individual, as a part of a family, as a member of a larger community, the following “Response to Climate Change” herein called the “Plan” outlines how I propose to change my behavior to stop being a part of this existential problem facing our planet and instead live the remainder of my life in mutual benefit of all Life. The Plan identifies the things I and my family can change to prevent further climate change.

In addition to implementing individual changes in my personal life, the Plan also identifies how I will work collectively with others to bring about changes in our human-created social systems so that others will be influenced to make choices that also contribute to stopping further climate change and to living more sustainably.

INDIVIDUAL ACTIONS (please check a box)

Electricity. Knowing what I know now about how rooftop solar PV can be used to significantly reduce emissions and climate change:

- I have already responded to climate change and invested in solar panels. **Congratulations! Take credit for a big piece (31%) of the emissions pie**
- I am seriously considering Solar PV **Great! Since you are serious about reducing emissions from the electrical sector, take credit for ½ of this piece of the emission pie (16%).**
- I need more information about Solar PV. **Remember you can get a free consultation from your Go 2 Green Guides.**
- This is not an option for me at this time.

Transportation. Knowing what I know now about today’s electric vehicle reduce emissions in the transportation sector:

- I have already responded to climate change and drive an electric vehicle. **Congratulations! Take credit for a big piece (27%) of the emissions pie.**
- I am seriously considering an electric vehicle. **Great! Being serious about reducing emissions from the transportation sector, take credit for ½ of this piece of the emission pie (14%)**

- I need more information about an electric vehicle. **Remember you can get a free consultation from your Go 2 Green Guides.**
- This is not an option for me at this time

Residential & Commercial Heating & Cooling

Knowing what I know now about geothermal heat pumps in reducing emissions related to heating and cooling:

- I have already responded to climate change and use a heat pump. **Congratulations! Take credit for another piece (12%) of the emissions pie.**

- I am seriously considering replacing my gas furnace with a heat pump.

Great! Since you are serious about reducing emissions from the Residential sector, take credit for ½ of this piece of the emission pie (6%)

- I need more information about a heat pump. **Remember you can get a free consultation from your Go 2 Green Guides.**
- This is not an option for me at this time

Industry. Knowing what I know now about how my Life Style (and the things I buy) affects GHG emission/ climate change:

- I’m already mindful of what I buy, as well as the emissions associated with producing it and where it comes from. I also reuse, reduce, refuse, recycle using the Zero Waste (Total Recycling) approach. **Congratulations! Take credit for a piece of the Industry’s piece of the emissions pie. (21%)**
- I (nearly) always remember my reusable bags when I do shop. I use refillable water bottles. I buy locally produced items wherever possible. **Great! You are trying to reduce emissions from the Industry Sector. Take credit for ½ of this piece of the emission pie (10%)**
- I need more information. **Talk with your Go 2 Green Guides.**
- This is not an option at this time

Agriculture. Knowing what I know now about food production, processing, and distribution

- I already grow and preserve most of my food without consuming fossil fuel. **Congratulations! Take credit for a piece (9%) of the emissions pie.**
- I support CSA and buy a share each season. I support local growers/farmers. I patronize local restaurants that source local foods. **Great! You are trying to reduce emissions from the Agriculture**

sector. Take credit for ½ of this piece of the emission pie (5%)

- I need more information. **Talk with your Go 2 Green Guides.**
- This is not an option at this time

Other/All. Knowing what I know now about Divesting/Investing and how it can support endeavors that contribute to emissions affecting climate change

- I have already moved my money out of Wall Street and divested from fossil fuel companies. I reinvested locally including my own home to assure I can live sustainably. **Congratulations! You are not contributing to GHG emissions indirectly through your investments. You receive “extra credit.”**
- I need to rethink the purpose of my investments. I can’t wait to explore environmental and socially responsible options. I am rethinking about how I invest in my home. **Great! You are**

trying to reduce GHG emissions that may be linked to your investments.

- I need more information. **Talk with your Go 2 Green Guides.**
- This is not an option at this time

COLLECTIVE ACTIONS (please check a box)

- I am involved in several organizations focused on much-needed changes in our U.S. social system so that our political, economic, legal, information and educational systems influence us to make choices that sustainable.
- I plan to contact a group and get involved in their efforts to change our social system so that it does not influence us to live unsustainably as it currently does.
- This is not an option at this time.

SUMMARY CARD

Enter how your Personal Plan will reduce GHG emissions and stop further climate change.

Electric	Transportation	Residential Commercial	Industry	Agriculture	Investments	TOTAL %

Closing – Question & Answer - Feedback

The last few minutes of this workshop were spent on a general discussion of climate change. Attendees were particularly interested in the financial topics described by Green₁

As the workshop facilitators fielded a number of questions about the presentation materials, the focus changed from the intended topic “What is our personal response to climate change?” to **“How is the Building for the Future (BFF) remodeling project for the church responding to climate change?”**

Fortunately, several workshop attendees were members of the BFF Building Committee or at least had some familiarity with the BFF goals at the time. They explained that the project was planning on using construction materials that were environmentally friendly and could be 100% recycled at their end of

usefulness. New windows and more insulation were being considered as a means of conserving energy and other features might be added depending on the results of the fundraising/capital campaign. And solar was being considered.

One of the young couples in attendance who made use of the childcare provided during the workshop also spoke up when the focus switched to the BFF remodeling project. Their perspective (as parents of two preschoolers) was a bit different and certainly unexpected:

“We think the first and mandatory design requirement for the BFF project is sustainability - including zero burnings of fossil fuel for the operation of the building. What we build today will last at least 50 years and we really can't be burning stuff for our energy needs beyond 20 years. In other words, the FIRST 10-15% of the BFF budget should go into making the building ‘totally green.’ Then the rest of the budget can be used for more classrooms, meeting area, office

Part III Building for the Future Capital Campaign

area, more space for the choir, etc. until the money runs out. Not the other way around so that we find there isn't enough money to incorporate the 'Green Requirements'." 41

Another attendee stood up and said,

"If I have the choice of giving \$100 to a church project that is not sustainable and giving \$200 to a project that is sustainable, I would give zero to the unsustainable project and \$200 to the sustainable project."

Several more attendees expressed similar perspectives. The workshop facilitators were taken aback with these unexpected emboldened comments from several passionate workshop attendees. By now, childcare had ended and youngsters were showing up in the meeting room looking for their parents. It was time to get back to real life.

That was 15 August 2015. The BFF committee was still requesting input from the church membership on what was important to include in the remodeling project.

It is strange how the Universe works sometimes. The following week one of the workshop facilitators and a member of the Green First Team, Green₅, was invited to become a member of the BFF Sustainability subcommittee. Two Green First members were invited to travel to Boulder for the next scheduled status meeting on 21 Aug 2015 with the BFF committee and the project Architects. One item on the agenda was to explore the feasibility of adding a geothermal heating and cooling system to the church renovation project.

The architects' response was surprising. Here is a condensed recap of the Sustainability subcommittee's presentation and architects' response.



Sustainability Presentation to Architects (21 Aug 2015)

Thanks in part to the persistence of Green₄ the lead for the BFF Sustainability Committee, an "Energy and Sustainability" meeting was scheduled with the architects for 21 August 2015. The entire BFF Building Committee was present as well.

The chair of this subcommittee, Green₄ invited Green First member, Green₅, to also attend. The intent of this meeting was to review/summarize all of the sustainability features the church wanted the architects to consider in their design activities and explore the feasibility of adding solar electric and

geothermal heating & cooling to the scope of the renovation project.

From: Green₄
Date: Friday, August 07, 2015 4:26 PM
To: BFF_{1,2,3}; Architect_{1,2}; Green₅
Subject: RE: "Energy meeting"

"... We have more than once discussed energy, sustainability and the need to have a focused meeting to discuss these topics... this will be an information sharing meeting and action items will most likely be to incorporate things, exclude, seek better costs, seek better understanding, etc.

...I will take the lead on presenting solar related options and will be prepared with some info slides and some updated proposals. Green₅ (who retrofitted his home with a geothermal system) will discuss some possible geothermal heating and cooling options...

Suggested Agenda for 21 Aug Meeting

- Overall Energy and Sustainability Objective:
 - Reduce carbon footprint and energy use.
 - Explore what it would take to get to zero carbon footprint. (loosely defined)
 - Discuss sustainable and green building practices, anticipated budget impacts, and vetting process.
- Energy – Document current 12 months electric and gas usage – establish baseline energy usage.
- PV Solar
 - High-level PV solar sizing and energy offset on all flat roof areas including the realities of 3rd party funding and timing. Get updated preliminary proposal for the church owned and 3rd party PPA lease.
 - Augment or substitute solar using Community Solar Garden
 - Visible solar opportunities, entrance skylight, Hampden facing awning, Orb/Sanctuary skylight treatment, etc.
 - Cost and ramifications of a solar shade structure in the parking area
- High-level Geothermal sizing and cost ramifications.
- LED Lighting (LED lighting costs can be added to a solar PPA to eliminate/reduce upfront cost)
- EV Kiosks, pre-wire or fully incorporate in design - can supply broad costs
- Other ideas, thermal solar, etc

Part III Building for the Future Capital Campaign

As indicated in the meeting Agenda, Green₄ spent the first half hour providing an overview of all the energy efficiency/conservation features that were being considered (e.g. new windows; additional insulation in walls, ceiling/roof, crawl space) as well as the proposed solar PV array planned for the flat portion of the roof. Green₅ followed with a 15-minute presentation exploring the possibility of including ground source geothermal heating & cooling.

The information presented at this coordination meeting is provided below:

First Universalist New Building Energy Considerations, (21 Aug 2015) - Green₄

Slide 2015.2

BFF Overall Energy Objectives

- **Design goal: Increase building size while not increasing energy use. Reduce energy use with onsite solar generation and other energy efficiency means.**
- **Explore what it would take/i.e. the size of hurdle/to reach zero carbon footprint. (requires defining)**
 - Net Zero HERS is considered over 90% average reduction
 - Electricity - Natural Gas – Domestic Hot Water
- **Green building practices, budget impacts, vetting process.**
 - LED Lighting, lighting control, occupancy sensors
 - Bathroom fixtures, Kitchen fixtures/appliances
 - Furnaces, Air Conditioning
 - Cool Roof
 - Interface Carpeting, windows, finishes ...
- **Green First Sustainability Signage**

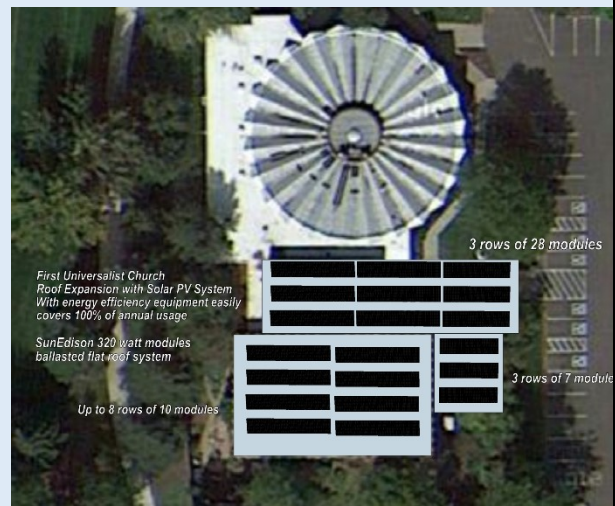
Slide 2015.3

First Universalist PV Solar Options

- **Utilize all available flat roof area for the most cost-efficient system**
 - System size ~ 44kW
 - Estimated offset = ~90% of current usage
- **Community Solar Garden**
 - Clean Energy Collective – ownership model
 - Sun Share – PPA model
- **Consider visible treatments:**
 - ~ 1 kW as a translucent awning over entry
 - ~ 1-2kW as thin film applied to sanctuary skylight
 - ~ 3 kW awning or vertical treatment along Hampden
 - ~ 50kW Parking Canopy structures

Slide 2015.6

Flat Roof Solar



Flat Roof Solar

- **44kW for an offset of ~ 90% of current electricity usage (unfortunately, only ~45% of the current \$\$ bill – due to demand rates, net metering bill offset is ~\$0.06/kWh. Common to all larger commercial Xcel accounts)**
- **Ballasted racking sits on the roof with no penetrations**
- **Ownership incentives (~50%+ of system cost) not available to a Not-For-Profit Organization**
 - 30% Investment Tax Credit, MACRS accelerated depreciation
- **Power Purchase Agreement provided by 3rd party owner**
 - 20-year agreement, generally at zero upfront cost
 - Option to purchase in year 6 when tax benefits are depleted
 - Example: \$898/mo payment, average \$1,408/mo savings through 10 yrs
 - Based on gross cost of around \$3.15/W.
 - Can incorporate LED and EE/Power Factor equipment – to offset ~\$30k - \$50k of construction costs

Flat Roof Solar – Billing Review

- **Opportunity to change Xcel Rate from SG/Demand to SGL, SPVTOU, or C to reduce or eliminate demand charges and achieve greater Net Metering savings, i.e. higher cost offset.**
- **Solar Rep + Church Rep meet with Xcel Rep to explore**

Community Solar Garden

- **Offset energy at church, augment onsite solar**
- **Appears unnecessary if design goals can be achieved, Max 125% applies**
 - JB - Recommend against additional Community solar
- **CEC proposal**
 - Ownership model at \$3.55/kW* after-tax benefits applied by CEC
 - Requires payment or debt – not supported by third-party PPA
 - 20-year agreement, with \$0.09 REC payment to church for 20 yrs
 - Variable Xcel bill offset credit is \$0.102/kWh + \$0.09 REC = \$0.19/kWh
- **Sun Share proposal**
 - PPA model, tax benefits absorbed by SS
 - Bill Credit estimated at \$0.104/kWh.
 - PPA rate \$0.10/kWh with 3.5% annual escalator – 20 yr savings - ~\$19,100
 - Can reduce escalator and increase savings with upfront \$10k payment
 - 20-year agreement, renewable at end of term

Solar Awning

- **Adds 15% - 20% cost that cannot be included in PPA, but a modest amount**
- **Est \$10,000**
- **Consider Alt architectural treatments**



Slide 2015.9

Solar Parking Canopy

- Adds 30% - 40% cost that cannot be incorporated to a PPA
- Would cause overbuild - cannot exceed 125% of 12-month historic usage



Slide 2015.11

Green First Committee Signage

- Small placards - Proposed UU GF Example

SUSTAINABLE MATERIALS

Carpeting in this building is recycled using Cradle-to-Cradle manufacturing. It will recycle again after its use here. Because it is laid in squares, only small sections need replacement upon heavy

Living Our Values



Slide 2015.12

Green Building Practices

- **Best practices, budget impacts, vetting process.**
 - LED Lighting, lighting control, occupancy sensors
 - Bathroom fixtures, Kitchen fixtures/appliances
 - Furnaces, Air Conditioning
 - Cool Roof
 - Interface Carpeting, windows, finishes
- **Establishing a Baseline Heat Load**
 - Lightly Treading - Energy Audit
 - American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) level 1 audit, walkthrough, inventory and benchmark Xcel bills/rates - ~1,000.

Slide 2015.10

Electric Vehicle Chargers



- The ChargePoint CT4000 - industry standard.
- Dual bollard unit ~\$6,500
- Charges ~20 miles of range per hour (RPH).
- "Smart" station - can collect revenue, control access, get reports, etc.
- Recommend running conduit for min 4 dual stations

- A north lot may be most practical
- Consider pre-wiring for 240V service
- Based on funding achievement, add units
 - with construction, future or special gifts.

Green₅ followed with a presentation focused on a proposed geothermal heating & cooling system. The goal of this presentation was to identify if there were any significant obstacles preventing the replacement of the ten natural gas furnaces with ground source geothermal heat pump furnaces.

Not knowing what this group had discussed in prior meetings, it seemed appropriate to the presenter to provide some background on why First Universalist was even considering a design option that probably was not the lowest cost solution.

Discussion of Ground Source Geothermal Heat Pumps for Heating & Cooling, (21 Aug 2015) - Green₅

At the time, the feasibility of introducing geothermal technology into this rebuilding project was a complete unknown. The Sustainability Team simply wanted to put the idea on the table and solicit feedback from the architects - as the Overview Chart indicates.

Being new to the group, the presenter provided a summary of his background.

Slide 2015.13

- **Member of First Universalist Church for 39 years**
- **The user of a Residential Geothermal Heat Pump**
 - Not an expert –Not a contractor – Not affiliated with any supplier.
- **Personal Experience of “Living Without Fire (no burning)” for the past four years.**
 - Now generate all our electrical power using rooftop solar (10kW). Stopped buying coal/gas-generated power.
 - Rooftop solar PV provides energy for our plug-in hybrid to drive 10,000 miles per year. Stopped buying gasoline (except for cross country trips)
 - Replaced gas furnace with a 4 Ton Geothermal heat pump that provides all heating and cooling for a 2000 ft² home built in 1974. Stopped burning natural gas for heating four years ago.
 - Participated in a Sierra Club Tour of the IKEA store in Centennial, CO that uses ground source geothermal heat pumps for heating and cooling their 415,000-square-foot, two-level store.
- **Discussion of input from a geothermal heat pump installer. Ground Loop concept.**
- **Requests Feedback on use of geothermal heating/cooling from an Architectural Perspective**

Thinking it was important to convey the value system of Unitarian Universalists (pertaining to sustainability), the first three charts (provided earlier in this book as Slide 2006.1, Slide 2014.1 & Slide 2015.1) were used to highlight Unitarian Universalist creation care principles as documented in recent UUA General Assembly “Business Resolutions.” Key points from the three charts are provided below.

Slide 2006.1 (Key Points Only)

The threat of Global Warming / Climate Change:

Unitarian Universalist General Assembly: 2006 Statement of Conscience:

Earth is our home. We are part of this world and its destiny is our own...

As Unitarian Universalists, ... we will not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grandchildren...

We ... are called... to halt practices that fuel global warming/climate change, [and] to instigate sustainable alternatives...

...As a people of faith, we commit to a renewed reverence for life and respect for the interdependent web of all existence.

Congregational Actions ...

- Treat environmentally responsible practices as a spiritual discipline;
- Use congregational financial resources to positively address the global warming/climate change crisis;

Slide 2014.1 (key Points Only)

**Fossil Fuel Divestment:
Unitarian Universalist Association
2014 Business Resolution**

WHEREAS, Unitarian Universalist congregations covenant by our Second and Seventh Principles to affirm and promote justice, equity, and compassion in human relations and respect for the interdependent web of all existence of which we are a part; and...

WHEREAS, the climate crisis threatens Earth systems through warming, destabilization of the atmosphere and climate, sea level rise, and the acidification of the oceans, of which the brunt of the burden has fallen and will fall on the poorest people in the world, who are least responsible for the crisis; and...

WHEREAS, the 2006 Unitarian Universalist Association (UUA) General Assembly approved a Statement of Conscience on the Threat of Global Warming/Climate Change declaring “that we will not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grandchildren”; and...

WHEREAS, we have a moral responsibility to Earth, to all beings, and to future generations to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy; and....

BE IT FINALLY RESOLVED that this General Assembly encourages Unitarian Universalist congregations and Unitarian Universalists to review their congregational and personal investments with a view to taking action to end climate change... to end use of fossil fuels, and to invest in renewable energy and conservation.

Slide 2015.1 (key Points Only)

**Support Strong, Compassionate Global
Climate Agreement:**

**Unitarian Universalist Association
2015 Business Resolution**

Act for a Livable Climate

BECAUSE: Global climate change is fundamentally a moral and ethical crisis induced and exacerbated by human activity that can and must be modified to maintain a livable world for ourselves, our descendants, and other species;

... **BECAUSE:** *The crisis of climate change is the gravest threat facing our world today*, recently wrote Peter Morales (UUA President) and Bill Schulz (UUSC President and CEO).

... **BECAUSE:** Our Principles impel us to act on climate change. The web of life is threatened; climate catastrophes, (in the near and long term), disproportionately impact the poor, disadvantaged, elderly, women and children; ... and our descendants are threatened, raising intergenerational equity issues.

BECAUSE: We are responsible as people of faith to mitigate, avert, and limit the potential catastrophes of climate change, standing with other faith traditions caring for our common home;...

THEREFORE: BE IT RESOLVED, That the 2015 UU General Assembly calls for Unitarian Universalists to unify and provide ethical and moral leadership for climate action and to do so within our congregations and within our multi-faith communities....

To bring this motivating factor closer to home, the following chart was compiled after recent comments from First Universalist members who participated in the “Responding to Climate Change: A Personal Planning Workshop” workshop held on 15 August 2015

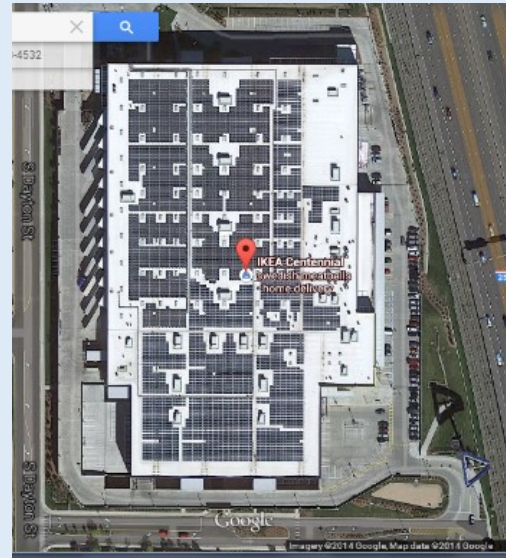
A fourth chart provides some specific information about members of First Universalist Church.

Green Expectations of First Universalist Church Members

- **There is a Broad Range of Green Expectations among First Universalist members**
 - *Climate Change Deniers.* “If we have any money left over, use it to paint something green.”
 - *Environmental Activists:* “If this building project is not ‘Totally Green’ I will not contribute one cent.”
- **Feedback from attendees of “Responding to Climate Change: A Personal Planning Workshop” 15 Aug 2015**
 - Opinions expressed by attendees about BFF:
 - Sustainability is a mandatory design requirement and first priority budget item,
 - Use the remaining budget to provide additional classrooms, office space, etc.
 - At least a handful of members consider Nature & all Life sacred.
 - Sustainable means:
 - No further burning of fossil fuels/ancient hydrocarbons
 - Use inexhaustible/renewable energy sources: i.e. solar, geothermal
 - Use green materials that can be recycled.
 - **Proposal for future renovation:**
 - Go 100% Green on any “new space.”
 - Design for the capability to go 100% Green (in the future) for existing space.

In general, the UU Ministry of Earth exemplifies the Unitarian Universalist version of creation care.

IKEA Centennial, CO Solar/Geothermal



Electrical Power. Most of the available roof area of the IKEA store in Centennial, CO is covered with solar PV modules. The individual modules are mounted on a framework that is “ballasted” in place on the roof. This eliminates the need to penetrate the roofing membrane with holes for fasteners that in turn become potential leak paths for standing water on the roof. The amount of ballast/weight required to hold the modules in place was determined by calculating the weight required to withstand wind loads.

Heating and cooling: The IKEA building uses ground source geothermal heat pumps – no natural gas is burned.

- IKEA Geothermal Ground Loop consists of 130 boreholes each 500’ deep. 415,000-square-foot, two-level store

IKEA’s goal was to harvest all their energy using solar PV and geothermal heat pumps.

At this point in time, it was not known how the introduction of a ground source geothermal heating & cooling into the project was going to affect the design or cost. So it was decided to ease into it slowly by putting a toe into the water.

Part III Building for the Future Capital Campaign

Design Option # 1 was limited to introducing geothermal into just the new construction – not the remodeled old portion of the building. This would limit the scope to a one or two geothermal heat pump furnaces and the associated ground loop.

Slide 2015.16

Suggestions – Design Option #1 (Minimum)

Estimated Cost Range: \$20,000 - \$30,000

- As a minimum, we suggest that any additional space added to our current facility during this “Building for the Future” project be heated and cooled with inexhaustible/sustainable energy – energy derived from the our Sun and/or exchanged with our Earth – not by using energy derived from burning/consuming one-time-only reserves of ancient hydrocarbons (fossil fuels).
- The new segment of our facility could be designed to use a forced air system for heating and cooling consistent with the rest of the facility.
- Instead of installing a traditional natural gas furnace for heating with an air-based A/C heat pump for cooling, we can “build for the future” and install a geothermal heat pump to provide heating and cooling for the new portion of the building.
- Installing a geothermal heat pump furnace requires contracting with a drilling company that installs the “ground loop.”
- For a 4-Ton rated furnace, two 4”-5” boreholes are drilled 300 ft deep and black plastic pipe is inserted for water circulation to exchange heat. At \$15/foot, the approximate cost of this ground loop is \$9,000.
- The proposed ground loop would be installed under the south half of the north parking lot.
- The new space would include a mechanical room for a 4-Ton heat pump furnace (same size as the natural gas furnace).
- Additional cost over a natural gas furnace plus A/C unit may be \$10,000. [e.g. \$18,000 (GT) - \$8,000 (NG)]
- Cost contingency – e.g. 20% = \$2,000
- **Total expected additional cost of installing geothermal, \$21,000**

The idea was to get a “Reading” on some of the architectural issues that would have to be considered.

Not hearing any objections from the architects, the emboldened presenter, stepped in a little further, ankle deep with a more ambitious Option.

Slide 2015.17

Suggestions – Design Option #2 (Recommended)

Estimated Cost Range: \$100,000 - \$125,000

- Option #2 is also Building for the Future on a larger scale.
- While the parking lot is being disturbed, ground loops for ALL the furnaces could be installed and the parking lot would be repaired/repaved and not have to be disturbed later as the existing gas furnaces are eventually replaced with GeoThermal heat pumps.
- The ground loop for one 4 ton heat pump furnace may cost \$9-10,000, but we may be able to install the ground loops for 10 furnaces for less than \$100,000 once the drilling rig is on site, possibly saving 10-20% on the ground loop cost.
- For this Option, two GeoExchange heat pumps would be installed for the new portion of the facility, AND the complete ground loop for the entire facility would be installed for future replacement of existing natural gas furnaces with GeoExchange heat pump furnaces.
- For this option, the new mechanical room might be extended to accommodate future growth and the additional ground loop manifolds.
- In five years when a few of the 9 natural gas furnaces need to be replaced, the ground loops to support GeoExchange heat pumps will already be in place.
- Upgrading is just a matter of pulling out an old gas furnace and replacing it with a GeoExchange heat pump furnace and hooking up the previously installed ground loop – no drilling or trenching required. The existing forced-air ductwork can remain intact.

Hearing no objections the presenter continued in a bit deeper.

Slide 2015.18

Opportunities for the Building for the Future Project

- The complete transition away from fossil fuel to renewable energy sources is not only possible with today's options, but it is also economically sound – even with our current broken economic system riddled with externalities that favor the fossil fuel burning industry. Investing in a “Green Energy” design can actually be less expensive.
- But economics is not the only yardstick we use in sizing up our options – we UUs also weigh alternatives against our values and principles.
- I suspect that if we took a vote within our membership, we would find that most of agree on the ethical/moral path, based on our beliefs, that coincides with what our fellows UUs voiced in the last several General Assemblies.

“... do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy;”

- There are other UU congregations who have made (or in the process of making) the transition from fossil fuel. (e.g. JUC has installed solar PV and geothermal heating and cooling). We have members who have made a transition away from fossil fuel.
- There is no question about the feasibility of transitioning from fossil fuel to renewable energy sources for our BFF project. The transition is low risk using proven off-the-shelf commercial hardware.
- The issue is “how swiftly can First Universalist make the transition with regulatory and financial constraints.”

Slide 2015.19

What's Required for a Complete Transition?

- Electrical power will be derived from renewable energy sources
- Heating and cooling will be derived from renewable energy sources
- It seems highly unlikely that the utility company that services our area is going to be generating the electrical power it sells us from 100% renewable sources in the foreseeable future.
- The BFF Project provides the opportunity for us to sustainably generate (honorably harvest) our own energy
 - The Sun willingly offers us solar energy we can use to convert to electrical power and thermal energy - using solar collectors (i.e. leaves)
 - The Earth willingly allows us to exchange (extract and deposit) thermal energy – using GeoExchange heat pumps and a ground loop (i.e. roots)

**Everything required for this transition
already exists & is proven
(I did it 2011 and everything is working fine)**

At this point, time ran out. The presenter stopped and requested feedback from the architects – the primary objective of this meeting: “What are the Architectural issues of Geothermal Heating/Cooling?”

Slide 2015.20

Feedback pertaining to use of Geothermal Heating / Cooling

- Architectural Issues
- Logistics/Construction Issues
 - Drilling Trenching Interference with other construction
 - Need for a buried line survey before drilling
- Impact on church operations
- Other

Conclusion. *The architect's immediate response was "no problem." They agreed to baseline a natural gas system but design the forced-air ducts to be about 10% larger in cross-sectional area to accommodate a geothermal system at no added cost. We could then decide later about whether to buy natural gas furnaces or geothermal heat pump furnaces.*

What followed was somewhat embarrassing. As it turned out, the architects were already familiar with ground source geothermal heat pumps.

They pointed out their firm had incorporated geothermal technology in a recent remodeling project at a sister church, Jefferson Unitarian Church (JUC) in Golden Colorado. JUC's new Mills building now uses a geothermal heating/cooling system.

The architects went on to explain that the air ducting for a geothermal system is slightly larger in cross-sectional area than for a gas furnace for an optimum design. The warm air from a heat pump furnace is not quite as hot as the air from a gas furnace so a slightly higher flowrate is needed. But the difference is small and has no significant cost impact. The architect recommended the air ducting be designed to accommodate a geothermal system and then it would work with a natural gas furnace as well. In general, the architect team seemed very receptive to considering geothermal in the new design.

Had the presenter done his due diligence and visited the architects' web site, he would have found:

"Our studio is committed to a transition toward a sustainable, green future."

Needless to say, this affirmation of the feasibility of geothermal was a high point for the Green First Advocate striving to transition from unsustainable natural gas to an inexhaustible clean energy alternative.

The energy efficiency features (new windows, additional insulation, etc.) had already become an integral part of the new design. An array of solar PV modules was already a consideration once the roof was complete because the solar equipment did not have a significant impact on the building mechanical design.

This coordination meeting also identified the goal to replace the natural gas furnaces with ground source /geothermal exchange heat pump furnaces that needed to be integrated into the building design (heat pump furnaces and water circulation manifold) and a

part that was separate from the building design (ground loop).

In retrospect, this presentation was an important coordination event for a number of reasons.

Although the Sustainability Subcommittee briefing was intended to coordinate First Universalist goals with the architects early in the design process, it actually served to inform and coordinate the BFF Committee itself. Some of BFF Committee members were hearing details about the solar and geothermal goals for the first time. Some were not familiar with the UUA resolutions pertaining to transitioning from fossil fuel to renewable energy.

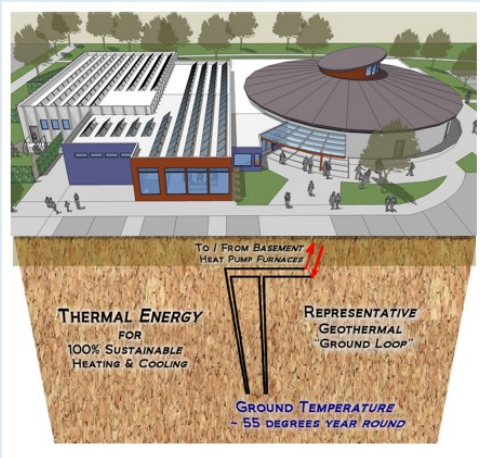
It seemed that starting off the presentation with the "big picture" that was grounded in faith-based values was informative, unifying and even introduced another sense of purpose into the project – beyond fixing a leaking roof, replacing the windows, and adding more space in the Sanctuary. **Note:** climate change was not discussed or even mentioned.

On the 45 minute ride home from the architect meeting, our carpool had a lively conversation about energy technology and especially geothermal heating & cooling. One of the BFF committee members, BFF₄, captured the key elements of the conversation and took on the task of summarizing the sustainability story/goals. She developed a "Sustainability Framework." After a half dozen iterations that incorporated inputs from all present at the meeting, a design goal emerged. It was published on a separate flyer that became part of the official BFF literature/handouts.



BFF Framework for Energy Sustainability (Sep 2015)

Planning Framework for Energy Sustainability



Our Board of Trustees and Building for the Future team adopted an Energy Sustainability and Green Building Framework for our new building. Here are the highlights:

Overall Design:

- 85% recycle; 15% expansion
- lighting, orientation, materials, restrained approach

Deconstruction:

- Recycling and reuse of demolition materials / avoid landfill

Building Science

- Windows, insulation, materials, methods
- Material choices vetted for sustainability
 - Renewable fuel sources (Solar, Geothermal) replacing fossil fuel

The following week, the architect sent the First Universalist team the following affirming email.

From: Architect₁
Sent: Thursday, August 27, 2015
To: Green₅
Cc: Board₅; Green₄; BFF_{1,2,3}; Architect₂
Subject: Ground Source Heat Pump

The cooling aspect, especially for a church with lots of bodies as heating units, is one of the real dealmakers for the ground source heat pump!

I am thrilled with all of your good work and motivational leadership for your community.

Keep up the vision.

David

Given this positive response to exploring the use of geothermal heating and cooling as a replacement for the fossil fuel based HVAC system, the Green First Team began to look at this option in more detail.

The proposed remodeling project was still in the conceptual design phase. The actual energy usage was not going to be definitized for another 9 months. So the Green First Team assumed the energy requirements would be similar to the original building to start the effort of sizing the solar and geothermal systems to arrive at a cost estimate. The goal was to put together a cost estimate and an implementation plan – how would the energy be added over time?

To minimize the amount of harm the facility was doing to the planet, the Green First Team wanted to make the transition from fossil fuel as quickly as financially possible. They realized that a cash flow model/analysis would be required.

By assuming the energy usage of the newly renovated facility would be similar to the old, the first obstacle was an Xcel Energy policy that a new solar system could not generate more than 120% of the past 12 months usage. This limitation is fine for a situation where one is adding solar – in this case, the energy formerly provided by natural gas going to be replaced by geothermal energy but that requires additional energy run the heat pumps. This additional energy can be estimated easily by knowing the COP of the heat pump. The church used 72,000 kWh of electric energy and 252,000 kWh of energy from natural gas. The COP of typical heat pumps is around 4 – meaning that it takes one unit of electrical energy to operate a heat pump that will extract 4 units of energy from the Earth. So to replace the natural gas energy with geothermal would require roughly an additional 56,000 units of solar electricity. But the Xcel limitation of 120% would prohibit adding more than 14,000. So the solar system would have to install in two phases.

Also to generate the total amount of power needed, we did not have enough flat roof space. So it was determined that the south wall could be used for additional solar modules and that they would be enough area even considering a 20% drop in performance of the panel on the south vertical wall.



Complete Transition by 2019

- Let's envision what a sustainable/green building infrastructure would provide:
- Sustainable electrical power for lighting, appliances, office equipment and other electronics,
- Sustainable heating and cooling as well as hot water.
- Let us start from the ground up. We will honorably harvest (exchange) thermal energy with the Earth.
- By installing some "tap roots" into the ground, we can create a geothermal ground loop system that allows us to exchange thermal energy with Earth.
- Water is circulated (but not consumed) in this ground loop to carry the thermal energy between the building and ground.
- A small amount of electrical power is needed to operate the circulation pumps.
- Our current natural-gas burning furnaces and A/C units will be replaced by Geothermal Heat Pump furnaces that provide both central air heating and cooling.
- Heat Pumps are made in the U.S. [e.g. Mitchell, SD (GeoComfort); Fort Wayne, Indiana (Water Furnace)]
- Electrical power is required to operate the heat pump furnaces (i.e. blower & compressor motor)
- All electrical power will be generated by honorably harvesting energy from the Sun using solar photovoltaic modules.

Two-Phase Transition to 100% Renewable Energy

- Using Solar PV modules on the flat roof, we will harvest the energy from the Sun to generate all our electrical power needs. The energy currently needed plus additional energy required to operate the new heat pump furnaces can be harvested on site. The current flat roof design appears to be able to accommodate enough modules to provide 90% of our current electrical needs.
- Placing additional solar collectors (between 40 – 55) on the new "South Wall" will take us to 110-120% of our current usage.

- Heating and cooling will be provided by Geothermal Heat Pump furnaces powered by the Sun.



Phase1 Concept

- 138 solar PV modules on a flat roof
- 50 solar PV modules on the South Wall
- 6 Geothermal Heat Pump Furnaces
- Complete Ground Loop

Phase2 Concept

- 36 solar PV modules on parking lot canopy
- 4 Geothermal Heat Pump Furnaces

We began constructing what seemed like a never-ending number of financial models in an effort to understand the pros and cons of different funding models. There is no need or space to present all these spreadsheet models because most ended up on the cutting room floor so to speak.

Net Present Value (NPV) Calculations (17 Oct 2015)

From: Green₈.
To: Green₅
Subject: Cash Flow Spreadsheet
Date: Fri, 14 Oct 2015

What I need from you still is an English description of what this analysis is trying to do. Obviously, I'm not a financial person and a number of people we will be explaining this to are not either.

From what I understand (please correct this), the NPV calculations you added to the workbook are doing the following:

A) Examining the current path we are for the next 20 years to estimate what the church operating

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expenses are expected to be. Because of inflation, [you assume an inflation rate (now a variable but 2% can be the baseline expenses (expressed as 2015 dollars) in outlying years must be discounted slightly - hence NPV. This cash flow summary for the church as is will serve as our "Baseline."

B) Next, we put together a case where we buy the equipment to harvest solar and geothermal for our energy needs. In this scenario, the cost is concentrated up front to buy this harvesting equipment (since we don't have any of this equipment now), but once we do, and it is put into operation, our expenses essentially go to zero for the next 20 years. The calculations you added compare this solar+geothermal case against the "as is" baseline case on a year-to-year basis. After 20 years, we look at the difference and the solar-geo case costs less and even makes a "profit" - can we call this a profit? or a net gain? or?

C) Then we do the same thing with a scenario where we just stop burning natural gas only - we still buy all our electrical power from Xcel who generated 80% of it from fossil fuel. Again, we calculate the difference in church's direct expenses between the two cases. In this case, the direct costs will probably be less if we do nothing and stick with our baseline method of buying natural gas and burning it for our heat - unless the escalation rate of natural exceeds 4% per year for the next 20 years.

D) Ditto C but here we continue to burn natural gas but stop buying Xcel electrical power and therefore do not require burning coal and natural gas for our electrical needs.

E) Look at a carbon tax

F) Look at how to minimize harm/ecocide. How to minimize the externalities. For completeness, we include a monetized estimate of the externalized costs.

Just as we "discount" future value because of inflation and the option to "invest" and grow wealth, seems we should increase the future negative value of externalities because of the compounding effect. A little harm we do today can spread to more harm, to cascading harm in the future. i.e. you don't discount externalities - just the opposite.

From: Green₅

To: Green₈

Subject: Net Present Value (NPV) Calculations

Date: 10/17/2015

Green₈,

Thanks for looking at this and commenting...

We started running some cash flow numbers for various funding scenarios:

1) **"As Is"** – In this case, we continue to use the equipment we have (replacing gas furnaces as needed) and continue to buy electrical power from Xcel for the next 20-25 years. That will be our baseline design. We will include the estimates of monetized externalities as an indication of additional "harm done" our church will be causing over the 20-year time-period of interest.

2) **"Complete Transition To Renewable Energy"** – In this case, we make a decisive transition away from fossil fuel and include its cost as a line item in the BFF budget. Obviously, we need additional equipment to harvest sustainable energy. Someone has to purchase that equipment.

a. For starters, we will assume the church buys the equipment, owns it, and receives 100% of the benefits from it. The equipment is paid for from pledges/donations and not from a loan or mortgage or a third party (so there is no financing cost).

b. In this case, we involved a third party for at least the cost of the solar system.

c. In this case, we borrow the money to buy the equipment and pay the usury fees.

For all these subcases, a decisive transition away from fossil fuel will minimize (if not eliminate) known externalities. However, the ROI, IRR, Payback, etc. for First Universalist will be different for the three scenarios.

3) **"Delay the Full Roll Out of a 100% Sustainable System"** – In this case, ostensibly our goal is to "save money" by not getting rid of "perfectly good gas furnaces" until they break down and stop their destructive behavior on their own. Only then would we replace the gas furnaces with geothermal heat pumps.

Again we will keep track of the externalities that occur during this slow roll out as an indicator of the harm we continue to do as we procrastinate getting to the end goal of a 100% sustainable energy system. Again the calculation of ROI, IRR, etc. and damages will be visible from the spreadsheet.

We hope that when you return in a week, this analysis will be completed and we can talk again. I need your help to verify and document the results to present to

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the BFF Sustainability Subcommittee, BFF committee, Board of Trustees, and whoever might be interested.

Have a good trip.

Thanks again for your advice/assistance.

Green₅

From: Green₈.

To: Green₅

Subject: Updates to Cash Flow Spreadsheet

Date: Fri, 16 Oct 2015

Green₅,

Attached is an updated spreadsheet. I fixed a few things that appeared incorrect to me...

I talked with Green₄ earlier today. He reassured me that Solar and Geothermal are definitely still baseline assumptions for the project, even though there are no "budget lines" for them yet. He suggested we have a meeting with BFF₂ and the entire Green group very soon to eliminate any confusion surrounding this point. Nonetheless, I think this work is valuable because we will need as much information as possible to convince possible nay-sayers that this is indeed the right approach.

Is there anything in particular that I can help with at this time? The spreadsheet has grown beyond my solid comprehension, so I am not quite sure where I can add value at this point unless you point me to it...

Cheers,

Green₈.

BFF Sustainability Subcommittee Formation (22 Oct 2015)

From: Green₄

Sent: October 22, 2015

To: Green First Task Force

Subject: Ground Source Heat Pump

"... we formed a BFF Sustainability Task group that will be working to plan and recommend energy and sustainability-related elements of the BFF project."

The BFF Steering Committee is BFF_{1,2,3,4}, and Green₄

The Resilient Investor Seminar (2 Nov 2015)

This particular seminar was hosted by a Green First member, Green₁ in response to the interest the Aug 2015 workshop attendees had about the financial aspects of divesting in fossil fuels and investing locally – particularly socially responsible investing. Slow money – Woody Cash was invited to talk about his book Slow Money. Although there is no direct link between the Resilient Investor seminar and the eventual financing model that ended up being used, there is at least an indirect connection. So it is included as a possible influence on the church membership because the slow money seminars were attended by church members who had heard about investment in renewable energy, local agriculture. So when we presented the congregation with the opportunity to lend the church money at a low-interest rate, so of those who did become lenders may have heard about this earlier.

Frequently Asked Questions & Answers (Nov 2015)

As the idea of including a new sustainable heating & cooling system in the BFF goals began to gain more traction, it seemed appropriate to begin constructing a list of Frequently Asked Questions (FAQs), because there were many. The topics are listed below:

Frequently Asked Questions (FAQs) Titles

ETHICAL/MORAL/SPIRITUAL ISSUES

- Has the Unitarian Universalist Association Documented a Position on Sustainable Energy Issues?
- Was our Church Doing Harm?
- What are We Doing to Stop/Mitigate the Harm?

SUSTAINABLE ENERGY ISSUES

- What are Our Energy Needs Annually?
- How much of Our Energy is Currently Generated Sustainably?
- If We Do Nothing Different Now, What Will the Energy Picture Look Like in 20 years?
- Can We Find Alternative Sources of Energy That Are Sustainable?
- What does a Sustainable Energy System for First Universalist Look Like and Cost?
- Is it Practical to Transition to 100% Renewable Energy?

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- Has the 'Building for the Future' (BFF) Committee Documented a Sustainable Energy Plan?
- What are the Benefits of a Sustainable Energy System
- How does a Sustainable Energy System Operate?
- Why Do We Need a New Energy System? Haven't We Already Incorporated Enough "Green" Features Into Our Plans?

Solar Concerns

- How much Solar Do We Need?
- How Much Does Solar Cost? (See Financial Issues)

Geothermal Concerns

- What is a Geothermal Heat Pump Furnace?
- Why Use a Geothermal Heat Pump Furnace?
- How Does a Geothermal Heat Pump Work?
- Who Else Uses Geothermal Heat Pumps that We Might Know?
- Aren't Geothermal Heat Pumps Too Risky?
- Can we Afford a Geothermal Heating & Cooling System? (See Financial Issues)

Recycling Gas Furnace Concerns

- How Many Gas Furnaces Do We Currently Have at the Church?
- How Can We Justify Replacing Perfectly Good Gas Furnaces?
- What is a "Good" Gas Furnace?
- What Do We Do with Our Old Gas Furnaces for Zero Waste?
- Who Will Recycle Our Old Furnaces?
- What are Deconstruction Services?
- What is a Deconstruction Assessment?
- Deconstruction Service Companies (Examples)

ECONOMIC/FINANCIAL ISSUES

- What are Our Energy Costs Currently? ...in 20 years?
- Isn't There Plenty Of Cheap Fossil Fuel?
- How Much Does Solar Cost?
- How Much Does Geothermal Cost?
- What does a life cycle cost?
- We Do Not Have Enough Money to Devote to a Sustainable Energy System for Our Church.
- Let us Save Our Money and Spend It on Other Things We Want.
- What are "Externalities?"
- Why is Our Current Energy System Unsustainable?

Detailed discussions are provided in Appendix J.



BFF Framework for Energy Sustainability – Revised (10 Dec 2015)

Final version approved by BFF Committee, Dec 10, 2015



Planning Framework for Energy Sustainability

At the beginning of the Building for the Future project, First Universalist expressed its vision about creating a Green Building. We said in our vision statement:

First Universalist envisions a transformation of our building that celebrates our principles, reflects our values, inspires our spirit, and stirs our actions...The building ...will speak to the world of who we are,...will incorporate sustainable building practices in use of energy, building materials, and ongoing maintenance, ...and will reflect our concern for the environment, connection with our surroundings, love of life, our deliberate commitment to learning and reinvention, and our need for quiet reflection.

In a 2014 Business Resolution, the Unitarian Universalist Association affirmed the following: ***We have a moral responsibility to Earth, to all beings, and to future generations to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy...***

And in 2015, the UU General Assembly called for UU's to ***unify and provide ethical and moral leadership for climate action within our congregations and our multi-faith communities.***

The BFF committee, in concert with the Green First Task Force and Barrett Studio Architects, proposes to achieve this vision and respond to the climate action challenge through an integrated set of design principles, investments, and choices as we build for our future. By adopting this energy sustainability framework, we are embarking on a plan that is consistent with our core values.

Designing for Conservation of Energy

As a starting point, our design goal is to add significant new space to our building with no increase in energy. This is accomplished with green building techniques and an improved thermal envelope. Such methods as dramatically increased insulation, a new roof on the North end of the building, use of energy efficient windows, LED

lighting, and other measures will create a positive starting point for a program to reduce and eventually eliminate our reliance on fossil fuels.

Harvesting Solar Energy to meet our electrical needs.

We plan to install Solar Photovoltaic (PV) modules on the flat roof sections of the building. Although the amount of roof area has not been finalized, space appears sufficient to generate 90% of our current annual power generation needs using solar energy. By using an innovative approach--a Power Purchase Agreement---third parties would build and own the solar on the building while the church would enter into a contract to purchase all energy from the system with a monthly fee that saves on our overall electric bills. This approach avoids the initial cash outlay of owning the Solar PV system outright, and the Church will have favorable options to purchase the system after the sixth year when the investor's tax benefits are exhausted. There will be minimal impact on the building construction budget, and positive impact on the annual operating budget while achieving significant progress toward the use of renewable sources of energy.

Commit to a multi-year program of replacing our heating and cooling system with a complete Geothermal/ Geoexchange system.

A further step in transition toward divestment from fossil fuel requires the installation during construction of geothermal heat loops, sized to support the building, probably in the North parking lot. Any new furnaces required for the additional space we are adding will be sustainable Geoexchange heat pumps run by electric power generated on our roof. Going forward, as a current natural gas furnace needs to be replaced under a planned maintenance schedule, the old gas furnace will be replaced with Geoexchange heat pumps in a progressive program over a number of years, but as quickly as possible financially. This commitment to replace existing furnaces as they wear out, within a defined schedule, allows us to budget and plan for the expenses, including such future sources of renewable energy as additional on-site solar and community solar gardens to support that transition. Additional energy ideas such as adding electric vehicle chargers on a gradual basis will be explored.

Additional and ongoing commitments

While this framework emphasizes our intentions and plans for energy sustainability, ---a critical element of a Green Building, ---additional elements, such as water efficiency and conservation, landscape features, health and safety measures, lighting and signage, and ADA/universal accessibility, will be presented at the design work progresses.

The building will have educational signage promoting its many green design features. Throughout the design and building process, our choices will be guided by sustainability as well as feasibility. We will choose building materials, furnishings and appliances, equipment and finishes with the best sustainability features we can afford—such as recycled materials, low VOC emissions, appropriate disposal of construction waste, etc., following, wherever possible, guidelines for LEED and EnergyStar Certifications. We will also foster ongoing congregational discussions and commitments about how our behavior and choices as we live in the new building can further support our goal and values.



At the time this “Planning Framework” was being drafted by the BFF Committee, the Global community (nearly 200 countries) was meeting in Paris to address the existential issue of climate change. That December 2015 meeting was the 21st Conference of the Parties (COP21) to discuss climate change. The outcome of this historical meeting was an increased awareness of the **urgency to transition from fossil fuels.**



Paris Agreement - COP21 (Dec 2015)

During the COP21 in Paris 2015, 195 delegations adopted the Paris Agreement that seeks to "contain"

2015 Paris Agreement - Highlights

- Global Response – COP21, the 21st Family Reunion - The 195 “parties” involved expressed concern about our Mother – Concern about our Island Nation cousins
- Article 2
 - 1) ...this agreement...aims to strengthen the global response to the threat of climate change... By:
 - a) Holding the increase in global average temperature to well below 2 deg C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 deg C ... recognizing this would significantly reduce the risks and impacts of climate change.
 - b) Increasing the ability to adapt to adverse impacts of climate change ...
 - c) Making finances flow ...towards low greenhouse gas emissions and climate-resilient development.
- Article 3
... The efforts of all parties will... recognize the need to support developing countries parties for the effective implementation of this Agreement.

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the increase of the global temperature "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 deg C."

Associated with the 1.5 deg and 2 deg temperature increase is a corresponding amount of additional GHG gases (measured as CO₂ emissions) that humans can dump into the atmosphere.

Using Table 2.2 from the IPCC Assessment Report 5, as of 2010 the remaining "Carbon Budget" that will limit global warming to 1.5 deg C ranges from 400 to 850 Gt CO₂ according to the various climate models. 50% of the models indicate the remaining budget for a 1.5 deg warmer planet was 550 GtCO₂ back in 2010. (See red circle below)

Remaining CO₂ Budget (ref: IPCC AR5)

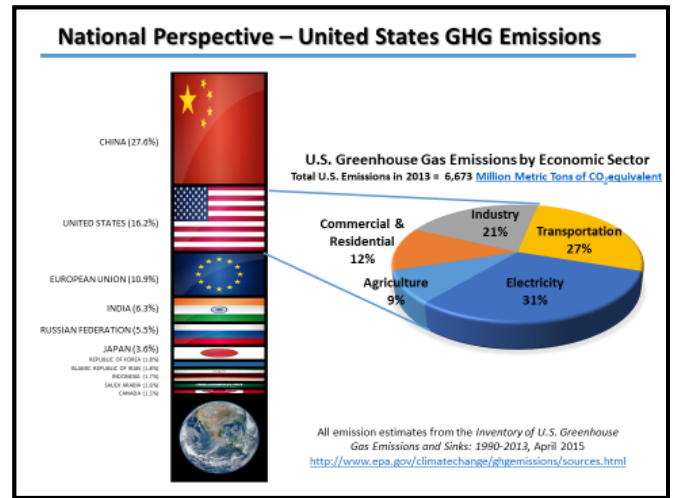
Table 2.2 Cumulative carbon dioxide (CO₂) emission consistent with limiting warming to less than stated temperature limits at different levels of probability, based on different lines of evidence. [WGI 12.5.4, WGIII 6]

Net anthropogenic warming *	Cumulative CO ₂ emissions from 2010 in GtCO ₂					
	<1.5°C			<2°C		
Complex models, RCP scenarios only †	400	550	850	1000	1300	1500
Simple model, WGIII scenarios ‡	No data	550 to 600	600 to 1150	750 to 1400	1150 to 1400	1150 to 2050
Total fossil carbon available in 2011 †: 3670 to 7100 GtCO ₂ (reserves) and 31300 to 50050 GtCO ₂ (resources)						

† Reserves are quantities able to be recovered under existing economic and operating conditions; resources are those where economic extraction is potentially feasible. [WGIII Table 7.2]
 1 Gt CO₂ = 1 Billion metric tonnes of CO₂ = 1,000,000,000 metric tonnes of CO₂

If the IPCC carbon budget is adjusted to reflect carbon emission through 2015, we find the 550 Gt is now reduced to 353 Gt since globally people are dumping nearly 40 GtCO₂ into the atmosphere each year.

Although there are over 7 billion people inhabiting the planet these days, their individual contribution to climate change varies significantly. Per capita, Americans are at the top of the list and responsible for five times the GHG emissions of the average Chinese citizen. But because China has more than 5 times as many people, China ranks as the number one nation contributing to climate change. The U.S. is number 2 and the European Union is number 3. These three groups are responsible for 50% of the global GHG emissions. If one adds in 8 more countries (India, Russia, Japan, Korea, Iran, Indonesia, Saudia Arabia, and Canada), we find that of the 195 countries signing on to the Paris Agreement, 11 of those countries are causing nearly 80% of the problem. If those 11 countries take responsibility for transitioning to renewable/inexhaustible clean energy sources of energy, the concern about climate change virtually disappears.



The chart also illustrates the U.S. GHG emissions by economic sector. For the average American, 31% of their emissions are linked to burning hydrocarbons to produce their electrical power – in other words, by adding rooftop solar to their home, an individual can reduce their emissions by 31%. By switching to a plug-in electric vehicle, one can reduce their personal GHG emissions by 27% and by using air source or ground source heat pumps for their heating (and cooling), they can reduce GHG emissions by an additional 12%.

Developed countries must continue to lead the way by committing to reduce their emissions to near zero. Developing countries are "encouraged" to move directly to solar, wind and hydro sources of energy – to skip fossil fuel technology. In return, they will receive financial support from developed countries.

COP22 was held in Marrakesh, Morocco in Nov 2016. Global attendees focused on the actions needed to achieve the various priorities outlined the year before in the Paris Agreement. These actions are intended to implement adaptation, transparency, technology transfer, mitigation, capacity building, compensation for loss and damages, and of course financing.

Funding Option Scenarios (10 Dec 2015)

Just as the BFF Committee was agreeing to a comprehensive plan to slowly transition to renewable energy (over 10-20 years), the Green First Task Force moved their goal posts.

"The urgency for transitioning from fossil fuel has just clicked up a notch based on the recent COP21 meeting in Paris."

From: Green₅
Sent: Thursday, December 10, 2015
To: BFF_{1,2,3,4};
Cc: Green₄
Subject: RE: BFF Energy/Sustainability
Attachments: TamoWorkbookIA.xlsx;
FourScenariosA.docx

BFF_{1,2,3,4}

Green₄ has put together a great 10-minute overview for our approach to energy & sustainability.

The enclosed information is just backup information for your files. As the project proceeds, we expect the cost numbers will be updated by the architects after the heat load analysis is completed and they define our actual heating & cooling requirements. But we think we have ballpark estimates that allow us to compare different funding scenarios.

Because we have not yet found any financial incentives available to "non-profits" for solar or geothermal, we were concerned about the traditional "economics" of our proposed 100% sustainable energy system. So with help from Green First Task Force members, especially Green₈, we evaluated five different funding approaches. Two of the approaches assumed that we can enter into a Power Purchase Agreement (PPA) with a third party (before the 30% tax credit expires) and two evaluated what happens if we can't get a PPA in place in time and just buy the entire system.

These five funding scenarios are discussed in more detail in the enclosed Word file and the supporting Excel workbook.

We found all funding scenarios examined result is a significant financial gain for the church over a 20-year time frame compared to our current fossil fuel energy system - even without any renewable energy "tax credits" or rebates offered to homeowners and "for-profit" organizations. As expected, we found the more we invest up-front in the energy system, the larger our financial gain.

Although I was initially an advocate for a slow phased-in approach for transitioning to a sustainable heating & cooling system, allowing our existing fossil fuel furnaces to "wear out" before replacing them, after this financial assessment, I now think we should just

make the 100% transition to a sustainable system a key feature of this BFF project.

The urgency for transitioning from fossil fuel has just clicked up a notch based on the recent COP21 meeting in Paris. Climate scientists expressed their concern that the former 2 degree Centigrade redline for global warming is not adequate and must be lowered to 1.5 degrees Centigrade to leave a reasonably habitable world for our children.

Although this is not included in the five scenarios enclosed, we found there is no significant financial gain in a slow transition from fossil fuel as originally suggested. **Continuing to burn natural gas and generate CO₂ for another ten years when we have a viable alternative to take our GHG emissions to zero is no longer defensible.** We have come to realize that there is no such thing as a "perfectly good gas furnace" - even if it is brand new. When even a new high-efficiency gas burning furnace operates, it still emits GHG and does harm.

We can properly recycle the existing gas furnaces (e.g. the good electric motors will be repurposed by a third party, and the sheet metal will be recycled and fashioned into sustainable equipment (e.g. geothermal heat pumps) - nothing goes into land fill or is wasted. From a resource perspective, all ten furnaces are equivalent to about 1/2 of a typical American car.

I am now an advocate for what Green₄ calls the "All In" approach. Let's just do it. Transitioning to a 100% sustainable energy system is a great message we can send to the younger generation as we build for their future.

Thanks again for all the work you all are putting in for this exciting project.

Green₅



Five Funding Scenarios: 100% Sustainable Energy System (Dec 2015)

NOTE: The following is an abridged version of a financial assessment that evaluated "Five Funding Scenarios."

Introduction – Background

Currently, we purchase all of the energy to operate our church from Xcel Energy Corporation in the form of electrical power and natural gas. 80% of the electrical power we buy from Xcel is generated unsustainably by burning ancient hydrocarbons. 100% of our heating needs are provided **unsustainably** by our 10 furnaces that burn natural gas. In summary, 93% of the energy we currently use to operate our church is derived from unsustainable energy sources that are doing harm to our sacred interdependent web of Life and creating a less habitable world for our children, their children, and all future generations.

Now that we are aware of this harmful behavior and the urgency involved, we are obliged to consciously make a choice as we move forward with the 'Building for the Future' (BFF) project. During the BFF renovation project, we have an opportunity to transition away from unsustainable fossil fuel to a new 100% sustainable energy system AND save money. In this energy system evaluation, we specifically evaluate the cost of a fossil fuel system vs a renewable energy system over the next 20 years.

Approach – Evaluate Five Funding Scenarios

Transitioning from fossil fuel energy sources to 100% renewable energy requires different technology and equipment. The BFF project provides an opportunity to procure and install the new equipment needed to honorably harvest⁴² energy from the Sun and Earth. The 100% sustainable Energy System we are proposing utilizes existing commercial off-the-shelf warranted solar photovoltaic and geothermal heat pump technology. The equipment consists of 182 solar modules (panels), and ten (10) geothermal heat pump furnaces (to replace the 10 natural gas burning furnaces we currently use) with an associated below-ground heat exchange network (referred to as a 'ground loop').⁴³ A rough order of magnitude estimate of the cost of this new

equipment is \$420,000 subject to further refinement as the project design matures.

We have evaluated five financial funding scenarios to acquire the equipment for a 100% sustainable Energy System. Although the equipment is the same for all five scenarios, the funding sources are different. We examined a 20-year time-frame since today's solar modules and geothermal heat pump furnaces typically have a service life of 15-25 years.

From a traditional economic/cost perspective, we found that **each of these five funding scenarios will result in financial gain** for the church over using fossil fuel as the source of energy for our electrical power and heating needs.

Scenario Overview

Five financing scenarios have been evaluated.

- 1) **Buy & Own the Energy System equipment.** Include the \$420,000 equipment cost in the BFF budget.
- 2) **Lease solar equipment** using a Power Purchase Agreement (PPA). Buy the remaining equipment using the BFF budget.
- 3) **Buy the Energy System equipment using partial financing.** Example: Include 2/3 of cost from the BFF budget; finance remaining 1/3 with a 15-year loan.
- 4) **Lease solar; Buy the remaining equipment** - Include 2/3 in the BFF budget; finance remaining 1/3 (15-year loan).
- 5) **Lease all the Energy System equipment from a third party (an LLC)** that can take advantage of tax benefits offered to businesses (e.g. a 30% Federal Tax Credit). Buy the Energy System from the LLC after 6-10 years at a discounted price.

Scenario Discussion/Evaluation

NOTE: For brevity, we discuss only Scenario #3 here. It most closely represents the funding approach we ended up using.

Scenario #3 Buy 2/3 of the equipment; Finance the remainder with a 15-year loan

In this case, we finance the energy system differently. We use \$280,000 from the BFF pledges and secure a 15-year loan for the remainder of the cost (\$142,000). (The idea for this funding scenario was suggested by Gene J.)

As shown in Figure 6 the solid red curve labeled “Fossil Fuel” indicates the yearly estimated cost of our existing fossil fuel energy system for the next 20 years.

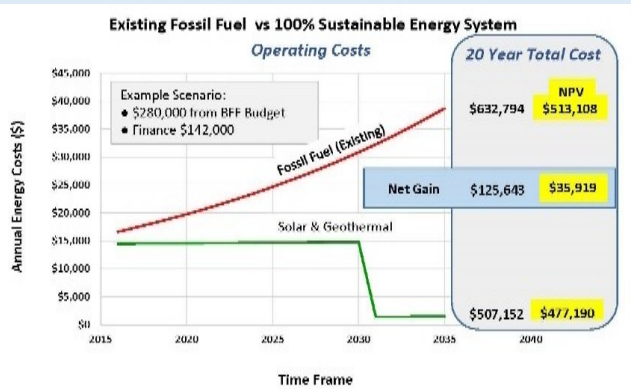


Figure 8 Church Operating Costs Over 20 Years – Scenario 3: Buy 2/3, Finance 1/3 of Equipment

The accumulated energy cost after 20 years is expected to be \$633,000 for our existing fossil fuel energy system. (The net present value of \$513,108 is highlighted in yellow).

As indicated by the green curve, the loan payments for this arrangement are around \$15,000 annually – slightly less than we currently pay for energy (electric and natural gas). After 15 years the loan is paid off and the “operating cost” drops to around \$1200/year as in scenario #1.

The 20 year cost for this approach is estimated to be \$507,000 (NPV = \$477,190). Because the “bank” (or another funding source) benefits from interest on our 15-year loan, our net financial gain over a 20 year period is reduced slightly to around \$126,000.

Advantages and Disadvantages of this funding approach are listed in Table 2.

Table 1 Buy 2/3, Finance Remainder of the Equipment to Transition from Fossil Fuel to Renewable Energy

Scenario # 3	PROS	CONS
Life Cycle Cost	<ul style="list-style-type: none"> The financial gain is \$126,000. ROI = 30 % 	
Initial/Installation Cost	<ul style="list-style-type: none"> Lower initial investment (\$280,000) than Scenario #1 	
Operational Cost	<ul style="list-style-type: none"> Operating Cost similar to the current fossil fuel system for 15 years, then drops to \$1200 annually 	<ul style="list-style-type: none"> Higher Operating Cost than Scenario #1 Loan Servicing
Decommissioning/End of Life	<ul style="list-style-type: none"> Own solar and geothermal equipment - can extend the end of life if the system still working Can assure owned equipment it is properly reused/recycled 	<ul style="list-style-type: none"> We are responsible for recycling old equipment at the End of Life
Leveraging Federal Tax Benefits for Renewable Energy Systems	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> None
Investment Opportunities for Church Members	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Possible opportunity for members to loan \$142,000 to the church with a modest (e.g. 4%) interest rate.

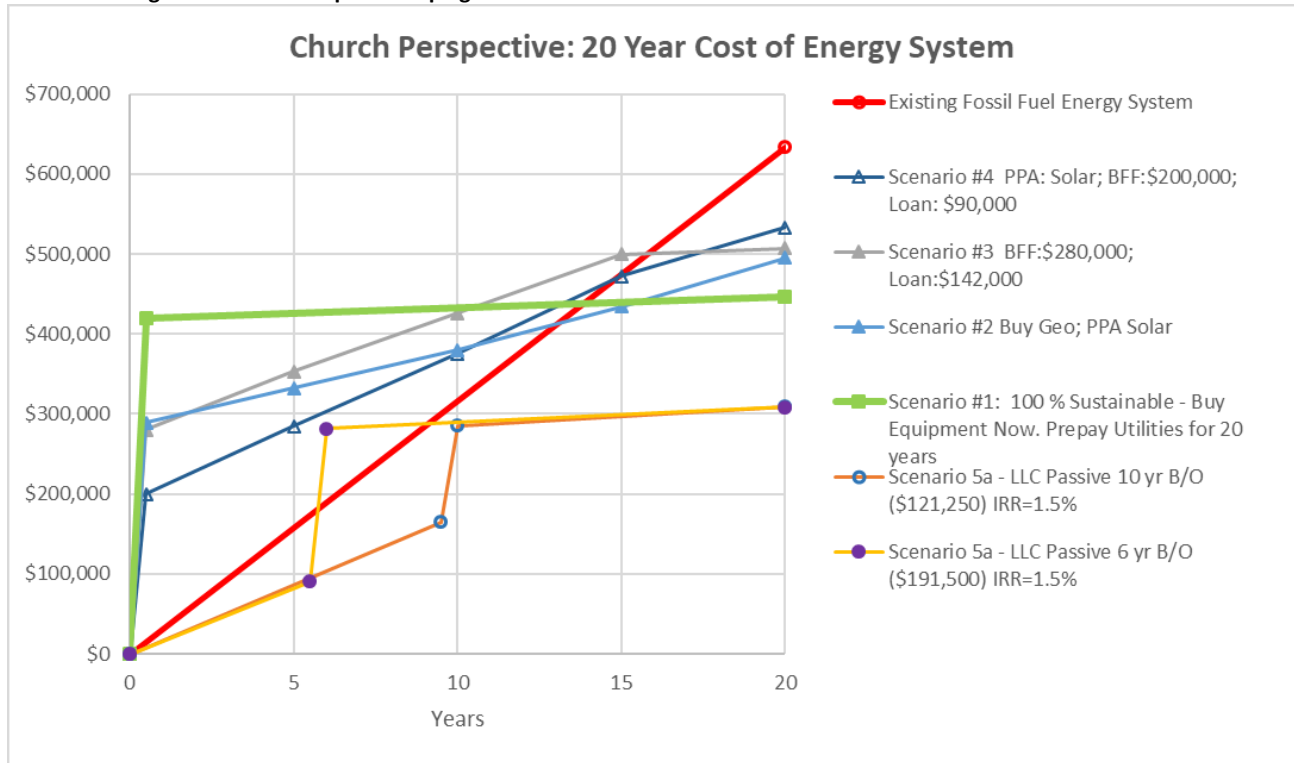


Figure 9 Summary Comparison of the Five Funding Scenarios.

Cash Flow Profile of Five Funding Scenarios

Figure 7 compares the five funding scenarios for a 100% sustainable (zero GHG emissions) energy system.

We also include the cost profile for the unsustainable scenario where we do nothing and continue to burn fossil fuel (shown as the **red line** in the graph below.) If we continue to burn fossil fuel as we are currently, at the end of 20 years, the church will have a pile of paid receipts indicating we spent ~\$633,000 on gas & electric and have dumped over 2,500 tonnes of CO₂ into the atmosphere. **Doing nothing will cost the church between \$100,000 - \$300,000 – the most expensive option.**

The **green line** is the cost picture if we buy and install the equipment to harvest our own electric and thermal energy as part of the BFF budget funded by member pledges. Note the initial equipment is expected to cost around \$420,000.

Once the equipment to harvest solar energy and geothermal energy is in place, the monthly utility bills drop to a minimal charge to stay on the “grid” and use Xcel energy as an electrical energy bank.

The gray line represents Scenario #3 where upfront donations reduce the system cost significantly and the remainder of the capital comes from commercial or member loans as described in detail above. At the 15 year point, the annual utility cost drops to near zero because the loans are paid off.

Summary/Conclusions

A 100% sustainable energy system, utilizing solar energy and geothermal energy was compared financially to our current fossil fuel energy system over a period of 20 years.

Five funding scenarios for the solar-geothermal system were evaluated. As a result, we can see the 20-year cost of the same system funded in different ways. We can also see the financial gain a renewable energy system provides over our existing fossil fuel based system.

All five funding scenarios indicate that transitioning from a fossil fuel energy system to a renewable energy system will result in financial gain.

Involving a ‘for-profit’ third party to take advantage of the 30% Federal Investment Tax Credit (ITC) needs to be seriously considered.

BFF Encouragement (13 Dec 2015)

From: BFF₂
Sent: Sunday, December 13, 2015
To: Green₅
Subject: RE: BFF Energy/Sustainability
Attachments: Energy Sustainability and Green Building framework as approved by BFF Dec 10 2015.docx

Hi Green₅ - ... great job laying out the financial options for solar and geothermal. Thank you for your good thinking. Because of your work I've learned a lot over the past six months. I now agree with you that it would be best for the church to do both solar and geothermal in toto up front (this is the same strategy adopted for our home in 2014 after reviewing solar leasing and purchase options).

..Now the unknown that concerns me most is whether or not we can raise enough money to do it all in 2016-17.

As a first step, I've been working on refining our budget estimates. I still have a few gaps I'm chasing down but it looks like the full cost will be roughly \$4.4M. As a second step, I'm constructing a simple model to track and predict capital campaign outcomes. My first rough cut shows a maximum pledge revenue of \$4.0M. These are first rough estimates but they do lead me to think about what strategies we might come up with to close any gap we have at the end of the capital campaign (late February). Some of the financing options for solar and/or geothermal look helpful in this regard. If you have suggestions along this line, I'd welcome them.

One thought that comes to mind is to recruit members of the Green Team to be Ambassadors for the February capital campaign. Ambassadors will meet with members to explain the building project and the operating budget prior to asking for dual pledges (operating budget and building budget). This would put Green Team members in a good position to explain and support the "all in" plan and may expand our revenue base. What do you think?

By the way, Green₄ did an excellent job explaining sustainability issues to the 76 members who attended two BFF briefing sessions today. The audience was impressed with the sustainability plans and the quality of the homework.

I've been thinking we need to plan an educational campaign for January to get the remainder of the congregation briefed on plans and costs. You've given us the material for solar and geothermal. We now need to spread it around more thoroughly. In addition to Green₄, who would you nominate to lead some briefing sessions?

BFF₁ and I will be meeting later this week to discuss budgets and strategies. Any ideas you'd like to add to our conversation would be appreciated also.

Also - you probably have heard that the BFF unanimously approved the **Planning Framework for Energy Sustainability** at its meeting last Thursday. That will now go to the Board of Trustees for their endorsement. I've attached the final approved version for your files.

Thanks again for your thoughtful work. It has been enormously helpful.

Best,
BFF₂



The Green First team had a moral compass and a general sense of direction but not a specific path to take. The Building Committee and Board of Trustees were worried about a range of other issues not related to energy or climate change.

There was uncertainty, confusion, lack of understanding and even a sense of competition for a limited financial resource at the time between the various groups.



Questions within the BFF Team (Dec 2015)

The following exchange captures an example of the internal discussions within the BFF Committee as this project is evolving.

From: BFF₃
Sent: Saturday, December 12, 2015
To: Green₅
Cc: BFF_{1,2,4}; Green_{2,4};
Subject: Re: BFF Energy/Sustainability

Thanks for sharing the documents Green₅. I appreciate all the effort went into them. I have a few

Part III Building for the Future Capital Campaign

questions for you, or maybe Green₄, about on site solar panels connected to the power grid.

If First Universalist generated all of its electricity, there would still be an important and ongoing relationship with Xcel Energy. What does that future look like? Is there any guarantee it will continue unchanged, for the estimated 20-year service life of a solar array? A changed relationship with Xcel could leave a future congregation in financial peril.

Green₄ Response: No change in relationship with Xcel – ever. Solar energy using a net meter means (from Xcel perspective) that there is a generation of electricity out on the grid “behind a meter” and this is what the Xcel grid system expects. This connection is covered by a formal “Interconnection Agreement” with a 20-year term (i.e. the part of the equation where the church generates energy to the grid) which states that everything will be connected safely. The relationship to buy electricity from Xcel does not change and there is no way in which the church would be able to operate or even wish to without its continuing account and connection since solar is only generated in sunlight. If we are able to get into an incentive program (hard to know at this time) there will also be an additional 20-year Agreement for that.

As things stand now, Xcel would buy First Universalist’s (or a PPA’s) excess electricity during daylight, and sell it back at night, to provide service 24 hours a day. Otherwise, some sort of onsite battery storage would be needed. Does Xcel buy this excess at the same price it sells it back? My assumption is it does, or close enough to be revenue neutral. Is there any regulation in place to prevent Xcel, a few years from now, deciding not to buy excess solar power from customer solar arrays, or changing the price structure to be revenue positive for them?

Green₄ Response: Xcel reimburses for energy 1:1 at whatever tariff rate the church is on for usage. In a prior email, I explained that the Church will need to change tariffs to optimize this important part of the puzzle. Net Metering was upheld in CO after an 18-month battle last year.

It can certainly be expected that this policy will evolve and change over many years. While it cannot be guaranteed, it would be unthinkable of the PUC upon making any change in this fundamental policy to make it retroactive for anyone. All behavior to date is that anyone with a current system keeps the arrangement they entered into originally (Grandfathered).

What might be a little confusing is that the energy generated on the roof can be thought of like natural gas going into the pipeline system or water going into a public water system? Once introduced, it no longer has an identity and is simply measured going in, then used in the system. In the case of behind the meter solar, it is used first to meet the internal energy demand of its building (i.e. the meter slows until “still”) and when that bucket fills up, it circulates out to the neighborhood to supply the energy needs of the neighbors. (the meter is now going backward).

[So when this happens – i.e. every sunny day, Xcel sells to our neighbor's electricity the Church paid for and capitalized 100%. Xcel, of course, charges the neighbors full retail rate for that free energy the church added to their grid.]

One of the best ways to think of this (and the way Xcel explains it) is Xcel provides a bank account (i.e. a virtual monetary system). So every sunny day, the church’s “bank account” starts to fill up with the metered amount of energy produced. When the sun goes down, the church uses the “money” from its bank account until exhausted before using “money” from the Xcel bank. If the solar generated during the day is 100% or more (our intended scenario) the church deposits more during sun hours than it withdraws overnight. So the excess stays in the bank account and accumulates.

There is, of course, a seasonal effect here as well that impacts how much might be in the bank from day to day and month to month. If at the end of the year, there is a “positive balance” in the bank, then the church gets an extra check. This is where the bad news comes in. Excess at the end of the year is only “purchased” by Xcel at the wholesale rate of about \$0.04/kWh. (Instead of a payout, it may be possible to roll over the excess into the next year.)

Another way to view it (i.e. net metering public policy) that drives me crazy, is that this whole idea of the utility claiming it loses ratepayer \$\$ when it credits solar at 1:1 of retail rate is flawed. If the church or your home found any mechanism to reduce the amount of electricity you buy from your electric company (say you downsize and become empty nester, you change all lights to LED, you purchase more efficient HVAC, etc., you go to Nevada for the winter and leave the house in idle for 6 months, and let’s say that results in a 40% reduction in the use of electricity. On the other hand, let’s say you put solar on the roof which reduces your electricity purchase from Xcel by 40%. The two are

Part III Building for the Future Capital Campaign

exactly the same. Of course, in neither case would you expect to pay a cent for the electricity that you did not purchase. So it is a misrepresentation - and widely so - that the electric company is “buying my energy” which seldom occurs except for the maybe 5% of instances when a building is actually offsetting 100% or more with solar.

There is a term that is used called VOS – Value of Solar. All intelligent science-based INDEPENDENT studies show that solar energy has value to utilities far higher than the retail rate of electricity which tends to be essentially the average cost + profit. Unfortunately, utility studies are almost always valuing solar much lower than independent studies so this is contentious. Utilities – all over the US – try to take the net metering 1:1 rate and claim that they need to subtract certain embedded costs of keeping a home/building connected to the grid. However, NEM 1:1 is just a convenient mechanism for reimbursement along with the rationale above. In order to ascribe actual grid costs as a subtraction, you must first properly determine the full VOS. In CO our studies show that is about \$0.18/kWh and that the grid cost subtraction would be about \$0.03/kwh. We have failed to get Xcel or the PUC to embrace that.

The supplied energy-use projections are very comprehensive. Has any thought gone into projecting what the future looks like for the energy companies? What percentage of electricity will Xcel generate from renewable sources ten years from now? I assume it will increase. They must be aware that reliance on fossil fuels is also an endangered business model for energy companies. Costs and regulatory changes will eventually drive them (kicking and screaming perhaps) in new directions. If ten years from now, Xcel generated a substantial percentage of electricity from their own renewable sources, how would that affect their outlook on purchasing customer generated renewable electricity?

BFF₃

Green₄ **Response:** The energy model will evolve and change for sure but will happen slowly. Solar is already identified as disruptive even though it is less than 2% penetrated in the US. All but about 14 states have Renewable Portfolio Standards (RPS) that require utilities to achieve overall renewable mix in their generation in the 30% range by 2020. (that is the CO standard which is on track). We will be pressing legislation to crank that higher for the third time since 2004. Batteries can be expected to have a bigger

impact on utilities than solar in my opinion. Both solar and batteries are likely to be a thing you can “rent” from the electric utility in the future.

Optimism Prevailed (Dec 2015 – Mar 2016)

At this point in time, despite the uncertainty, the Green First Task Force appeared optimistic about the possibility of having a 100% sustainable energy system incorporated into the building remodeling effort.

The campaign to raise the needed capital for the project began with the ambitious goal to raise around \$4.6M.

Search for Funding Models (Dec 2015 – Mar 2016)

The Green First Task Force now recognized that there was a distinct cost advantage for homeowners and business owners to conserve energy and install renewable equipment because they could take advantage of Federal Tax programs and IRS Tax deductions for equipment depreciation.

Green₄ found a financial model developed by a nearby church, St. John’s Episcopal, in Boulder that involved a for-profit third party.⁴⁴ Some of their members formed a third party LLC that could take advantage of the 30% Federal Investment Tax Credit (ITC) for renewable energy as well the IRS equipment depreciation allowances. As a result, the LLC could purchase and operate the solar energy equipment and lease it back to the church as a Power Purchase Agreement with a distinct cost advantage for the church.

St. John’s Episcopal had used this model successfully to install a modest solar PV system that provides 1/3 of their electrical needs. The First Universalist goal was to install a solar PV system that provided 100% of the church power needs and installed a ground source geothermal system for all the heating and cooling needs.

Part III Building for the Future Capital Campaign

The contacts at St. John's Episcopal Church were very helpful. They even provided their Excel spreadsheet model that was then adapted to First Universalist needs.

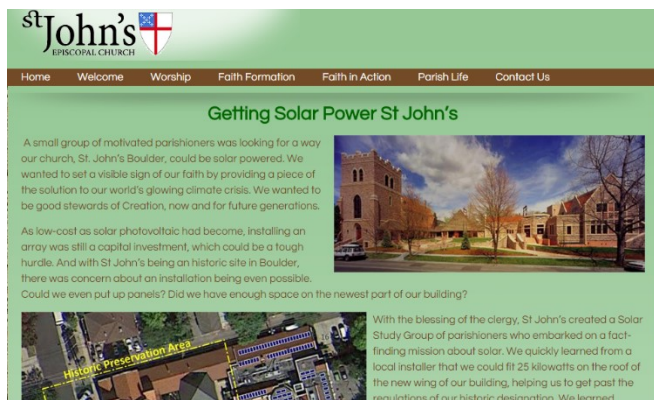


Figure 10 St. John's Episcopal Solar System

St. John's was also generous enough to provide other 'Lessons Learned' from their experience including the legal documents they used to form their LLC. This was useful guidance when First Universalist formed a partnership to loan money to the church.

Green First Team members Green₁, Green₄ and Green₅ spent the better part of a month in early Jan 2016 attempting to make the LLC model work for First Universalist. It was finally concluded that the LLC model would work and be able to take advantage of the 30% Federal Investment Tax Credit and the IRS equipment depreciation allowances **only if** enough

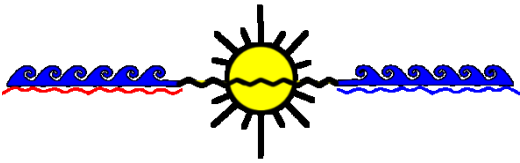
investors at First Universalist had significant passive income (i.e. income from rental properties).

After completing an informal member survey of potential investors, it was concluded the first Universalist membership did not involve enough investors that met this passive income requirement. Reluctantly, the Green First Team had to abandon the idea of leveraging government subsidies enjoyed by the for-profit sector.

It became clear that the current State & Federal incentives to invest in renewable energy equipment did not help the non-profit sector. It was starting to appear that First Universalist would have to finance a sustainable energy system on their own.

This was difficult to accept. The cost reduction for renewable energy systems enjoyed by homeowners and for-profit businesses is 30-40% of the total cost. However, there is no cost reduction to encourage transitioning to renewable energy available to the non-profit sector of our society - organizations such as schools, universities, hospitals, or religious organizations. It could be argued that the sacred principle of "Separation of Church and State" has no relevance to helping churches, temples, synagogues, mosques transition to clean energy sources that stop doing harm to our planet.

Only after abandoning the search for public subsidies was First Universalist able to see other funding possibilities.



Part IV Energy System Capital Campaign (3 Apr 2016– 6 Nov 2016)

“... do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy...”

- UUA General Assembly 2014 Business Resolution:
FOSSIL FUEL DIVESTMENT

Prior to the capital campaign to raise money for the renovation project, church members had been lead to believe (and were assured by BFF representatives) that the solar and geothermal equipment had become an integral part of the BFF remodeling project and contributions to the BFF project would be financing the new sustainable energy system. Solar and geothermal objectives had been included in the projects “Sustainability Framework.”

The BFF capital campaign ended around March 2016 and the \$3,502,834 raised in pledges fell well short of the estimated cost of the remodeling project. The scope of the project was reduced to \$4,009,545.

Members made their generous pledges /donations to the project but then found out that because of the shortfall in pledges, the sustainable energy system, some classrooms, and several other items were being deleted from the BFF project.

So after the capital campaign was over the “environmental” donors found out none of their pledges were going to help finance renewable energy. This decision deeply offended members who supported the UU Ministry for Earth. They had donated or pledged to the project from the outset thinking the church was going to transition to renewable energy and was going to stop contributing to global warming/ climate change.

A number of contributors felt they were misinformed if not misled. Some even mentioned

feeling they just experienced a “bait and switch” by their church leaders. A former member (who still made a generous contribution to the project) asked a Green First Task Force member, “Did you know when you made your pledge that none of your money was going to be used for transitioning to renewable energy system?” The Green First Task Force member admitted simply, “No, I didn’t.” Most Green First members were surprised to hear this decision at the 3 April 2016 congregational meeting.

The renewable energy system represented 10% of the total project cost. A number of members, as well as the Green First Task Force, believed that the first 10% of the pledges should have been used to transition the church from fossil fuel. To do no harm (out of respect for the interdependent web of life) was their number 1 priority – even before adding space to the Sanctuary or adding more classrooms. The remaining 90% of the pledged capital could then be used for roof repair, expansion, etc.

Congregational Approval of Revised Building Project (3 Apr 2016)

The following was extracted from the published minutes of the congregational meeting on 3 April 2016. Of particular interest is Item #4 of the motion.

194 people attended our Special Congregational Meeting on Sunday, April 3rd, and we are grateful for all those who brought their questions, concerns, and comments to the meeting.

The meeting included presentations from the BFF Steering Committee on our updated building plans and budget, a brief presentation from the architects, and a time for discussion. The agenda included a proposed motion to approve a total budget of \$4,009,545. Because the capital campaign raised only \$3,502,834, the proposed motion also sought approval of a mortgage loan of \$400,000 with a plan to solicit \$100,895 in donations. The motion also proposed a plan to solve the renewable energy funding and provide authorization to BFF to raise additional funds to complete the project and, hopefully, restore cuts.

In the end, a vote was called to approve the motion with amended language clarifying the separate construction loan (not to exceed \$2.5 million), which is included in the overall budget. An overwhelming majority voted in support of the final motion:

Shall the congregation of First Universalist Church of Denver **approve the building project recommended by the BFF Committee and endorsed by the Board of Trustees with:** (1) a base budget of \$4,009,545; (2) a mortgage not to exceed \$400,000; (3) a construction loan not to exceed \$2,500,000; **(4) solar and geothermal systems supported by external investments and approved by the Board of Trustees;** and (5) an authorization for the BFF Committee to spend any additional funds received to complete the plan as presented.

Item # 4 states the following:

“Approve the building project recommended by the BFF and endorsed by the Board of Trustees with....

(4) solar and geothermal systems supported by external investments and approved by the Board of Trustees.”

The motion approved by the congregation severed any renewable energy effort from the BFF project and correspondingly any of the capital that had been raised for the project.

But all was not lost for the advocates of the UU Ministry for Earth at First Universalist. When the Congregation approved the motion to reduce the scope and cost of the building renovation project, they also approved Item #4 of the final motion. As one door closed, another door was opened for the Green First Task Force to pursue external/third party funding subject to Board approval.

The Green First Team felt betrayed by the BFF Committee for removing their priorities from the project. However, the motion was also “enabling” because it authorized the Green First Team to seek “external” funding. At the time, the Green First Team took that authorization to mean:

a) the BFF project was not going to support the sustainable energy project financially. The new energy system was now a separate project,

b) the Green First Team must/could go out and find funding from any other source they could locate, and

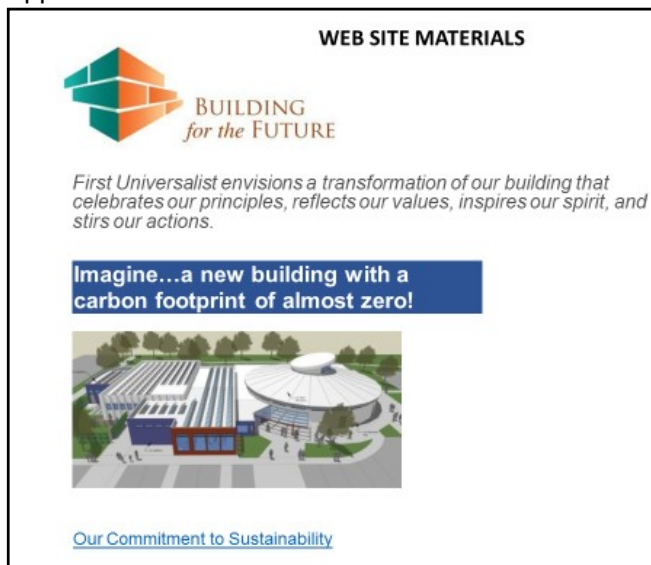
c) the Green First Team must submit any funding plan to the Board for approval.

The BFF capital campaign had officially ended. Nevertheless, the BFF committee was still trying to solicit donations for the general BFF reserve fund, so they viewed any Green First Team “fundraising” as competition for the same financial resources of the church members.

As described later in the Case Study, this perceived “competition” was not actually factual.

BFF Website Information (May 2016)

Information about the Energy and Environmental Sustainability of the remodeled facility continued to appear on the church web site.



This information was updated at a BFF meeting on 4 May 2016.

To retain an Energy Sustainability Framework and



to leave the **“Renewable fuel sources (solar, Geothermal) replacing fossil fuel”** feature in the statement implied someone still hoped the Green First Team could still find a way to finance the renewable energy system.



Renewable Energy Cost Update (4 May 2016)

Renewable energy. On 4 May 2016, several church members representing the Staff, the Board of Trustee, the BFF Committee and the Green First Team met with the general contractor, architect, and mechanical engineer. They confirmed the design accommodates the solar PV system needed to meet the electrical needs of the church and that the solar equipment could be financed/installed through a power purchase agreement (PPA) with little money down.

They discussed the current design of the building and its existing equipment (duct work, furnaces, air conditioners, etc.), as well as what would be needed in the new building, how it could use geothermal energy and at what cost. With or without geothermal, the architect was recommending adding two ventilation units (to three already planned) to increase airflow in the building, at an additional cost of \$44,000.

They discussed some ways of reducing the cost of geothermal from our earlier estimate, chiefly by minimizing disturbance to the north parking lot. At present, it appears that it will cost \$210,000 for the building to be “geo-ready,” essentially with all of the necessary conduit and the well-field constructed. We

directed the mechanical engineer to design for those features (so that design, plans, and permitting stays on schedule) while the church group continues to explore phasing and financing.

From: Green₅

Date: Thursday, May 5, 2016

To: Green₆

Subject: RE: Three Small Items

Hi Green₆,

... The meeting did provide a bit more information about the cost of the geothermal system. There were probably 15 people there. We got off to a great start when the Contractor started his presentation and handed out 4 copies of his presentation for the group of 12, then proceeded to go into detail and noted that one of the first items on the list that cost \$125,000 was actually \$115,000 in the Base Budget? The four people who had the handout were frantically trying to figure out where the \$125,000 was, what it pertained to and which was the correct number. I knew this was going to be a long meeting...

We might still be there but the Contractor had to leave at 2:30 for another meeting.

It was a good meeting in that the \$600,000 for geothermal that has been floated around by the BFF committee appears to be more like \$300,000 (ballpark). The solar system appears to be more like \$160,000. The total system is then about \$460,000. (Green₄ and I had guessed \$420,000 in trying to put together the LLC funding model)

The BFF Committee did authorize the completion of the "mechanical design" by DMA (Stephan Forester) for the heating and cooling assuming there will accommodate a geothermal system. This will result in a ducting design that can accommodate either natural gas or geothermal. The black plastic tubing (manifold) required inside the church will be designed so the contractor could provide an updated bid for the installation cost of the 10 heat pump furnaces if required.

The \$125,000 or the \$115,000 cost of the air ducting was moved out of the geothermal category and into the General Budget since it is needed for natural gas default option as well.

The contractor did lower the cost of "repaving" the north parking lot from \$60,000 to \$25,000. I

Part IV Energy System Capital Campaign

argued that was even too high since the ground loop contractor will dig three trenches 2 feet wide and 60 feet long disturbing less than 400 sq feet of asphalt - not the 6,000 sq. feet included in their cost estimate.

So they are moving forward on a path that keeps our renewable energy system option alive, for another 4-6 weeks until the detail mechanical design is complete and they need to start the permitting process for real. Then we will need to make decisions.

Green₄ is still pursuing a loan for the entire system through the PACE program.

But I couldn't sleep last night so around 1:00 am I got up and opened some of our old Excel spreadsheets and loaded in what I had learned from yesterday's meeting.

Here's an updated funding scenario.

Securing the Up Front Construction Funding

Let's assume the following:

1) we can get \$100,000 more in donations specifically for the energy system (I know we can get half to 3/4 of \$100,000 already)

2) we get the general church membership to contribute ~ 10% (\$40,000) from the pledges so everyone has "some skin in the game" and can feel like they are contributing to this feature of the remodeled church. As it currently stands, those who have already pledged know that none of their pledges is going to making the church sustainable except for changing light bulbs and windows.

3) we solicit members who are "tapped out" for donations but are willing to loan money to the church expecting to get back their principle if not any interest. (This is something Green₂ suggested. I know that even Green₁₀, a part-time member would be willing to put up a loan because it is a constructive socially responsible way to respond to climate change.)

I believe in this manner we can finance the entire energy system (solar plus geothermal with NO tax benefits, PPA, third party, LLC, etc.).

How does the church repay the loan?

To repay the member loan, the church will just make its normal utility payments (with an expected 3-4 % increase over time that accounts for inflation and the expected price increase of fossil energy.) Each year the "utility cost" paid by the church will be distributed as partial repayments to the folks who loaned the

money (or member can just credit the amount to their annual pledge so no money actually has to change hands - the lender's choice). After 15 years, the "loan" will be paid off and the church no longer has any utility bill - freeing up about \$25,000/year from then on. The church members see no change in their operating expenses during the first 15 years. Then there is a windfall after that when the "utility" payments go essentially to zero.

We have an Excel spreadsheet showing the loan repayment schedule.

The Good News

Beginning in 2017, our remodeled church facility will no longer be doing harm. We will not be buying electrical power generated by burning fossil fuel. We will no longer be burning natural gas at our church and contributing to further climate change, etc.

We will be able to describe our church as 100% sustainable, zero carbon emissions, net zero (fossil fuel) energy, etc.

We will have divested totally in the fossil fuel burning industry and we will no longer be supporting the coal, oil, natural gas industry by buying their products.

And much more.

Because 1/3 of the cost of geothermal is putting the ground loop in place and routing the black plastic to the 4 mechanical rooms in the church (and because that infrastructure doesn't have to be replaced for 50-200 years), the long term cost of geothermal heating and cooling goes way down in the church's future budgets. We just have to periodically replace the sustainable heat pump furnaces as needed after 20-25 years.

Conclusion.

After envisioning a possible baseline path that still makes some sense & cents, I was able to get some sleep.

After the meeting yesterday, I would have said the odds were about 20% we can end up with a sustainable energy system. Green₇ seemed pretty "down" as well. This morning, I think the odds are back up to 25%; there's still hope, despite the major setback in April.

Green₅

Science Presentation (17 May 2016) How First Universalist is Responding to Climate Change:

The Building For the Future (BFF) Project Viewed from a Science Perspective.

Green₆, a retired NASA scientist, coordinated a monthly “Science Discussion Group” for church members. Each month he would line up a guest speaker to address a specific science-related topic. In his role as a Green First Task Force member, he told his Science Discussion Coordinator self to line up a speaker to address the BFF Project from a science perspective. He found a candidate speaker, and fellow scientist, who happened to be on the Green First Team willing to take on this challenge. There were around 15-20 attendees at this “Science” presentation on 17 May 2016

The presenter, Green₅, a retired engineer/physicist, was a member of First Universalist Church for 40 years and served as Moderator in ‘85-’86. More recently, he was a member of BFF Sustainability subcommittee and a member of the Green First Task Force. In 2011, he transitioned his home to renewable energy by adding rooftop solar and ground source geothermal heating and cooling.²⁹

The presenter made a deliberate attempt to focus only on the science perspective of the building project and avoid all mention of the ongoing contentious financial issues. The Green First Team was still reeling emotionally from the fact that none of the money raised during the capital campaign was going to be used

for transitioning to renewable energy. Some of the science presentation charts are provided below.

The presentation, “How We are Responding to Climate Change” was divided into three parts.

- 1) How we are responding to climate change as **Global Citizens**,
- 2) How we are responding to climate change as **Unitarian Universalists**, and
- 3) How we are responding to climate change as **Members of First Universalist**.



Global Perspective – Energy Resources

From a global science perspective, we ask, “What are the energy sources of Spaceship Earth and how much is there?” helps illustrate what we know about energy resources today.

Since the beginning of the Industrial Era, humans have become fixated on burning ancient hydrocarbons as a primary energy source for doing work. The fixation is most obvious on Wall Street where energy equates to coal, oil, and gas. This narrow concept of energy must be reframed to be able to even see viable alternatives directly in front of us. Marc and Richard Perez developed an interesting graphic using “marbles” to help reframe our concept of energy. As adapted in Figure 11 Global Energy Perspective – Types and Quantities of Energy, the marbles tell a more comprehensive story of “energy.”



Energy Resources for the Planet

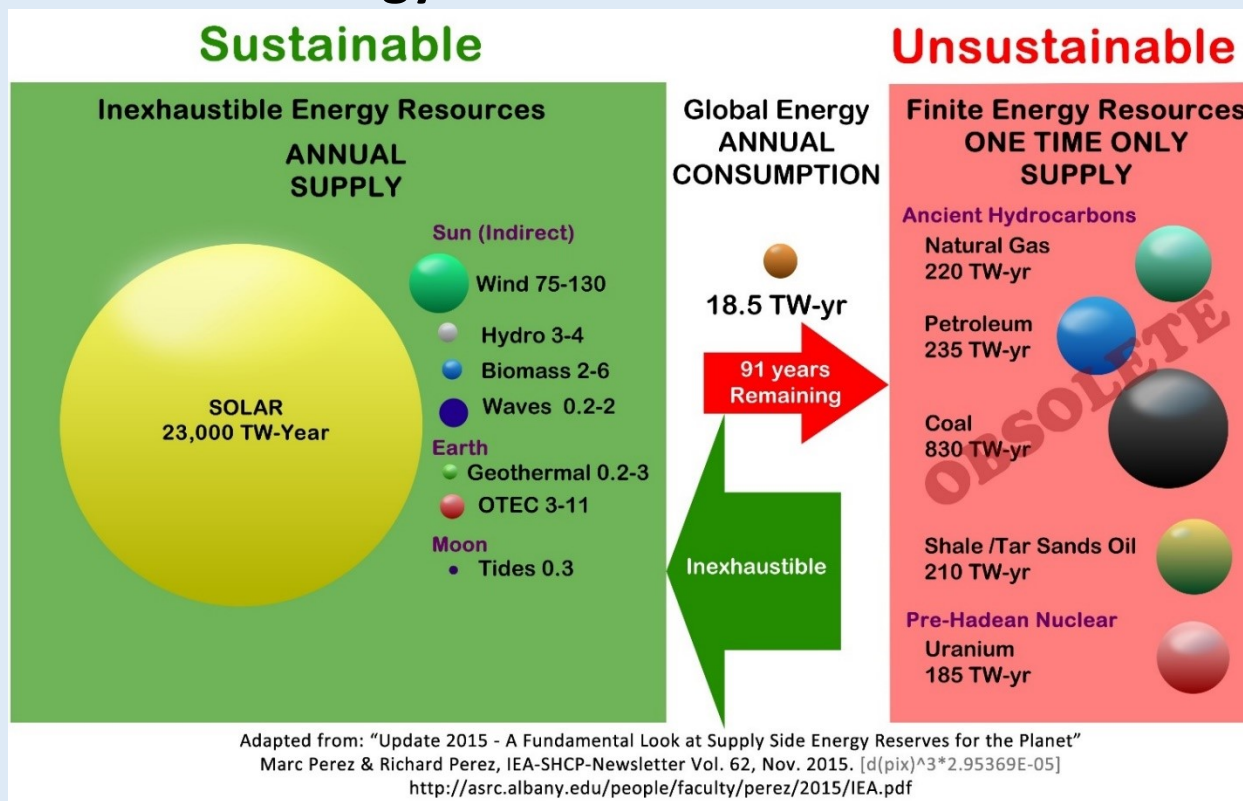


Figure 11 Global Energy Perspective – Types and Quantities of Energy

The colors of the marbles/spheres denote different forms of energy and the size of the sphere relates to the remaining quantity of that type of energy. The five marbles on the right within the red box are the unsustainable (finite) sources of energy remaining on the planet – including fissionable Uranium. The quantities are specified in uncommon energy units: terawatt years (TW-yrs). One TW-yr is 8.765×10^{12} kW-hours. Globally, coal remains the single largest amount of ancient hydrocarbons.

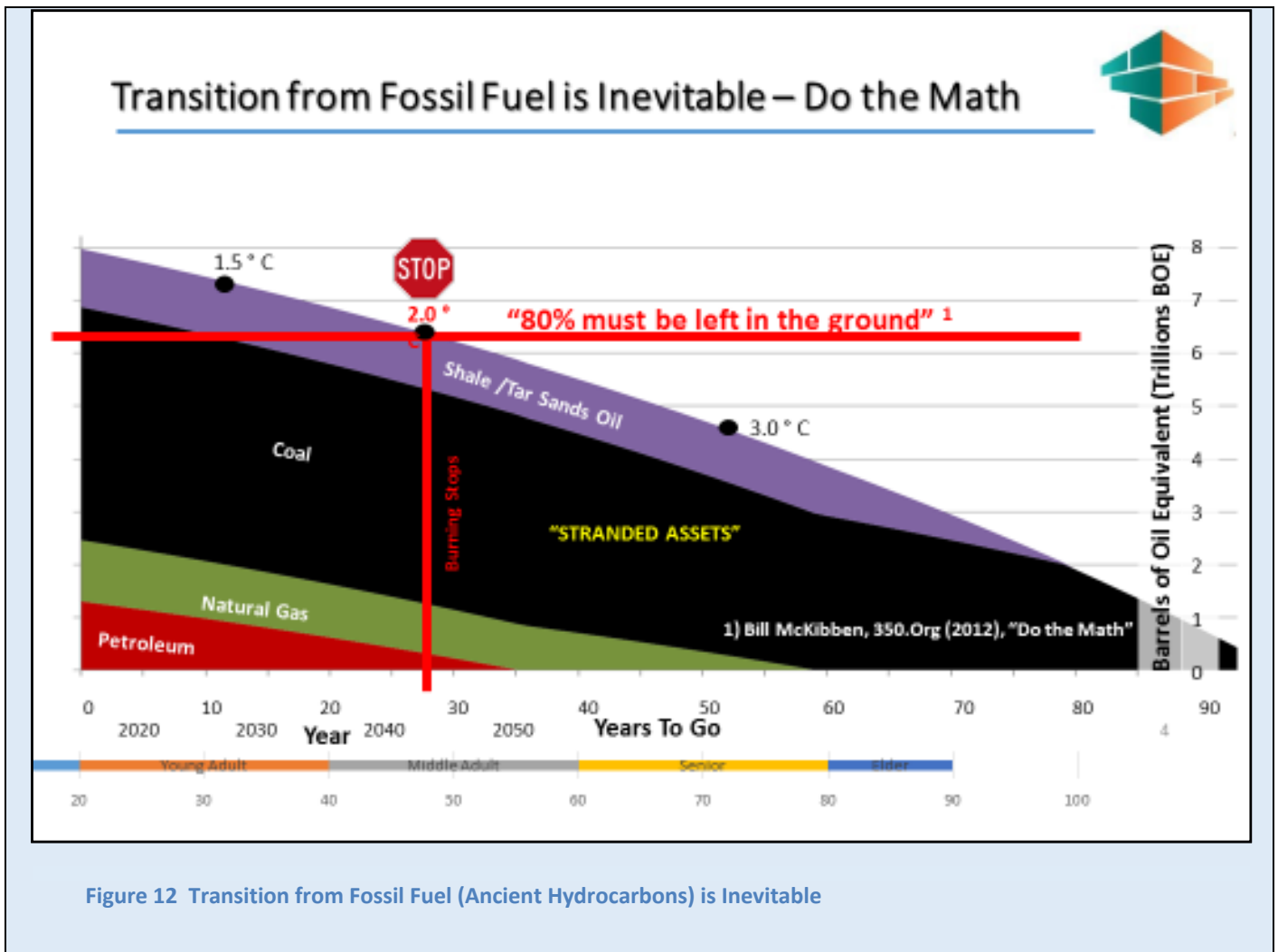
The small yellow sphere in the middle white space of the chart represents the amount of energy (18.5 TW-yrs) consumed by the global human community (over 7 billion souls) on an annual basis. If you do the math and add up all the finite energy resources⁴⁵ in the red box and divide by the annual global consumption, we find there are roughly **90 years of unsustainable energy remaining** to consume. In other words, children being born today will likely live long enough to see the end of 'fossil fuel' and yellow cake ore (Uranium) during their lifetimes, unless we change our current behavior, now.

Obviously, these dwindling supplies of finite ancient hydrocarbons cannot be considered a sustainable source of energy. **The transition from fossil fuel is inevitable.** The science is obvious (we live on a finite planet); the math is simple.

On the other hand, on the left side of the chart in the green box, sustainable energy sources are identified. These green forms of energy are characterized as inexhaustible and sustainable.

Of course, the dominant feature of this graphic is the large yellow sphere depicting the amount of solar energy incident on land each year. Anyone who says, "without coal and oil, you snowflakes will freeze to death, go hungry and won't be able to see at night because there is not enough solar energy" obviously does not live on planet Earth.

"There would be no life on the planet without the Sun..." Vaclav Smil, *"Energy: A Beginners Guide."* 2006, pg26.



The transition from Fossil Fuel is Inevitable

Figure 12 “Transition from Fossil Fuel (Ancient Hydrocarbons) is Inevitable” is another way of conveying the same idea as Figure 11 “Global Energy Perspective – Types and Quantities of Energy”; but as a timeline that conveys a sense of urgency for transitioning to inexhaustible energy. In this graphic, the reserves of ancient hydrocarbons are quantified as barrels of oil equivalent (BOE). The chart shows how these 8 trillion barrels of oil equivalent will be drawn down over time for the next 100 years assuming our current consumption rate plus a 1% annual increase for population growth.

Also shown in this chart are some insights from climate science. In 2012, Bill McKibben, one of the

founders of 350.org traveled across the country on his “Do the Math” tour. Based on the IPCC calculations, McKibben noted that if we continue our current rate of consumption, around the year 2040, all burning of ancient hydrocarbons must stop (as indicated by the red stop sign) if we want to limit global warming to 2°C. He pointed out that to limit global warming to 2°C, we are actually saying “80 % of the known reserves of coal, oil and natural gas must be left in the ground” and labeled as “stranded assets.”

The mere thought of having to write off 80% of their stranded assets must send chills down the spine of ExxonMobil’s management, board, and stockholders. Actually, the outlook for the oil & gas industry is not quite that bad if they just stop being a **fossil fuel burning** industry. A more accurate statement would be “80% of the ancient hydrocarbons

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in the ground cannot be burned and converted into greenhouse gases.” However, this requires reframing.

There are sustainable uses for these valuable hydrocarbon resources if we stop calling them fossil **fuel** and instead refer to them as ancient hydrocarbons. These hydrocarbons are actually rich sources of precious concentrated carbon that can be used sustainably. For example, they are used as the feedstock for manufacturing recyclable carbon fiber for lightweight materials used in the transportation sector. Instead of burning them, these ancient hydrocarbons can be the feedstock for many types of recyclable plastics (including high-density polyethylene (HDPE) pipe used for circulating water in ground source geothermal heat pump applications and solar thermal heating systems). There are a number of other useful products and non-burning applications for these ancient hydrocarbon resources that do not contribute to global warming.

Before leaving this graphic, we see milestones along the top of the declining curve labeled 1.5°C, 2°C, and 3°C. If we do decide to set our global warming goal at 1.5°C in an effort to save our island nations and coastal cities, we need to make the transition to inexhaustible energy source within the next 10-12 years – before 2030.

Finally, at the bottom of the graphic is a multi-colored strip with numbers representing the lifeline of today’s college student. We can see that to limit global warming to 1.5°C, we need to stop all burning when they are 30 years old. We see that to limit warming to 2°C, the “Stop Burning” sign occurs when they are in their 40s. Today’s college students will be in their 50s when the remaining petroleum will be too expensive to extract and in their 80s when all that is left is coal, tar sands, and shale oil.

History of Climate Change Science

Table 2 contains a recent history of key events in climate change science.

We can trace the awareness of greenhouse gases (such as water vapor, carbon dioxide, ozone, methane) and their influence on Earth temperature back to the 1800s.

The May 1953 issue of Time Magazine, reported on the work of Gilbert Plass, “**...If man’s industrial growth continues, the earth’s climate will continue to grow warmer.**”

It was in the 1980s that we see evidence of a split personality within some oil & gas corporations. Their staff scientists, (many of whom were geologists grounded in the laws of nature) were aware of and were studying the impacts of carbon dioxide and other greenhouse gases linked to the fossil fuel burning industry on the Earth’s climate. They were publishing their findings in technical journals rarely read by the public. In parallel, the marketing/advertising front of the organization was funding advertorials of uncertainty according to a recent Harvard study of ExxonMobil publications.⁴⁶

Table 2 History of Climate Change Science (Global Response)

1800's	1950's	1960's	1970's
<p>In 1859, John Tyndall studied the radiative properties of various gases. He measured how gases such as water vapor, carbon dioxide, ozone, and hydrocarbons strongly absorb and transmit radiant heat even in small quantities. (Note A)</p> <p>In 1896, Svante August Arrhenius published a paper in the London, Edinburgh and Dublin Philosophical Magazine and Journal of Science entitled "On the influence of CO₂ in the air upon the temperature of the ground."</p>	<p>Dr. Gilbert N. Plass (a Canadian-born physicist) made important early contributions to the carbon dioxide theory of climate change. Time magazine reported on Plass's work in May 1953, "Invisible Blanket," which ends "for centuries to come, if man's industrial growth continues, the earth's climate will continue to grow warmer." (Note B)</p> <p>The New York Times reported on Plass' work in 1956 with this strong headline:</p> <p>"warmer climate on the earth may be due to more carbon dioxide in the air" (Note C)</p>	<p>In 1965, the president's Science Advisory Committee warned President Johnson that "Man is unwittingly conducting a vast geophysical experiment," and that "Within a few generations, we (humans) will burn all the fossil fuels that accumulated in the earth over the past 500 million years." (Note D)</p>	<p>Wallace Broecker, one of the first scientists to predict an imminent rise in the earth's temperature due to the human output of carbon dioxide, was credited with introducing the phrase "global warming" into the scientific lexicon in the 1970s.</p> <p>In 1979, the U.S. National Research Council assembled a panel of experts who wrote a report warning of the prospects for serious warming if we continued on the path of unrestricted carbon dioxide emissions. The panel explained, "A wait-and-see policy may mean waiting until it is too late."</p>

- A. <http://earthobservatory.nasa.gov/Features/Tyndall/>
- B. <http://www.time.com/time/magazine/article/0,9171,890597,00.html>
- C. <http://www.desmogblog.com/1956-new-york-times-article-warned-of-warmer-climate>
- D. <http://www.dailyclimate.org/tdc-newsroom/2015/02/president-johnson-carbon-climate-warning>

1980's	1990's	2000's	2010's
<p>1980's</p> <ul style="list-style-type: none"> • Exxon alleged Climate Change coverup <p>1988 James Hansen (NASA)</p> <ul style="list-style-type: none"> • Testifies before U.S. Senate <p>1988 IPCC Established</p> <ul style="list-style-type: none"> • Intergovernmental Panel on Climate Change (IPCC) 	<p>1992 Rio Earth Summit</p> <p>1994 UN Framework on Climate Change (UNFCCC).</p>  <ul style="list-style-type: none"> • Membership of 195 parties <p>COP1 Berlin (1995)</p> <ul style="list-style-type: none"> • Angela Merkel (Germany's Environmental Minister) <p>COP2 Geneva (1996)</p> <p>COP3 Kyoto (Dec 1997)</p> <ul style="list-style-type: none"> • Kyoto Protocol <p>COP4 Buenos Aires (1998)</p>	<p>COP5 Bonn (2000)</p> <p>COP6 Bonn (July 2001)</p> <p>COP7 Marrakesh (Nov 2001)</p> <p>COP8 New Delhi (2002)</p> <p>COP9 Milan (2003)</p> <p>COP10 Buenos Aires (2004)</p> <p>COP11 Montreal (2005)</p> <ul style="list-style-type: none"> • Montreal Action Plan <p>COP12 Nairobi (2006)</p> <p>COP13 Bali (2007)</p> <p>COP14 Poznan (2008)</p> <p>COP15 Copenhagen (2009)</p>	<p>COP16 Cancun (2010)</p> <p>COP17 Durban (2011)</p> <ul style="list-style-type: none"> • Green Climate Fund <p>COP18 Doha (2012)</p> <p>COP19 Warsaw (2013)</p> <p>COP20 Lima (2014)</p> <p>COP21 Paris (2015)</p>  <p>Paris Climate Conference, Paris Agreement</p> <ul style="list-style-type: none"> • Keep global warming below 2°C. • Paris Agreement Adoption (22 April 2016 – 21 April 2017) • INDC Report (2 May 2016) <p>COP22 Marrakesh (Nov 2016)</p> <p>COP23 Bonn (Dec 2017)</p> <p>COP24 Katowice, Poland 2018</p>

Ref: https://en.wikipedia.org/wiki/United_Nations_Climate_Change_conference

In 1988, Dr. James Hansen first appeared before the U.S. Congress to brief them on climate change. That same year, the international community formed the Intergovernmental Panel on Climate Change (IPCC).

It was in 1994, that the first UN Framework Convention on Climate Change was formed and in 1995 the first Conference of the Parties (COP1) convened in Berlin. Angela Merkel, Germany's Environmental Minister at the time presided over this initial COP.

COP21 Paris Agreement.

There were significant events at each annual COP, but at COP21 in December of 2015, we see a significant milestone known as the Paris Agreement. The 195 "parties" that attended expressed concern about the harm human were causing by continuing to burn hydrocarbons and dump greenhouse gases into the atmosphere. Of particular concern, global warming was already contributing to sea level rise and the submergence of island nations as well as coastal cities. A formal global response to climate change was published. A few excerpts are provided below:

Article 2

1) *...this agreement...aims to strengthen the global response to the threat of climate change.... By:*

*a) Holding the increase in global average temperature to well below 2 deg C above pre-industrial levels and to **pursue efforts to limit the temperature increase to 1.5 deg C** ... recognizing this would significantly reduce the risks and impacts of climate change.*

Article 3

... The efforts of all parties will... recognize the need to support developing countries parties for the effective implementation of this Agreement.

When COP21 adjourned, each party left with an assignment – to re-examine their country's sources of greenhouse gases and determine how rapidly they can transition to renewable energy sources that do not emit CO2 and other greenhouse gases. Then submit these goals along with a timeline for implementing these goals by April 2016. On 2 May 2016, the UNFCCC Secretariat released an updated synthesis report outlining the aggregate effect of the intended nationally determined contributions (INDCs) submitted by 189 Parties as of 4 April 2016.

The report found "... the INDCs would result in total aggregate global emission levels of 55 Gt carbon dioxide (CO₂)-equivalent (eq) in 2025 and 56 Gt CO₂-eq in 2030....this emissions trajectory ...is far from ...the goal of limiting warming to 2°C or 1.5°C above pre-industrial levels."

"... [the] 17 INDCs that cover 78% of global energy-related CO₂ emissions ... finds that the energy supply must be more rapidly de-carbonized and energy productivity ... improved at a much greater rate than these 17 Parties committed to in their INDCs."⁴⁷

Deeper reductions in GHG emissions than those voluntarily submitted on the first round are required.

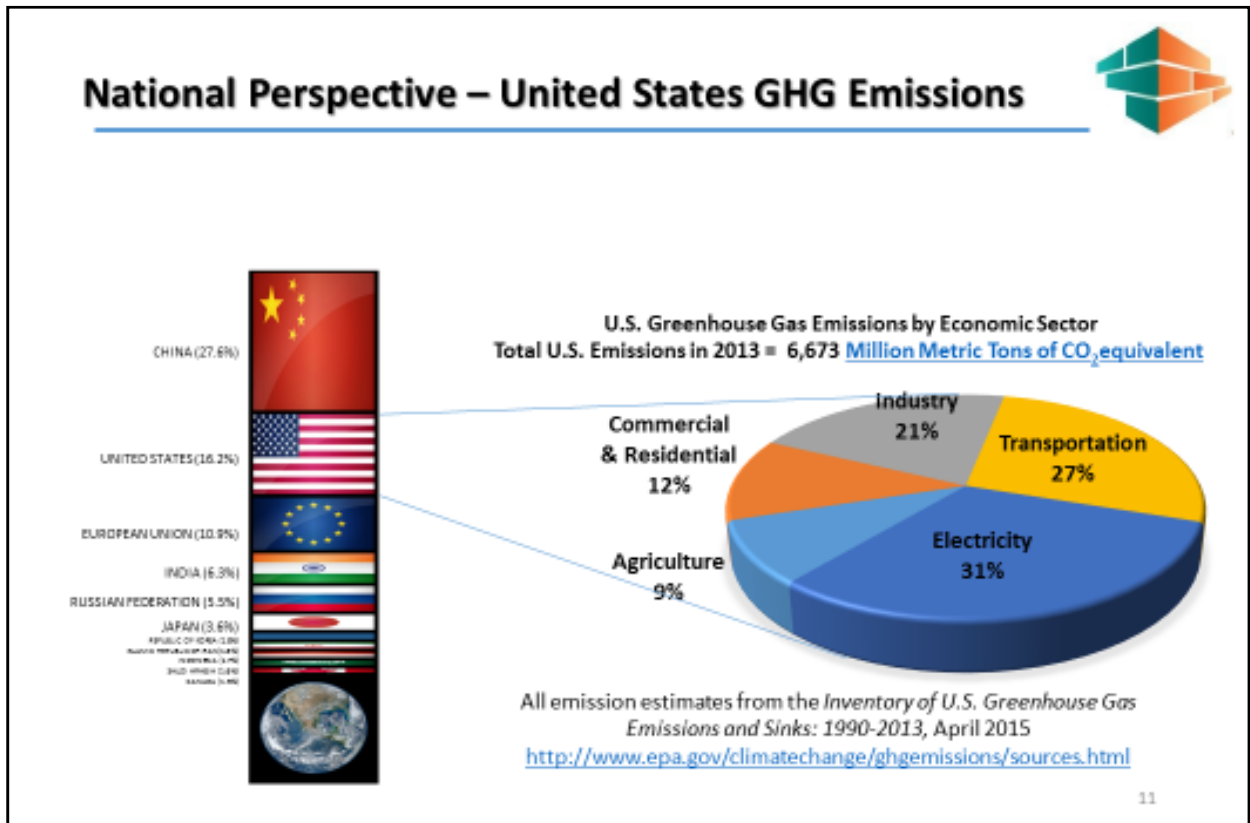


Figure 13 Global and National Greenhouse Gas Emissions

Figure 13 “Global and National Greenhouse Gas Emissions” identifies the primary greenhouse gas emitters responsible for climate change.

The top three parties, China, United States of America, and the European Union emit 50% of the CO₂ and other greenhouse gases into the atmosphere. If we add the next 8 countries, India, Russia, Japan, Republic of Korea, Islamic Republic of Iran, Indonesia, Saudi Arabia, and Canada, we can account for nearly 80% of GHG emissions and anthropogenic cause of global warming.



Global Temperature Increase Linked to GHG Emissions (The Carbon Budget)⁴⁸

Table 2.2 of the AR5 IPCC Report, Page 64 published in 2015 provides our current understanding of the correlation between the amount of additional CO₂ we can add to our atmosphere and the resulting average Earth temperature. Let’s start in the middle with 1.5 deg with the 393 gigatonnes remaining budget – valid in 2015.

Table 2 Carbon budget for a 1.5, 2, and 3 degrees C Warmer Planet

Level of Global Risk	Global Surface Temperature Rise (above pre-industrial period)		
	< 1.5 deg C	< 2 deg C	< 3 deg C
<i>For 66% model agreement</i>	<i>Carbon budget in GtCO₂</i>		
Carbon Budget Remaining ^(a)	243	843	2243

No. of years remaining ^(b)	6.0		20.9		55.7	
Stranded Assets (Unburnable fossil fuel reserves) ^(c)	95%	-2%	84%	-7%	58%	-17%
		+2%		+4%		+10%
<i>For 50% model agreement</i>			<i>Carbon budget in GtCO₂</i>			
Carbon Budget Remaining	393 2015 Goal		1143		2643	
No. of years remaining	9.8		28.4		65.6	
Stranded Assets (Unburnable fossil fuel reserves)	93%	-4%	79%	-10%	51%	-23%
		+1%		+5%		+12%
<i>For 33% model agreement</i>			<i>Carbon budget in GtCO₂</i>			
Carbon Budget Remaining	693		1343		3093	
No. of years remaining	17.2		33.3		76.8	
Stranded Assets (Unburnable fossil fuel reserves)	87%	-6%	75%	-12%	43%	-27%
		+3%		+6%		+13%

^(a) Taken from Table 2.2 in the IPCC's 5th AR Synthesis Report http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf pg 64. Calculated from the IPCC's budget in 2010 minus total CO2 emissions in 2011-2014 from The Global Carbon Project. <http://www.globalcarbonproject.org/carbonbudget/index.htm>

^(b) Calculated from the budget remaining in 2014 (see footnotes a and b) divided by current emissions in 2014

^(c) Calculated using the midpoint in the IPCC's range for total fossil fuel available in 2011 and the remaining budget in 2014 (see footnotes a and b) http://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full.pdf



A spreadsheet model was constructed to explore “Paths to Reducing GHG Emissions” that would comply with the IPCC carbon budget. Using the 2015 Paris Agreement goal of limiting global warming to 1.5 degrees C, results in a carbon budget of 393 Gigatonnes (50% model agreement). If humans dump more than 393 Gigatonnes into the air, the planet will warm more than 1.5 deg C. First adjust the carbon budget for 2016.

Globally humans add just under 40 Gt of GHG each year, so in 2016, the remaining budget was **353 Gigatonnes** as indicated in the middle of the graphic. The plot in the center with a gray image of the planet shows the path we are currently on.

As shown by the solid black line, if we plan to continue to burn fossil fuel, as usual, we will have used the remaining budget by around 2025 at which point everyone on the planet who is still burning hydrocarbons must stop and magically switch to renewable energy (or freezes and goes hungry). Not a pleasant way to retain a habitable 1.5 deg C planet.

Or we can start now to reduce our emissions by 10% a year and use the “glide path” shown by the green solid line. That plan seems doable. A 10% reduction in GHG emissions per year buys us an additional 10 years before we use up the budget and have to stop completely for a 1.5 deg C warmer planet.

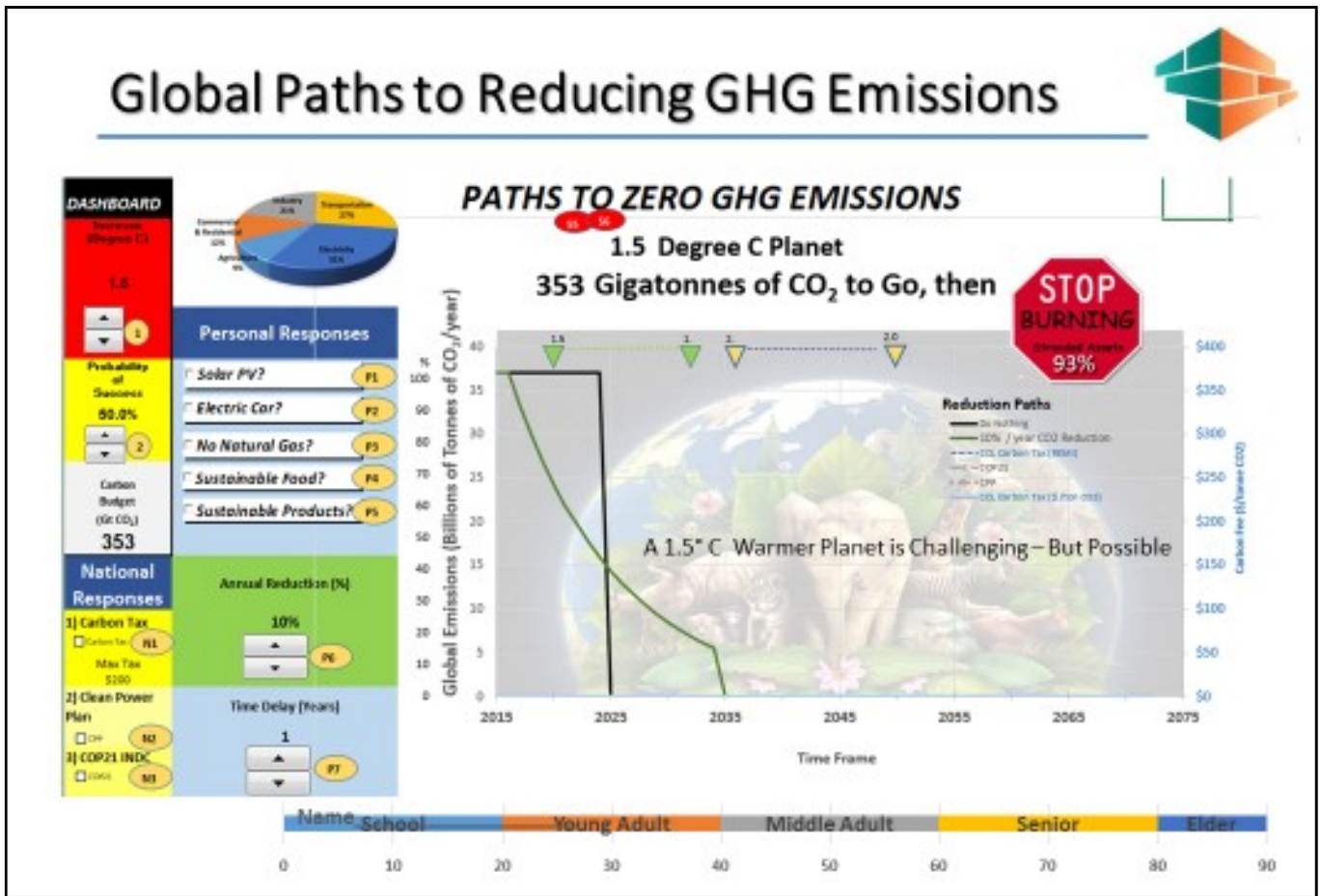


Figure 14 Paths to Zero GHG Emissions

The red stop sign near the upper top right corner indicates 93% of the known reserves will be “stranded assets” and cannot be burned. These ancient hydrocarbons can still be used to make sustainable items that can be recycled (as discussed earlier) – they just cannot be burned.

NOTE: Due to time constraints for this presentation, there was no further discussion of the “model.” However, it was used in prior and subsequent Climate Change workshops sponsored by the Green First Team.

Based on our current understanding of the laws of Nature, scientifically derived and verified evidence indicates every human must reduce their GHG emissions to near zero if we are to retain a habitable planet.

This does not mean we have to go back to living in caves or straw huts. It simply means we have to harvest the amount of energy that we need to support our individual lifestyles from sustainable sources (solar,

wind, hydro, etc.) Each of us is free to live a responsible life that uses the amount of energy we harvest (without burning ancient hydrocarbons). Reducing GHG emissions is not synonymous with reducing energy usage or lifestyle. It is synonymous with reducing the burning of hydrocarbons and transitioning to solar, etc. instead.



How are we as UUs responding to Climate Change?

Unitarian Universalist Association Response

Most, if not all, religious denominations around the world have their own version of ‘creation care.’

For example, the Unitarian Universalist Association (UUA) “Purposes and Principles” express a fundamental concern and respect for all Life. The UU living tradition draws on many sources including direct experience of that transcending mystery and wonder...

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that moves one to a renewal of spirit and an openness to forces that create and uphold life.⁴⁹

These eclectic sources of spiritual wisdom include all established world religions as well as the spiritual teachings of the Earth-centered traditions known to celebrate the sacred circle of life and instruct one to live in harmony with the rhythms of nature. More specifically the Unitarian Universalist Seventh Principle encourages “**Respect for the interdependent web of all existence of which we are a part.**”

Among its many ministries, the UUA sponsors the efforts of the UU Ministry for Earth (UUMFE). In addition to providing support and resources, the UUMFE periodically takes the pulse of the larger UU community to determine their position on environmental issues such as climate change/global warming/sustainable living.

Within the past decade there have been at least three position statements pertaining to climate change that were agreed upon by the several thousand delegates attending the annual General Assemblies (GA) of the UUA:

THREAT OF GLOBAL WARMING/CLIMATE CHANGE, UUA Statement of Conscience, GENERAL ASSEMBLY 2006, <http://www.uua.org/statements/threat-global-warmingclimate-change>

FOSSIL FUEL DIVESTMENT, Business Resolution, UUA GENERAL ASSEMBLY 2014, <http://www.uua.org/statements/fossil-fuel-divestment>

ACT FOR A LIVABLE CLIMATE, Support a Strong, Compassionate Global Climate Agreement, Resolution, UUA GENERAL ASSEMBLY 2015, <http://www.uua.org/statements/support-strong-compassionate-global-climate-agreement-2015-act-livable-climate>

Note: These three “Statements of Conscience /Resolutions” were presented earlier in this Case Study as Slides 2006.1, 2014.1 & 2015.1 and will not be repeated here; however, they were discussed in more detail in the science presentation.

Response by “Sister Churches”

Jefferson Unitarian Church (JUC), Golden, CO utilizes both solar PV and geothermal heating/cooling.

Mount Vernon Church in VA (Kate Walker is Senior Minister) utilizes both solar PV and geothermal

heating/cooling. <http://mvuc.org/new-solargeothermal-energy-project-functioning-well/>

How are We as First Universalist Responding to Climate Change?

For more than a decade, members of First Universalist have worked together as environmental activists (i.e. Green First Task Force) concerned about sustainable living, climate change, global warming, ocean acidification, ethical eating, socially responsible investing, zero waste, recycling, environmental justice and other facets of the UU Ministry for Earth (UUMFE).

As a congregation, First Universalist became a UUMFE certified Green Sanctuary in 2010 after enacting a number of operational changes under the leadership of Green1. The Green Sanctuary certification process increased awareness of environmental issues that contribute to climate change and helped ensure sustainability features became embedded in the Building for the Future (BFF) project from its inception.

At this point in time, the BFF Committee had published a commitment to Sustainability but defunded the renewable energy portion due to a shortfall in the capital raising campaign.

Sustainability Information Available on the BFF Web Site

At a meeting on May 4, 2016, the BFF Committee affirmed they had embedded sustainability features in the remodeling project. They posted an update to the previously published “Framework for Energy Sustainability” on their web site. This latest update:

“...confirmed that the design accommodates our solar energy needs...”

The update also confirmed their intent to accommodate geothermal heating & cooling although they were still concerned about cost:

“We discussed the current design of the building and its existing equipment (duct work, furnaces, air conditioners, etc.), as well as what would be needed in the new building, how it could use geothermal energy and at what cost.”

• Sustainable Church Facility Features

Overall Design:

- Energy Efficiency, Natural Lighting, Materials Selection

Deconstruction:

- Recycling and reuse of demolition materials/avoid landfill

Building Science:

- Windows, insulation, materials, methods
- Material choices vetted for sustainability
- Renewable energy sources (Solar, Geothermal) replacing fossil fuel

100% Sustainable Energy System Science:

- Latest Solar PV technology for generating electrical power
 - 30% of the energy usage is in the form of electric power: 72,040 kWh
 - Flat Roof Ballasted Mounting of solar modules – no roof membrane penetrations
- Ground Source Geothermal technology for Heating & Cooling
 - 70% of the energy usage is in the form of thermal energy: 152,243 kWh (5196 therms)
 - 10 geothermal water-to-air heat pump furnaces will replace natural gas furnaces
 - Ground loop heat exchanger: 12 boreholes 300 feet deep located in North Parking Lot



First Universalist Vision

An early graphic depicts the concept of a 100% sustainable energy system.

- Sunlight incident on the rooftop is harvested with solar PV modules to generate 100% sustainable electrical power.
- Plastic pipes are inserted in the ground for exchanging thermal energy to provide 100% sustainable heating and cooling.

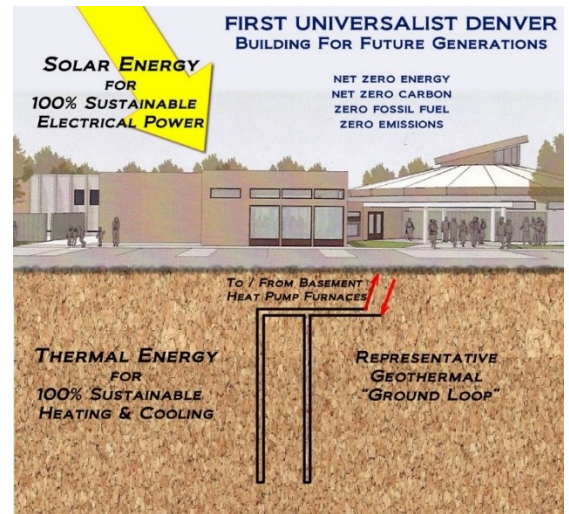


Figure 15 Early Concept of a 100% Sustainable Energy System - First Universalist Vision

The back-story of this transition project has been told in earlier sections. There is no question that some of the motivation and human energy to transform a vision into a reality was rooted in a team member’s common value system referred to as the UUA Purposes and Principles. Those involved would specifically cite the principle of “respect for the interdependent web of all existence of which we are a part” as a key source of intersectional energy that held the group together in times of internal conflict – and there were many such times.

Being spiritually connected to every other being, and to Earth itself, allowed the team members to observe the wisdom embedded in other living systems. After all, species alive today are the survivors of at least five mass extinctions over the past 3.8 billion years that life on Earth has been evolving – and that survivability alone deserves our deepest respect - even reverence.

Those who ponder how our autotrophic cousins harvest the Sun’s energy to live sustainably cannot help but be moved by this inherent wisdom. With little time to spare, homo sapiens have finally learned a clever, albeit crude, way to mimic their success using photovoltaics.

Biomimicry is an ancient practice⁵⁰ that continues today, particularly within indigenous cultures.



Figure 16 Biomimicry

Fortunately, thanks to the dogged persistence of Janine Benyus,⁵¹ who pioneered the modern practice of looking to nature for strategies to solve human challenges, the practice is being translated into the language of the scientific community.

An Example of Biomimicry:

To some, the Columbine is a sacred flower.

Its outstretched green leaves look to the Sun for the gift of energy to power its photosynthetic life process. Its roots securely embedded in the soil, harvest key minerals from the soil that are the building blocks for creating the sacred flower.

The renovated church facility will have humble human-made leaves (aka solar PV modules) to harvest the Sun's energy.

The remodeled church facility will put down simplistic roots (aka black plastic pipe) to honorably harvest/exchange thermal energy with Earth. Withdrawing energy in the winter; depositing energy in the summer.

The church will receive ten new artificial hearts, aka heat pumps that circulate thermal energy (embedded in water) throughout the building for moderating temperature (homeostasis.)

The facility will receive five new lungs in the form of Energy Recovery Ventilators (ERVs) that will automatically inhale fresh air and exhale stale air when the CO₂ levels in the room exceed 800 ppm.

The building will acquire a thicker coat of fur (more insulation) for protection against extreme external temperatures.

Documenting this Case Study is an attempt to capture key information for possible replication of the project - not unlike encoding biological DNA.

Is There Enough Solar Energy Available On-Site to Operate the Church facility?

The solid blue lines in Figure 17 denote the property lines of the First Universalist lot. The surface area within the blue lines encompasses about 1.7 acres (74,000 ft²) (6880 m²). The church is the steward of the building and grounds within these virtual boundaries.

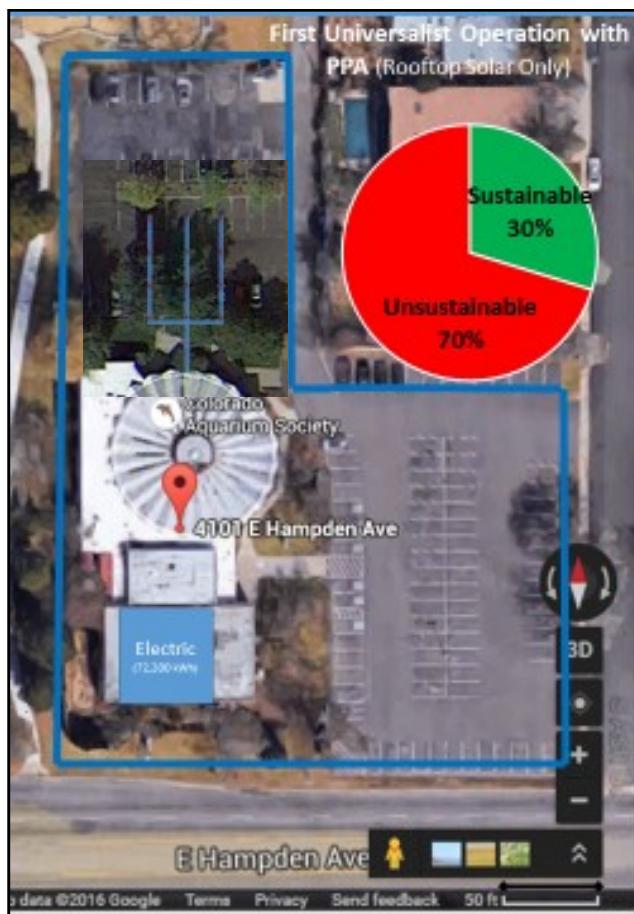


Figure 17 First Universalist Property Lines / Lot Size

The Sun provides a gift of 1790 kWh/m² on these grounds each year – that's 12,300,000 kWh /year. A 1 kW panel laying flat will generate 1349 kWh /year.

In 2015, the church electrical usage was 72,040 kWh. So how much of the church property has to be covered by solar PV panels to harvest enough sunlight to generate the electrical needs of the church facility?

The National Renewable Energy Lab (NREL) provides an online computer tool (PVWATT) that can be used to size a solar PV system. The computer model takes into account the complicated Sun angle variations that are a function of latitude, time of day, day of the year, and tilt angle of the solar modules. The model also considers the efficiency of the solar modules and the expected weather-related losses to determine the amount of power that can be generated monthly as well as annually.

PVWATT calculations indicate that in the Denver area, a 49 kW rated solar array, facing due south with a

10-degree tilt angle can harvest 72,040 kWh of energy per year.

Using 345 Watt Sunpower PV modules as an example, 143 modules covering 3240 ft² (a 57' x 57' square) are required to generate 72,040 kWh annually. This is equivalent to about 4% of the church lot as shown as a blue square on the church roof.

Conceptually, if the blue square became solar panels, that would sustainably generate all of the electrical power needed for the church; however, transitioning to solar provides only 30% of the total energy used by the church. The remaining 70% of the energy usage is provided by natural gas to heat the building (as illustrated in the red/green pie chart.)

Adding solar is necessary but not sufficient to be totally sustainable.

Conclusion. There certainly is enough solar energy incident on the property and surface area available to provide the electrical power for operating the facility.

A small amount of sunlight is harvested by the few trees and grass surrounding the building, but two thirds (2/3) of the Sun's gift of daily energy currently falls on asphalt and is unfortunately turned into waste heat. Greening the grounds, as well as the building, is the responsibility of the steward.



Is There a Sustainable Source of Thermal Energy for Heating the Church Facility?

Yes. There are several sustainable zero-emission heating options including a) all-electric heating, b) solar thermal heating, c) air-source heat pump heating and d) ground-source geothermal heat pump heating. The latter was used as the "baseline" for comparison to the other options.

- 1) **Electric Heating.** Although a viable/sustainable zero emission option, for First Universalist an all-electric heating system was estimated to be significantly more expensive (\$100,000 more than the baseline ground source geothermal heat pump option.)
- 2) **Solar thermal heating** is a viable option. For First Universalist roof area was limited. The space available was needed for installing solar photovoltaic modules to generate electrical power – the number one energy priority. Typically using sunlight to generate electrical power has

precedence over using sunlight to produce heat.

Because storing thermal energy in water is a challenge, solar thermal works very well for heating domestic hot water. The heat is automatically stored in the hot water tanks. Solar-heated water can also be circulated through pipes for radiant space heating (i.e. embedded in the floor, or stand-alone radiators). Heat pumps generally are used to make hot water but not steam, although small capacity (30kW) units that make steam are available commercially.⁵² but the installation of these pipes is an added expense. Also, storing enough thermal energy for space heating the facility for several days during cloudy weather in the winter is a significant challenge. Alternatives to solar thermal are now available.

3) **Heat Pump Technology** is a preferred option.

Heat pump technology is a viable sustainable option for heating and cooling. Instead of burning hydrocarbons or some other fuel, the heat pump extracts/deposits thermal energy that is already onsite and generally free (i.e. energy in the air or in the ground). There are two types commercially available today: air-source/sink and ground-source/sink.

Cooling. A typical kitchen refrigerator found in most homes is an example of air-sink heat pump technology used for cooling only. A refrigerator uses heat pump technology to transfer thermal energy from cold air inside the box to the surrounding warmer air in the kitchen. A traditional air conditioning unit utilizes heat pump technology to transfers heat from the warm air inside a home to even warmer air outside.

Heating. Modern electric hot water heaters use an air-source heat pump to extract thermal energy from the surrounding room air and transfers this energy into hot water as an augmentation to the electrical heater element in the tank. An air-source heat pump becomes very inefficient as the air temperature drops below 20-30 deg F and therefore, in general, is not used in northern latitudes. At low temperatures, the air-source heat pump activates an electric heating element and becomes an electric furnace. First Universalist Church Denver requires significant heating making an air-source heat pump less attractive than its cousin, the ground-source heat pump.

- a. **Air-Source Heat Pumps.** Just as the name indicates, air-source heat pumps use the surrounding air as the source/sink of thermal energy. A standard heat pump has a reversing

valve so it can be used for both heating and cooling.

- b. **Ground Source geothermal heat pumps.** A geothermal heat pump furnace provides both sustainable heating and cooling in a single unit. Thermal energy is withdrawn from the Earth when the building needs heat. When the building is too warm, excess heat is deposited in the Earth.

The ground-source geothermal heat pump technology was selected as the baseline heating and cooling system for several reasons:

- i. The church is located in a climate where it is not unusual to have a number of sub-zero days during the winter, so the church does have significant heating requirements.
- ii. Also at that point, there was some possibility that the natural gas forced-air furnaces would be replaced over a number of years as the old furnaces failed. [This strategy was later determined to be untenable.]
- iii. The geothermal heat pump furnaces are a simple replacement for natural-gas burning forced-air furnaces. For example, a 4-Ton rated natural-gas furnace and a 4-Ton geothermal heat pump furnace both have the same output: 48,000 BTU/hr (14 kW).
- iv. There was a convenient location to install a geothermal ground loop heat exchanger in the

north parking lot (as indicated in Figure 15 by the three blue lines north of the round building.)



The Science of Ground Source/Geothermal Heat Pumps

The ground source geothermal heat pump equipment proposed for the church is basically the same as used in our refrigerators today except:

- 1) It is larger to accommodate larger heat transfer rates,
- 2) The source/sink of thermal energy is the Earth, not the Atmosphere,
- 3) There is a reversing valve that allows the heat pump to heat as well as cool, and
- 4) The heat exchanger coils (normally located under or on the back of a refrigerator to transfer heat into the air) are located underground to transfer heat into the soil. So in the summer, excess heat in the building is transferred into the ground. In the winter heat is withdrawn from the ground to heat the building.

Several diagrams were used to help explain the physical principles involved. See Figure 16 & 17.

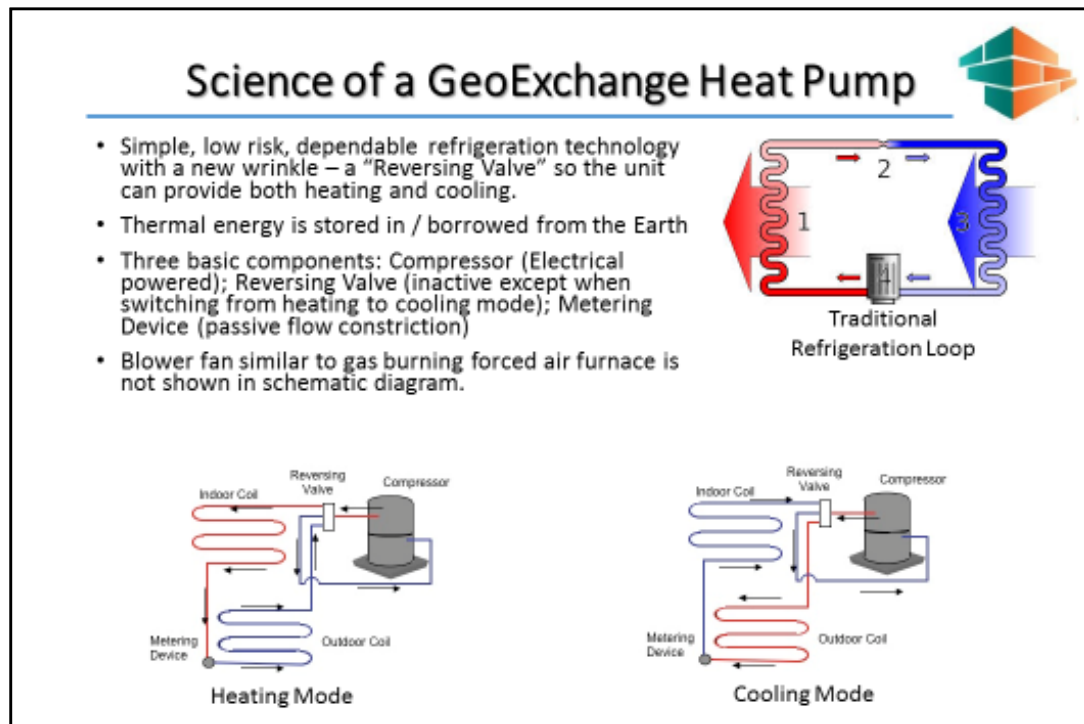


Figure 18 Science of a GeoExchange Heat Pump

Reversing Valve Concept

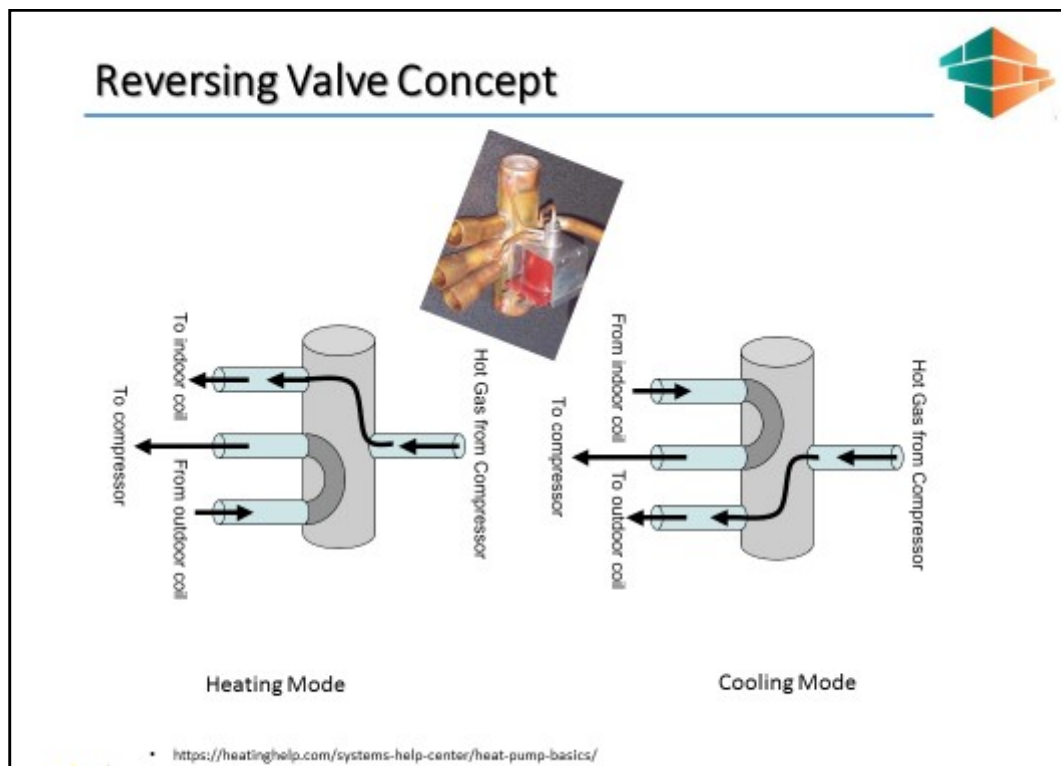


Figure 19 Reversing Valve Concept

The clever thing about a heat pump is the reversing valve that allows the heat pump to provide both heating and cooling.

Conclusions of the Science Discussion

- There is an enormous amount of solar energy incident on the Earth's surface that is available to be harvested by humans and non-humans alike. On an annual basis, the Sun provides 23,000 TeraWatt-years of solar energy on the land area alone. 7 billion people currently consume 18.5 TeraWatt-years of energy – most of it derived from buying and burning ancient hydrocarbons. To live sustainably, we just need to harvest 0.1% of the free solar energy.
- The transition from burning ancient hydrocarbons is inevitable. Children being born today will see this transition within their lifetimes in one of two ways.
 - If humans continue using this finite resource at the current rate, simple math indicates all coal, oil, gas reserves will be exhausted in less than 100 years. No science is required, just arithmetic, or,
 - If humans want to leave a reasonably habitable planet for their children and their children, evidence-based climate science indicates a “voluntary” transition to 100% renewable energy with the next 20-25 years is required to limit global warming to 1.5 deg C above pre-industrial temperature.
 - Today's best climate models indicate the remaining carbon budget for a 1.5 deg C warmer planet is around 353 gigatonnes of CO_{2eq} as of 2016. If more greenhouse gas than the remaining budget is added, the thermal blanket will become thicker and cause even more warming. The average global surface temperature has increased 1 deg so far and we are already seeing an increasing number of extreme weather events and changes in ocean acidification.
- The science indicated that adding solar panels to the church was necessary but not sufficient for a sustainable energy system. Adding a Solar PV system alone would only transition 30% of the energy used by the church to renewable energy. The majority of the energy used by the church was in the form of burning natural gas for heating.

- The church began exploring a path that would transition to a 100% Sustainable Energy System with near zero emissions.
- The “science and technology” of a 100% Sustainable Energy System for First Universalist appears to be straight forward and well established. The equipment needed to make this transition is commercially available today. If designed & installed competently, the proposed solar/geothermal energy system would be low risk.
- There are a growing number of successful examples of transitioning from fossil fuel to renewable /inexhaustible energy sources.
- The First Universalist Building for the Future renovation project appears to be a great opportunity to get in right relationship with our independent web of life. A new sustainable energy system appears to save the church money in operating expenses. This is a great opportunity to stop doing harm to future generations.
- The challenge is finding a way to finance the new energy equipment.



Comments Related to Science/Feedback

There was a brief question and answer session at the end of the presentation. The dialog was constructive.

One attendee asked a good question that required some further analysis.

Question #1: "Why not just add more solar instead of using geothermal?"

After a top-level evaluation, Green5 provided the following answer to the inquisitive attendee in a Post Presentation correspondence.

Answer: Good question. The church grounds provide ample surface area to harvest additional solar energy. For example, carport solar panels could be installed in the parking lot. Electric heating is certainly clean and the solar energy source is essentially inexhaustible and does no harm to the planet or Life on it.

- The all-electric heating system is technically viable.
- However, electric heating is significantly more expensive than a geothermal heating system,

- Over a 20-year time frame, an all-electric heating and cooling system appear to be around \$105,000 more expensive than a geothermal heating and cooling system for the church.
- Interestingly, the all-electric solution (using solar electric) is still less expensive than continuing to burn fossil fuel (assuming the historical 3-4 % annual increase in fossil fuel costs.)



Comments Related to Funding/Feedback

The presenter of the science presentation made a deliberate effort not to mention any funding aspects of the energy system. However, during the Question & Answer session at the end, attendees brought up the topic of financing.

At that point, it had been decided that none of the pledge money from the capital campaign from the renovation project was going to be used to fund a new energy system. Alternative funding would have to be found for the new energy system to go forward.

- Attendees seemed to understand the “science” associated with the need for a zero-emissions energy system and expressed a desire to move on and find a means of funding a 100% sustainable energy system.
- Funding of the complete Energy System was still uncertain. By then, the Green First Team had already explored third-party funding but found no interest when the geothermal system was included.⁵³
- The lack of funding would result in a failure to implement the geothermal component that was 70% of a sustainable energy system.
- But it seemed there was a growing number of people saying, “Let’s Do This. Let’s find funding for the complete solar and geothermal energy system. Our children and their children will thank us.”
- One attendee suggested we might consider a new financial model based on the State Bank approach (e.g. North Dakota State Bank). North Dakota encourages internal financing within the state whenever possible so the “proceeds” then benefit the State rather than Wall Street.

- Self-funding the complete energy system was mentioned using member loans at a nominal interest rate of 1.5% (similar to a bank CD).

The mere mention that member loans were being considered opened up a floodgate of unexpected concerns. A long-time member of the congregation pointed out the church had tried member loans in the past. Their recollection was “it was a disaster.”

Fortunately, BFF₂ was able to provide more information about the history of those past member loans. No member lost any money.

The situation occurred several decades ago when the commercial interest rate on loans at the time was around 6-7%. The church needed some capital for a specific project. A request for donations ended up with a shortfall. A few members agreed to loan the church the money to make up the shortfall at a reduced rate, say 4-5%. Years later, the commercial rates dropped below the member loan rate. The loans were still being repaid and it then appeared the member lenders were profiting unfairly at the expense of the congregation. To make matters worse, apparently one year when the church budget had a shortfall for operating expenses, the Senior Minister/ Board asked the member lenders for permission to extend the payback period of their loans by several years and only make payments on the interest (no repayment of the principle) for a few years until the church was in a better financial position. The member lenders agreed, but this merely prolonged the time the member lenders were “making money” off the rest of the congregants. Although the member loans were the result of a mutual agreement between the Board, Staff and the members holding the promissory notes, the optics of the situation created some ill-will among members.

The current situation was different. Members would be asked to loan money at a fixed rate of 1.5% interest (comparable to a bank CD) at a fixed term of 15 years. It would be difficult to contend that these member lenders were getting rich at the expense of the congregation.

After the science presentation had ended, BFF₂, co-chair of the building committee, approached the science presenter and said simply, “We have to make this happen.”

BFF₂ requested a proposal from the Green First Team for a member-financed approach to a sustainable energy system. Green₅ agreed to provide a 20-year

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cash flow spreadsheet that illustrated how such a member-funded scenario could be constructed. It was agreed that any member solicitation should be preceded by authorization from the BFF Committee and then the church Board. BFF₂ agreed to take the member sponsored funding concept to the Board for their review.

Other third-party funding approaches were being pursued as well. Green₄ was exploring funding possibilities using the PACE program. The initial PACE results were expected within a week or so and could be compared to the member financed approach.

Conclusions of the Funding Discussion.

Although the “Science Discussion of a Sustainable Energy System” was deliberately crafted to avoid any discussion of finances, ironically attendees insisted on bringing up the topic. A productive discussion about funding the project occurred and progress was made on the financial front.

The Green First Team had been trying for several months to identify a for-profit third party able to take advantage of tax-based incentives and willing to sponsor the church project. However, no third party could be identified that was willing to include the geothermal equipment in the funding package – just solar. We did end up using a “Prepaid Power Purchase Agreement” with a third party for the solar equipment.

“Borrowing” money from members at a low-interest rate still seemed to be viable if not a preferred option after the “Science Presentation.”

“Borrowing” money from members at 1.5% interest rate should avoid the perception that a few privileged members were making money off other members – especially if the terms and conditions of the loans were fixed or at least managed carefully.

1.5% Interest Loan Discussion within the Green Team

The use of a combination of donations and low-interest member loans seemed to be emerging as a leading candidate because this approach was aligned with a number of other ideas advocated by the members of the congregation.

Plus the Green First Team had heard from members that they were “tapped out” for donations” but would be willing to “loan” money to the church if they at least got back their principle. Unexpectedly, the unsolicited comments from attendees at the “Science Discussion” were later used to formulate a funding model that worked for this situation.

As explained later in this case study, the Green First Team believed the funding approach could be adapted to other non-profit organization seeking to transition from burning ancient hydrocarbons to harvesting inexhaustible solar and geothermal energy.

The Green First Team had slowly built up a new sense of optimism since the April 6, 2016 decision to “defund” the new sustainable energy system.

After the “science” presentation and suggestions from a number of people, it was back to the spreadsheet financial model. How could low-interest loans, plus donations be used to create a feasible method to finance this project? It was starting to look hopeful that it might be possible to create a revenue-neutral approach after all.

Three Green First Team members, Green_{1,4,5} had been involved for several months over the 2015-2016 winter trying to figure out how to make a third party LLC funding model work. This LLC approach was patterned after a model developed locally by St. John’s Episcopal Church in Boulder. The St. John’s congregation created an LLC to fund their rooftop solar system that would provide 30% of electrical power requirements. The Green First Team had set a goal to fund a 100% solar system plus 100% heating & cooling system. The geothermal system made the traditional economics less attractive, but the Green First Team was insisting on an “all in” system now.

Unfortunately, the size of the First Universalist capital goal compared to the member demographics did not support this LLC funding approach. (First Universalist did not have enough members with significant “passive income” to make the LCC approach work.)

As they struggled to find an LLC funding approach work for First Universalist, the team became aware of how onerous high-interest rate loans can be. The team could only make an LLC model work if the “investors” were willing to accept a minimal return on their investment (ROI). [Minimal means zero to 1%]

As recalled by Green₅,

"After the Science Presentation, we put together a new cash flow model that included a donation option, a commercial loan option, and a member loan (1.5%) option. After trying various arrangements of donations/loans we finally stumbled on a possible solution that seemed to work. It involved donations for about 40-50% of the capital required to buy the new energy system and the remainder as member loans at 1.5% interest rate. The end result was a monthly repayment plan comparable to the current monthly budget for gas & electric (r(local financing per Earl _(slow money per Green₁)) as Gene_ suggested that was later labeled as a 'revenue neutral' approach by Board₁). After discussions with Green₆ who suggested conferring with Green₁, the funding expert in the Green First Team, we made a few changes and constructed a new spreadsheet funding model illustrating the cash flow over the next 20 years. The funding model confirmed there would be a significant financial gain by the church over a 20-year time frame and the plan was 'revenue neutral' meaning it did not increase the church operating budget."

Before moving forward to solicit church members for loans, the approach needed to be reviewed by the entire Green First Team, the BFF Committee, the Board of Trustees and the Staff to get their suggestions and buy-in.



Invitation to Present Energy System Plan to the BFF Committee, Board of Trustees, and Staff

From: BFF₁
To: Board_{1,5}; Senior Minister; Green_{1,2,4,5,6,7};
Cc: BFF_{2,3,4}
Sent: Sunday, May 29, 2016
Subject: Renewables Progress Meeting -- June 14 at 10 am

Noticed this in today's paper, maybe one of our options:

<http://www.denverpost.com/2016/05/25/rooftop-solar-facing-industry-shift/>

The BFF team thinks that six weeks after our last meeting would be a good time to check back in reference to our options for providing renewable energy in the new building. Since a decision will need to go to the Board before September, we think it important to continue the momentum towards developing the alternative(s) to be presented to the Board and perhaps ultimately to the Congregation.

Green₅, the material you developed is very helpful in understanding how we might achieve our goal. We also know that Green₄ has been engaged in discussions with the PACE providers and hope to have an update on that.

The Senior Minister has been invited too, but unable to attend earlier meetings, but plans to join us for this one.

And I need to note that Green₄ put on a fabulous concert last night that raised over \$1,200 for the building project.

Hope to see you on June 14.

BFF₁

There was now a deadline coming up to present the Green First plan to the BFF committee on June 14th. Trying to find a time when eight busy people (all volunteers) could meet turned out to be a major challenge.

From: Green₂
Sent: Monday, May 30, 2016
To: Green_{1,3,4,5,6,7}
Subject: Re: Renewable energy meeting -- June 14, 10 am

Do you all want to get together sometime between now and the 14th to refine the best options for making geothermal happen at First Universalist? I won't be able to do the normal first Thursday Green First meeting this month. Maybe we could get together in the evening of June 7, 8, or 9th? I'm open to other times also.

Green₂

From: Green₅
Sent: Tuesday, May 31, 2016, 8:56 PM
To: Green_{1,2,3,4,6,7}
Subject: RE: Renewable energy meeting -- June 14, 10 am

My schedule is flexible so whatever works for most of you. However, we should definitely meet before June 14th.

I have enclosed the latest internal financing model that uses low interest (1.5%) member loans as suggested the other night at the "science" discussion. We have Earl S. to thank for bringing up the North Dakota State Bank model that night. In addition, this model seems to fit nicely with A. Green's "slow

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money" approach. With the proposed plan, nobody gets rich financially, but benefits in other ways instead.

Notice I "suggested" the BFF Committee find a way to contribute a token \$35,000 (1% of their pledge money) to the energy system to assuage folks who learned later that none of their pledges went to the sustainable energy system. After all, it is an investment - the church will save more than \$180,000 using a renewable energy system instead of continuing to burn fossil fuel as we do now - that is a great ROI for the church.

Of the \$480,000 for a complete system, I believe we already have \$100,000 in donations and \$100,000 in low-interest loans lined up (Green₆ has the actual numbers). If we can get \$35,000 from the BFF pledges, we just have \$245,000 to go in member loans.

The model complies with Board₁ requirements not to affect the church's cash flow. The loan repayment schedule falls under the current and projected annual fossil fuel system costs - so the church budget/cash flow is unchanged. Moreover, all the loans will be repaid in full in 15 years.

In addition, I added a "perspective" chart that shows the annual church operating budget is about \$900,000. Current "Utilities" line item in the annual budget and the future "100% Sustainable Energy System" cost is less than \$20,000 annually. This is 2% of the church's annual budget that we have been struggling with for a year.

Let me know if you have any questions or find any errors in the spreadsheet model.

We definitely need to see how Green₄'s PACE information fits into financing a complete energy system.

Green₅

After a further exchange of emails indicating schedules conflicts, including a Doodle Poll, somehow 10:00 am on 9 June 2016 turned out to be a time when the eight people involved could get together and discuss the new plan. The next Green First Meeting was on.



Green First Meeting – 9 June 2016

The Green First Team had reserved a classroom at the church for their special meeting at 10 am, but when

the first members arrived, they found the room locked. Fortunately, the Senior Minister was there to let the group in.

The latest spreadsheet model utilizing low-interest (1.5%) member loans was presented by Green₅. He pointed out that without any significant solicitation of church members at large, \$100,000 in donations and \$100,000 in member loans had already been pledged over a three year period (mostly by Green First members). These pledges provided over 40% of the capital needed for the new energy system. Surprisingly, the donations from the Green First members had already lowered the effective cost of the proposed energy system significantly.

When these initial pledges were input into the cash flow spreadsheet model, they made an encouraging impact on the financial feasibility of the project. There was now a glimmer of hope that the remaining capital could actually be raised with member loans.

As the discussion continued, a part-time member who joined the group during the summer months, Green₈, quietly walked around the room and passed out some small pieces of paper she had torn up from a page in her notebook. At a pause in the ongoing discussions, she asked all the Green First members present that morning to write down a number representing an amount they would be willing to "loan" the church for installing a renewable energy system.

There was a moment of silence in the room as folks scribbled down a number. The scraps of paper were then collected and tallied up. To everyone else's surprise, from that small group of Green First members assembled for the meeting, there were now pledges for donations of \$100,000 and for \$200,000 in low-interest loans.⁵⁴

Now, if the BFF Committee would contribute say \$35,000 from the general fund, that would bring the total to \$335,000 out of the \$480,000 goal. Only \$145,000 in additional member loans would be needed to fully fund the 100% Sustainable Energy System Project.

What a great story to carry forward to the upcoming meeting with the BFF Building Committee on 14 June 2016.

Green₅ volunteered to provide the Introduction and history of the project; Green₆ volunteered to update the spreadsheets and present the financial

story to the BFF Committee. Green₄ agreed to present his findings related to our backup plan to use commercial financing under the auspices of the PACE program and possibly reduce the scope of the project to solar only.

Needless to say, every member of the Green First Team was elated. That meeting was definitely a turning point in the morale of the small group. Optimism was as high as it had ever been since the April vote to not fund the renewable energy system. Amazingly, hope was still alive. The 100% Sustainable Energy System project was starting to look like a real possibility again. At least for the moment.

The Green First Team spearheaded a drive to solicit funds in the form of low-interest loans among the congregants who were most dedicated to this project. Green₆ did much of the initial fundraising and found people were surprisingly willing to make a loan (or in a few cases to donate) once they understood the idea and the benefits to both the larger issues of climate change and the long-term benefit to the church operating budget.

The Green First Team recognized that repaying multiple loans from members would put an unwanted burden on the church staff. So Green₁ suggested we form a separate legal entity (e.g. a simple partnership) that receives the monthly “utility” payment from the church and then disperses the funds once a year to the member lenders.

The team now had a comprehensive funding plan to present to the BFF building committee and Board representatives.



About the ERVs (June 2016)

There was some confusion about the Energy Recovery Ventilation (ERV) system that is being added to the heating and cooling system. An active ventilation system is now required by the building code for public buildings regardless of whether the building is heated by burning fossil fuel (e.g. natural gas furnace) or by exchanging thermal energy with the Earth (ground source heat pumps). When the CO₂ levels in the room air reach 800 ppm, a sensor activates the ERV that draws in the fresh air and exhausts stale air.

From: Architect₂

Date: Mon, 20 Jun 2016

To: Green₄

CC: Steven F; Green₅ ; BFF₃

Subject: Re: FW: question on Geothermal and energy numbers

Green₆ and Green₅,

One difference between the existing building energy use and the renovated building ...is the amount of energy that is required to bring in, heat and exhaust the code-required levels of fresh air.

Green₅ Response to Architect₂: Is the ventilation code intended to replace oxygen consumed by fossil fuel burning furnaces/appliances and by people or just by people?

Architect₂ Response to Green₅: The ventilation that we have to add to the church is required by the commercial code to provide fresh air for the occupants. It is a pretty significant amount, so it takes energy to move it and heat or cool it depending on the season.

The current system (that is not up to code) uses residential furnaces that are not bringing in the required fresh air.

This new ventilation is required with either the natural gas or geothermal system.

Green₅ Response to Architect₂: This seems to indicate the ventilation is intended to replace the oxygen used by people and is not linked to combustion appliances.

Architect₂ Response to Green₅: That is correct.

Having the Energy Recovery Ventilators, ERV's will help keep this energy usage lower than a standard fresh air system, but it is the main reason that the energy usage on the ... the new building will be higher than the existing building has historically used.

Green₅ Response to Architect₂: We have been told that the geothermal system requires the ERVs but the gas system does not. Could you explain why?

Architect₂ Response to Green₅: The ERV's are an upgrade to the existing gas system as well, but more critical for [the construction cost of] the geothermal system. We could just bring in the fresh air and run it through the heat exchanger, but that would use much more energy to condition the air. [typically the energy recovery efficiency of an ERV is around 50-60%]

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[The new ventilation code]... requires larger rated furnaces (gas or geothermal) and higher equipment cost. For the Geothermal system, it requires enlarging the bore field/ground loop and possibly higher capacity water circulation pumps that are front-end costs. [For the Natural Gas system, it requires more gas usage and higher operating cost over the 20-year life of the system. For the geothermal system, the source of energy is free so there is a negligible increase in operating cost. Generally speaking, the life cycle cost of a geothermal system is less expensive than a natural gas system regardless of the fresh air ventilation requirements. Plus the geothermal system has zero emissions and from a "true cost" perspective is certainly better for the planet]

Green₅ Response to Architect₂: Thanks again for the explanation.

Architect₂ Response to Green₅: Hope this clears some things up,

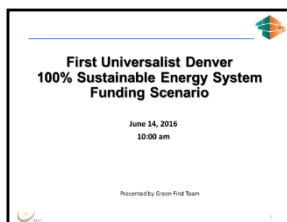
Architect₂, Principal
Barrett Studio Architects

In any case, the ERVs are required and add complexity to the HVAC control system because they must be integrated into the operation of the ten heat pump furnaces. Since the HVAC system was becoming more complex, it was agreed that a commissioning agent (with geothermal experience) be hired to represent the owner's perspective and verify the performance of the total HVAC system. This was an unplanned added cost.

Green First Presentation to BFF Committee/Board of Trustees Representatives (14 Jun 2016)

The Green First Team decided to break the presentation up into three parts. Green₅ would present Part I that provided the history of the proposed 100% Sustainable Energy System. Green₆ then would present Part II, the proposed baseline funding approach, Green₄ would follow-up with Part III, an alternative funding model using commercial loans.

As the story unfolds, you will see the Green First Team struggle to persuade



their fellow church members who were in positions of power regarding church financial decisions that a change in church operations was needed (to respond to climate change.)

The audience for this presentation was the entire Building Committee and several members of 10 person Board of Trustees. One hour was allocated for the meeting.

Background Presented by Green₅

First Universalist Denver 100% Sustainable Energy System Funding Scenario

June 14, 2016
10:00 am

Presented by Green First Team

Agenda – BFF Energy System Meeting

- **Opening Words** (Rev. Senior Minister/BFF₁)
- **Background** (Green₂, Green₅)
- **Baseline Funding Scenario** (Green₆)
- **Backup Funding Scenario** (Green₄)
- **Conclusions & Recommendations** (Green₆)
- **Questions/Concerns /Discussion** (BFF₁)

Background – 100% Sustainable Energy System

- People Involved
 - BFF Committee
 - BFF Sustainability Subcommittee
 - Green First Task Force
- Review of Past Year's Search for & Analysis of Funding Options (PPAs, LLCs, PACE)
- Today's Default System (Fossil Fuel)
 - \$10K-\$15K for new gas furnace & A/C unit currently in the \$4M budget.
- Solar Only Power Purchase Agreement (PPA) - 32% Sustainable (Burn Natural Gas, continued CO₂ emissions)
 - \$140,000 - Prepaid PPA (Capital: Low-Interest Loans; Servicing: From Current Utility Budget)
 - \$223,755 - Pay as You Go over 20-25 years
- Solar & Geothermal - 100% Sustainable Energy System (No Fossil Fuel, Zero Emissions)
 - \$480,000 Total System

- Lease Solar (Pre-Paid PPA) & Buy Geothermal - (Capital: Donations, Low-interest Loans); Servicing: From Current Utility Budget)

Several charts were available that provided a history of significant events over the past year. Only a few key items were actually discussed.

Review of Past Year's Energy System Efforts

2015

- **3 Jun.** Toured church facility with Geothermal installer to assess the feasibility of replacing gas furnaces with geothermal heat pumps.
- **5 Jul.** Sunday Program. Rev. Guest Minister and Green₆ shared a two-part sermon on Climate Change.
- **15 Aug.** Green_{1,5,10} facilitated a workshop at First Universalist on "Responding to Climate Change: A Personal Plan"
 - Included discussions of solar, geothermal heating and cooling and electric vehicles – things we can do personally to reduce GHG emissions.
 - The workshop was attended by about 30 church members including two BFF representatives.
 - At the end of the 3-hour workshop, attendees asked questions. One question was "Will the BFF project include Solar & Geothermal?" BFF responded.
 - About 6 attendees seemed very animated/passionate about the importance of having their church be sustainable. One attendee surprisingly responded, "If I am asked to choose between giving \$200 for a church that was sustainable (solar and geothermal) versus \$100 to a church that wasn't sustainable, I would give \$200 to the sustainable church and nothing to the unsustainable church."
- **21 Aug.** Green_{4,5} invited to present solar & geothermal options to Barrett Studio Architects
 - Learned Architects designed recent JUC renovation project that included solar and geothermal.
- **4 Sep.** BFF Committee created a BFF Sustainability policy statement that included solar and geothermal among a number of other features of the church design.
- **Sep.** Meeting with Architects/Mechanical Engineer. Toured church
 - Architects were off and running to include a 100% sustainable energy system using solar and geothermal.
- **Oct – Dec.** Green First Task Force work continued financial analyses as the architectural team completed the building design
 - Green First continued to evaluate the size of solar and geothermal systems
 - Green First developed financial models, cash flow models and different funding scenarios.

2016

- **21 Jan.** Published results of funding analyses. "Four Funding Scenarios" are listed in order of their monetary gain over a 20-year time frame.
 - Buy & Own the Energy System equipment. Include equipment cost in the BFF budget.
 - Lease solar equipment (~ 85%) using a Power Purchase Agreement (PPA) and buy the remaining equipment from the BFF budget.
 - Buy the Energy System equipment using partial financing. Example: Include 2/3 of cost in BFF budget; finance remaining 1/3 with 15-year loan.
 - Lease solar (~ 85%) using a PPA; Buy the remaining equipment - Include 2/3 in the BFF budget; finance remaining 1/3 with a 15-year loan.

All four funding scenarios indicate that transitioning from a fossil fuel energy system to a renewable energy system will result in financial gain.

Investing \$420,000 (i.e. Scenario #1), is expected to result in a financial gain of \$185,000.

- **16 Jan – Mar.** Green₄ located an LLC model from St. John's Episcopal Church in Boulder
 - Reverse engineered spreadsheet and applied it to First Universalist Energy System
 - LLC takes advantage of the 30% Federal Investment Tax Credit and Equipment Depreciation tax deductions.
 - Works well for investors with significant passive income.
 - Green₁ identified SEC issues in soliciting investors.
 - Could not identify enough investors with passive income at First Universalist to raise the needed capital.
- **22 Jan.** Green₄ provided examples of a Power Purchase Agreement for solar.
 - Did not find any third party sponsored PPA that would fund our whole system (solar and geothermal)
- **10 Mar.** Published Fifth Funding Option - "First Universalist LLC"
 - LLC model was not totally successful for First Universalist
 - Capital required for total energy system exceeded the passive income investor pool.
- **3 Apr.** Congregational Meeting
 - The shortfall in pledges capped project at \$4M
 - Energy System deleted from the project unless "external funding" could be found.
- **4 May.** BFF Meeting with Building Contractor
 - Received updated energy system cost estimates.
 - \$153,562 for 50 kW Solar System; \$325,000 for Geothermal System
 - \$480,000 Total System Cost (2015 Internal Cost Estimate based on preliminary design had been \$420,000)
- **17 May.** Science Talk: "First Universalist Response to Climate Change"
 - The presentation was limited to the science of our proposed Energy System.

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- Discussion at the end turned to funding. Attendees mentioned internal funding using the North Dakota State Bank Model. Discussed issues with member loans.
- After the Science Talk, cash flow spreadsheets were modified to evaluate “low-interest member loans.”
- **7 Jun.** Published “A Simple Approach to Funding a 100% Sustainable Energy System.”
- Funding approach uses a combination of donations and low-interest loans with no change in the operating budget.
- Green First Task Force choose this as a baseline approach.
- Green₆ will present this internal funding approach on 14 June.
- **9 Jun.** Green₄ received a response back from the PACE program
- Will present the backup external funding scenario on 14 June.

So What Will Be Presented to the BFF Committee?

- A proposed 100% Sustainable Energy System with Zero GHG emissions
 - Does use a combination of member donations and low-interest member loans, and
 - Does not require any unfunded up-front capital,
 - Does not change the church operating budget, and
 - Does result in a significant financial gain for the church (relative to doing nothing and continuing to burn ancient hydrocarbons).
- Current Energy Costs (Fossil Fuel System)
 - Annual energy-related costs are currently 2.4% (\$20,000 out of \$830,000) of total operating budget.
 - Cost includes the purchase of “imported” electrical power and natural gas plus replacement of aging gas burning equipment.
 - Cost does not include hidden, ignored social costs (Externalities).

Perhaps the Green First Team focused too much, on “What” physical changes were needed (using facts, figures, reason, and logic, climate science) and did not focus enough on “Why” changes were needed (using ethics, spirituality, their common UU Seventh Principle, indigenous teachings, etc.) But based on informal conversations with individual members of the Building Committee and Board, the Green First Team understood that “Cost” was their major challenge.

For perspective, Figure 20 illustrates the 2016-2017 church operating budget. 91% of the Budget was allocated to the Staff and church Services/Programs. 9% was allocated to building expenses. As indicated, the annual cost of the Energy System (electric and natural gas plus the annual cost of repairing & replacing furnaces) was around 2.4% of the total operating

budget. So the “Cost” of the energy system was not and should not be a major church expense.

The Green First Team was about to learn these four characters C-O-S-T create a frame - a way of thinking and that frame is different for everyone who hears it. The Green First Team probably failed to appreciate the different cost frames of their audience that morning.

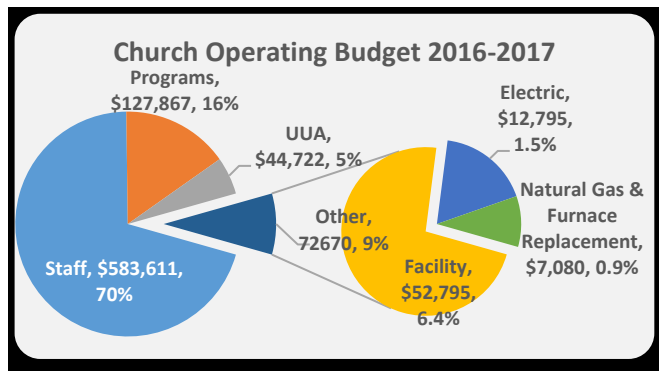


Figure 20 Perspective of Church Operating budget (2016-2017)

Without providing background information, they immediately jumped into a discussion of the Life Cycle Cost Analysis of their proposed new sustainable energy system. This approach takes a 20-year cost perspective and is an appropriate viewpoint when considering an investment in capital equipment that has a design life of 20 years and a significant annual operating cost.

However, if you are listening to the presentation as a member of the ad hoc Building Committee, your primary focus at the time was controlling the estimated construction cost – not the 20-year Life Cycle cost. Finishing the renovation project within the authorized budget and on schedule would be your main concern. Any new proposal that even hints at increasing the front-end construction cost causes a major problem and frankly is unacceptable if it not already fully funded regardless of the Life Cycle Cost.

Likewise, the Green First Team may not have appreciated the cost perspective of the two Board representatives present either. If you only have another year or so to serve on the Board, your primary cost concern is balancing the budget for the current year and possibly the next year. (Actually, the Board was dealing with a \$40,000 shortfall in the operating budget that year.) The Board members did not find an argument that the operating budget in 15 years will be lower to be very compelling.

Even the current Senior Minister was not that enthusiastic about the prospect of reducing the church operating expenses 15 years from now – they would probably be serving another congregation by then. Now, if the proposal would reduce near term operating expenses, even a small amount, that would get their attention. Unfortunately, the soon-to-be-revealed cost analysis was not going to do that.

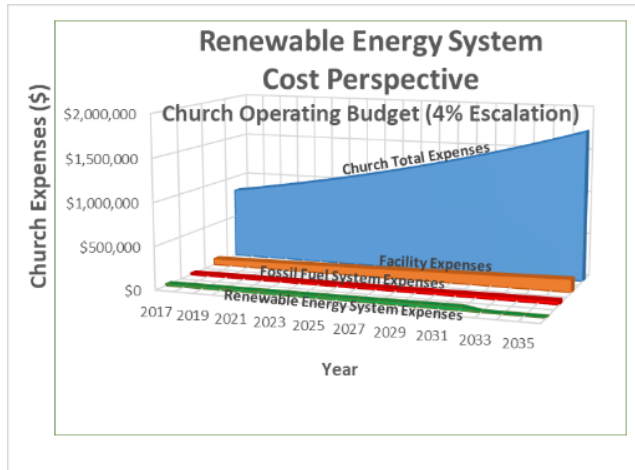
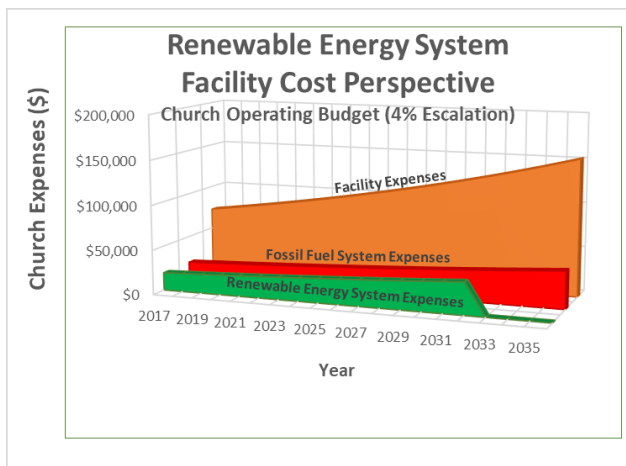


Figure 21 Expected Growth in Operating Budget Over 20 years

Instead, the next two charts illustrated the expected increase in the church operating budget and the Facility expenses over the next 20 years regardless of the type of energy system being used. (See Figure 21 and Figure 21.) Using a nominal 4% annual escalation rate, operating costs would be expected to nearly double over the next two decades. Annual gas and electric bills that are now \$20,000 can be expected to be around \$40,000 in 20 years.



The green profile in Figure 22, represents the

Figure 22 Facility Cost Perspective. Renewable Energy vs. Fossil Fuel costs

operating cost of the new sustainable energy system designed to replicate the monthly cost of the fossil fuel based system so there would be no change in the church operating budget. In 15 years, as indicated, the construction loans for the energy system would be fully paid off. This event would reduce the “utility costs” to a few thousand dollars annually so there will be a significant cost saving/ financial gain beyond 15 years. (See the notch in the green profile for renewable energy.)

The Green First Team continued to focus on the operating cost and presented the chart shown in Figure 23.

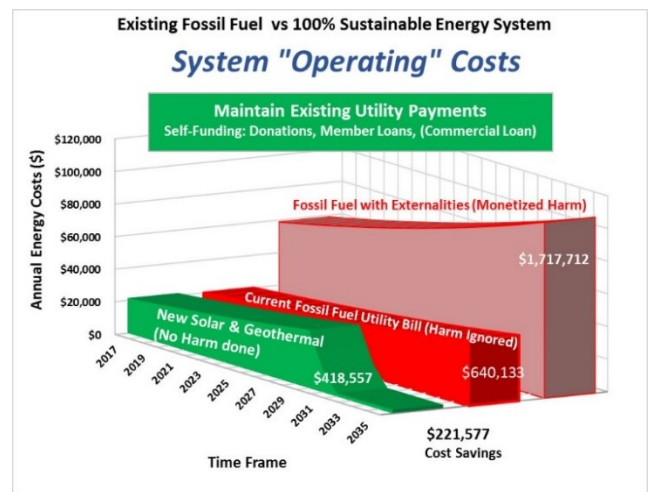


Figure 23 New Energy System Operating Cost

The intent of this chart was two-fold.

First, to emphasize there is a financial gain associated with transitioning from burning fossil fuel to sustainable energy. A comparison of the Life Cycle Costs shows that transitioning from a Fossil Fuel System to a Renewable Energy System is expected to provide a financial gain of more than \$200,000 over 20 years.

Second, the light red “wall” at the back of the chart introduces another consideration intended to make a stronger case for investing in a new sustainable energy system. The intent was to show the **true cost** of operating a fossil fuel based energy system for an honest comparison with the operating cost of a green renewable energy system. The true cost includes the hidden socials (See **Appendix K Externalities** for details) and is based on the work of Paul Epstein et. al.

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of the Harvard Medical Center for Health and the Global Environment.⁹¹ In their detailed study, Epstein et. al. identified and monetized over a dozen hidden social costs associated with coal-fired electrical power generating plants including:

General U.S. Public Externalities

- Land disturbance
- Methane emissions from mines
- Carcinogens (mostly to water from waste)
- Public health burden of communities in Appalachia
- Fatalities in the public due to coal transport
- Emissions of air pollutants from combustion
- Lost productivity from mercury emissions
- Excess mental retardation cases from mercury emissions
- Excess cardiovascular disease from mercury emissions

Global Community Externalities

- Climate damage from combustion emissions of CO₂ and N₂O
- Climate damages from combustion emissions of black carbon

Epstein's study results are incorporated in the last row of the chart in Figure 23 labeled "Fossil Fuel with Externalities (Monetized Harm)."

*[Note: After the presentation, a Board representative advised the Green First Team to exclude the discussion of "Externalities" in future presentations. The Board member indicated externalities just made the discussion more complicated. Know your audience. Ironically, knowing the **true cost** of unsustainable human behavior can be a powerful motivation for change. Appendix K Externalities provides an additional discussion on this topic.]*

To the Green First Team, the most important consideration was that the proposed renewable energy system (e.g. solar electric and heat pump heating and cooling) would allow the church to stop doing harm to the interdependent web of life. To them, eliminating this self-inflicted injurious behavior is not only possible, but it is also mandatory. To them, our current ecocidal behavior was recognized as an existential threat to human life, to all complex forms of life and it must stop.

In preparation for this initial presentation to the Building Committee and Board, The Green First Team had "done its homework" in analyzing the church energy usage and quantifying the amount of harm the church was doing relative to climate change (Item #10 on Epstein's list). It is interesting to observe that all of

the social costs evaluated in the Harvard Medical Center are eliminated by transitioning to renewable energy.

A summary of that harm related to climate change follows.

Starting with the energy usage during the previous year, the utility bills indicated the church had used 72,040 kWh of electrical energy and 5196 therms of natural gas. That is total energy usage of 224,283 kWh.

Knowing the type and quantity of energy used, the Team could identify and quantify the amount of GHG emissions the church was generating by burning ancient hydrocarbons as an energy source.

The harm is hard for humans to envision. We have limited eyesight and cannot see greenhouse gases with the naked eye. If we could see into the infrared portion of the electromagnetic spectrum (as some nocturnal species can do), we might see something like that depicted in the next graphic.

These GHG Emissions are doing Harm

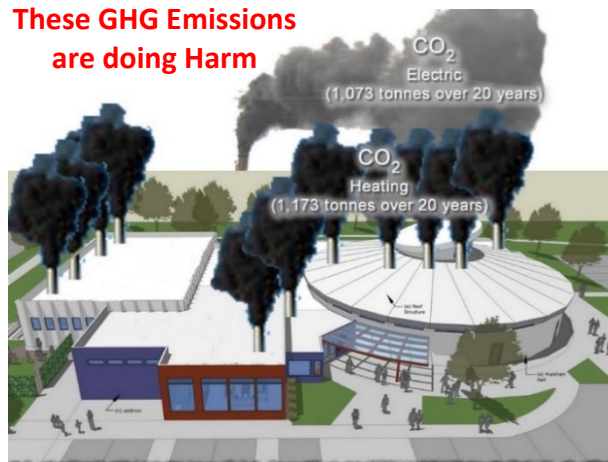


Figure 24 Quantifying the Harm Caused by Burning Ancient Hydrocarbons

(Notice the distant Xcel generating plant depicted on the horizon spewing out a huge plume of CO₂.)

Figure 24 illustrates that by continuing to buy 72,040 kWh of electrical power from Xcel Energy annually; First Universalist is responsible for dumping 54 tonnes of CO₂ eq into the atmosphere annually. That is 1,073 tonnes of CO₂ eq added to the atmosphere over the next 20 years.

Using the utility bills, the Green First Team was able to quantify additional harm caused by its natural gas furnaces. By continuing to burn natural gas for heating the facility, the church would consume 5196 therms of natural gas annually. As a result, First

Universalist was on a path to add around 59 tonnes of CO₂ per year to the atmosphere. That would be 1,173 tonnes of CO₂ over 20 years as graphically indicated in Figure 24.

In summary, the existing church facility at the time was contributing about 113 tonnes of CO_{2eq} per year to global warming because they were using an energy system that burned ancient hydrocarbons.

Generally, the amount of GHG in the atmosphere is expressed as “parts per million.” The amount of carbon dioxide produced by burning a quantity of ancient hydrocarbons is often expressed in metric tonnes.⁵⁵ Figure 25 illustrates how much volume 1 metric tonne of CO₂ would occupy at sea level pressure.

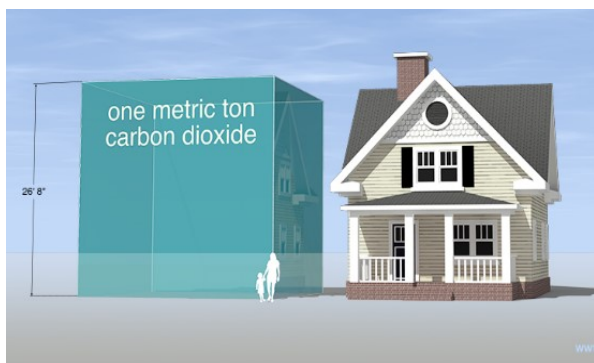


Figure 25 One Metric Tonne of CO₂ (sea level pressure) Ref: Carbon Visuals. See Factoid A.9

The Green First Team found that if the church only added rooftop solar to avoid the Xcel CO₂ emissions linked to generating 72,040 kWh per year, they would only be “greening” 32% of their energy usage as shown in Figure 26.

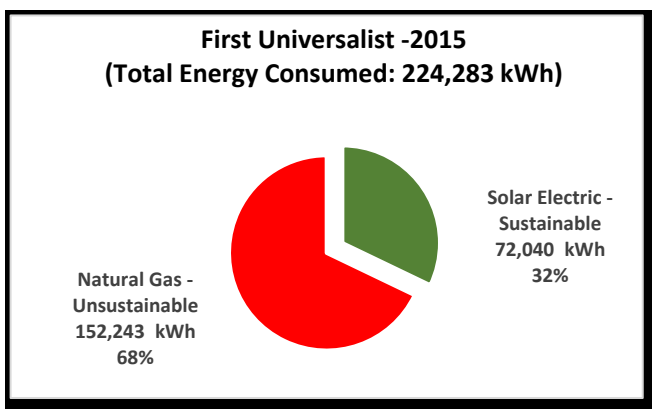


Figure 26 Greening Electric Energy Usage

A “Solar Only” response to climate change would have eliminated over 50 tonnes of CO_{2eq} each year;

however that was only half of church GHG emissions as depicted in Figure 27.

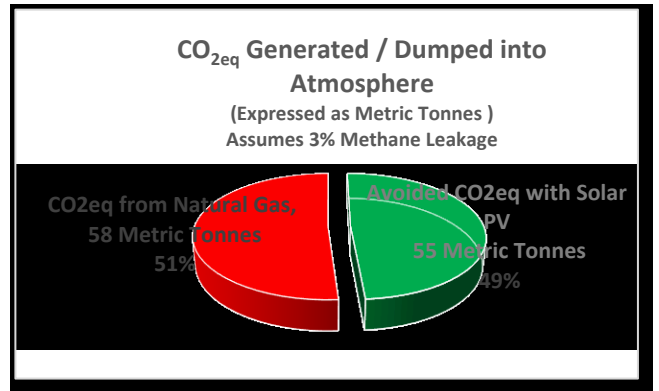


Figure 27 CO_{2eq} Remaining with a Solar Only Transition.

With solar PV panels installed on the roof, they could reduce their emissions by around 50%, but the CO_{2eq} emissions linked to burning natural gas would continue as illustrated in Figure 28.

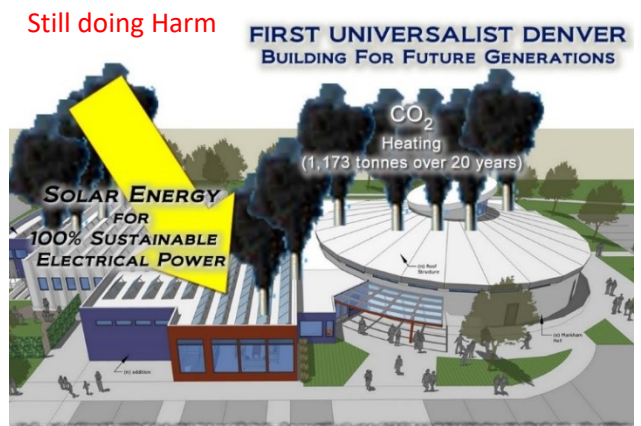


Figure 28 Adding Solar PV would reduce GHG Emissions by 50%.

After the December 2015 Paris Agreement, the Green First Team became aware of new frames of reference. For example, terms like “Carbon Budget” for a 1.5°C or 2° C planet; “Remaining Carbon Budget,” and “Zero GHG Emissions.” The proposed energy system was “all in” meaning it included both solar and geothermal with zero GHG emissions.

The proposed solar/geothermal system was sized to provide all the electrical power needed to operate the church on an annual basis and provide all the heating & cooling needs of the church – with zero GHG emissions. The church would stop “importing” energy

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derived from burning ancient hydrocarbons and begin “harvesting” local energy that was already on site.



Figure 29 Vision of the Proposed 100% Sustainable Energy System for First Universalist.

As the story unfolds, it was discovered after this presentation that the BFF Committee preferred a less ambitious goal involving rooftop solar only that would have minimized the front end/construction cost.

Background Summary

VISION. The BFF Project is our opportunity to complement the outstanding Human Energy of First Universalist Denver with an exemplary sustainable facility Energy System that is in right relationship with our interdependent web of life.

CONCLUSIONS.

- A 100% Sustainable Energy System that does no harm is consistent with our UU principles and our responsibilities as Global Citizens, as Parents, as Grandparents.
- Compared to our current fossil fuel burning system, a renewable energy system will save money for the church over the next 15-25 years.
- An assessment of financing options concluded that internal funding using a combination of donations & low-interest loans seems to provide the best financial gains for First Universalist.
- Donations are nearly tapped out; Member Loans to the church appear to be a possible source of capital for purchasing the new energy equipment.
- A Partnership of lenders will be formed to avoid adding administrative work for the church staff
- There will be no unfunded upfront cost.

- There will be no change in the operating budget.
- A significant financial gain (around \$100,000 to \$150,000) is expected over the next 20 years.

Baseline Funding Scenario by Green₆ (14 Jun 2016)

Another member of the Green First Team, Green₆ Presentation Part II. After a few introductory charts, he provided a detailed discussion of the funding approach for the proposed 100% Sustainable Energy System.

Green First Energy System Baseline Funding Scenario

June 14, 2016

10:00 am

“Seeing a broken world, we seek to fix it.”

... Rev. Jeannie Shero, June 12, 2016



1

The “Outline” chart indicated there would be a presentation of the System’s installation costs as well as the operating costs. The decision had been made to use a Pre-Paid Power Purchase Agreement with a third party (who could qualify for the federal Investment Tax Credit and equipment depreciation for tax deductions) to acquire the Solar PV system thereby minimizing the church cost to under \$2.50/Watt. The Green First Team did not identify a third party willing to take on the funding of the Geothermal Heat Pump HVAC system, so the decision was made to just buy it and try to finance it internally.

The presentation would explain the cash flow spreadsheet model that further explains the funding approach. A brief description of potential risks would be followed by Conclusions and recommendations.

Outline



- **Baseline Funding Scenario: Solar & Geothermal**
- **100% Sustainable Energy System**
 - Installation Cost
 - Cost to operate / Life cycle Cost
- **Lease Solar (Pre-Paid PPA) & Buy Geothermal**
 - Financed by member donations and low interest member loans through a Green First Energy Cooperative.
- **How the loan repayment works – cash flow spreadsheets**
 - 29% externally funded scenario
 - 100% internally funded scenario
- Risk assessments
- **Conclusions & Recommendations**

As indicated in the chart below, there were a number of constraints placed on the funding approach. Some third parties would lease the equipment for six years but then expect a buyout payment. The proposed funding approach does not involve a buyout. The “monthly/annual utility payments” for the new system would mimic the existing payment to Xcel Energy

Cost and Constraints



- No balloon payments or other buyout payments
- Annual costs not to exceed current utility expenditures
 - Electric, gas (\$16,625 in 2015)
 - Furnace and AC replacements (\$3,250/year) – based on current ages and expected service life
 - Total costs for existing fossil fuel system: **\$19,875/year**
- **Included expenses for Renewable Energy System**
 - A 50kW Solar PV system on roof
 - 20 year maintenance part of the \$140,000 cost
 - Xcel connection fees
 - Geothermal Heat Pumps & Ground Loop for heating and cooling
 - 10 furnaces, total \$125,000
 - Ground Loop, \$207,000
 - Annual system servicing fees
- Total cost \$480,000 including \$7,800 for misc. expenses

At this point Green₆ presented the Cash Flow Spreadsheet Model for Case # 1 that represented the current status of the Green First campaign to solicit funds for the new energy system. See Figure 30. **Observations from the 20 Year Financial Model.** This example provides a status of the funding effort for the energy system at the time of the presentation (Jun 2016). It also illustrates how the spreadsheet model works.

Approach



- Lease Solar (Pre-Paid PPA) & Buy Geothermal
 - PP-PPA can be explained in more detail by Green First later
- Current “utility bills” (\$19,875 / year) will be redirected to loan payments
- No additional Up-Front Money. No change in operating budget
- We have pledges for \$100,000 as “seed money”
 - We need to raise an additional \$35,000
- We have loan commitments for \$200,000
 - We need an additional \$145,000 in loans
 - 15 year term loans at 1.5%
- If needed, commercial loan for short fall at 6% interest
- See spreadsheets for details for 20 years

The total “**System cost**” is \$480,000. The “**Current Outlays – Utility Payments**” for energy expenses are \$19,875. The Building Fund is providing \$35,000 identified as “**Additional Cash Contribution**” to support the energy system there reducing the effective cost of the project to \$445,000. Members have pledged \$100,000 identified as “**Dedicated Pledges for Energy System**” bringing the amount to be financed to \$345,000. At this point in time, members have agreed to loan the church money \$245,000 identified as “**Financed by Member Energy Loans.**” The terms of the member loans are a 15 year period at a 1.5% interest rate. If no other capital can be obtained from the members, the project would need a \$100,000 loan from a commercial bank with probably a 6% interest rate.

An interesting feature of this particular financial model is the flexibility to accommodate a commercial loan in the event there is a shortfall in raising the needed capital from the congregation. To comply with the ground rule that the church operating budget will not increase, the sum of the repayment of the bank loan and member loan cannot exceed the annual utility expense. But the commercial loan has precedent – so the model first pays off the bank loan, then uses the remaining funds for the member loans. So in this case during the first nine months, the member repayment will be less than a traditional loan repayment and deferred to later. As the utility payments increase with time due to inflation, around year ten, the members start receiving a larger repayment than expected for a standard loan. In the end, the bank is repaid fully as are the member lenders with interest.

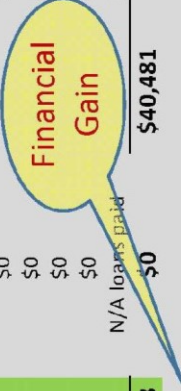
Table 3 CASE # 1 Donations (21%) Loans (79%) - Loans: Member Loans (71%) Plus Commercial Loan (29%)

BASELINE PROPOSAL		"MAINTAIN EXISTING UTILITY PAYMENTS"		MEMBER LOAN FINANCING -		71% COMMERCIAL LOAN -		29%			
Current Electric & Gas Utility Annual Bill		\$16,625	(2015 Actuals)	Xeol hookup				\$660			
Annualized Equipment Replacement Cost		\$3,250	var (Ref: ASHRAE)	Equip servicing				\$650			
Total		\$19,875		Annual Operating Expense				\$1,310			
"MAINTAIN EXISTING UTILITY PAYMENTS" SCENARIO											
100% Sustainable Energy System Cost		\$480,000		Fraction of Total Renovation Project Cost		10.0%					
Additional cash contribution		\$35,000		Additional Cash Contributions from BFF		1%					
Dedicated Pledges for Energy System		\$445,000		Inflation rate		3%					
Financed by Member Energy Loan		\$345,000	(21%)	Fuel cost escalation		2%					
Financed by Commercial Energy Loan		\$245,000	71%	Interest Rate		1.5%					
20 Year Life Cycle Cost (Renewable)		\$100,000	29%	Interest Rate		6.0%					
20 Year Life Cycle Cost (Fossil Fuel)		\$458,108		Total Loans		\$425,642					
20 Year Savings with Solar/Geothermal		\$182,025									
<div style="display: flex; justify-content: space-around;"> <div> <p>System Costs</p> <p>for 15 years @ 29%</p> </div> <div> <p>Loans</p> <p>for 15 years @ 6.0%</p> </div> </div>											
Year	Fossil Fuel Utility Bill plus Replacement	New Operating Cost	Commercial Loan Servicing	Member Loan Servicing	Disbursement to Members	New Utility Bill	Deferred payments	Interest payments by church	Cum Utility Cost	Cum Disbursement to Members	Annual Payout on loans / 1K Share
2017	\$21,497	\$1,336	\$10,126	\$18,250	\$10,034	\$21,497	\$8,216	\$1,054	\$21,497	\$10,034	\$41
2018	\$22,357	\$1,363	\$10,126	\$18,250	\$10,867	\$22,357	\$7,382	\$1,141	\$43,853	\$20,902	\$44
2019	\$23,251	\$1,390	\$10,126	\$18,250	\$11,734	\$23,251	\$6,515	\$1,232	\$67,104	\$32,636	\$48
2020	\$24,181	\$1,418	\$10,126	\$18,250	\$12,637	\$24,181	\$5,613	\$1,327	\$91,285	\$45,273	\$52
2021	\$25,148	\$1,446	\$10,126	\$18,250	\$13,576	\$25,148	\$4,674	\$1,426	\$116,434	\$58,849	\$55
2022	\$26,154	\$1,475	\$10,126	\$18,250	\$14,553	\$26,154	\$3,697	\$1,528	\$142,588	\$73,401	\$59
2023	\$27,200	\$1,505	\$10,126	\$18,250	\$15,569	\$27,200	\$2,681	\$1,635	\$169,788	\$88,970	\$64
2024	\$28,288	\$1,535	\$10,126	\$18,250	\$16,627	\$28,288	\$1,623	\$1,746	\$198,076	\$105,598	\$68
2025	\$29,420	\$1,566	\$10,126	\$18,250	\$17,728	\$29,420	\$522	\$1,862	\$227,496	\$123,326	\$72
2026	\$30,597	\$1,597	\$10,126	\$18,250	\$18,873	\$30,597	(\$624)	\$1,982	\$258,093	\$142,199	\$77
2027	\$31,821	\$1,629	\$10,126	\$18,250	\$20,065	\$31,821	(\$1,816)	\$2,107	\$289,913	\$162,264	\$82
2028	\$33,093	\$1,661	\$10,126	\$18,250	\$21,306	\$33,093	(\$3,056)	\$2,237	\$323,007	\$183,570	\$87
2029	\$34,417	\$1,695	\$10,126	\$18,250	\$22,596	\$34,417	(\$4,346)	\$2,373	\$357,424	\$206,166	\$92
2030	\$35,794	\$1,729	\$10,126	\$18,250	\$23,939	\$35,794	(\$5,689)	\$2,514	\$393,218	\$230,105	\$98
2031	\$37,226	\$1,763	\$10,126	\$18,250	\$25,336	\$37,226	(\$7,086)	\$2,661	\$430,443	\$255,441	\$103
2032	\$38,715	\$1,798	\$1,798	\$18,250	\$18,306	\$20,105	(\$18,306)	\$0	\$450,548	\$273,748	\$75
2033	\$40,263	\$1,834	\$0	\$18,250	\$0	\$1,834	\$0	\$0	\$452,382	\$273,748	\$0
2034	\$41,874	\$1,871	\$0	\$18,250	\$0	\$1,871	\$0	\$0	\$454,253	\$273,748	\$0
2035	\$43,549	\$1,908	\$0	\$18,250	\$0	\$1,908	\$0	\$0	\$456,161	\$273,748	\$0
2036	\$45,291	\$1,947	\$0	\$18,250	\$0	\$1,947	\$0	\$0	\$458,108	\$273,748	\$0
Total Loan Payments		\$332,466	\$151,894	\$273,748	\$273,748	\$458,108	\$0	\$26,825	\$425,642	\$273,748	\$0
Total Loan Payments		\$425,642	\$425,642	\$273,748	\$273,748	\$182,025	\$0	\$26,825	\$425,642	\$273,748	\$0

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Table 4 CASE # 2 Donations (21%) Loans (79%) - Loans: Member Loans (100%) Plus Commercial Loan (0%)

BASELINE PROPOSAL		"MAINTAIN EXISTING UTILITY PAYMENTS"		MEMBER LOAN FINANCING -		100% COMMERCIAL LOAN -		0%			
Current Electric & Gas Utility Annual Bill		\$16,625 (2015 Actuals)		Xcel hookup		\$660					
Annualized Equipment Replacement Cost		\$3,250 (Ref: ASHRAE)		Equip servicing		\$650					
Total		\$19,875		Annual Operating Expense		\$1,310					
"MAINTAIN EXISTING UTILITY PAYMENTS" SCENARIO											
100% Sustainable Energy System Cost		\$480,000		10.0% Fraction of Total Renovation Project Cost							
Additional cash contribution		\$35,000		1% Additional Cash Contributions from BFF							
Dedicated Pledges for Energy System		\$445,000		2% Inflation rate							
Financed by Member Energy Loan		\$100,000 (21%)		2% Fuel cost escalation							
Financed by Commercial Energy Loan		\$345,000		1.5% Interest Rate		\$385,481 (Member Lender Gain)					
20 Year Life Cycle Cost (Renewable)		\$0		6.0% Interest Rate		\$0 (Wall Street Gain)					
20 Year Life Cycle Cost (Fossil Fuel)		\$417,948		Total Loans		\$385,481					
20 Year Savings with Solar/Geothermal		\$640,133									
		\$222,186									
Year	Fossil Fuel Utility Bill plus Replacement	New Operating Cost	Commercial Loan Servicing	Member Loan Servicing	Disbursement to Members	New Utility Bill	Deferred payments	Interest payments by church	Cum Utility Cost	Cum Disbursement to Members	Annual Payout on loans / 1K Share
2017	\$21,497	\$1,336	\$0	\$25,699	\$20,161	\$21,497	\$5,538	\$2,117	\$21,497	\$20,161	\$58
2018	\$22,357	\$1,363	\$0	\$25,699	\$20,994	\$22,357	\$4,705	\$2,205	\$43,853	\$41,154	\$61
2019	\$23,251	\$1,390	\$0	\$25,699	\$21,861	\$23,251	\$3,838	\$2,296	\$67,104	\$63,015	\$63
2020	\$24,181	\$1,418	\$0	\$25,699	\$22,763	\$24,181	\$2,936	\$2,390	\$91,285	\$85,778	\$66
2021	\$25,148	\$1,446	\$0	\$25,699	\$23,702	\$25,148	\$1,997	\$2,489	\$116,434	\$109,480	\$69
2022	\$26,154	\$1,475	\$0	\$25,699	\$24,679	\$26,154	\$1,020	\$2,592	\$142,588	\$134,159	\$72
2023	\$27,200	\$1,505	\$0	\$25,699	\$25,696	\$27,200	\$3	\$2,698	\$169,788	\$159,854	\$74
2024	\$28,288	\$1,535	\$0	\$25,699	\$26,753	\$28,288	(\$1,055)	\$2,810	\$198,076	\$186,608	\$78
2025	\$29,420	\$1,566	\$0	\$25,699	\$27,854	\$29,420	(\$2,156)	\$2,925	\$227,496	\$214,462	\$81
2026	\$30,597	\$1,597	\$0	\$25,699	\$29,000	\$30,597	(\$3,301)	\$3,045	\$258,093	\$243,462	\$84
2027	\$31,821	\$1,629	\$0	\$25,699	\$30,192	\$31,821	(\$4,493)	\$3,171	\$289,913	\$273,654	\$88
2028	\$33,093	\$1,661	\$0	\$25,699	\$31,432	\$33,093	(\$5,733)	\$3,301	\$323,007	\$305,086	\$91
2029	\$34,417	\$1,695	\$0	\$25,699	\$32,722	\$34,417	(\$7,024)	\$3,436	\$357,424	\$337,808	\$95
2030	\$35,794	\$1,729	\$0	\$25,699	\$34,065	\$35,794	(\$8,366)	\$3,577	\$393,218	\$371,873	\$99
2031	\$37,226	\$1,763	\$0	\$25,699	\$13,608	\$15,371	\$12,091	\$1,429	\$408,589	\$385,481	\$39
2032	\$38,715	\$1,798	\$0	\$0	\$0	\$1,798	\$0	\$0	\$410,387	\$385,481	\$0
2033	\$40,263	\$1,834	\$0	\$0	\$0	\$1,834	\$0	\$0	\$412,222	\$385,481	\$0
2034	\$41,874	\$1,871	\$0	\$0	\$0	\$1,871	\$0	\$0	\$414,093	\$385,481	\$0
2035	\$43,549	\$1,908	\$0	\$0	\$0	\$1,908	\$0	\$0	\$416,001	\$385,481	\$0
2036	\$45,291	\$1,947	\$0	\$0	\$0	\$1,947	N/A loans paid	\$0	\$417,948	\$385,481	\$0
Total Loan Payments		\$32,466		\$0		\$417,948		\$0		\$40,481	
Total Loan Payments		\$32,466		\$385,481		\$385,481		\$385,481		\$385,481	
				Savings							
				\$385,481							



Part IV Energy System Capital Campaign

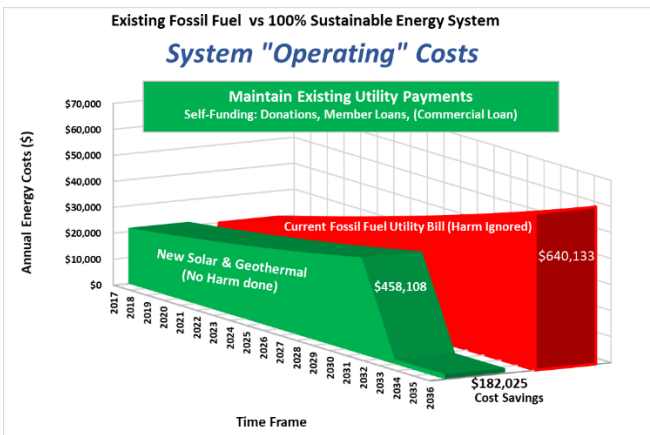


Figure 30 CASE # 1 71% Member Loans; 29% Commercial Loans

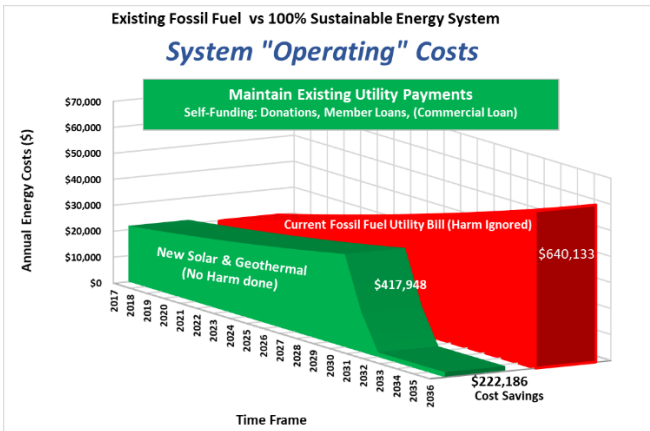


Figure 31 CASE #2 100% Member Loans

Risk analysis



- Solar only option leaves existing fleet of old gas furnaces
 - Based on age, the next furnace(s) to fail could be anytime
 - Limited reduction of carbon footprint
 - 2/3 of our energy use is due to heating and cooling.
 - We will still be dumping 1/2 of our CO₂ into the atmosphere.
 - Cost to install geothermal later as a retrofit will probably be higher - with little enthusiasm for another capital campaign
 - Less protection against carbon tax on fossil fuel (next slide)
- Geothermal technical risks
 - With sound construction oversight during installation, the ground loop should last 50 to 200 years
 - Heat pump technology is well understood. It's used in your refrigerator.
 - Many geothermal systems are installed and operating successfully (e.g. several UU churches including Jefferson UU).
- Budgetary risks: the church is always short of money and won't pay its loan commitments



Summary and Conclusions



- Green First proposes installing both the solar and geothermal systems to achieve zero GHG emissions
 - Our stated financial commitments would have to be re-examined without the geothermal component
 - We should be as responsible as many other UU churches (and IKEA).
- We think there should be an opportunity for everyone to contribute something, no matter how small.
- The church will have a stable and predictable "utility budget" protected against fuel cost growth, carbon taxes, etc.
- *Worship the homeless and the poor. They contribute not to climate change. It is we the more affluent who are responsible and it is we who must assure the future of humanity. This special opportunity must not be wasted.*



Backup Funding (PACE) by Green4

Part III of the presentation was provided by Green4. The Property Assessed Clean Energy (PACE) Program is an alternative method of financing the project that was explored. This approach is often a good option for the for-profit business sector. It uses commercial financial institutions and commercial interest rates. As a result, it was not as cost competitive as the low-interest member loans. As illustrated in the figure below, the PACE funding over a 20 year period would cost \$588,700 whereas a member-funded plan would cost only \$417,948. It should be noted that the PACE-funded transition to solar/geothermal still resulted in a financial gain of \$81,439 when compared to using fossil fuel.

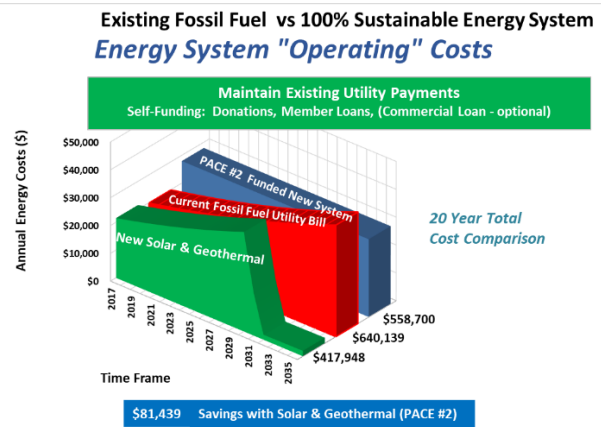


Figure 32 A PACE Funded Transition to Renewable Energy (less expensive than burning fossil fuel)

Post Presentation Observations

After the presentation, the Green First Team was encouraged. It appeared the response from the Board of Trustees was positive. In the end, Board₁ volunteered to meet with the Green First Team to work out a funding scenario that the Board would find more acceptable. A meeting was immediately set up for the following week with an expectation there would be a good exchange of information and perspectives.

The Green First Team was puzzled why anyone would be opposed to transitioning to a renewable energy system, especially if:

- a) the operating budget remains the same,
- b) there is no front-end cost,
- c) the facility stops harming the planet's habitability, and
- d) there is a financial gain after 15 years.

They would be even more surprised by what was about to occur next.



BFF Preferred Energy Option (15 Jun 2016): “Solar Now; Geothermal Ready”

The day after the Green First Team presentation to the Board, the BFF Committee sent out an email provided below.

Although not intended to do so, it “blindsided” the Green First Task Force because nothing along these lines had been mentioned the day before at the meeting with the Board. As it turned out, the BFF Integration Team (a subcommittee of the BFF Committee) had a preferred Energy Option.

From: BFF₁

Date: Wednesday, June 15, 2016

To: Green_{1,2,4,5,6}; BFF_{2,3,4}; Senior Minister; Board₁;

Subject: BFF Solar Now; Geothermal Ready option

Thanks, everyone for the hard work and positive discussion yesterday. While some questions remain, all of us appreciate the careful work and analysis that was evident in both presentations. Both are creative approaches to reach our goal of sustainability.

We think everyone knows that BFF has been considering a **Solar Now; Geothermal Ready** option as a fallback to the Green First Team's proposal. We were prepared to share a draft of this option yesterday, but the discussion and the amount of time available did not allow it.

Make no mistake, we understand fully that the Green First Team does not support this approach. There may be some ideas in here that are helpful or this may represent a part of the solution should we need to develop a phased approach as the process goes forward. Mostly, we are not comfortable with the idea that there was some "secret" document out there that we hadn't shared with you.

I feel like I should "duck" as I press the Send button, but the BFF folks feel it better to share our thinking going into yesterday's meeting than to pull it out sometime later if needed.

BFF₁

Although BFF₁ placed a number of caveats in his email (e.g. Thanks everyone for the hard work, positive discussion) the BFF Committee wanted a different approach they called “Solar Now: Geothermal Ready.” Their rationale was explained in an attachment.

Here's is how it appeared.



BFF Integration Team Preferred Energy Option

Solar Now; Geothermal Ready Option

Draft of June 13, 2016

The thorough analysis by Green₅ of a 100% Sustainable Energy System for First Universalist provides a basis for considering an additional option that First Universalist has for achieving energy sustainability. Green₅'s analysis focused on an approach that we have called "all-in," or "net-zero,"—that is, an approach that would achieve net-zero dependence on fossil fuel by investing up front in both a photovoltaic energy system as well as a complete geothermal system. Combining both systems into one analysis allows us to see clearly the relationship between up-front costs, fossil fuel reductions, and potential energy cost savings of each system. The cost of the two systems combined is estimated now at \$490,000 additional cost, including \$158,000 for solar (32% of total energy sustainability investment) and \$332,000 (68% of total investment) for geothermal.

The analysis further shows that electrical energy is the source of 32% of the church's energy consumption. There is a small percentage of our electrical use that is powered by wind and solar—around 6% of our total current use comes from these renewable sources through our purchase of electrical energy from Xcel. Ninety-four percent of our energy **use** currently is from non-renewable fossil fuel. Natural gas is 68% of the current use and non-sustainable electric makes up 26% for a total non-renewable use of 94%.

Green₅'s analysis makes a compelling UU values case for a complete system but that result is difficult to achieve financially. The analysis also revealed a number of realities about what we can achieve in a short-time frame with a more affordable investment. This option, which we are calling the **Solar Now; Geothermal Ready Option**, would mean investing in a full photovoltaic system at the time of construction and paying for the investment through energy savings over a period of years. The building is designed to accept geothermal at a later date.

Additional sustainable energy investments could be made by the congregation in the form of off-sets of our natural gas use, or perhaps through addition of geothermal or other new systems at a later date. We asked the contractor if the geothermal system would have a much greater cost if added later. His response was that it would not, because we are sizing the ductwork appropriately at this time. The loop and the geo units could be added and connected at any time without greater costs.

We could achieve a significant reduction in fossil fuel dependence with an investment in solar. Instead of only 6% renewable energy, our sustainable energy profile would move to at least 32% sustainable energy with this investment alone.

A full investment in geothermal would complete a net-zero scenario but natural gas use does not account for the greatest amount of energy **expense** of the church. Our 2016 annualized cost of energy is \$19,000 per year. Since electric accounts for seventy-eight percent of our energy **costs**, installing solar will provide a major savings.

Installing geothermal at a cost of \$332,000 would take us to net zero use of fossil fuels but represents a cost savings of only 22%. To summarize:

	Cost now (annualized)	% of cost	Energy use
Gas	\$4,265	22%	68%
Electric	\$14,750	78%	32%
TOTAL	\$19,015	100%	100%

In the future, we should see our electrical bill go to zero while the cost of gas is expected to decline. Additionally, with the numerous investments in energy efficiency already designed into the construction (and budgeted for), we actually will see a reduction in use of natural gas even with the increased square footage in the building. Such features as new energy efficient windows and doors, LED lighting, greater insulation, a new roof, account for at least \$200,000

We are substituting electric appliances for gas as well. We do not know how to estimate the cost of the design work, improved mechanical systems, and use of recycled material and green construction techniques that are additional to these specific investments but they do represent an important investment already committed.

The table below provides three options and a recommendation for moving forward with the solar option.

SOLAR NOW; GEOTHERMAL READY						Available dollars from operating budget (electrical charges) - annual
Cost = \$158,000						
Financing options	Amount to finance	Finance rate	Years	Monthly cost	Annual Cost	
Option 1. ZERO GIFT SUPPORT	\$158,000	5%	10	\$1,675.84	\$20,110.08	\$14,750
			15	\$1,249.45	\$14,993.40	
Option 2. \$50K GIFT SUPPORT	\$108,000	5%	10	\$1,145.51	\$13,746.12	
			15	\$854.06	\$10,248.72	
Option 3. \$100K GIFT SUPPORT	\$58,000	5%	10	\$615.18	\$7,382.16	
			15	\$458.66	\$5,503.92	
Recommendation: Raise \$58K; borrow \$100K						
	\$100,000	5%	10	\$1,060.66	\$12,728	\$14,750

In addition to considering the financial implications of either option, we are fully aware of and support the value proposition that is articulated by the Green Team’s approach. However, we have struggled to balance those values with a wide array of values implicit in the choices we are making in implementing this building project while remaining within the resources available. These choices include such values as energy efficiency, improved aesthetics, appropriate educational and programming space, and safety and health improvements in our facility. These values are well expressed in the Vision Statement for the Building for the Future project, adopted by the congregation almost two years ago.

We believe that the church has a responsibility to do what it can do toward energy sustainability within its fiduciary responsibility to the congregation. We suggest that the Board appoint a committee charged with evaluating our energy usage and exploring options going forward reporting annually both on our energy usage, our progress toward eliminating fossil fuels as well as advising regarding technology advances and alternatives that we might consider as we consider other investments in our mission and goals.

It is difficult to describe the impact this message from the BFF Building Committee had on the Green First Team. Based on subsequent correspondence, it was obviously significant. Here is a sample of responses from some of the Green First Team members.

Response to BFF Geothermal Ready Proposal from Green₄

From: Green₄
To: BFF_{1,2,3,4}; Green_{1,2,5,6,7}; Senior Minister; Board_{1,5}
Sent: Sunday, June 19, 2016
Subject: BFF Solar Now; Geothermal Ready option

BFF₁, and the BFF Integration Team,

As I read and re-read the draft attachment BFF₁ sent on Wednesday (BFF ITM Preferred...) I started at first trying to flag some technical corrections and information errors, but quickly discovered that I could not edit that version of the document – principally because it seems like the wrong message (with incorrect message points) to put to the Board – starting with the filename.

So my edits resulted in an alternate document with a different file name and that is also attached. Here are the framing and reasoning of what I would kindly ask the Team to reconsider in its message to the Board.

- The Team has just received two very similar proposals for an All-In “do no harm” energy system backed by combined hours of research and analysis

Part IV Energy System Capital Campaign

that number in the hundreds over approximately 9 months. They differ mostly in the blend of outside vs inside funding. So while the Team may have good reasons to show an alternate scenario and recommend it over these two approaches, it is important to present that alternate as a financial choice alongside the other two approaches.

- The Table in BFF₁'s draft shows the Board three slightly different blends of member and outside financing on the same scenario. There is very little difference in what looks like three scenarios and I know I would be confused by looking at these and might think this is the summary of everything the Team examined. So I strongly suggest replacing that table with one that conveys what the Team has learned and compares two approaches, All-In and Solar-Only. See attached.
- The "All-In" scenario has two approaches that the Board needs to consider because of the implications of either more or less member financing. So that scenario is labeled as 1.a and 1.b while Solar only is labeled as 2.0.

You will see that I spell out in my edits – wearing the Team hat – that there can be no doubt that since solar is a lower cost part of the energy system and offsets a higher portion of energy, that its "ROI" is faster and greater than the All In scenarios. That is obvious. For better or worse, I think it is a dangerous predisposition. Any pure financial business decision should and would go with a Solar Only option. My edits parallel BFF₁'s, putting forward a "qualified" "financial only" recommendation for Solar Only while making clear that the Board should consider both approaches taking into careful consideration congregation values, member expectations, and impacts.

Importantly, when Geothermal is blended in, while it drags down that Solar ROI, it does not eliminate it. Thus, the way in which 1.a and 1.b are posed, they contribute to reducing the total 25-year total building + energy financing + energy operating cost of the project just as Solar Only does. And with zero or minimal impact. (often referred to as a "no-brainer")

And therein lies the importance of what the Green First group is putting forward. This is a church with members and with values. Therefore, this is only in part a business/financial decision. Furthermore, the strong ROI of solar is the mechanism that allows 1.a and 1.b to be presentable as a financial decision at all. In the absence of Solar, Geothermal is very difficult to

rationalize financially. It should be clear that not putting in the ground loops and geothermal as part of this construction even if some HVAC units are delayed, when it can be tied with the energy dynamics of Solar, means that it will be essentially impossible to financially justify Geothermal stand-alone – at least with borrowed funds – at any time in the future. This is the giant moment it can be justified as a complete package.

Happy to discuss as needed.

Best, Green₄

Response from Green₂

From: Green₂

To: Green_{1,4,5,6};

Date: Sun, 19 Jun 2016

Subject: Draft BFF Solar Now; Geothermal Ready Option

Green₄ and Green First Team,

Thanks for summarizing and presenting a better comparison between the different options. I like the way you point out the importance of members and values separate from the pure business/financial decision. However, my thoughts about the solar only option have included the way these two sides interact. I have been hesitant to point this out because it could be taken the wrong way.

A key component to the all-in approaches is the member donations. The generous people who have pledged these donations are motivated by a strong belief that we need to stop using fossil fuels now (not sometime in the future) to limit climate change. Will these church members provide such generous support for an approach that only eliminates 1/3 of the church's carbon footprint? I suspect not, but I would like to hear your opinions on this.

Without those member donations, the solar only approach would need to be commercially financed for 15 years to start out close to the current electrical utility budget. Or the BFF would need to raise money in addition to the current \$200K shortfall. The additional \$44K mechanical system shortfall included with an asterisk in Green₄'s table adds to that and should be presented more prominently in the comparison between these options.

Please let me know if you agree that member donations will be difficult to achieve with the solar only options, and whether you think this is a point I should

bring up in a response to BFF₁, or if you think that will be overly confrontational.

Thanks,

Green₂

Response from Green₁

From: Green₁

To: Green_{2,4,5,6,7};

Date: Sun, 19 Jun 2016

Subject: BFF Solar Now; Geothermal Ready option

Green₂:

My opinion is as follows: 1) member donations would be very difficult for the solar only options; 2) if First U is not "all in" for geo and solar, many members will be very upset and some could either a) readjust their original pledges or b) terminate their church memberships. Personally, I would have a very difficult time supporting First U if we don't move forward with 100% renewables.....how hot was it today!!!!!!!

In the last paragraph of the draft opinion that BFF₁ sent is the following sentence, "**We believe that the church has a responsibility to do what it can do toward energy sustainability within its fiduciary responsibility to the congregation.**" I disagree with this statement. The church has a fiduciary responsibility not only to the congregation (members) but also to all stakeholders in the interdependent web of existence of which we are a part. To act truly within our fiduciary responsibility, moving forward with 100% renewables is mandated. This sentence in BFF₁'s draft is eerily similar to the mantra used by our corporate industrial economy for so many decades in which the board of directors of corporations referred to their fiduciary responsibility to maximize shareholder profits at the expense of people and planet. It is all about short-term profits with a total disregard for the short and long terms costs in achieving these profits. Unfortunately, I do not see much of a difference with this corporate mentality and how this BFF project has unfolded. I am sure that we all agree that given the science and our UU principles and values, the renewables should have been the baseline for the project and everything else added to its costs. So what is the problem!!!

Therefore, we need to be very firm and if that is deemed confrontational, so be it!!

Green₁

Reply to Green₁ by Green₅

From: Green₅

To: Green₁

CC: Green_{2,4,5,6}

Date: Sun, 19 Jun 2016

Subject: BFF Solar Now; Geothermal Ready option

Green₁,

Well stated. Outstanding.

I do not see our proposed complete system approach as being confrontational but rather as an alternative solution that is more encompassing than others.

For those who want solar, the complete system provides solar.

For those who do not want to change how much the church spends on "utilities", the funding approach in the words of Board₁ is revenue neutral - the monthly/annual utility bill remains the same.

For those who do not want the church to have to borrow more money, the commercial loan of \$100,000 proposed by the BFF Integration Team is the same as the \$100,000 commercial loan proposed by Green₆ (in the event we cannot find any additional capital in the form of member loans.)

For those who want to keep the capital within the church community (local financing), the proposed funding scenario does just that.

For those who care strongly about "do no harm," the complete transition away from fossil fuel to renewable energy and the inclusion of other sustainable elements in the design of the building do just that.

Thanks for your "statement."

Green₅

Reply to Green₂ from Green₅

From: Green₅

Date: Monday, June 20, 2016

To: Green₂

Cc: Green_{1,3,4,6,7,8}

Subject: BFF Solar-Now; Geothermal-Ready Option

Green₂,

Thanks for drafting this.

I concur, "member" donations will be difficult to achieve with the solar only option."

Part IV Energy System Capital Campaign

Personally I am unable to contribute further to a building project that results in a facility that continues to do harm to our interdependent web of life and all future generations (of all living beings). To be blunt, with today's consciousness/awareness, spending \$4M on a new building that continues to burn fossil fuel and does harm is unconscionable.

However, I will gladly donate and loan money to a project committed to installing an energy system that stops doing harm - to a facility that is sustainable.

Fortunately, I find myself embedded in a tribe of like-minded (green-minded) UU souls and I am so grateful. I am also amazed at how far this tribe has come in financing the "All-In-Now" or 100% sustainable energy system. Although it is impossible to predict what's out ahead, I believe Board₁ is prepared to present the "revenue neutral" funding approach for the complete system (presented by Green₆ at the 14 June BFF meeting) to the Board fairly and favorably.

If we could cast a slightly bigger net that includes a few more church members, we might be able to pass out some more "small pieces of paper to write on" and practically close the remaining \$100,000 to \$150,000 financial gap in the "All-In-Now" scenario.

Then, if we can devise an entity that assembles the capital required to fund the complete energy system; that provides a firewall between member lenders and the church Board and Administration; that keeps the borrowed and repaid capital within the church community; that handles all of the financial and administrative functions (promissory notes, tax forms, etc.); we can eliminate even more of the Board's potential concerns.

We are not there yet, but it would be cool to cross the finish line before someone tells us we cannot enter the race?

Thanks again Green₂ for getting the conversation going,
Green₅

Response from Green₆

From: Green₆
Sent: Monday, June 20, 2016
To: Green_{2,5}
Cc: Green_{1,3,4,7,8};
Subject: BFF Solar Now; Geothermal Ready option

I believe the tribe is of one voice on this matter.

We second Green₅'s email (sent @ 8:55 this am) speaking of our tribe.

Yes, Green₁. Well said.

...The BFF ought to be trying to find common ground with us.

Green₆

Response from a Board Representative

Fortunately, Board₁ sensed the tension that was building up between the Board and Green First Task Force and acted as a moderator/peacebuilder. Here is the response.

From: Board₁
Sent: Tuesday, June 21, 2016
To: BFF_{1,2,3,4}; Green_{1,2,4,5,6,7}; Senior Minister; Board₅
Subject: Clarification!

I spoke yesterday to Green_{6,7} for about one hour. I asked for their conversation to address the tension I am late in recognizing between the Green First Team and the BFF Committee. By the way, I became a member of BFF in March 2014, focused almost exclusively on the Capital Campaign, but was also a part-time liaison re Energy, as I have an above average working knowledge of the industry.

Green_{6,7} said something that caught me by surprise, namely that several recipients of BFF₁'s email (see below) interpreted it as follows:

Subsequent to the summit meeting last Tuesday, June 14, that BFF had a meeting and created their Preferred Solar-Now, Geo-Ready proposal. And that one would be the only one the Board would consider. Said recipients were very upset by this, feeling BFF was not listening to the Green First Team and not interested in considering an "All-In-Now" proposal.

From my perspective, those recipients who interpreted BFF₁'s email that way are, simply put, wrong. My points:

1. BFF's proposal was drafted the day before the June 14 meeting and is dated such.
2. As BFF₁ clearly states in his email, BFF₂ was going to present it on the 14th but ran out of time.
3. BFF₁ again states clearly his email intent is transparency, to make sure all interested parties understand each other's thinking.

Also, as a Board member, I assure the Green First Team that the Board will look at Green First's proposal thoughtfully and try to help First Universalist members make a smart decision, both as regards the ethics of fossil-fuel usage and the cash-flow future of First Universalist.

Board₁

Response from BFF₄

From: BFF₄

Date: Tue, Jun 21, 2016,

Board₁, you are absolutely correct.

The BFF Integration Team simply sought to present an option—in this case, one that we thought might be financially feasible and fulfill some of the renewable energy commitment in the near term and allow for other parts to be fulfilled in the future.

We saw it as a sequenced choice, not an either-or choice. We did not ask the full BFF to consider or approve any particular option, as we felt this would be a Board/Congregation decision. The presentation last week was so rushed and full of information that we did not have the kind of dialogue that might have yielded better understanding.

While every member of the BFF supports the over-arching pursuit of a complete solution, we are also acutely aware that present resources are limited, future resources are somewhat unknown, and we, the Board and Congregation have to make hard choices about the best way to address our multiple values. It will be a complex choice with many considerations and it is important that the range of considerations be on the table for all.

BFF₄



Emerging Issues between BFF Committee and Green First Task Force

After the 14 June presentation, The Green First Task Force continued to respond to the concerns of the BFF Committee and Board of Trustees.

BFF Committee Concern: The Green First Task Force is competing with the BFF Committee for member capital. The proposed energy system was going to increase the construction cost and not be fully funded.

Green First Task Force Response: Green First Task Force maintains that their separate fundraising has not been in competition with the main BFF fundraising. Green First Task Force was soliciting only low-interest member loans – not donations. The primary donations by the Green First Task Force members themselves were already in place. Church members were telling Green First Task Force that “they were tapped out” for donations but they would consider loaning the church money at a low-interest rate (similar to a bank CD). Loans would not work for the BFF Committee, because those loans added to the annual debt service for the church – in addition to paying on the \$400,000 mortgage, the church would take on the re-payment of the member loans.

In contrast, loans for the energy system did have a means of repayment already built into the church budget – the “Utility Expense” line item that could be relabeled as “Energy System Loan Repayment.”

Board Concerns: The energy system must be “Revenue Neutral” meaning it could not increase the church’s operating budget or the renovation project’s net cost to the church.

Green First Task Force Response: The Green First Team continued to work on the suggestion by Board₁ that the financing is “revenue neutral” – a concept they were trying to achieve but couldn’t name. In other words, the Green First Task Force plan was to simply redirect an existing line item in the church operating budget i.e. “Electric and Gas Utility Expenses” to “Energy Loan Repayment.”

This entire case study was about “change.” It was not about increasing the church budget – it was about using the existing 2.4% of the budget earmarked for “gas and electric” in a different manner that allowed the church to stop dumping greenhouse gases into the atmosphere, stop contributing to global warming, and stop harming future generations.

Some people would even argue that 2.4% of the church budget is in the “noise level.” Even if the new energy system increased the budget by 2.4% (it didn’t increase it at all), it would be worth it to become responsible parents, grandparents, global citizens and stop doing harm to others, to all life on the planet, and to live more sustainably.



Request to Present at 5 Jul 2016 Board of Trustees meeting

From: Green₆
Sent: Thursday, June 30, 2016, 4:35 PM
To: Green First Task Force
Subject: July 5 Board Meeting
Attachments: Status summary for BOT

Dear friends of solar and geothermal,

I have requested to make a presentation of our proposal for funding the solar and geothermal for the church at the board meeting on Tuesday, July 5th.

I hope some of you can come and provide “moral support.” I attached the spreadsheet I will use (we have many other cases) and a one-page summary that should be circulated to the board before the meeting. I will make a very brief presentation and then try to answer the questions.

I will rely on Green₁ to answer questions about the “separate entity” we will set up and Green₄ to answer questions about the separate solar contract. To keep it simple, I suggest we not present anything about PACE or other options unless we get questions.

Green₆

Attachment#1 Status summary as of June 25th prepared by Green₆ for Board of Trustees.

The Green First Solar-Geothermal System “All In” Proposal Status

Cost summary

- Solar + ground loop + 10 heat pumps replacing existing furnaces
 - Total assumed cost \$480,000 (BFF Estimate)
 - (\$140,000 solar, \$207,000 ground loops, \$125,000 heat pump furnaces)
 - Paid for by
 - Cash contributions of \$145,000 of which \$105,000 is accounted for (30%)
 - Member loans of \$270,000 (>80%) or more at 1.5% interest. Of this, \$220,000 is raised.
 - The remainder (<20%) to be paid for by commercial loan at 5% interest.

Payback

- The church would pay for “utilities” at its current costs for gas and electric plus 4% inflation for the next 15 years
 - Stable budget
 - Known and predictable costs
 - Protected against unpredictable cost increases (e.g. carbon tax)
- We propose to establish a yet to be named entity to handle the interface to the loaning members so church staff will not be burdened by this task. The “utility payments” will go to the Energy Lending entity that in turn will pay back the member and commercial loans.

Savings: over the 20-year lifetime, the church will save more than \$190,000 of accumulated utility costs. The savings accrue after the loans are paid off. Member loans are paid back on a delayed basis to minimize costs to the church in the first 7 years. This is not possible with the commercial loan. Lenders know the payback agreement.

4% inflation of utility costs may end up being slightly larger than inflation (Green₄'s commercial suppliers assume 3.5%), but the inflation rate assures payoff of the loans within 15 years. If we can finance the final 20% with member loans, we can reduce the assumed inflation to 3.5%. We believe this is fair to both the church and the lenders.

Final points

- A final accounting spreadsheet will be made once the costs are firm.
- We must make sure the ground loop is installed by a certified geothermal contractor. It is recommended that we hire an independent expert to oversee the installation. Properly installed, the ground loops will last more than 50 years.

The Board of Trustees submitted thirteen questions to the Green First Team just before the scheduled presentation. The response to the Board's questions is provided below:

Questions from Board of Trustees (BOT) re Green First Funding Proposal of Carbon Neutrality for the New Building

Green First Responses added July 4, 2016

[] indicate edits for this case study documentation

Introduction

Thank you for sending your questions and for giving us the opportunity to explain our proposal better.

For many of us on the Green First Task Force, this is a serious social justice issue. As UUs, we tend to take a different world perspective than many others. With our current awareness of anthropogenic climate change that affects all humanity and all life on our planet, continuing to burn fossil fuel and dump greenhouse gases into our planet's atmosphere [when there are viable energy alternatives] is a gross social injustice.

Our proposed energy system is sized to allow us to harvest all the energy we consume annually from sustainable (so-called renewable) energy sources without dumping greenhouse gases into the air – this includes all the electrical energy and all the thermal energy for heating and cooling. So from the Earth's perspective, First Universalist Church will be behaving like a responsible adult and honorably harvesting all the energy it requires for sustainably operating the church.

Let us be clear and honest. Our church as we currently operate it [by using energy derived from burning ancient hydrocarbons,] is contributing to global ecocide. We, First Universalist, are doing harm.

Using fossil fuel based energy, we are compromising our UU values and social justice goals as articulated in recent UUA Resolutions at 2006, 2014, and 2015 General Assemblies. [described elsewhere].

We respectfully respond to Board of Trustees (BOT) Questions below:

BOT Q1: Why should this request [to transition from a fossil fuel based energy system to a solar/geothermal system] take precedence over other compromises in the original building plan necessitated by financial limitations?

[First, Do No Harm. That is the first priority of the Green First Task Force.]

Most notably, eliminating the expansion to the lower level for religious education; why not restore that to the building plan first if member loans are an option to do so?

If we allow Green First to proceed we set the precedent for any other well-organized group in the church to do the same thing in order to make changes to the already voted on financing and construction plan.

The congregational vote on 3 April 2016 authorized the Green First Task Force to seek funding for the solar and geothermal for our utilities going forward. External funding was studied but determined to be more expensive and have high near term costs. The funds pledged for the Green First proposal are restricted to the purpose proposed. No other specific projects were authorized. (We don't see why other interest groups shouldn't fundraise for their own interests too. But to maintain the ground rule that the operating budget of the church should not be affected, a source of repayment funds should be identified for any loans.)

BOT Q2: The type of present value analysis we were sent is highly impacted by assumptions years out that we will know little about. So, saying that we will be ahead with geothermal is in no way guaranteed and we have no way to know if it will actually be cash flow neutral. Given that the church's actual energy costs went down from 2015 to 2016,⁵⁶ we would like to see a scenario where costs don't rise as much so that we understand our exposure. One actual value analysis we reviewed from an already completed projected (which relied on similar assumptions) in reality would have been much more financially beneficial had traditional heating and cooling been used.

We cannot predict the future - that is correct, but we can create it. Our transition away from burning fossil fuel as our energy source creates a future that makes us independent of future fossil fuel-related cost increases.

Without the Green First proposal, the church will continue to have a fossil fuel dependent utility bill. We have made it predictable. How fast costs would

rise in the future without our approach is anyone's guess. We point out that after 15 years, the member loans will be repaid and the church's utility bill will decrease to nearly zero.

So from a strictly financial point of view, it might be slightly cheaper in the early years to continue using our current furnaces. We take that risk for the long term gain. In any event, the effect of the interest rate is very small in the overall budget (\$200 in year 1 and \$733 in year 10). The second sentence is incorrect. With the combination of solar and geothermal, we can be certain to be heating and cooling our building independent of future energy costs. If we don't assume some kind of cost growth for utilities in the future we have no way of paying back the loans. If you wish to "cherry pick" the trend of one year and project costs to the future, you are engaging in the same behavior that climate change deniers use when they say the temperature stopped increasing in 1998. The most reliable predictions for the future are based on the longest possible trending. Regarding the final sentence, if you provide the source of this information we can study their situation and compare it to ours. But note that our thinking and analysis is for a 20-year time span, with an approach that protects the church from short term fluctuations in costs.

BOT Q3: Has Finance reviewed the proposal and will they offer an opinion?

We are willing to discuss this with the finance committee and welcome their opinion. We acknowledge the impact many loans would have on the financial staff; thus the TBD "entity" to minimize the burden.

BOT Q4: Is input being sought from the staff on the proposal?

Rev. Senior Minister attended the June 14th meeting with the BFF and members of the board. She is very familiar with our proposal. We are not sure how knowledgeable her other staff members are. We would be glad to sit down with anyone on the staff to discuss our proposal.

BOT Q5: What does BFF think of this proposal?

On June 14th we presented our proposal to the BFF. BFF₁ presided. As far as we know, no vote was taken.

BOT Q6: A substantial change to the building finance plan such as this will require a congregational vote. What is Green First's outreach plan to educate members and respond to their feedback before such a meeting?

This financing is independent of the building's financing plan. We have assumed that if we need a commercial loan to supplement member loans, it would be obtained separately. If the board chooses to combine this with the \$400,000 loan based on Board₁'s recommendation, we have no objection.

It is not our call to decide whether a congregational vote is required or not. We would welcome suggestions on how to present this plan to the congregation as a whole. We are confident others would welcome an opportunity to loan money to their church with the expectation that it will be repaid fully, with a minimal interest of 1.5% and within a reasonable time frame of 15 years or less. After 15 years, the utility bill for the church will drop to near zero for the next 5-10 years.

Members of Green First Team are talking to others in the congregation, but it's a big congregation. We would welcome the opportunity to use survey tools such as SurveyMonkey to poll the larger church membership to determine if there is additional interest. Communication and openness are extremely important and we are not clear how many people have been reached. We did hold an open-to-all science discussion that considered the topic (May 17). We have discussed having a church service dedicated to climate change with the Senior Minister yesterday (July 3), who said she thought it a good idea and is checking how to schedule it.

BOT Q7: Will the member loans have any call or default provisions?

We are not sure what is being asked. The member lenders and the church will agree to the terms of the loans, and both sides must keep their commitments. Members pledging loans have seen the spreadsheets and know of, and have agreed to, the delayed payback schedule. Note that having member loans that have an up-front acknowledged delay is the payback schedule is the only way we can

avoid having larger costs in the first few years. This would not be possible with a significant commercial loan. One older potential member lender has indicated he might name the church as the beneficiary of the loan in case of his death, i.e. giving the money to the church if he does not need it towards the end of his life.

BOT Q8: What guarantees do we have that the additional debt service will not compromise the programming and social justice goals of the church?

This new energy system is integral to the social justice goals of the church. This is a social justice action and our proposal takes nothing from any related budget. Numerous UUA and BFF resolutions support the intention for the church to become carbon neutral and tie that action to our principles.

Global warming is the biggest threat to the poor populations of the world. They are the ones who cannot easily escape the floods, the droughts, and the rising seas. By doing this we will not merely have a zero carbon footprint but will set an example for members of our congregation and the broader community. Note that the “debt service” should be thought of as equivalent to making payments to a utility company for electricity, heating, and cooling. We maintain this issue is solved by our approach to financing within the constraint of the current utility bill. After 15 years, new budgetary space will be freed up for other purposes.

BOT Q9: It seems that we could fulfill our goal of creating a sustainable building without such a large commitment of our community’s resources upfront. It seems that solar panels could be installed without us buying them. We would pay for them out of our monthly utility bill and own them after a few years without incurring debt. When looking at the Energy Sustainability Framework we adopted a few months ago, it says we would put the well-field and ground loop in at the beginning of the project, but add the heat exchangers as our furnaces give out.

If we assume that the \$105,000 in donations committed to geothermal can be used for the well-field and geothermal loop, then the

amount of additional money we need to raise or borrow becomes more manageable. We would achieve our goal of zero carbon as soon as we replace our last furnace.

Apparently, we have not been able to describe our Green First Proposal adequately. The proposed energy system includes a rooftop solar PV system that is installed by a third party under a pre-paid power purchase agreement. We save around \$20,000 by leasing the solar equipment in this manner, but by pre-paying, there are no monthly payments to the third party. We will repay the member lenders who provided the capital for the solar PV system from the current utility budget.

Instead of tying up capital in a partial inoperative geothermal system while simultaneously paying Xcel for natural gas, our Green First Proposal has member lenders provide all the capital needed for a complete operational geothermal heating and cooling system. There will be no additional gas bill each month. As with the solar system, we will repay the member lenders who provided the capital for the geothermal equipment from the current utility budget. The combined repayment on the loans will be equal to or less than the current utility bill so there is no change in the church operating budget as a result in transitioning from a fossil fuel based energy system to a solar-geothermal energy system.

As you stated, the \$105,000 in donations committed to the geothermal reduces the amount of capital we need to borrow from member lenders and makes this approach financially manageable.

We did seriously consider the option you mentioned (“adding the geothermal heat pumps gradually as the gas furnaces give out”); in fact, it was the original plan until we evaluated the 20-year cash flow for a delayed transition. A spreadsheet showing our current gas bill continuing, and replacing the furnaces with heat pumps as the furnaces fail would require 20 years to complete. The member loans would have to have much longer terms that are unacceptable to the lenders. The proposed \$105,000 in donations were all made under the assumption of our “All-In” (solar plus geothermal) plan. We are certain that the “assumption” mentioned above would not be true. It is, however, incompatible with the need to finance our proposal within the current constraints of the projected utility bills.

BOT Q10: Since we must stay connected to the grid for power needs at night and when the solar panels aren't generating electricity (e.g., cloudy days) isn't it disingenuous to call this a carbon neutral proposal?

Yes, we plan to stay connected to the grid.

The proposal is "carbon neutral" when averaged over a year of operations. The solar system is designed to generate extra power when the sun shines and we get it back when it becomes cloudy or dark (also for summer- winter). This is currently true of all solar PV systems, so while the term may be a bit misleading, it is the commonly accepted definition for "carbon neutral."

The fact that our excess energy generated during the day flows into the grid and is used by the nearest neighbor down the alley is actually irrelevant from a social justice perspective.⁵⁷

From the planet's perspective, we, First Universalist, will have behaved in a sustainable manner by harvesting as much energy as we consume, as all responsible individuals should.

BOT Q11: Aren't there solar systems which utilize batteries to store unneeded electricity production allowing buildings to be completely off the grid?

Yes, there are isolated instances in the U.S., particularly in rural areas, where batteries are used to allow households to get off the grid. Actually, this is an emerging solution in underdeveloped countries that have not already invested in complex power transmission grids.

BOT Q12: If so, have the costs of this type of system been explored?

Batteries are an interesting suggestion. They can solve the day-night problem, but season-long storage technology is not yet available. Because this involves unknown technology and costs, we did not consider this approach. Perhaps the church can do this during the next big facility upgrade 25-30 years hence. We plan to stay on the grid for now and use Xcel as our battery⁵⁸.

BOT Q13: Article VI Section 3 of the bylaws probably requires us to give 30 days' notice before a Board meeting to discuss this matter;

therefore we will probably need until August to flesh out the detail, get questions answered and deliberate.

We have been under a lot of pressure from the BFF committee to get the energy system funding resolved so they can complete their contractual obligations on schedule. A congregational meeting on this in the fall seems appropriate.



Presentation to the Board of Trustees (5 Jul 2016)

Prior to this presentation, the Board had received the Green First Team's written response to their questions the day before. The amount of time to present the proposed energy system and funding plan was very limited. Green₆ was the spokesperson and proceeded to provide the same information presented two weeks earlier to the BFF Committee and two Board representatives - the same that is until the "Approach" chart.

In the past three weeks, additional donations and loan commitments had been made. The "Approach" chart and spreadsheet model were updated to reflect these new pledges. As indicated, donations now totaled \$105,000 and member loans were now \$220,000. Two-thirds (2/3) of the capital required for a new energy system had been pledged.

The Green First Team was elated.

Table 5 Baseline Proposal Showing a Plan with 81% Member Financing (81%) and a Commercial Loan (19%)

BASELINE PROPOSAL		"MAINTAIN EXISTING UTILITY PAYMENTS"			MEMBER LOAN FINANCING -		81% COMMERCIAL LOAN -		19%		
Current Electric & Gas Utility Annual Bill		\$16,019	(2015 Actuals)						Xcel hookup		
Annualized Equipment Replacement Cost		\$3,250	par (Ref: ASHRAE)						Equip servicing		
Total		\$19,269							Annual Operating Expense		
"MAINTAIN EXISTING UTILITY PAYMENTS" SCENARIO											
100% Sustainable Energy System Cost		\$480,000			10.0%		Fraction of Total Renovation Project Cost				
Additional cash contribution		\$40,000			1%		Additional Cash Contributions from BFF				
Dedicated Pledges for Energy System		\$440,000			2%		Inflation rate				
Financed by Member Energy Loan		\$335,000	(22%)		2%		Fuel cost escalation				
Financed by Commercial Energy Loan		\$270,000	81%		1.5%		Interest Rate		(\$301,681 (Member Lender Gain)		
20 Year Life Cycle Cost (Renewable)		\$65,000	19%		5.0%		Interest Rate		(\$92,523 (Wall Street Gain)		
20 Year Life Cycle Cost (Fossil Fuel)		\$426,670	for 15 years @				Total Loans				
20 Year Savings with Solar/Geothermal		\$620,615	for 15 years @								
		\$193,945									
Year	Fossil Fuel Utility Bill plus Replacement	New Operating Cost	Commercial Loan Servicing	Member Loan Servicing	Disbursement to Members	New Utility Bill	Deferred payments	Interest payments by church	Cum Utility Cost	Cum Disbursement to Members	Annual Payout on loans / 1K Share
2017	\$20,841	\$1,336	\$6,168	\$20,112	\$13,337	\$20,841	(\$6,775)	\$1,401	\$20,841	\$13,337	\$49
2018	\$21,675	\$1,363	\$6,168	\$20,112	\$14,144	\$21,675	(\$5,968)	\$1,485	\$42,516	\$27,481	\$52
2019	\$22,542	\$1,390	\$6,168	\$20,112	\$14,984	\$22,542	(\$5,128)	\$1,574	\$65,058	\$42,464	\$55
2020	\$23,444	\$1,418	\$6,168	\$20,112	\$15,858	\$23,444	(\$4,255)	\$1,665	\$88,502	\$58,322	\$59
2021	\$24,381	\$1,446	\$6,168	\$20,112	\$16,767	\$24,381	(\$3,345)	\$1,761	\$112,883	\$75,089	\$62
2022	\$25,357	\$1,475	\$6,168	\$20,112	\$17,713	\$25,357	(\$2,399)	\$1,860	\$138,240	\$92,802	\$66
2023	\$26,371	\$1,505	\$6,168	\$20,112	\$18,698	\$26,371	(\$1,414)	\$1,964	\$164,611	\$111,500	\$69
2024	\$27,426	\$1,535	\$6,168	\$20,112	\$19,723	\$27,426	(\$389)	\$2,071	\$192,037	\$131,223	\$73
2025	\$28,523	\$1,566	\$6,168	\$20,112	\$20,789	\$28,523	\$677	\$2,183	\$220,560	\$152,012	\$77
2026	\$29,664	\$1,597	\$6,168	\$20,112	\$21,899	\$29,664	\$1,787	\$2,300	\$250,223	\$173,911	\$81
2027	\$30,850	\$1,629	\$6,168	\$20,112	\$23,053	\$30,850	\$2,941	\$2,421	\$281,074	\$196,964	\$85
2028	\$32,084	\$1,661	\$6,168	\$20,112	\$24,255	\$32,084	\$4,143	\$2,547	\$313,158	\$221,219	\$90
2029	\$33,368	\$1,695	\$6,168	\$20,112	\$25,505	\$33,368	\$5,393	\$2,678	\$346,526	\$246,723	\$94
2030	\$34,702	\$1,729	\$6,168	\$20,112	\$26,806	\$34,702	\$6,694	\$2,815	\$381,228	\$273,529	\$99
2031	\$36,090	\$1,763	\$6,168	\$20,112	\$28,152	\$36,090	\$8,040	\$2,956	\$417,311	\$301,681	\$104
2032	\$37,534	\$1,798	\$6,168	\$20,112	\$0	\$1,798	\$0	\$0	\$449,110	\$301,681	\$0
2033	\$39,035	\$1,834	\$6,168	\$20,112	\$0	\$1,834	\$0	\$0	\$480,944	\$301,681	\$0
2034	\$40,597	\$1,871	\$6,168	\$20,112	\$0	\$1,871	\$0	\$0	\$512,815	\$301,681	\$0
2035	\$42,221	\$1,908	\$6,168	\$20,112	\$0	\$1,908	\$0	\$0	\$544,724	\$301,681	\$0
2036	\$43,910	\$1,947	\$6,168	\$20,112	\$0	\$1,947	N/A loans paid	\$0	\$576,670	\$301,681	\$0
\$620,615		\$32,466	\$92,523	\$301,681	\$301,681	\$426,670	\$0	\$31,681	\$426,670	\$301,681	\$0
Total Loan Payments				Savings							

Green₆ used the spreadsheet model in Table 5 to illustrate the 20-year cash flow with this funding model.

Figure 33 summarized the 20-year cost assessment. Green₆ pointed out that the profile was designed to be the same as the projected utility bills assuming a 4%/year escalation in expenses due to the sum of inflation and rising energy prices.

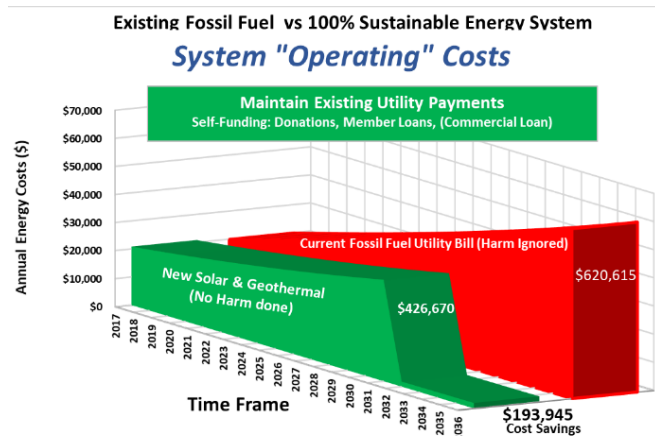


Figure 33 Summary of Renewable Energy System compared to Fossil Fuel System - 20-year cost profile

Summary and Conclusions



- Lease Solar & Buy Geothermal and finance with member contributions & loans and, if necessary, supplement with commercial loans.
 - \$105,000 contributions and \$220,000 loans committed to date.
- Green First unanimously recommends maintaining both the solar and geothermal components
 - Our stated financial commitments would have to be reexamined without the geothermal component
 - We should be as responsible as many other UU churches (and IKEA).
- We think there should be an opportunity for everyone to contribute something, no matter how small.
- The church will have a stable and predictable “utility budget” protected against fuel cost growth, carbon taxes, etc.
- Installing a 100% Sustainable Energy System (at no added cost to church operations) will give our UU youth hope that adults are actually doing something to reduce climate change/global warming.



13

The Green First Team knew that their work was not done, that there was still a large amount of capital to line up to make this project happen, but not hearing any major dissent albeit subdued enthusiasm from the Board, and silence from most, it seemed encouraging to keep on keeping on. The Board had not precluded the use of member lending as one method of funding the project.

After this presentation to the Board and the meeting was adjourned, one Board member approached a small group of the Green First Team and

indicated that he would be willing to help them work things out with the Board.



Independent Reviewers (Appointed by the Board)

It was not too long after this presentation that the Board recruited two church members to serve on an Independent Review Panel. These individuals were professional civil engineers specializing in the water and wastewater sector. Their role was to review the design of the geothermal system and report back to the Board on the feasibility of the system and the risks involved. The independent viewpoints were extremely valuable and they played a key role in moving this project forward.

Although the Green First Team did have a number of science and technology savvy members, these independent reviewers turned out to be a very valuable addition to the team and contributed to the success of the project.

Reviewer₁ made the final presentation to the Board and the Congregation. Both reviewers facilitated “Town Hall” meetings to inform the church members about the proposed new energy system.



Renewable Energy Working Group (REWG)

Shortly after the 5 Jul 2016 presentation, The Board and the BFF Committee formed an ad hoc committee that took on the name Renewable Energy Working Group (REWG) that specifically focused on making a decision about the energy system so the construction contract could be updated/finalized. The BFF Committee had to delay any decision about geothermal until it had been approved or rejected by the Board and the Congregation.

The Green First Team was aided in this endeavor at different times by Board members and many others who provided insights to the Board’s concerns.

The Board provided assistance by creating a Renewable Energy Working Group (REWG), chaired by a Board member. This small ad hoc committee was formed to coordinate the remaining design effort and

Part IV Energy System Capital Campaign

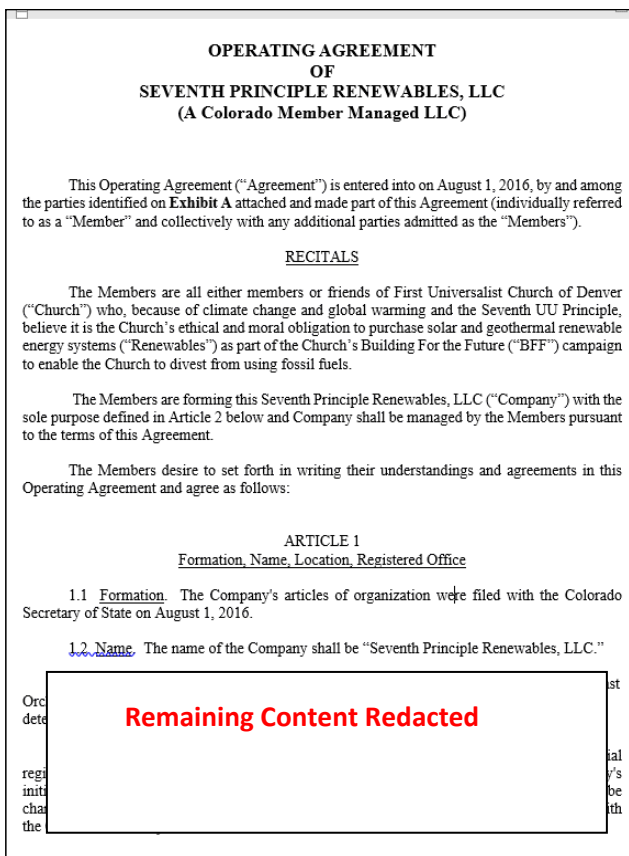
finalize the funding approach for the renewable energy system. The committee met during the months of July, August, Sept and October 2016. There were about a dozen members of this committee. The chair reported back to the Board of Trustees.

This ad hoc committee was very useful in identifying issues requiring an owner perspective and decision. With representatives of the Board on the REWG, the working group was aware of the Board’s technical & financial concerns at all times.



Seventh Principle Renewables, LLC (Aug 2016)

We were getting closer to needing a legal entity to consolidate the member loans for loan repayment purposes. It would have been a burden on the church staff to make individual payments to 15 member lenders (monthly/annually). Based on the model used by St. John’s Episcopal Church in Boulder, A. Green our team’s legal counsel, draft an LLC document to see how that might work.



This “LLC” eventually morphed into a simple “Partnership.”



REWG Email (2 Sep 2016)

From: Board₃
Sent: Friday, September 2, 2016, 9:21 AM
To: Green_{2,4,5,6,7}; BFF_{1,2,3}; Senior Minister; Board_{2,4,5}; Reviewer_{1,2}

Good Morning All,

Just a quick recap of last night's renewable energy meeting.

1. Thanks to all for such focused work in the past few weeks to iron out the myriad issues with the geothermal and solar proposals. In particular, I want to thank BFF₃ for facilitating several important discussions with Faurot, Barrett, and Forrester. Green₄ for getting critical solar bids. And Reviewer_{1,2} for their time and professional advice on the geothermal proposals.

We are getting close....

Based on this email, it seemed as if the project was making progress.



Board of Trustees Email (7 Sep 2016)

Then an unexpected email from the Board had a major impact on the Green First Team – about a 7.5 on the Richter Scale.

[Ed: Bold text was added to the email by the reporter to highlight the comments that indicate a significant misunderstanding between the Board and the Green First Task Force. The source of the misunderstanding is the limited time the two groups had to come together to describe/discuss the project. Their primary method of exchanging information was email. Information from the Green First Team was posted on the church “BaseCamp” for the Board members to read individually.]

Board Perspective

From: Board₃
Date: Wednesday, September 7, 2016
To: Green_{2,4,5,6,7}; BFF_{1,2,3}; Senior Minister; Board_{1,2,4,5}; Reviewer_{1,2}
Subject: Re: Renewable Energy Working Group Meeting Tonight from 5 pm to 6:30 pm.

All,

Part IV Energy System Capital Campaign

The Board of Trustees (BOT) held its regular monthly meeting last night. I updated the BOT on our work over the last month, with substantial input from Board₁ and Board₅, and received feedback from members, which I will do my best to summarize below.

Here are the important things you need to know:

- 1) The board passed a motion to require our Renewable Energy Working Group to submit a final proposal for the renewable energy package for BOT action no later than COB, September 30, 2016. Included in the proposal should be a final technical plan with selected bids for solar and geothermal and a way to pay for it.
- 2) There is broad support on the BOT for a package containing both solar and geothermal elements, but there is an important caveat. Members are concerned that the solar and geothermal systems as currently financed are simply **too expensive for the church to afford**. Their concern is not that the proposal's current costs outweigh its benefits. Members get that the non-monetary, environmental benefits of this system are significant and should be considered. **Their concern is that the proposal's dollar costs will likely lead to an important loss of opportunity to perform other essential church ministries and services over the next 15 years.**

Members observed that the geothermal system has a price tag of approximately \$335,000 and that the financing model rationalizes repaying member loans in this amount with a set of assumptions that likely inflate current and future costs of conventional fuel. This observation has two parts.

First, members are concerned that the model's 5-year fuel cost average may overstate what the church currently pays for fuel.

Second, members noted that while fuel prices may rise annually as predicted in the model, actual fuel expenses could hold steady or even decrease due to new energy efficiency in the building. **Thus the 3% escalator in the model is problematic because it probably overstates future conventional fuel costs and because that overstated amount is the primary driver of increasing loan costs over time.**

This last point is important because members noted that even if the church installed no solar or geothermal and continued using conventional fuel, the church **fuel costs will likely hold steady or maybe go down** because it will, in any event, have a

significantly more efficient building. **It thus makes little sense to many members for the church to rationalize the costs of paying for geothermal with an inflated estimate of future conventional fuel costs especially when those higher costs may also represent a lost opportunity in other areas of ministry and church support.**

3) This leaves us with some important decisions that need to be finalized in the next 3 weeks to meet the BOT's September 30 deadline:

A) We need to make a final decision on the solar contractor;

B) We need to reach consensus on all issues related to the geothermal installation contractors, and most importantly;

C) We need a way to reduce the cost to the church for the combined geothermal and solar package.

I know this is a tall order--and you all have been given several tall orders already. But we've made huge progress over the last month.

We are close. Let's keep working on the problem. I am available to talk by phone when necessary. I will also be at the meeting on Friday in Boulder with Precise and others.

Board₃

[Ed: The Board/Senior Minister were facing a 5% budget deficit in 2016 (~\$40,000).]

Green First Perspective

The Green First Team was shattered by this unexpected Board response.

This latest email indicated the Green First Team still did not have a funding approach that the Board would approve. Now a solution to these new issues that just surfaced was not obvious.

As perceived by the Green First Team, once again the goal posts had been moved. The latest email indicated there was still misunderstanding about the proposed method of funding the new energy system.

The Green First Team had used the sound advice of one Board member who suggested creating a "Revenue Neutral" funding model that mimicked the current fossil fuel expenditures so there would be no impact on the church operating budget.

Part IV Energy System Capital Campaign

It was now clear that there was still a lack of agreement about how to realistically characterize and project the expected operating cost of the current fossil fuel system. Without an agreed upon baseline, it was not possible to design a financial model for the new sustainable energy system (solar-geothermal) that had similar operating costs as the old system.

And to make matters even more challenging, the Board was now demanding that *“the cost to the church had to be reduced”* meaning *“Revenue Positive.”* The Board failed to acknowledge that the Funding model was already showing a financial gain of more than \$150,000 over 20 years.

The Board demand that *“the cost to the church had to be reduced”* had an emotionally devastating impact on the Green First Task Force.

From: Green₄
Sent: Wednesday, September 7, 2016
To: Green_{1,2,5,6,7}; BFF₃;
Subject: RE: Renewable Energy Working Group Meeting Tonight from 5 pm to 6:30 pm.

I'm wondering if our group would like to have a conference call to huddle regarding the Board's message. If so, I could set a conference call tomorrow afternoon or Friday.

Best, Green₄

From: Green₅
Sent: Thursday, September 8, 2016 1:09 PM
To: Green₄
Cc: Green_{1,2,3,6,7};
Subject: Renewable Energy - BOT Email

I think a Green First Task Force conference call or meeting would be appropriate – since Green First members are the front line stakeholders in this project (i.e. roller coaster ride). I'm available.

Green₅

This was probably the lowest point in the morale of the Green First Team.

For over a year, their group had tried diligently to practice their Ministry for Earth without creating a financial drain on the church (a revenue neutral scenario as one Board member requested), but the rules kept changing. In the past, they were able to

figure out a way around the obstacle. This hurdle seemed different.

They decided to meet at a member's home where they shared their disappointments, their frustrations, their weariness of this struggle, and their anger at having the goal posts moved yet another time. It seemed like a year of mixed messages and failures to communicate.

That meeting was essentially a 'wake.' Seeing no way to appease the Board, they seemed resigned to throw in the towel. They agreed it appeared to be time to walk away from an untenable situation. They expressed gratitude to each other. They acknowledged that a few people wielded the power to decide the fate of their Ministry for Earth and there was no solution in sight for these latest demands of the Board.

Also, it seemed obvious that the voice coming from the Board had the effect of marginalizing, if not negating, their “respect for the interdependent web of all existence” (Seventh UU Principle.) This rejection of their fundamental value system cut deeply into the group's psyche.

They were ready to say goodbye to this project and some were ready to say goodbye to their church.

But something was still holding them together.

Despite significant differences and the apparent intractability of the situation, **the Green First Team was held together by a few intangible forces: shared UU values and their common concern for the greater good in the face of an existential threat to life on Earth.**

So they were moved to persist.

The Green First Team did not dissolve and instead continued to address the Board requirement to “reduce the cost to the church.”

Outsider's Perspective

So it meant that the Green First Team would have to go back to the drawing board and design another financial model. They would have to contact the individual sponsors, probably rescind around \$100,000 in loans and attempt to find more donors to raise an additional \$100,000 from an already “tapped out” congregation.

The Green First Team challenge was to finance a new energy system using only a revenue stream that was lower than the current amount being spent on gas and electric.

Part IV Energy System Capital Campaign

To the outside observer, it appeared that two factions within this congregation were in conflict over a relatively small monetary issue that was influencing their decision about a major existential issue.

The monetary issue involved 2.4% of the church budget (the annual fuel cost was under \$20,000). To create a cost baseline, the Green First Team had assumed fuel costs would increase by 3% annually (\$600 increase/year). The Board contended the fossil fuel “will likely hold steady or maybe go down” over the next 20 years.

How did a 3% change in a 2.4% line item (or \$600) in the church operating budget become “problematic?” There must be something else going on in that congregation.

Perhaps a closer examination of the Board email will provide a better understanding.

Issue #1

“Members are concerned that the solar and geothermal systems as currently financed are simply too expensive for the church to afford.”

This statement indicates two things: 1) The Board does not understand how the new energy system is being purchased, and 2) The Green First Team did not explain the funding approach to the Board adequately.

With the current fossil fuel based energy system, the church “imports” all of the energy it requires to operate in the form of electrical power and in the form of natural gas for heating.

With the proposed new energy system, the church will no longer import energy. Instead, the church will be equipped to “harvest” the energy that is already onsite (solar and geothermal). However new 21st-century equipment is required. Once the new equipment is in place, the church will no longer buy electricity for power or natural gas for heating from Xcel Energy.

The church will remain “on the grid” and the church will still pay Xcel a “connect” fee. The grid will no longer be the source of energy but it becomes an energy storage system (e-bank). During the day, the solar PV system will generate excess power. That excess is measured by a Net Meter and “stored in the grid.” In the evening or on cloudy days, the church withdraws the excess for its operations. On an annual basis, the system is sized to require net zero energy from the utility company.

The church will no longer buy natural gas from Xcel for heating the facility. Instead, ground source heat pumps will be used to extract thermal energy from the Earth beneath the North Parking lot to heat the building. The heat pumps are powered by solar electric generated onsite.

With the current fossil fuel system, \$20,000 is leaving the church community annually and going to Xcel Energy based in Minnesota.⁵⁹ Since Xcel would no longer be the church energy supplier, the same check that would have gone to Xcel for gas and electric will go to a new member-owned organization, Seventh Principle Renewables, that will actually buy all the new solar and geothermal equipment for the church.

With the new system in place, the church will pay the Seventh Principle Renewables \$20,000 annually for 15 years. At that point, the borrowed money will be repaid to the member lenders. The church would be spending their money on local contractors and create local jobs rather than sending it to Xcel. That’s how the solar & geothermal systems will be financed.

Saying the “***solar and geothermal systems as currently financed are simply too expensive for the church to afford***” is saying that the church cannot afford to pay its Xcel utility bills for the next 15 years. And that is not true.

Issue #2

“Their concern is that the proposal's dollar costs will likely lead to an important loss of opportunity to perform other essential church ministries and services over the next 15 years. “

This statement indicates two things: 1) The Board does not understand how the new energy system is being financed, and 2) The Green First Team did not explain the funding approach to the Board adequately.

As explained in Issue #1, the money used to purchase the new equipment is already in the church operating budget under the line item called “Utilities.” As indicated in Figure 34, the money allocated for electric and gas is 2.4% of the total budget. It is that money that is being used to purchase (repay the loan).

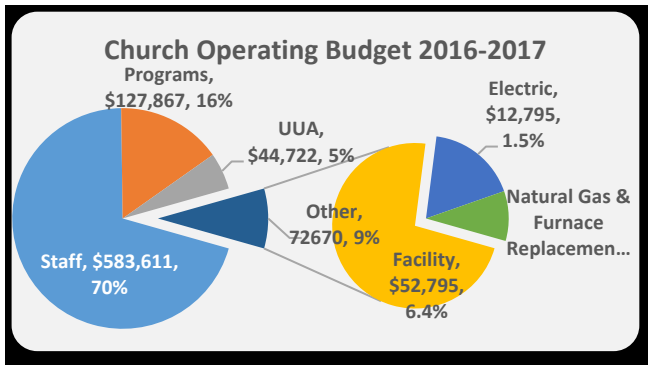


Figure 34 Perspective of Church Operating budget (2016-2017)

Saying “...dollar costs will likely lead to an important loss of opportunity to perform other essential church ministries and services over the next 15 years” is like saying,

“paying our utility bills so we can keep the lights on and the building at a comfortable temperature will likely lead to an important loss of opportunity to perform other essential church ministries and services over the next 15 years.” That is not true.

To be frank, this Board comment was quite offensive (albeit not intentionally) to the Green First Task Force and other sponsors of the proposed sustainable energy system. From their perspective, the primary reason for investing in this new energy-related equipment is to stop doing harm to our children and their children. The church is currently dumping over 100 tons of CO₂ into the atmosphere and contributing to global warming/ climate change/ extreme weather/Sea level rise/displacement of Island Nations/etc. The Green First Team considers their work, the UU Ministry for Earth, to be an “essential church ministry over the next 15 years.” For the Board to marginalize their ministry is inappropriate.

Issue #3

“the church fuel costs will likely hold steady or maybe go down because it will, in any event, have a significantly more efficient building.”

This statement indicates the Green First Team did not explain the physics of a Heating Ventilation and Air Conditioning system very well.

First, let’s address the “*significantly more efficient building.*” This is a very good point. Indeed, the new windows added insulation in the walls and on the roof will reduce the heating and cooling requirements. In fact, the heat load analysis by the architect’s mechanical designer indicates the church can expect to

see as much as a 40% reduction in heating requirements. The annual cost of natural gas was around \$4000 in 2015. So the church can expect to see a reduction of \$1600/year. Another efficiency item is changing from compact fluorescent to LED lighting. Let’s assume this is an additional savings of \$400/year. As a result, It would be appropriate to expect the \$20,000 gas and electric bill could be reduced \$2000 with the more energy efficient building. So the initial baseline gas and electric bill for the new facility would be \$18,000 the first year.

Second, let’s address “*will likely hold steady.*” The efficiency of the building, however, does not determine general economic inflation or the price of fuel such as natural gas.

The Colorado price of natural gas increased from \$4/1000 cubic feet in 1996 to \$8/ 1000 cubic feet in 2016. That is a 100% increase over 20 years or 5% per year average (See Factoid A.7 in Appendix A.).

It is not realistic (nor is there any evidence) to think the price of natural gas “**will likely hold steady or maybe go down**” (not increase) over the next 20 years.

The Green First Team had started the cost comparison between the old (fossil fuel) system and the new (solar/geothermal) system with an energy escalation rate used by the commercial energy world at that time of around 4.0-4.5%. Nevertheless, the Board/Senior Minister had requested that the escalation rate be reduced to 3% and the Green First Team complied and revised the funding model.

Now, this latest email indicated that a “3% escalation is problematic” because “fuel costs will likely hold steady or maybe go down” in the future. From the perspective of the Green First Team, these latest demands were a frustrating puzzlement.

The Green First Team was trying diligently to design a financial model that would mimic the existing fossil fuel system operating costs. The escalation rate is an important factor in designing a loan repayment schedule that is fair to both lenders and borrowers. Assuming a lower than actual (or zero) escalation rate in the fossil fuel price translates to a lower repayment rate and a longer time-frame to repay the low-interest member loans and more interest expenses to the Congregation. This is not fair to the members or the member lenders. Assuming a higher than actual escalation rate for the price of fossil fuel in the future requires a higher repayment schedule that puts

excessive pressure on the operating budget. That is not fair to the Congregation.

The assumed fuel price escalation rate or the general inflation rate does not affect the cost of the energy system. The church signs a contract and purchases the equipment now. So inflation and future fuel cost do not affect the current system cost. The assumed inflation/escalation rate is used only for trying to mimic the operating cost profile of a fossil fuel based system. So the assumed "Utility cost" and "escalation rate" determine how rapidly any loans are repaid (and how much interest is added to the system cost).

Issue #4

"We need a way to reduce the cost to the church for the combined geothermal and solar package. "

This demand was the biggest challenge.

And time was running out. A solution had to be found and approved by the Board within a month so the Congregation could approve the Funding Plan in November. Only then could the construction contract be modified to incorporate the solar & ground source geothermal systems.

Back to the Drawing Boards

First, the Green First Team acknowledged it was important to incorporate the Board's observation that the renovated church was going to be a more energy efficient building. They immediately lowered the projected operating expenses for the new facility by \$2000. This, of course, lowered their revenue stream by \$2000 making it more difficult to service loans.

There was now a lower threshold for the amount of low-interest loans that could be serviced. This increased the amount of donations required to make the financing work. All this could be figured out quickly because the Funding Model was actually a spreadsheet model.

The Green First member who was focused on the solar system found a contractor willing to lower their cost by using a "Pre-paid Power Purchase Agreement."

The BFF Committee was getting more refined cost estimates for the geothermal equipment and that cost was actually dropping as well.

Some of the member lenders agreed to "convert" their loan to a smaller donation over a three year period.

Time was running out, but enthusiasm to make it to the finish line was growing. Folks were starting to believe a 100% Sustainable Energy System with zero GHG emissions was a real possibility.


Work continued and a new Funding Plan evolved that was 95% funded when it was time to present the plan to the Board for Approval.

There was no guarantee the Board would approve it.



Board of Trustee Approval (4 Oct 2016)


It was decided to have a third party present the latest proposal to the Board. The Independent Reviewers selected by the Board were now strong advocates for the ground source geothermal heating & cooling system as well as the solar PV system and the other energy-related equipment. One was selected to present the revised proposal to the Board. Reviewer₁ put together an excellent straight forward PowerPoint presentation. The Board meeting was held at the nearby Plymouth Congregational church who provided meeting space to First Universalist during the renovation.




Net Zero Carbon Sustainable Energy System

Living our Principles

September 30, 2016
Renewable Energy Working Group



Net Zero Carbon Sustainable Energy System




An extraordinary commitment to our 7th Principle supported by extraordinary contributions by church members


- Provides substantial long-term cost savings, but...
- Requires up-front investment with extended pay-back period

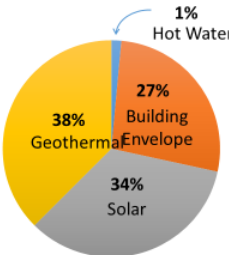
Critical questions to be addressed

- What is it and what does it do?
- Can we make it work?
- How do we pay for it?
- What are the compelling reasons to do it?




What is it and what does it do?





- **Building envelope improvements** – major improvements in insulation and sealing incorporated into building design
- **Solar** – photovoltaic array for onsite power generation, and connection to grid for night-time power (\$125,000)
- **Geothermal** – system of multiple wells, circulating coolant and heat transfer pumps for both heating and cooling (\$312,000)
- **Hot water heating** – water-to-water heat transfer pump, with electric hot water heater for top-up (\$10,000)

Carbon Savings
Total: 88 metric tonnes/year
(1 tonne = 1,000 kg = 2,200 lbs)




Solar Power Generation

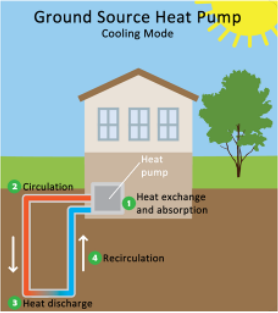




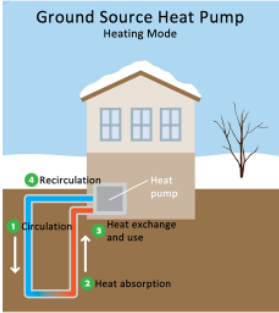
Geothermal System




Ground Source Heat Pump
Cooling Mode




Ground Source Heat Pump
Heating Mode






Can we make it work?



- **Proven technologies** – both solar and geo-thermal are now proven, reliable technologies, with good track records in Denver Metro
- **Qualifications** – all key players have necessary and applicable experience:
 - Barrett (architect)
 - DMA (mechanical & electrical designer)
 - Faurot (general contractor)
 - Brite Street (solar subcontractor)
 - Precise (HVAC subcontractor)
 - Colorado Geothermal Drilling (drilling subcontractor)
- **Design review** – all design performed according to industry standards, with reasonable, conservative allowances and assumptions
- **Outside review and commissioning** – performance assessment and assurance to be provided by Lightly Treading (and others)

Bottom line: technically sound!



How do we pay for it?

Costs

Solar	\$125,000
Geothermal	\$312,000
Certification	\$6,400
Total	\$443,000

Funding

Loans (15 yrs, 1.5%)	\$180,000- \$265,000
Cash contributions	\$180,350

Notes

1. Member loan servicing payments equal to or less than the energy savings from transition from fossil fuel to renewable energy
2. Loan commitments available are currently \$265,000
3. Fund raising to continue, to increase cash contributions and reduce amount of loan



What are the compelling reasons to do it?

- Substantial long-term cost savings
 - 20-yr life cycle cost (fossil fuel) \$493,283
 - 20-yr life cycle cost (renewables) \$304,417
 - 20-yr savings with solar/geothermal \$188,866
- Church member contributions have minimized investment impact
 - Member **donations** made as stretch contributions to fund complete energy system, and primarily to cover cost of geothermal.
 - Member **loan components** reduced to point where loan payments will be more than offset by energy savings
- Eliminates risk of dependence on fossil fuels
 - In an unstable energy market, long-term costs are likely to increase, we own our energy production and become our own energy company
- Demonstrates 1st U commitment to 7th Principle
 - By acting now to do its part to address global climate change, First Universalist sets an example in the community and demonstrates that we do in fact live by our principles



Sept. 2018 PROPOSAL	"MAINTAIN EXISTING UTILITY PAYMENTS"	MEMBER LOAN FINANCING - 100%	COMMERCIAL - 0%
Current electric demand @ \$11.00/kWh	\$11,000		
Current Gas Utility annual bill	\$3,370 (2018 Actual)	gas	2000
New building cooling	75,000	Solar	\$125,000.00
Annualized equipment replacement cost	1,761.11 average	Geothermal	\$312,000.00
Replacement options	Total 1 17,831	add cash balance	18,400.00
		Total budget	\$443,000.00
\$1,250 / year (flat increase)			Flat budget
\$22.75 / year (flat increase @ 2000kWh)			Energy servicing \$650
			Annual service \$1,350
"MAINTAIN EXISTING UTILITY PAYMENTS" SCENARIO			
100% Sustainable Energy System Cost	\$453,400	Cash contributions by donor	1.4% additional cash
Additional cash cost (donations needed)	\$23,000		1.2% of total budget
Additional Pledges for Energy System	\$620,200	down payment	3.0% inflation rate
Range \$180,000-265,000			
Member loan commitments	\$265,000		
Assured financing by Member Energy Loan	\$265,000	1.5% for 15 years @	1.4% Interest Rate \$268,161
Financed by Commercial Energy Loan	\$0	4% for 15 years @	3.4% Interest Rate \$0
			Total Loan cost \$268,161
20 Year Life Cycle Cost (Renewable)	\$304,417		
20 Year Life Cycle Cost (Fossil Fuel)	\$493,283		
20 Year Savings with Solar/Geothermal	\$188,866		
Net cost available to budget	\$180,350		

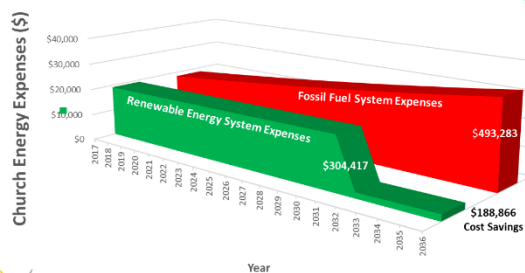


Key Features of the Energy System

- 100 % Sustainable Energy System
 - Harvests Solar Energy using the rooftop solar PV system.
 - Exchanges thermal energy with Earth using Ground Source Heat Pump
- The new sustainable Energy System has Zero Emissions
 - Stop dumping 100 tons of CO₂ annually into the atmosphere
- Does not consume precious western water.
 - Saves 144,000 gallons of water annually
- No longer doing harm
- No longer contributing to global warming / ocean acidification / glacial ice melt / sea level rise.
- Role model for others. Demonstrates sustainable living.



Energy System Options
20 Year Cost Perspective
First Universalist Operating Budget



After this presentation, the Board of Trustees discussed the proposal. There was an effort to reduce the number of member loans even further – below \$240,000 to further reduce the monthly/annual utility payments the church would have to pay.

There was an attempt by Board₃ to reduce the loan amount to \$200,000. He conducted an “Auction” and slowly raised loan limit but was not getting any response. When he got to \$240,000, several Board Members joined his position. The Board of Trustees then voted unanimously to limit loans to \$240,000 and approved the funding approach thereby clearing the way for congregational consideration and approval.

Limiting the loan amount meant that the Green First Team had to rescind about \$25,000 in loans and replace that amount with \$25,000 in donations. This meant going back out for more donations and that was just about impossible at this point.

Reducing the loan limit, reduced the repayment schedule (i.e. the new “Utility Bill”) by about \$2000. The Board chair acknowledged the church still had a budget shortfall for 2016 of around \$40,000 and they were devising an “integrated” fundraising plan. (e.g. an integrated goal of raising \$25,000 for the Sustainable Energy System and \$40,000 for general operating expenses.)

In addition to the remaining fundraising challenge, there was one more hurdle ahead - getting congregational approval in November.

This was a bittersweet moment for the Green First Task Force, but there was certainly reason for optimism.

After the Board Approval (5 Oct 2016)

The Board was optimistic that the congregation would approve the proposal. Nevertheless, the group concluded that an information campaign would be appropriate before the congregational vote to explain the plan and provide an opportunity for members to ask questions about the new energy system.

There was time for Town Hall meetings after Sunday services before the November congregational meeting. The Senior Minister suggested that the Sundays on October 16, 23, 30 were probably the best for town halls meetings after the church service.

A ‘Geothermal 101’ session was added after one of the Town Hall meetings for those members who

might want to ask more technical questions about the geothermal heat pump system.

Reviewer₁, a member of the independent review team appointed by the Board, made a number of these presentations.



Town Hall Meetings -Three (Oct 2016)

The three Town Hall meetings were attended by 20-30 members on each of the three Sundays. The discussion used the same charts presented to the Board. Members were encouraged to ask questions and express any concerns about the proposed energy system.



Geothermal 101 Community Forum (23 Oct 2016)

A Green First Task Force member suggested a short informative session entitled Geothermal 101 to the church members. She had been asked by a number of members, “What is geothermal?” As a result, she thought a brief introduction to this emerging technology for heating & cooling homes and businesses would be useful.

As part of the member educational program to familiarize them with geothermal heating & cooling basics, the Green First Team provided a 45 minute “Town Hall” style presentation followed by a Question and Answer sessions.

As part of this mini-seminar, the Green First Team also provided a bit of “show and tell” using samples of the HDPE black plastic pipe and various fittings to illustrate the “pipe” that would be inserted in the ground for heat exchange purposes. Several posters with illustrations of how a geothermal system circulates water between the Earth and the building for exchanging thermal energy were available for review. There was also a quart jar filled with the bentonite clay “grout” that is used to backfill each borehole after the black plastic pipe is inserted to fill the air space and provide good thermal conductivity between the pipe and the Earth (leaving an air gap does not provide a good conduction path for the energy exchange.) These samples were provided by the certified geothermal drilling contractor we had selected for our project.

The key “Geothermal 101” charts are provided below.



Community Forum

Geothermal 101

First Universalist Renewable Energy System

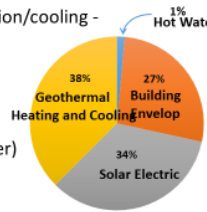
October 23, 2016
Green First Task Force



Overview – Geothermal 101



- Terminology
- Background of Geothermal Heat Pumps – Response to Climate Change
 - History
 - Heat Pump Technology emerged for refrigeration/cooling - then was extended to heating
 - Basic Principles / Physics
 - Elegance of Ground Source Heat Pumps
- Equipment / Refrigerant Fluid Involved
 - Ground Loop (water to ground heat exchanger)
 - Heat Pumps (water to air heat exchanger)
 - Refrigerant
- Future of Geothermal / Ground Source Heat pumps
- Questions



Terminology



- Geothermal - geo = earth; thermal = heat / energy
- Low Temperature Geothermal – used for space heating, hot water
- High Temperature Geothermal – used for generating electric power [Not Us]
- Heat Pump. A Refrigerator with a “Reversing Valve” So it can cool and heat
- Ground Loop = typically loops of black plastic pipe used to circulate water underground for heat exchange purpose.
- Ground Temperature.
 - Below about 20-30 ft, the ground temperature is relatively constant year round
 - Ground temperature is around 50-55°F here in the Denver region.



We divided the presentation into four parts followed by an opportunity for Questions & Answers. After identifying basic terminology, we provided a historical background of geothermal heating and cooling system to illustrate the basic physics have been known for over 250 years. The third segment describes the actual equipment involved. The last segment summarizes the benefits of this sustainable energy technology for the future.

The term, ‘geothermal’ refers to thermal energy or heat that is present in the Earth. But we are quick to point out that our church application refers to “Low-Temperature Geothermal energy.” Think 50 to 55 degree F. That is the year-round temperature of the ground directly under the church and parking lot.

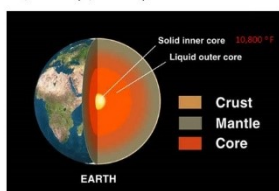
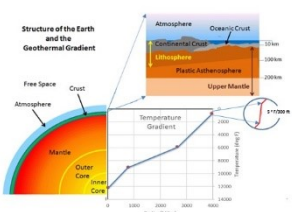
For our application, we are not considering “High-Temperature Geothermal Energy” that boils water and makes steam for geysers like Old Faithful in Yellowstone.

NOT High Temperature Geothermal Energy

Our Earth has multiple layers:

- the crust, thickness= 3-30 mi (5-48 km) [r = 3952 - 3959 mi]
- the mantle, thickness of 1,793 mi (2,886 km) [r = 2159 - 3952 mi]
- the liquid outer core, thickness of 1,400 mi (2,300 km) [r = 759 – 2159 mi]
- the solid inner core. [r = 759 mi]

The boundary between the inner and outer core is now estimated to be about 10,800 °F (6,000 °C). That's as hot as the surface of the sun.

<http://www.livescience.com/10324-earth-core-layer-scientists-claim.html>
[https://en.wikipedia.org/wiki/Crust_\(geology\)](https://en.wikipedia.org/wiki/Crust_(geology))

This is the geothermal energy we are not talking about today – energy that emanates from the molten core of the Earth. It is now believed that at the boundary between the solid inner core and the out liquid core, the temperature is around 10,000 deg F – that’s about the same temperature as the surface of the Sun. Of course, this high-temperature geothermal energy is also considered an inexhaustible source of energy. And it is being utilized in various regions of the world. So when some people mention geothermal energy they are referring to this high-temperature thermal energy.

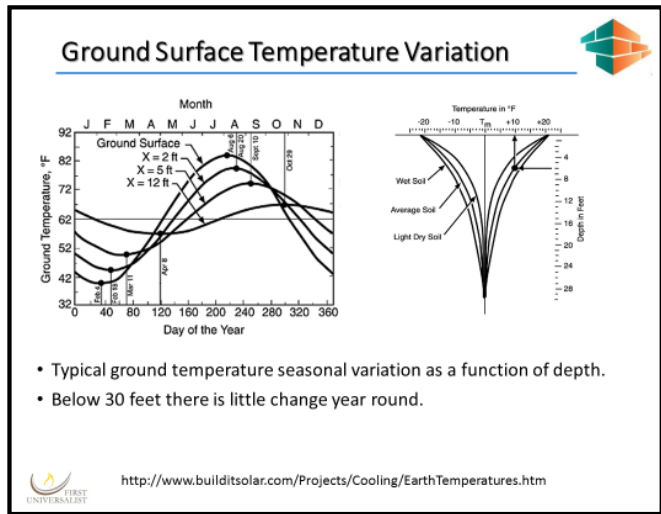
But this is not what we are referring to when we say we are transitioning to a geothermal heating and cooling system. We will not be drilling down 10 miles to tap into this energy resource

So what is a heat pump? You probably have one in your home or apartment. A geothermal heat pump is just a refrigerator with a “reversing valve” so it can cool and heat. And the heat transfer coils are placed in the ground.

A geothermal heat pump is often called a “Ground Source Heat Pump” because it extracts energy from the Earth. There are also “Air Source Heat Pumps” used in more moderate climates (e.g. southern U.S.) that extract energy from the surrounding air.

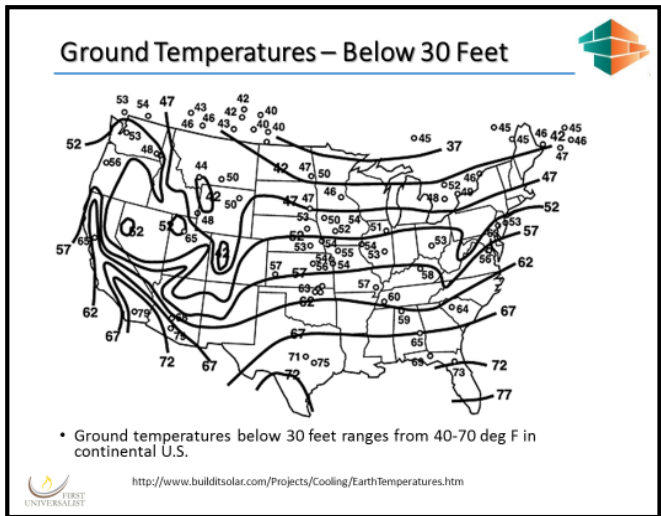
The ground source heat pump is also called a GeoExchange Heat Pump to acknowledge that the heat pump allows us to exchange thermal energy between a building and the Earth. In the winter, heat is extracted from the ground; in the summer excess heat in the building is stored in the ground.

In our application at church, we plan to replace our air conditioning units & natural gas furnaces with geothermal heat pump furnaces for heating and cooling.



Our geothermal system will include a ground loop with black plastic pipe buried in the ground.

Twelve holes 300 feet deep will be drilled in the ground. Black plastic pipe will be inserted and interconnected to allow water to circulate in a closed loop through these pipes for heat exchange purposes.



When one drills down, 30 feet below the surface, the ground temperature remains relatively constant year round. For example, the ground temperature in the Denver, Colorado area remains around 52 degrees Fahrenheit year round. Down to 30 feet below the surface, there is a slight seasonal variation.

Video Introductions

Low Temperature Geothermal:

<https://www.youtube.com/watch?v=rDqCn7d3rMA>
(Bosch)

https://www.youtube.com/watch?v=y_ZG8Hy48R0
(Department of Energy)

These two short videos provide an introduction to geothermal heating and cooling as residential applications.

History of Ground Source Heat Pump Technology

Linked directly to “refrigeration” technology

- 1755, Scottish professor [William Cullen](#) designed a small refrigerating machine in using [diethyl ether](#)
- 1758, [Benjamin Franklin](#) and [John Hadley](#), professor of chemistry, confirmed that the evaporation of alcohol and ether, could be used to freeze water. Franklin wrote, “From this experiment, one may see the possibility of freezing a man to death on a warm summer’s day.”
- 1805, American inventor [Oliver Evans](#) described a closed loop [vapor-compression refrigeration](#) cycle for the production of ice by ether under vacuum.
- 1834, an American expatriate to Great Britain, [Jacob Perkins](#), built the first working closed-cycle vapor-compression refrigeration system in the world as he described in his patent: *I am enabled to use volatile fluids for the purpose of producing the cooling or freezing of fluids, and yet at the same time constantly condensing such volatile fluids, and bringing them again into operation without waste.*
- 1948, Professor Carl Nielsen of Ohio State University develops the first ground-source heat pump (GSHP), for use at his residence.
- International Ground Source Heat Pump Association (IGSHPA) forms in 1987.

<http://energy.gov/eere/geothermal/history-geothermal-energy-america>

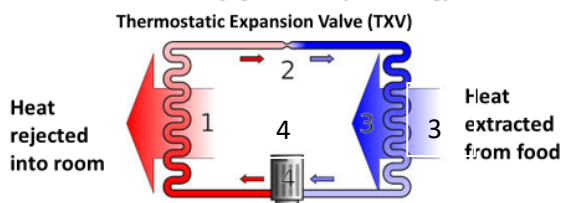
The underlying physics of heat pump technology was observed over 250 years ago by a Scottish professor, William Cullen. Even Ben Franklin has his fingerprints on this technology in 1758 when he and John Hadley used the evaporation ether to freeze water. In 1834, Jacob Perkins built and patented the world’s first closed-cycle refrigeration system. By adding a “Reversing Valve” in 1948, Ohio State University professor Carl Nielsen developed the first ground-source heat pump (GSHP) for his home. The International Ground Source Heat Pump Association (IGSHPA) was formed in 1987 as a professional society to help standardize and promote sustainable ground source geothermal energy technology.

Thermal energy (heat) normally/naturally flows from hot (high energy level) to cold (lower energy level). A heat pump can is a clever human invention that can transfer thermal energy from a cold region to a hot region, making the cold region even colder or the hot region even hotter. But as expected, there is no free lunch; the heat pump does require an external source of energy (e.g. electrical power) to operate.

Just as a crowbar and properly placed fulcrum can provide a mechanical advantage for lifting heavy objects, the heat pump provides an “energy” advantage. For example, by using one unit of energy to operate a heat pump, you can transfer/pump 4 to 5 units of energy from the ground to heat your home. Or conversely, you can transfer 4-5 units of heat out of your house into the ground to cool your home.

Science of a Ground Source/Geothermal Heat Pump 

Traditional Refrigeration Loop Technology



- Five basic components:
 - 1) Heat Rejection Coil (heat exchanger)
 - 2) Thermostatic Expansion Valve (passive flow constriction)
 - 3) Heat Extraction Coil (heat exchanger)
 - 4) Compressor (Electrical powered)
 - 5) Refrigerant fluid (R 410 A)
- Simple, low risk, dependable refrigeration technology
 Ref: <https://heatinghelp.com/systems-help-center/heat-pump-basics/>




The figure above depicts the simple heat pump that is used in our refrigerators. As indicated, there are 5 basic elements:

#5 is the refrigerant fluid (typically R-410A) that is pumped/circulated around a closed loop when the refrigerator is operating.

The compressor (#4) compresses/pumps the fluid around the closed circuit loop. The fluid entering the pump is cool, like the temperature inside the refrigerator. After being compressed by the pump, the fluid leaves the pump at high pressure and is also at a temperature warmer than room temperature (if you touch it, it will feel hot).

The hot fluid then flows through a heat rejection coil (#1). The heat rejection coil (#1) is typically under or behind the refrigerator. If you touch the coil when the refrigerator is operating, the coil will feel hotter than room temperature so it can naturally transfer thermal energy from the refrigerator into the room. A small fan pushes air over the hot coil and some of the thermal energy is transferred naturally into the room air. That thermal energy used to be inside the refrigerator but it is now outside in the room warming up the kitchen up a bit.

#2- is the expansion valve. It is a small restriction in the tube. The high-pressure warm fluid now passes through the small orifice/expansion valve. As it expands into a lower pressure region of the loop, it cools again – actually to a temperature lower than it was inside the refrigerator (because it transferred some of its thermal energy into the room air.) This very cold fluid now circulates through a coil inside the freezer section of the refrigerator shown as #3.

Evolution of Modern Refrigerants 

Refrigerants No Longer Available			
	Ozone Depletion Potential	Global Warming Potential	Status
R-11 CFC	100%	High	Production ceased in 1995
R-502 CFC	28%	High	Production ceased in 1995
Refrigerants Currently in Use			
	Ozone Depletion Potential	Global Warming Potential	Status
R-22 HCFC	5%	1760	Production Phased Out
R-134A HFC	0%	1300	Replaced R-12
R-404A HFC	0%	3943	Replaced R-502
R-410a HFC	0%	1924	
Refrigerants Emerging			
	Ozone Depletion Potential	Global Warming Potential	Status
HFO-1234yf	0%	4	Solstice® yf (Honeywell) Opteon™ (Dupont) Replaces R-134A

The refrigerant fluids continue to improve over time. Before becoming aware that CFCs did harm to the ozone layer in our upper atmosphere, fluids similar to Freon was used. To prevent further depletion of the protective ozone layer, fluids like R-410a are now used in many refrigeration appliances and air conditions. Then we became aware of greenhouse gases (GHG) and there effect on our Earth’s heat balance with the Sun – i.e. global warming. Sure enough, the new refrigerants

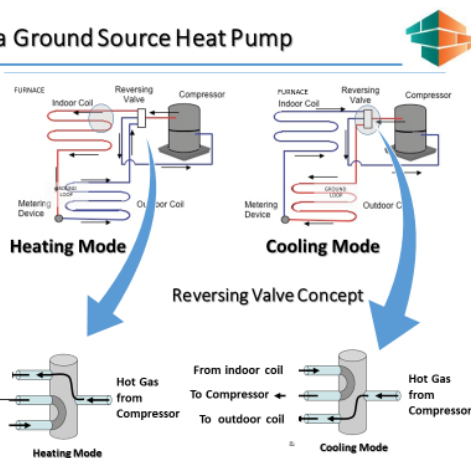
that mitigated the ozone problem were unfortunately extremely potent greenhouse gases.

Within the last several years, a new refrigerant (e.g. HFO-1234yf) has been developed that does not harm the ozone layer and does not act as a GHG and contribute to global warming. Although it is now being used in European automobile air conditioners, it has not yet been introduced into U.S. heat pump furnaces.

The Carrier heat pumps used at First Universalist have R-410a that is good for the ozone layer but bad for global warming if this refrigerant is allowed to escape into the atmosphere. We can prevent that from happening by properly recycling the heat pumps at their end of life 20 years from now.

Science of a Ground Source Heat Pump

- Simple, low risk, dependable refrigeration technology with a new wrinkle – a “Reversing Valve” provides both heating and cooling.



Ref: <https://heatinghelp.com/systems-help-center/heat-pump-basics/>

As illustrated in the graphic above, the heat pump is simply a refrigerator with a “Reversing valve” so it can be used to cool a building AND by activating the reversing valve, the same heat pump can be used to heat the building. There is no need for a separate air conditioning unit outside the building. During the summer when there is excess heat inside the building, the heat pump transfers the thermal energy into the Earth.

Who manufactures GSHPs in the U.S.



- Carrier
- ClimateMaster Inc.
- FHP Manufacturing Bosch Group
- GeoSmart Energy Inc.
- Heil
- Hydro-Temp Corporation
- Trane and American Standard Heating and Air Conditioning
- WaterFurnace International, Incorporated
- York International Corp.



Typically, the same people who manufacture HVAC systems now sell air and ground source heat pumps for heating and cooling – and there are nearly a dozen to choose from in the US market.

Tangible Benefits of Geothermal



- No use of fossil fuel resources, No Burning, No Emissions
 - No need to be concerned about flames, explosions, gas leaks, carbon monoxide poisoning, or related accidents
- No water consumption involved.
- Quiet. Provides consistent, comfortable heating and cooling.
- Notably longer operational life of the system:
 - 25 years on average for the heat pump and
 - Essentially permanent underground heat exchange loop.
- Most efficient heating & cooling system available;
 - Ground Source Heat Pump uses 1 unit of energy to exchange 4-5 units of (free) thermal energy (COP = 4-5)
 - Same equipment used for heating and cooling
- Heat pump is located inside (unlike an air/conditioner compressor)
 - System is safe from corrosion, damage from extreme weather events and vandalism.

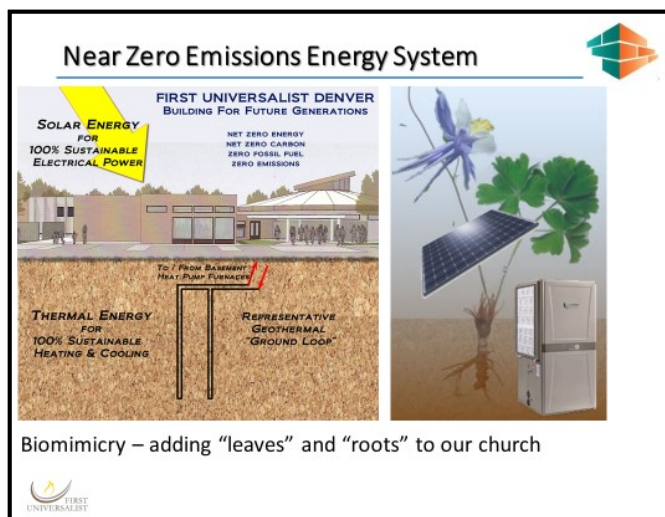


As indicated in this graphic, the primary benefits of using a ground source geothermal heat pump for heating and cooling are numerous. There is only one mechanical unit involved and it is located inside where it is protected from the weather and vandalism. The heat pump transfers thermal energy from an inexhaustible source, the Earth.

Summary – Geothermal 101



- Geothermal / Ground Source Heat Pumps (GSHP) are the best kept secret in the energy sector.
- GSHPs tap into an inexhaustible supply of thermal energy for 100% sustainable living.
- Current social system does not support the geothermal ground loop “infrastructure.” (unlike natural gas lines, electric lines, sewer, water lines)
- Refrigerant technology continues to evolve in response to growing environmental awareness.
 - First CFCs were replaced with HFCs to reduce ozone depletion potential.
 - Now HFCs are being replaced with HFOs to reduce global warming potential.
- Exchanging thermal energy with the Earth is an honorable way to harvest energy for our human needs.



So after three “Town Hall” meetings after Sunday morning services, and one Geothermal 101 session, time to inform the congregation ran out and it was time to vote.

Preparation for the Congregational Meeting

Before the final detail design of the new energy could be authorized, it was necessary to finalize the means of funding the renewable energy system.

First, a funding model for acquiring the needed capital had to be developed and approved by the Board of Trustees. The funding approach could not impact the church budget – a Board requirement.

Next, the capital required had to be pledged before seeking approval by the entire Congregation.

In the end, the Board of Trustees approved a financing approach/budget as indicated below and recommended the approach to the congregational vote.

The new energy system was approved unanimously by the congregation on Nov 6, 2016, and incorporated formally into the BFF construction contract.

The work of the ad hoc Renewable Energy Working Group was completed and the committee was quietly dissolved after the congregational vote.

Final Spreadsheet Analysis of the Funding Model.

The final financial assessment available for the November 2016 Congregational Meeting to Approval vote is provided in the Table below. As indicated, the total cost of 100% sustainable energy system comprised of a 57 kW solar PV system and a 45 Ton rated ground source geothermal heating and cooling system was \$443,000. \$208,000 was raised as church member donations (and the member donors were able to use their donations as charitable deductions on their personal taxes). The remainder of the capital required for the energy system was derived from member lenders who loaned the church money at a 1.5% interest rate repayable over a 15-year term.

This funding approach is considered to be “revenue neutral” from a church operating perspective. In other words, the church is currently spending a certain amount of money on gas and electric. There is a line item in the operating budget to cover these energy-related expenses based on purchase gas and electric from the local utility company, Xcel Energy. Using a fuel mix of approximately 80% fossil fuel generated and 20% from renewable energy sources, the church utility bills based on a fossil fuel energy system was around \$16,520 for electric and natural gas plus \$2910 for annualized equipment replacement costs for a total of \$19,430.

Based on the heat load analysis of the renovated building, the church expects to save money by switching from compact fluorescent to LED lighting and the new windows and added insulation should reduce heating/cooling costs so they expect at least a \$2,000 reduction in energy costs due to New Building Savings.

The renovated facility must comply with the current building code that now includes a new fresh air ventilation requirement for public spaces. This requirement increases energy usage.

Part IV Energy System Capital Campaign


The adjusted utility cost going forward with the renovated building was estimated to be \$17,430. This is an important number to start with because it determines the size of the loan that the church can service without changing the budget.

The goal was to create a financial model that was revenue neutral – meaning there would be no upfront down payment and no change in the church operating budget.


The spreadsheet model allows the user to stipulate their current annual utility bill and the cost of

installing a new renewable energy system (e.g. a 100% sustainable system with zero GHG emissions) and then calculate the amount of donations/grants that are required to end up with a “revenue neutral” funding model.

Just plug in a “loan amount” and the terms of the borrowed money (term, interest rate) and it will indicate how much will be required in the form of grants, donations, rebates, etc.

RENEWABLE ENERGY SYSTEM PROPOSAL - NOVEMBER 2016										
MEMBER LENDER FINANCING "TRADITIONAL LOAN REPAYMENT"				\$203,000 GREEN GRANTS						
FOSSIL FUEL ENERGY SYSTEM COSTS					RENEWABLE ENERGY SYSTEM COSTS					
Current Electric Annual Bill	\$13,150	(2012-2016 Average)		Solar Electric (55kW)	\$125,000	Base Fees - Xcel	\$660			
Current Gas Utility Annual Bill	\$3,370	(2016 Actuals)		Geothermal + 2 ERVs, etc.	\$318,400	Equip servicing	\$650			
New building saving	-\$2,000			Total Equipment Budget	\$443,400	Annual O & M	\$1,310			
Annualized Equipment Replacement Cost	\$2,910	Average		2016 Church Budget	\$828,870					
Total	\$17,430									
"TRADITIONAL LOAN SERVICING" SCENARIO										
100% Sustainable Energy System Cost	\$443,400									
Dedicated Grants/Donations for Energy System	\$203,400	(46%)								
Financing with Member Energy Loan	\$240,000	(54%)								
Interest	\$28,160	15 year term @		1.5% Interest Rate						
Total Financing Cost	\$268,160									
Annual Loan Payments	\$17,880									
20 Year Life Cycle Cost (Renewable)	\$304,390									
20 Year Life Cycle Cost (Fossil Fuel)	\$482,060	3.0% Energy Escalation Rate								
20 Year Cost Reduction with Solar/Geotherma	\$177,670									
Year	Old Utility Bill plus Replacement	New Operating Cost	Member Loan Servicing	Cum Disbursement to Members	Renewable Energy Utility Bill	Cum Utility Cost	Reduction in Energy Expenses (Resources for other Programs)	Cum Cost Reduction	Energy % of Church Total Budget	
1	2017 \$17,950	\$1,350	\$17,880	\$17,880	\$19,230	\$19,230	(\$1,280)	(\$1,280)	2.3%	
2	2018 \$18,490	\$1,390	\$17,880	\$35,760	\$19,270	\$38,500	(\$780)	(\$2,060)	2.3%	
3	2019 \$19,040	\$1,430	\$17,880	\$53,640	\$19,310	\$57,810	(\$270)	(\$2,330)	2.2%	
4	2020 \$19,610	\$1,470	\$17,880	\$71,520	\$19,350	\$77,160	\$260	(\$2,070)	2.1%	
5	2021 \$20,200	\$1,510	\$17,880	\$89,400	\$19,390	\$96,550	\$810	(\$1,260)	2.1%	
6	2022 \$20,810	\$1,560	\$17,880	\$107,280	\$19,440	\$115,990	\$1,370	\$110	2.0%	
7	2023 \$21,430	\$1,610	\$17,880	\$125,160	\$19,490	\$135,480	\$1,940	\$2,050	2.0%	
8	2024 \$22,070	\$1,660	\$17,880	\$143,040	\$19,540	\$155,020	\$2,530	\$4,580	1.9%	
9	2025 \$22,730	\$1,710	\$17,880	\$160,920	\$19,590	\$174,610	\$3,140	\$7,720	1.9%	
10	2026 \$23,410	\$1,760	\$17,880	\$178,800	\$19,640	\$194,250	\$3,770	\$11,490	1.8%	
11	2027 \$24,110	\$1,810	\$17,880	\$196,680	\$19,690	\$213,940	\$4,420	\$15,910	1.8%	
12	2028 \$24,830	\$1,860	\$17,880	\$214,560	\$19,740	\$233,680	\$5,090	\$21,000	1.7%	
13	2029 \$25,570	\$1,920	\$17,880	\$232,440	\$19,800	\$253,480	\$5,770	\$26,770	1.7%	
14	2030 \$26,340	\$1,980	\$17,880	\$250,320	\$19,860	\$273,340	\$6,480	\$33,250	1.6%	
15	2031 \$27,130	\$2,040	\$17,880	\$268,200	\$19,920	\$293,260	\$7,210	\$40,460	1.6%	
16	2032 \$27,940	\$2,100	\$0	\$268,200	\$2,100	\$295,360	\$25,840	\$66,300	0.2%	
17	2033 \$28,780	\$2,160	\$0	\$268,200	\$2,160	\$297,520	\$26,620	\$92,920	0.2%	
18	2034 \$29,640	\$2,220	\$0	\$268,200	\$2,220	\$299,740	\$27,420	\$120,340	0.2%	
19	2035 \$30,530	\$2,290	\$0	\$268,200	\$2,290	\$302,030	\$28,240	\$148,580	0.2%	
20	2036 \$31,450	\$2,360	\$0	\$268,200	\$2,360	\$304,390	\$29,090	\$177,670	0.2%	
		\$482,060	\$36,190	\$268,200	\$304,390	\$304,390	\$177,670			
		Total 20 yr Fossil Fuel Costs	Total Loan Payments	Total 20 yr Renewable Energy Costs	Total Cost Reduction					

Congregation Approval of the Sustainable Energy System (6 Nov 2016)




Net Zero Carbon Sustainable Energy System


Living our Principles

First Universalist Congregational Meeting
November 6, 2016

Renewable Energy Working Group



Net Zero Carbon Sustainable Energy System




An extraordinary commitment to our 7th Principle supported by extraordinary contributions by church members


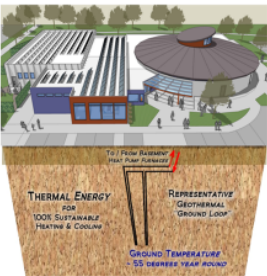
- Provides substantial long-term cost savings, but...
- Requires up-front investment with extended pay-back period

Critical questions to be addressed


- What is it and what does it do?
- Can we make it work?
- How do we pay for it?
- What are the compelling reasons to do it?




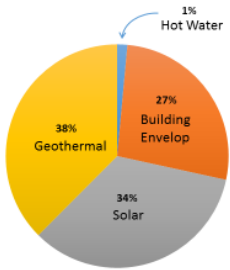
What it is


- **Building envelop improvements** – major improvements in insulation and sealing incorporated into building design
- **Solar** – photovoltaic array for onsite power generation, and connection to grid for night-time power (\$125,000)
- **Geothermal** – system of multiple wells, circulating coolant and heat transfer pumps for both heating and cooling (\$312,000)
- **Hot water heating** – water-to-water heat transfer pump, with electric hot water heater for top-up (\$10,000)




What does it do?

Carbon Savings
100 tons CO₂ per year




Can we make it work?




- **Proven technologies** – both solar and geo-thermal are now proven, reliable technologies, with good track records in Denver Metro
- **Qualifications** – all key players have necessary and applicable experience:
 - Barrett (architect)
 - DMA (mechanical & electrical designer)
 - Faurot (general contractor)
 - Brite Street (solar subcontractor)
 - Precise (HVAC subcontractor)
 - Colorado Geothermal Drilling (drilling subcontractor)
- **Design review** – all design performed according to industry standards, with reasonable, conservative allowances and assumptions
- **Outside review and commissioning** – performance assessment and assurance to be provided by Lightly Treading (and others)

Bottom line: technically sound!




How do we pay for it?



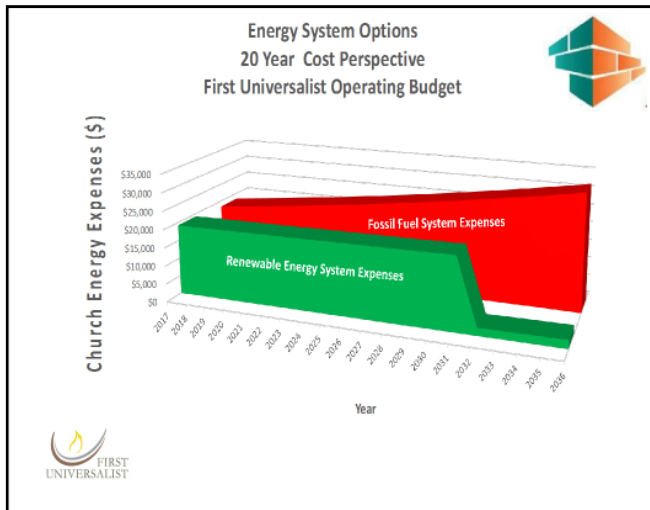
Total cost	\$443,400
Funding	
Member loans (15 years, 1.5%)	\$240,000
Cash contributions	\$203,400

Notes

1. Member loan servicing payments equal to or less than the energy savings from transition from fossil fuel to renewable energy
2. The church will make scheduled loan payments to a member lender partnership, which will in turn handle distribution of all loan payments to individual lenders.
3. Fund raising to continue, to increase contingency and reduce amount of loan



Part IV Energy System Capital Campaign



What are the compelling reasons to do it?

- **Substantial long-term cost savings**
The church will have no energy bill after 15 years. The church will also not be subject to rising carbon fuel prices, which experts estimate will increase 3-5% per year. All church HVAC equipment will be replaced and not require costly repair or replacement in the near term. Reserve funds for equipment/ building repair are not used.
- **Church member contributions have minimized investment impact**
Member donations made as stretch contributions to fund complete energy system, and primarily to cover cost of geothermal. Member loan components reduced to point where loan payments will be more than offset by energy savings
- **Eliminates risk of dependence on fossil fuels**
In an unstable energy market, where long-term costs are likely to increase, we own our own energy production and become our own energy company
- **Demonstrates 1st U commitment to 7th Principle**
By acting now to do its part to address global climate change, 1st U sets an example in the community and demonstrates that we do in fact live by our principles

After the presentation, congregants had time to ask questions. A motion was presented by one of the Board of Trustees and seconded.

Motion

Whereas on April 3, 2016, the Congregation approved BFF's church renovation and construction proposal to include **"solar and geothermal systems supported by external investments and approved by the Board of Trustees;"**

And whereas on October 4, 2016, the Board of Trustees unanimously approved a **Net Zero Carbon Sustainable Energy System** (attached to this motion as Exhibit 1), including design, cost, and member loan components;

It is therefore moved:

That the congregation of First Universalist Church of Denver authorizes its Board of Trustees to borrow up to \$240,000 from a partnership of individual church members repayable over 15 years at 1.5% interest, without collateral or lien on church property, for the purpose of completing payment for the Net Zero Carbon Sustainable Energy System.

The church members then voted **unanimously** to approve the motion brought by the Board to fund the proposed Sustainable Energy System for the church facility.

After approximately 2 years of internal discussion, dissension, conflict, compromise, collaboration, cooperation and commitment to their core values, First Universalist Church, Denver, Colorado decided unanimously to replace their fossil fuel energy system with a carbon-free energy system using a solar photovoltaic modules for electric power and geothermal/ground source heat pumps for heating and cooling.

This was a momentous decision and one in which the congregation can have great pride.

That this "energy system" project took place at all is somewhat miraculous. That it took place concurrently with a much larger (ten times larger) all-consuming expansion and renovation endeavor is even more astonishing. That this project took place, despite the opposing forces of the surrounding social system influencing it to maintain its status quo, is bordering on profound.

This project would not have been possible without the financial support of 44 member donors and lenders or without the combined human energy, resolve and common purpose of many more.

By reflecting on their common values, by managing and resolving their internal differences, by respecting their diverse insights, by sharing knowledge and experience, by applying their sacred principles, this group of people changed within and then enacted an external change that now benefits their larger community. In a sense, reason, logic, spirituality, and science prevailed over the opposing forces of a damaged social system much in need of significant repair and reform.

Members of this congregation can now meet in a sacred place knowing that here they have stopped doing harm to their children's future. They would hope this can serve as an example and their efforts will make it easier for others to follow. They know their worship facility is now in compliance with the COP21 Paris Agreement to reduce GHG emissions to zero because they stopped dumping 100 tons of GHG into the atmosphere annually. They are willing to provide tours and give seminars on the lessons learned and potholes to avoid as others make the choice to transition from burning hydrocarbons.

After the congregational vote, there was some celebrating as exemplified by the two email messages below:

-----Original Message-----

From: Green₆
Sent: Sunday, November 6, 2016, 6:57 PM
To: Green₅
Subject: Thank you so much

Green₅,
I cannot thank you enough for the inspiration to make this long journey to a zero carbon church. I was deeply moved today by the unanimous congregational vote today!

And you have backed your dream with your money - thank you for the generous contribution by check today...and thank your partner for her wonderful words that got the loan fund started.

All my best,
Green₆

This email was followed-up with the reply:

From: Green₅
Sent: Sunday, November 6, 2016, 9:04 PM
To: Green₆
Subject: RE: Thank you so much - *and you too*

Green₆,
Thank You and Green₇ for helping to make this vote happen.
I too am astonished and deeply moved that our small Green First Task Force persisted and was able to increase awareness of climate change within our broader church community sufficiently to craft a response consistent with our professed values. That our congregation voted unanimously to stop our carbon/greenhouse gas emissions by investing in solar electric and a ground source geothermal heating & cooling system was totally unexpected, but acknowledged with gratitude to all who helped make this happen.

We all can pause for a moment and take pride in getting to this point with the church remodeling project.

But there is still work to be done. My focus this winter will be split between,
1) working with others to assure this energy system is properly designed and will work as it is intended (there are still a few technical concerns but nothing that can't be mitigated with some additional diligence) and
2) documenting the 'Lessons Learned' this past year. Other churches (and non-profit organizations) can benefit from our experiences just as we benefited from the financial model developed by the folks at St. John's Episcopal in Boulder.

Take care, good friend. Have a good winter.
Regards,
Green₅

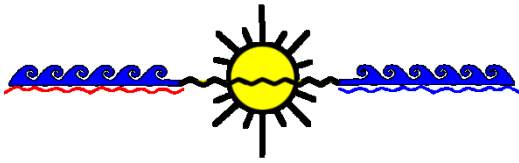
In retrospect having the congregation vote in a democratic fashion was a wise decision - this vote allowed everyone to ask questions and vote on the new energy system.

Some Green Advocates After the Vote



Figure 35 Green Advocates Celebrating a “Carbon Free Church” after Unanimous Approval, 6 Nov 2016.





Part V Final Design, Construction, Commissioning (Nov 2016 – Apr 2018)

*“Energy and persistence alter all things.”
-- Benjamin Franklin*



After Congregational approval on 6 November 2016, the effort began focusing on finalizing the financing approach and the detail design of the energy system so construction and commissioning could proceed.

After the Congregational approval, a separate contract was finalized for installing the solar PV system and the construction contract was modified to install the geothermal system.

The Green First Team emphasis changed from convincing others this is “the right thing to do” to actually making it happen and “doing the thing right.” In other words, the focus turned to the technical aspects of the project – the final design, procurement, permitting, construction, and commissioning of the new Energy System.



Finalizing the Energy System Funding

Seventh Principle Renewables Partnership

One of the Green First Task Force members, a practicing lawyer, took on the responsibility of forming a Partnership for consolidating the 15 different member loans and acting as the administrator to distribute the loan/“utility repayments” from the church.

From: Green₁

Date: 1/15/2017 9:23 PM

To: Green_{2,3,5,6,7}; Board_{1,5}; Lenders_{1,2,3};

Subject: Overview of the Seventh Principle Renewables Partnership

... I thought it would be helpful to provide a brief overview of the Seventh Principle Renewables Partnership.

Purpose of the Partnership: The sole purpose of the Partnership is to aggregate all the money the 11 of us desire to loan to the church in one loan instead of 11 separate loans. This will dramatically simplify the administration for the church by making one monthly payment under one loan instead of 11 monthly payments under 11 loans. In addition, if the church is required to issue a 1099 at the end of each year, it will only have to issue one instead of eleven. The Partnership will not conduct any other business or make any other loans in addition to this one church loan.

Why form a Partnership: By forming a general partnership for such a single purpose, we believe we will be able to simplify our administration by enabling us to elect out of the requirements to file a partnership tax return and issue K-1s to each of us every year. Hopefully, we will be able to keep it simple for the church and also keep it simple for us by not having to file partnership returns and K-1s every year. We will formally elect out of the partnership tax status with the IRS and partners will declare their interest income each year on the individual tax return.

How will this work for the next 15 years: We will have the one loan/promissory note with the church. The church will make monthly principal and interest payments on the 15-year note at 1.5% annual interest directly to our partnership bank account.

After each calendar year, the partnership will write checks to each partner for their respective share of principal and interest payments made by the church. You will each receive the same amount of principal and interest from the partnership (assuming the church pays in a timely manner) that you would have received if you had made an individual loan to the church for your respective loan amounts. You will then be responsible for declaring the interest on your tax return each year.

Part V Final Design, Construction, Commissioning

I will be opening a checking account with Colorado Business Bank in the DTC and the following persons have agreed to be signators on the account and we will take turns administering the account over the 15 year period: We will have some minor expenses to pay over the 15-year term and we will all have to contribute to these expenses based on our pro-rata shares as defined in the Partnership agreement.

Transfer of Partner's Interest and Withdrawal: We are all in this for the 15-year term unless the church prepays the note, which it has the right to do. We can transfer our Partnership Interest by will or trust, but cannot transfer our Partnership interest for any other reason or to any other person without the consent of 2/3 of the Partnership Interest. Below are the two relevant sections relating to withdrawal and transfer.

6.1 Forfeiture of Partner Interest. If a Partner voluntarily withdraws ("Withdrawing Partner") prior to the satisfaction of the Note in full and has not transferred his or her Partnership Interest pursuant to Section 6.2 below, the Withdrawing Partner shall forfeit his or her Partner Interest and the remaining Partners shall have no obligation to purchase or redeem the Withdrawing Partner's Partner Interest. In this event, the Withdrawing Partner's withdrawal shall be deemed a transfer and assignment of the Withdrawing Partner's right to future Annual Distributions to the Church. The Church shall be entitled to all future Annual Distributions that would have been made to the Withdrawing Partner but the Church shall not be considered a Partner and shall have no voting rights under this Agreement.

6.2 Transfer of Partner Interests. Partners may not transfer their Partner Interest without the written consent of Partners holding at least two-thirds (2/3rds) of the Partner Interests, except as follows: a Partner may transfer his or her Partner Interest to a member of the Partner's immediate family, to a family trust or IRA, or by bequest or devise. Any transferee accepting the Partner Interest must agree in writing to be bound by the terms and conditions of this Agreement. A transferring Partner shall also have the right to gift, transfer or assign to the Church, his or her right to future Annual Distributions to the Church. In this event, the Church shall be entitled to all future Annual Distributions that would have been made to the transferring Partner but the Church shall not be considered a Partner and shall have no voting rights under this Agreement. In lieu of making a distribution

to the Church and with the consent of the Manager, the Church may reduce its annual Note payment by the Annual Distribution to which the Church would otherwise be entitled hereunder.

We tried to keep this as simple as possible while addressing the major concerns and issues relating to a 15-year commitment. Let me know if you have any questions.

Sincerely,
Green₁

Unexpected Good Financial News (Xcel Energy Rebates) (11 Jan 2017)



One Green First/BFF member, Green₄, had focused on the design and installation of the solar PV system. A decision had already been made based on competitive bids to contract the solar installation work to BriteStreet Energy.

The solar contractor worked with a representative of the church to complete the Interconnection Agreement with the local utility company.⁶⁰

Local utility companies may be mandated (e.g. by State regulations) to provide energy conservation and 'rebate/reward' programs that incentivize their customers to conserve energy and transition to renewable energy (solar, wind and geothermal). These programs tend to reduce the utility company's revenue stream, so their "cost" is negotiated with the PUC and built into the rate structure of the utility company. (e.g. All Xcel customers in Colorado are assessed a 2% 'renewable energy' fee to pay for the conservation and SolarReward™ programs.)

As a 'non-profit' organization, the church had set the 'expectation-of-a-rebate' bar very low. So as the paperwork with Xcel proceeded, they were pleasantly surprised by some unexpected good news:

From: Green₄
To: BFF_{1,2}
Cc: Green_{5,6} ; BFF_{3,4}; Reviewer_{1,2}; Senior Minister;
Board_{1,2,3};
Sent: Wed, 11 Jan 2017
Subject: Some very good news

BFF_{1,2}, and the cc list ... I have a very big grin on my face tonight. We have had two developments in our efforts to get rebates on our bold energy commitment.

1. While tentative, our Energy Rebate partner assigned by Xcel has submitted to Xcel for approval an amount just a little north of **\$20,000**. This requires sign off from Xcel that we should get within a week or so – and they have the right to adjust... This amount is paid out at the end of construction when our partner will sign off that all energy reduction components have been installed and commissioned.

2. Today we submitted our solar application for the Xcel REC payment program (called Solar*Rewards).

a. For context: These REC payments are awarded on a first come – first served basis... this program ... is highly limited... As a result, in our projections that we used to show the economic savings of going solar to BFF and the Board, we did not assume we would get this benefit.

b. This morning I was with Brite Street at their computer and we got into the program and received an ID number to start our documentation process including engineering and other document and program process.

c. As a result, the Church will have a 2nd Agreement with Xcel (aside from the Interconnection Agreement) which is a REC Purchase Agreement. The church will receive under contract \$0.0475/kWh for all energy generated by the system for the next 20 years – in monthly payments.

Year one payments will total just a little more than \$3,800 and - because of the slight decline in production over its lifespan - will drop to about \$3,200 in year 20. The total 20-year amount is approximately **\$71,000**.

Congratulations to First Universalist!

Best,

Green₄

The sum total of these energy-related rebates is approximately **\$91,000** over the next 20 years. Only

about half of the \$20,000 in rebates can be associated with the active solar electric and geothermal heating and cooling systems. The other half are linked to energy conservation attained by careful building design, selection of materials and construction practices (additional insulation, new windows, elimination of air leaks, use of LED lighting, use of Variable Frequency Drive motors for pumps & fans, etc.)

The \$71,000 REC Purchase Agreement is related entirely to the solar PV system.

An \$81,000 cost rebate for the energy system is equivalent to a significant unexpected 18% reduction in the new Sustainable Energy System life cycle cost.

Possible Not-So-Good Financial News (Xcel Energy Demand Rates)

An unknown at the time this case study is being documented, the new utility rate structure as applied to the church operations. The solar PV system was sized to generate all the power used by the facility on an annual basis, so it is not expected the Church will need to buy any power for the next 20-25 years unless operations change significantly.

Nevertheless, the Church will remain “on the grid” and use the utility company as their energy bank to store/deposit excess energy during the day and then withdraw from the account at night. There will still be a monthly service charge and either a new “Demand Charge” based on the peak demand during a billing period or a “Time of Use Charge.”

This type of commercial demand rate design does not work well with Net Metering Policy all over the US since NEM only allows reimbursement 1:1 at the retail rate of the usage part of the bill. Typically, that means that only about 50% of a commercial utility bill is offset by NEM policy while nearly 100% of a typical residential bill is offset by the same policy. This is also a reason that commercial buildings are slow to adopt rooftop solar all over the country.

Green₄ will work with Xcel Energy to determine which approach provides the least operating cost for First Universalist.



Finalizing the Solar PV System Design

One member of the Green First Task Force, Green₄ who had years of experience in the solar industry, focused on the Solar PV system design and installation. After getting several quotes, BriteStreet was selected as the solar system contractor. They, in turn, subcontracted the electrical work to City Electric. The BriteStreet team developed the design, provided input for the necessary building permits, and installed the solar system.



Finalizing the Geothermal/Ground Source Heating & Cooling System Design



Figure 36 Energy System Concept (Solar & Geothermal)

Geothermal System Design

Another member of the Green First Task Force, Green₅ and one member of the Board's Independent Review Team, Reviewer₂ began reviewing the geothermal system design developed by DMA (mechanical engineering) to be sure they understood how the new geothermal heating and cooling system was being designed to work.

Heating & Cooling System Sizing

Initially, there was some concern about the "sizing" of the heating & cooling that was being specified for the remodeled facility. Normally when a facility transitions from fossil fuel to renewable energy, the old gas furnace rating(s) can be used to purchase a comparable ground source heat pump furnace. However, in this case, it was more complicated. The

entire building envelop was being changed as well as the method of heating and cooling. More space was being added, all the windows were being replaced and more insulation was going to be added with this renovation project. When the heat load calculations were completed, the results indicated that the new larger facility was projected to use only 60% of the energy required to operate the old building

This was such a dramatic decrease in energy use, it seemed almost too good to be true. So to be on the safe side, the Green First Task Force recommended hiring an independent energy professional to review the project engineer's heat load model.

After checking the assumptions and input values used for the original model and heat load analysis, the independent party concluded that the two heat load calculations agreed to within 10%. Good enough. Having the second opinion provided confidence the heat load criteria used to specify the sizes of the ten new furnaces was acceptable.

Ground Loop Design

The ground loop heat exchange system to be installed in the ground under the north parking lot was then designed to accommodate the calculated heat transfer requirements. The initial design for the ground loop required 12 holes 300 feet deep and used 1¼ inch diameter HDPE black plastic pipe to circulate water for heat transfer requirements. Just before the holes were to be drilled, additional funds were found to extend the boreholes to 400 ft in depth thereby adding some margin to the ground loop heat exchange capability.

Geothermal System Operational Reliability

When the Green First Team attention turned from financial issues to technical issues, they found there were no detailed installation drawings for the geothermal system – only the line drawings prepared for the permitting process. It was not clear how the geothermal system was designed to operate, so a technical meeting/conversation was scheduled with the mechanical designer on Jan 11, 2017.

At the technical meeting, it became clear that First Universalist had not communicated some unique reliability requirements to the design team. The church staff, the Board of Trustees, and members had grown accustomed to the high reliability of the old fossil fuel based heating & cooling system. The old system used

10 independent natural gas furnaces. So if one furnace failed, the remaining 9 furnaces continued to operate normally and were to some degree even able to compensate for the failed furnace.

After the Jan 11th meeting, it was obvious the new geothermal heating & system was designed to operate differently. The review team found six (6) different critical components in the new geothermal heating and cooling system design that could be characterized as “single point failures.” If any of this component were to fail, the **entire** heating and cooling system for the entire church complex would become inoperable.

The review team learned the water circulation design consisted of two independent circulation loops interconnected by a hydraulic separator.

As designed, there was one large (135 gallon per minute) water circulation pump for operating the external ground loop. If this single pump failed, the heating and cooling system for the entire church would become inoperable because all ten heat pump furnaces used that same ground loop heat exchanger.

Another large circulation pump operated the inner water circulation loop that supplied water to each of the ten heat pump furnaces. If this pump failed, the heating and cooling system for the entire church would become inoperable because all ten heat pump furnaces used this common water circulation pump.

The small review team recommended using a dual/redundant pump design so that when the primary pump failed, the backup pump could be easily activated to avoid any downtime for the heating & cooling system. Opponents to a dual pump design suggested having a spare pump stored on site in a nearby cabinet. Even with a spare pump on hand, it was estimated there could be a half day of downtime to get a contractor to come out and replace the failed unit. Murphy’s law was applied, “If a pump can fail, it will occur at the worst possible time – e.g. Sunday morning, a few hours before the scheduled morning services.”

It was agreed that it would be difficult to settle for less reliable heating & cooling system than the church had in the past. And there was no need to accept a less reliable system because a simple change in the design (use of dual pumps) would add redundancy and restore the reliability of the system.

From: Reviewer₂
Date: 1/19/2017
Subject: Re: G-T System consolidated notes

To: Green₅
Cc: Reviewer₁; Green₆

...duplex pump systems are set up with both active, with operation switched manually or automatically from time to time. That way all equipment is live, and removing a pump requires no more than closing some isolation valves and carting off the removed unit for repair or replacement...

Adding a redundant ground loop circulation pump was an unplanned cost.

Waiting for Final Installation

The ground loop was installed mid-year and the main water circulation lines were installed throughout the building to each heat pump furnace. The geothermal installer then had to stand down until the HVAC contractor positioned the heat pump furnaces in the final location and the electrical contractor pulled the wires to each the ten furnaces. Because the building was still under construction and unable to be secured at night, it was decided to wait to install the circulation pumps until more of the other trades had completed their work and the facility could be secured 24/7. It was the fall of 2017 when it was possible to finish connecting up the geothermal system. It was commissioned and considered operational in time for the first use on 24 Dec 2017.

Monitoring System Design

The basic contract for the installation of the geothermal system did not include any performance monitoring equipment other than the standard programmable wall thermostats for the heating and cooling system.

As a result, the energy system was commissioned without additional temperature or pressure sensors, etc. for the heating and cooling system and with no additional metering of electrical power generation or usage than that provided by the utility company. Additional performance monitoring instrumentation had to be added after final inspection and occupancy.

The Green First Team had always planned to add an eGauge system that records the detailed energy usage of the building after the system was up and operating. Several Green First members use an eGauge system for monitoring electric power usage at their

residence and St. John’s Episcopal, Boulder, CO displays such a monitoring system on their web site.

But the church energy system is a bit more complicated because it involves not just solar PV but also ground source heating and cooling equipment as well as five ERVs (Energy Recovery Ventilation Units)

The Green First Team became aware they could (and should) do more to observe the operation of this rather complex energy system. On previous installations for other customers, the Geothermal Drilling Contractor had installed a web-based monitoring system that measures system temperatures as well as power usage. The system is called the Web-based Energy Logger (WEL) and is manufactured by a small company owned by Phil Malone. (See WELserver.com)

To better understand how the WEL system works, a Green First member purchased and installed a WEL system involving 10 temperature sensors to monitor their home ground source geothermal system. Although there was a learning curve, the WEL system was relatively straight forward to install, and it seemed to work well.

A conceptual design for both an eGauge and WEL monitoring system was developed and the idea of a comprehensive monitoring system was presented to the BFF committee. The monitoring equipment was estimated to cost around \$3500-\$4000.

----- Original Message -----
From: Green₅
To: BFF_{2,3}, Green₄
Cc: Green₆
Sent: Mon, 04 Sep 2017
Subject: Energy System Monitoring Instrumentation Study

BFF_{2,3}, Green₄,

After the recent church tour, we mentioned that instrumentation needs to be added to our new energy system so we could properly monitor its operation and provide a display of key information to our staff/members (similar to the example set by St. John’s Episcopal in Boulder).

The enclosed Talking Paper identifies the recommended additional instrumentation and provides a cost estimate to get the discussion started... all of these sensors are attached externally and simply

monitor current, temperature, etc. – they do not alter the equipment or affect the operation.

I recommend we buy the equipment and have member volunteers install it to minimize cost. (eGauge provides all the software and internet connection.)

I am not aware of what monitoring capability BriteStreet intends to provide under our baseline agreement. The proposed eGauge monitoring system includes several sensors to monitor the solar PV electrical production as well as the building consumption. The WEL monitoring equipment has been used by Colorado Geothermal Drilling for geothermal systems he installs (one has been operating for 8 years).

Monitoring Equipment Cost Estimate Summary
 (Details and rationale are provided in the attached file.)

eGauge Budget	\$1,960
WEL Budget	\$1,540
Grand Total	\$3,500

The proposed instrumentation would help us operate the geothermal system properly and more efficiently – and make it more visible to others via the internet.

Green₅

The BFF Committee concurred such a system would be of value to the church, but they indicated they had no budget to purchase and install such a system.

From: BFF₂
Sent: 9/5/2017 8:02 AM
RE: Energy System Monitoring Instrumentation Study
To: Green₅
Cc: BFF_{3,4}, Green₆

Gentlemen ... we have a \$17,700 gap between our projected expenditures and our estimated revenues... **we cannot sustain any new additions to the BFF budget...**geothermal monitoring equipment would be a nice addition but the idea will have to be accompanied by the funds necessary to pay the entire cost.

BFF₂

Part V Final Design, Construction, Commissioning

The Green First Task Force found the funds to finance a complete combined monitoring system and plans to install it after the building has been certified for occupancy.

While waiting for electrical and mechanical contractors to complete their work, it was decided to pull the main “bus” wire needed for the WEL system before the ceilings were drywalled. Green₄ obtained and pulled this CAT3/CAT5 wire through the crawl space and across open ceilings in the lower level of the building in preparation for final installation of approximately 75 current transformers (CTs) for the eGauge system and nearly 70 temperature sensors for the WEL system.

A preliminary graphic was created to display this complex array of information in a way that might make it easier to understand. Completion of the monitoring system was put on hold until final inspection and certification of the facility.

Summary of Design Changes/Additional Scope & Cost

Item	Final Quote (with Faurot Fee)
Additional Ground Loop Capability (300 to 400 ft deep boreholes)	\$18,795
Backup Pump (with installation)	\$6,353
HVAC Commissioning	\$10,000
Solar & Geothermal Performance Monitoring System [eGauge(Energy Usage) & WEL(temperatures)]	\$3,500
Total Upgrades	\$38,648
Remaining Budget Reserve from Green First fundraising	\$23,500
Additional funds to be raised by Green First Team	\$(15,148)



All Member Tour of the Church (August 12, 2017)

Early on one of the project completion dates was August 2017. However as August rolled around, there were still 4-5 months of work to be completed. Nevertheless, seven members of the BFF Committee

hosted an all member tour of the church construction status on an August Saturday morning. The Tour Guides were stationed at various locations around the church facility and provided a 5-10 minute overview of that segment of the facility.

A member of the Green First Team, located in a dimly lit area of the lower level near one of the mechanical rooms, provided an overview of the ‘Energy System.’ The Posters used for the brief overview are provided below.

Poster #1 provides an overview of the complete “100% Sustainable Energy System,” illustrates the new system avoids 100 tons of CO2 annually and could save as much as \$186,000 in energy costs over a 20-year time frame.

Poster #2 focuses on the Solar PV system that consists of 180 solar photovoltaic modules (panels) rated at total production of 57 kW. The system is expected to produce 80,500 kWh of electrical power annually.

Poster #3 illustrates the Ground Source Geothermal heating and cooling system

Poster #4 illustrates some of the steps for installing the ground loop heat exchanger

Poster #5 illustrates internal geothermal equipment

Poster # 6 illustrates the use of five ERVs intended to conserve energy

100% Sustainable Energy System

(Eliminating GHG Emissions using Solar PV & Ground Source Heat Pumps)

An exemplary commitment to our Unitarian Universalist Ministry for Earth

- Demonstrates "Respect for the interdependent web of all existence of which we are a part." (7th Principle)
- Replaces an unsustainable 20th century fossil fuel system with a sustainable 21st century renewable energy system.
- Demonstrates our investment in "Building for Future Generations."
- Provides substantial long-term cost savings

Carbon Savings with Renewable Energy System

Total Emissions Reduction: 100 tons of CO₂ eq / year

Equivalent to:

- Removing 19 vehicles every year, or Annual electricity used in 13 average homes, or
- 85 new acres of US Forest land each year

SOURCE: EPA GOV Carbon calculator
<https://www.epa.gov/energy/earth-hour-equivalencies-calculator>

Financial Savings with Renewable Energy System

Church Energy Expenses (\$)		Financial Benefits to Church Budget	
	Fossil Fuel System Expenses	20 yr life cycle cost (fossil fuel)	\$493,283
	Renewable Energy System Expenses	20 yr life cycle cost (renewables)	\$304,417
		20 yr church savings	\$188,866
		Member Funding	
		Loans (15 yrs, 1.5%)	\$240,000
	Donations	\$203,000	

Figure 37 Poster1 System Summary

100% Sustainable Energy System

(Eliminating GHG Emissions using Solar PV & Ground Source Heat Pumps)

Solar Energy for 100% Sustainable Electrical Power

180 modules Total rating: 57 kW

- 18 Modules on roof of the Oculus - flush mounted
- 69 Modules – Friendship Hall @ 10 deg (Ballasted)
- 87 Modules – Forum @ 10 deg (Ballasted)
- 6 modules – South Wall @ 13 deg

Production: 80,500 kWh / year

CONTRACTOR: BriteStreet Energy Group, LLC
<http://www.britestreet.com>

Your Solar Solutions Provider

Figure 38 Poster 2 Solar PV System

100% Sustainable Energy System

(Eliminating GHG Emissions using Solar PV & Ground Source Heat Pumps)

Ground Source / Geothermal Energy for 100% Sustainable Heating & Cooling

- **10 Geothermal Heat Pumps. Total Rating: 45 Ton.**
- **Ground Loop: 4800 ft of 1½" Heat Transfer Pipe.**
 - 12 boreholes 400 ft deep.
 - 3 circuits. 4 boreholes / circuit.
- **Wilo-Stratos™ Water Circulation Pump for Ground Loop (135 gpm).**
- **Grundfos™ Circulation Pumps (6-18 gpm) for each Heat Pump.**
- **No Burning. Zero GHG Emissions.**
- **Avoids 24 metric tonnes of CO₂ eq / year (2300 therms with 3% CH₄ leakage)**

CONTRACTOR: Colorado Geothermal Drilling, Dan Rau
IGSHPA Accredited Installer
<http://www.cogeothermal.com>

Figure 39 Poster 3 Geothermal Heating & Cooling

First Universalist Church Geothermal (Ground Source) Heating and Cooling System

EXTERNAL GROUND LOOP

Equipment & Supplies

Drilling & Grouting

Trenching & Installing External Manifold

Trenches Backfilled

CONTRACTOR: Colorado Geothermal Drilling, Dan Rau
IGSHPA Accredited Installer
<http://www.cogeothermal.com>

Figure 40 Poster 4 Installation of the Ground Loop

166



Figure 41 Poster 5 Internal Equipment for Geothermal

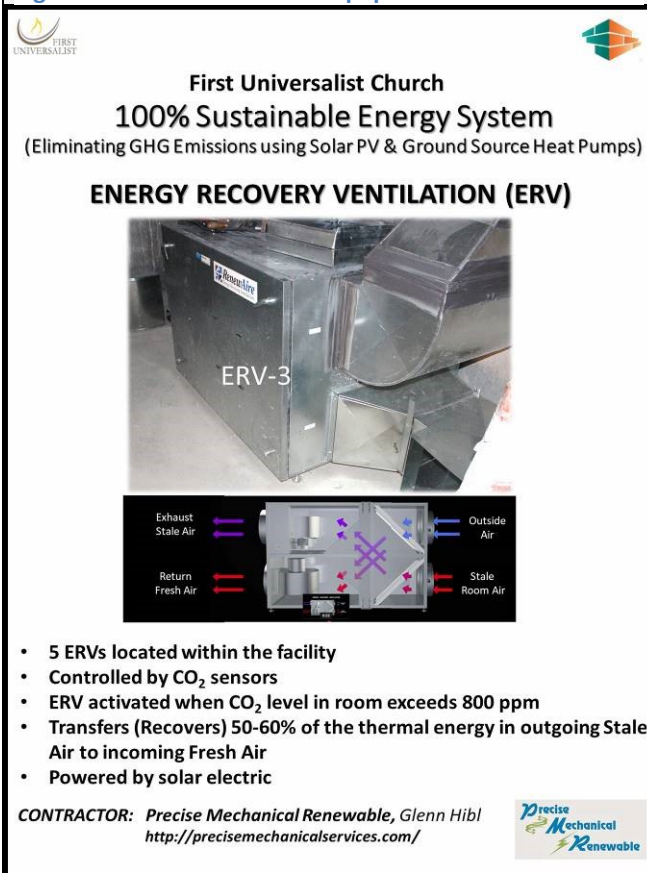


Figure 42 Poster 6 Energy Recovery Ventilation (ERV)

Energy System Installation Progress (7 Nov 2017)

The final installation of the solar system was delayed until the middle of January 2018. The solar installers, City Electric, were delayed until more foam insulation could be added to the roof. Then the installation was delayed due to a backlog in scheduling a solar installation crew. Xcel Energy installed the Net Meter on 1 June 2018. City Electric activated the system on 6 June 2018.

The geothermal ground loop heat exchanger was installed within one week in June 2017. Internal work was delayed until the HVAC contractor finished installation of the furnaces, positioned them, installed the forced-air ductwork, installed the ERVs, and the electrical contractor provided power to the water circulation pumps and heat pump furnaces. The geothermal system was completed in November 2017.

“There’s Not Enough Room”(10 Nov 2017)

This story is included because it illustrates several lessons learned:

- a) the flow of information during the course of the project,
- b) the importance of having the Green First Team involved throughout the project, and
- c) the importance of having a technology expert (i.e. a commissioning agent) involved as the eyes and ears of the owner to assure quality workmanship and operational performance.

This story begins with a “Field Report” from the commissioning agent. During one visit to the construction site, the agent observed that the installation of the geothermal valves and pumps was “slightly different” from the blueprint/engineering drawings. He documented his concern in Field Observation #3 as an attachment to an email memo below:

Here is how the story unfolded.

From: Commissioning Agent₁.

Sent: Friday, November 10, 2017

To: Architect₂ (Barrett); Construction₁ (Faurot)

Part V Final Design, Construction, Commissioning

Construction); Mechanical Engineer (DMA); BFF₃; Green₅

Subject: First Universalist Church_Iconergy WSHP Field_Observation 3

Please see the attached field observation report, and the contractors are requested to provide a response back to me to all open issues next week.

If some of the details that I identify as issues have been changed (and agreed to by the design engineer), then please let me know about that.

Thanks
Commissioning₁.

The commissioning agent's comments were passed along to the general contractor, and then forwarded to the HVAC subcontractor then to the geothermal subcontractor responsible for the actual construction. Around five days later, the geothermal contractor responded with the following email:

From: Geothermal₁.
Sent: Wednesday, November 15, 2017
To: Commissioning₁
Cc: HVAC₁, Construction₁, Green₅
Subject: RE: First Universalist Church - Iconergy WSHP Field Observation 3

Commissioning₁,

In response to the comments: FO-3-1

Due to space constraints, there is physically not enough room to install full port isolation valves on both sides of each of geo pumps 11 and 12. These pumps would require an additional 18-24" of the length of wall space and we are trying to install all piping for the system before being in the doorway of the room ...

The intent of the design is still maintained [*Ed: even with the two shut-off valves missing?*]. The pumps can be isolated if necessary in the future if [*Ed: when*] a pump change out is required with the 3" gate valves located either side of the (2) pumps installed in the room....

...Give me a call and let me know if you have any other questions.

Thanks

Geothermal₁

As is often the case, this situation arose because there was a lack of communication. All the pumps, valves and other flow control equipment were laid out in a mechanical room of the round building. When they

were interconnected and attached to the north wall of this small room, it became obvious that space was very limited. So to save space, the geothermal contractor decided to eliminate two of the four shut-offs (butterfly) valves that were in the original design.

As installed, it was necessary to shut down the whole heating and cooling system to replace a failed pump. Since this was a deviation from the drawings/blueprints, the Faurot Project Manager indicated the Geothermal Contractor would fix it. The fix involves adding two more shut-off valves and it was relatively easy to accommodate.

The installation contractor indicated, "There is not enough room" to build it as designed.

Back story: The shut-off valves had been inserted in the design to be able to isolate each of the main circulation pumps when a pump failed. The two valves on either side of the failed pump could be closed while leaving the redundant pump and the heating & cooling system fully operational at all times. The isolated failed pump can then be changed out or repair anytime without having to schedule a complete shut down of the whole heating & cooling system down and disrupt church operations.

A member of the Green First Team who was also unofficially monitoring the progress of the construction had a different perspective and submitted the following comments to the commissioning agent.

Green First Team Response: "... an additional 18"-24" of the length of wall space" appears to be on the high side.

Our estimate based on limited input is more like 5" to 6" of additional length. But our assumptions need to be verified.

We contacted a technical support representative of the pump manufacturer, Wilo USA @ 1-888-945-6872. We indicated we had purchased some Wilo 3x3-40 pumps and needed to place a butterfly valve on both sides of the pump and we had a severe space constraint. How close could we install these valves? Is there a concern about affecting the operation of the pump? Could we attach the valve directly to the pump flange?

After some time on-hold while the Wilo tech checked with others, he came back on-line and conveyed the following:

"On the inlet side, there should be no problem with the butterfly valve attached to the pump. However, there is instrumentation on the

discharge side of the pump. To avoid disrupting the instrumentation (if you are controlling off of it), we recommend that the valve be placed 5 diameters (15" in our case) from the pump – but certainly at least 3 diameters away (9" in our case) to avoid any interaction between the pump and valve."

Since we are controlling off temperature measurements (not pressure) located in a different portion of the manifold, we would probably be okay using the minimum spacing criteria (i.e. 3 diameters or 9 inches) guideline on the outlet side. Since there was already a flanged "spool" on the outlet side that was about 3-4 inches long, we would just need another 5-6 inches of separation distance.

Summary: Replace two 3" diameter, 3-4 inch long spool pieces with 9" long spool pieces on the discharge side of the pumps. Move existing butterfly valves inside the two Tee assemblies. **Add two new butterfly valves.** Move separator assembly 5-6 inches to the left. There should be enough room for that thereby allowing us to return to our original design.

Green First Team Response: With regard to "The intent of the design is still maintained (*with the two shut-off valves missing*)," we disagree. Without the two additional isolation valves, the total system must be shut down to replace/repair a pump, so we have to schedule the repair when the building is not being used.

The owner's intent was to have no (zero) downtime for the entire new heating & cooling system (**similar to the old natural gas system the geothermal system is replacing.**) To our knowledge, there was never a time in church history that we had to close down the church because a furnace went out.

We cannot afford to have a new system that imposes "inconveniences" that the old natural gas system did not impose. When we proposed switching to geothermal heating and cooling, there were many "naysayers." Any new inconvenience caused by the new geothermal system, however small, will result in some folks saying, "We told you so. Geothermal is too risky. The technology is not ready."

Without the two additional valves shown on the drawing, there will be a system downtime while we change out the failed pump. Granted it will be down for a minimal amount of time measured in hours

(rather than minutes if the other two valves were in place.)

We expect individual heat pump furnaces to fail over a period of 20-25 years; they can be changed out without shutting down the entire system.

We expect the Wilo circulation pump to last for 5-10 years, so it is not IF the pump fails but WHEN the pump wears out. Without the two additional isolation valves, we will have to schedule a system shut down to remove a failed pump. Paying a servicing contractor to show up when the church is not being used (e.g. after 9 pm) is not a fun thing to look forward to. With the two additional isolation valves, we can avoid all that stress and schedule the pump replacement anytime without any disruption in operations.

From: Commissioning Agent₁
Sent: Tuesday, November 21, 2017
To: Geothermal₁
Cc: HVAC₁ (Precise Mechanical); Construction₁ (Faurot Construction); Green_{5,6} BFF₃;
Subject: RE: First Universalist Church_Iconergy WSHP Field_Observation 3

Geothermal₁,

Thanks for your feedback. F0-3-1 is the only item that needs additional discussion/work.

Regarding F0-3-1: The current installation does not meet the design or the owner's requirements which is to have zero downtime in the event of a pump replacement. The design is required to be followed so that pump isolation valves can be installed on each pump.

This is a proposed solution: Move separator assembly 6 inches to the left. Replace two 3" diameter, 3-4 inch long spool pieces with 9" long spool pieces on the discharge side of the pumps. Move existing butterfly valves inside the two Tee assemblies. Add two new butterfly valves. (Some other brackets may have to be moved if required)

Info from the pump manufacturer: *On the inlet side there should be no problem with the butterfly valve attached to the pump. However, there is instrumentation on the discharge side of the pump. To avoid disrupting the instrumentation, we recommend that the valve be placed at least 3 diameters away (9" in our case).*

Commissioning₁

Geothermal₁ then replied to Commissioning₁

From: Geothermal₁
Date: November 26, 2017T
To: Commissioning₁
Cc: HVAC₁ (Precise Mechanical); Construction₁ (Faurot Construction); Green_{5,6} BFF₃;
Subject: RE: First Universalist Church_Iconergy WSHF
Field_Observation 3

Commissioning₁,

Please note, changing a pump head on a Wilo pump is typically a 15-minute job. There are only 4 Allen bolts to remove to change out the pump head. Downtime would be at a minimum. Valves either installed as is or installed per plan will isolate pumps for removal.

That being said we will accommodate your request and add valves as shown. My concern is with the other trades piping, conduit, etc, in the way (gas, electric, sprinkler, etc). The other concern is if this is done, the piping coming off of the left side of the separator could end up in the doorway, or we will have to turn and run across the room towards the crawlspace at very low head height. All piping is butt fused together with a fairly large machine and we will do our best to get everything put together as tight as possible.

We will get the valves in as requested, but please note we will do our best to keep piping out of the way, but cannot guarantee that piping will be located as far out of the way in the space as our previous plan.

Please give me a call or email if you would like to discuss or have any concerns. We will be working on the changes and piping starting Monday.

Thank you

Geothermal₁

The two valves were installed per the commissioning agent's 11/21/2017 proposed approach. The additional 5-6 inches of lateral spacing did not affect the final routing of the 3" diameter overhead black plastic pipe, albeit there is limited head clearance when passing under this pipe.

As of December 18, 2017, the control system based on the water temperature difference in the ground loop had yet to be installed. One of the heat pump furnaces that serviced the Sanctuary, HP-3, was also not working properly. Christmas Eve was fast

approaching. Folks were wondering if the system would be fully functional for these services at 3, 5 and 7 pm.



Feedback from the Maiden Voyage (24 Dec 2017)

The renovation effort was sufficiently completed on the ground level to allow the first use of the facility for the Christmas Eve service. It was cold outside that evening and the new geothermal system was keeping the Sanctuary at a comfortable temperature. Then around 350 people arrived. By the end of the service, folks were fanning themselves with their Order of Service. Afterward, as the congregants were leaving, one was overheard saying, "It was 78 degrees in there."

Note: An adult human gives off the same amount of heat as an old fashion 100 Watt incandescent light bulb. 350 light bulbs will warm up a room.

Normally the Sanctuary thermostats would have commanded the heat pump to switch over to the cooling mode. As it turned out, the staff had not been informed where the thermostats were located, and the thermostats had been hurriedly set to the "Heat" only mode instead of the "Auto" mode that would have allowed the heat pump furnaces to switch to their cooling mode and maintained a comfortable temperature. So much for the maiden voyage.



Monitoring Performance of the Energy System (Jun 2018 – Dec 2018)

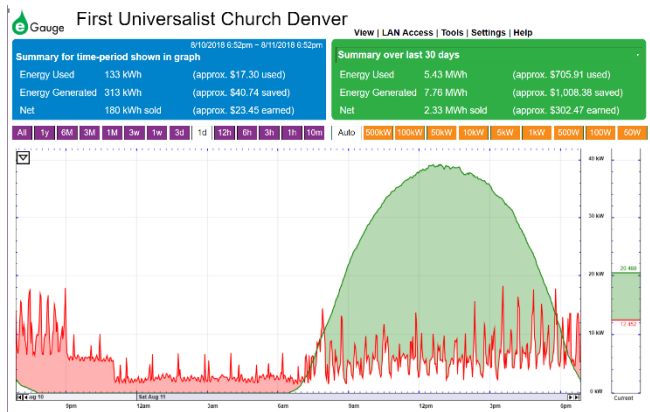
After the building was fully inspected and certified for occupancy, several members of the Green First Team installed the energy system performance monitoring instrumentation. Cat 5 wires had been pulled to each of the ten furnaces and five ERVs the previous fall before drywalling was completed in anticipation of the monitoring systems.

Over the course of approximately one week in April 2018, 70 sensors were installed to monitor air and water temperatures. In May of 2018, eighty (80) CTS (current transformers) were installed in five circuit panels around the facility to measure power usage from major energy users.

Part V Final Design, Construction, Commissioning

City Electric activated the solar system on 6 June 2018 and the new energy system began producing electrical power. City Electric also installed six of the eGauge CTs that allowed the church staff to monitor the solar production and net energy usage of the building.

A typical August weekday is shown below. The green profile depicts the solar PV system production (peaks at just under 40 kW around 1:00 pm); the red outline depicts the power consumed by the church facility (usage spikes peak at around 18 kW).



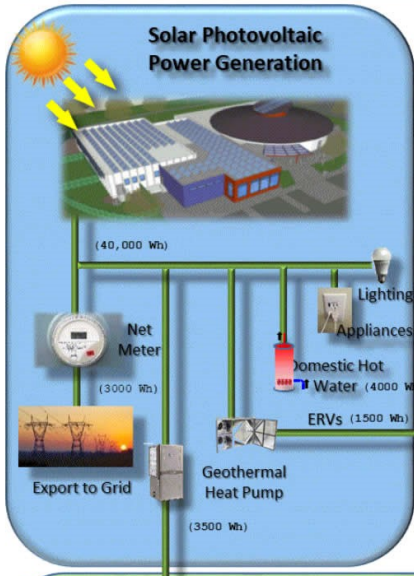
The WEL monitoring system records the energy system temperatures throughout the facility. The information is then displayed real-time (and available via the internet) on the graphic below.

Time: 16:18:51 EST
Date: 01/26/2019
FIRST UNIVERSALIST

Sustainable Energy System (No Burning – No Emissions)

CO₂ eq Avoidance
121.3 ton /year

Annual Summary
Energy Harvested: (80500 Wh)
Energy Used (70500 Wh)
Net Energy (10000 Wh)



Production: Solar PV

Annual Production: 80.5 MWh
CO₂ eq Avoidance: 66.0 Ton

Current Production (1500 Wh)
Today (1500 Wh)
This Month (1500 Wh)
Since Startup (1500 Wh)

System Summary

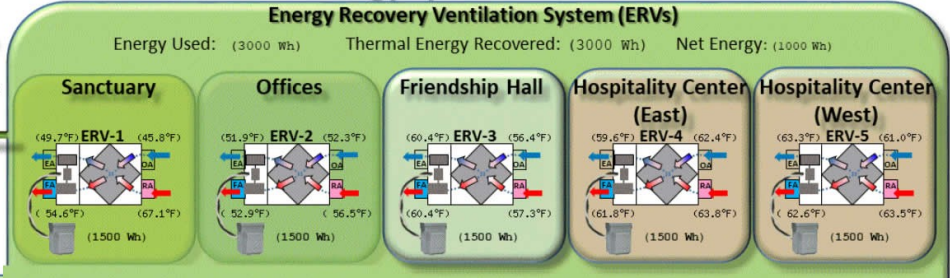
Usage

Current Usage (1500 Wh)
Today (1500 Wh)
This Month (1500 Wh)
Since Startup (1500 Wh)

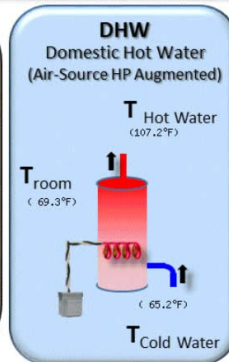
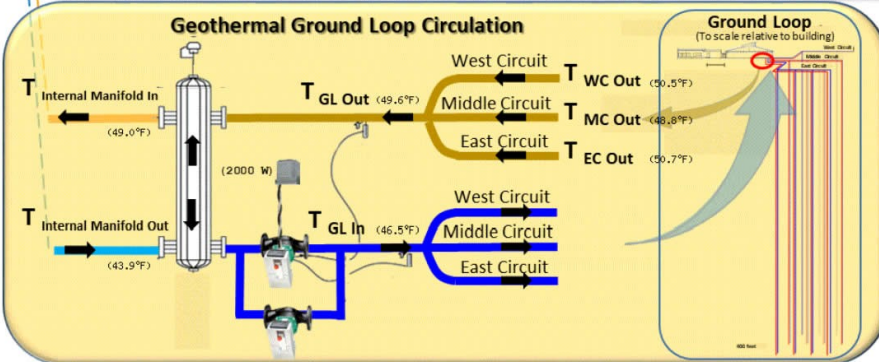
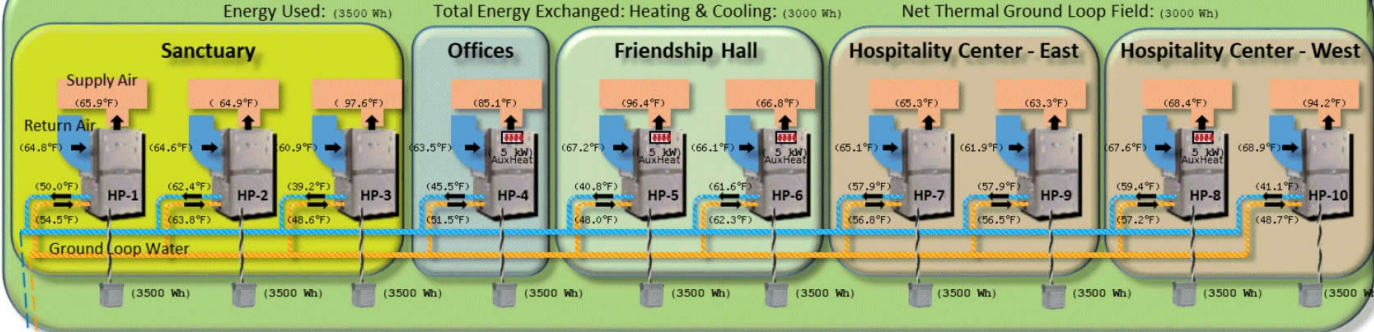
Net Energy

Current Demand (1500 Wh)
Today (1500 Wh)
This Month (1500 Wh)
Since Startup (1500 Wh)

Energy System Details



Geothermal (Ground Source) Heat Pump Heating & Cooling



Geo-Thermal Energy Annual Exchange

Withdrawn from Earth for heating: (-67,469 Wh)

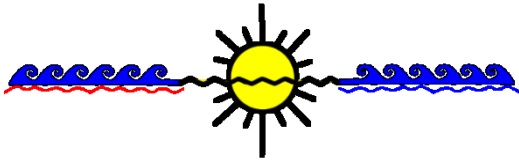
Deposited into Earth for cooling: (+30,889 Wh)

Net Effect: (-36,580 Wh)

CO₂ & Other Harm Avoidance

CO₂ eq avoided: 55.3 Ton

Local air warming avoided: 30.9 kWh



Part VI Post Project Reflections/Lessons Learned

“At times our own light goes out and is rekindled by a spark from another person.

Each of us has cause to think with deep gratitude of those who have lighted the flame within us.”

---Albert Schweitzer
Philosopher, Physician, Nobel Peace Prize Winner



With gratitude, we acknowledge the many who gave their time and talent to develop a plan to transition from unsustainable energy sources (i.e. burning ancient hydrocarbons) to sustainable inexhaustible energy sources (solar and ground source geothermal energy), thoroughly vet it, and explain how it could work.



Some Things Have Changed

2018 IPCC Special Report



The 2015 Paris Agreement (to limit global warming to 2°C with every effort to limit it to 1.5°C) was clarified by the 2018 IPCC 1.5°C Special Report. This publication provided a new awareness of the urgency of changing human behavior and reducing GHG emissions to net zero.

<https://www.ipcc.ch/report/sr15/>

Subject to correction, copy-editing and layout	
Summary for Policymakers (mirror)	3 pgs
Headline Statements (mirror)	34 pgs
Subject to correction, copy-editing, layout and "trickleback" adjustments to the text of the full report to ensure consistency with the approved Summary for Policymakers	
All Chapters	1,173 pgs
Chapter 1 (mirror)	61 pgs
Chapter 1 Annex (mirror)	22 pgs
Chapter 2 (mirror)	113 pgs
Chapter 2 Annex (mirror)	99 pgs
Chapter 3 (mirror)	246 pgs
Chapter 3 Annex (mirror)	111 pgs
Chapter 4 (mirror)	198 pgs
Chapter 4 Supplementary Materials (mirror)	171 pgs
Chapter 5 (mirror)	77 pgs
Chapter 5 Table 5.3 (mirror)	20 pgs
Glossary (mirror)	55 pgs
Changes to the Underlying Scientific-Technical Assessment to ensure consistency with the approved Summary for Policymakers (mirror)	

- Assessment of 6,000 scientific references
- 91 Authors
- 40 Countries
- 5 Chapters plus Glossary
- Typically 15-20 authors per chapter

The 2018 IPCC report was compiled by 91 authors (climate science experts) from 40 countries around the world, who evaluated over 6000 scientific references. Their findings indicated:

- 1) the remaining carbon budget for limiting warming to 1.5°C is around 530 gigatonnes of CO₂ (adjust for Jan 2019),
- 2) adding more GHG will result in warming beyond 1.5°C,
- 3) there is a significant reduction in the habitability of our planet between 1.5°C and 2°C warming,
- 4) all pathways consistent with 1.5 °C global warming go to net zero emissions before 2050 with a decline in net anthropogenic CO₂ emissions of 50% by 2030 as illustrated in Figure 33.

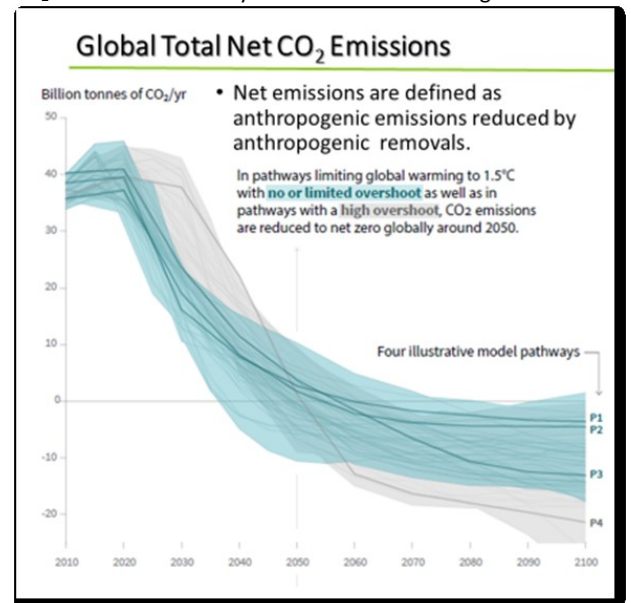


Figure 33 Paths to Zero GHG Emissions for a 1.5°C World

Part VI: Post Project Reflections

Definitions / Terminology (Ref: IPCC 1.5°C Glossary)

Carbon budget

- The estimated **cumulative amount of global carbon dioxide emissions that limits global surface temperature to a given level** above a reference period (e.g. 1.5°C warming above the pre-industrial era temperature.)
- The estimate takes into account global fossil-fuel and cement emissions, land-use change emissions, ocean and land CO₂ sinks, and the resulting atmospheric CO₂ growth rate.

Remaining carbon budget (from 1 Jan 2018)

- Cumulative global CO₂ emissions from the start of 2018 to the time that **CO₂ emissions reach net-zero that would result in a given level of global warming (e.g. 1.5°C warming.)**

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Headlines - Summary

Understanding Global Warming of 1.5°C

A1. **Human activities are estimated to have caused approximately 1.0°C of global warming...Global warming is likely to reach 1.5°C between 2030 and 2052** if it continues to increase at the current rate.

A.2. Warming from anthropogenic emissions will persist for centuries to millennia and will cause further long- term changes in the climate system, such as sea level rise....

Projected Climate Change, Potential Impacts and Risks

B1. Climate models project ... increases in: mean temperature in most land and ocean regions, **hot extremes** in most inhabited regions, **heavy precipitation** in several regions, and the probability of **drought** and precipitation deficits in some regions.

B2. **Sea level will continue to rise** well beyond 2100, and the magnitude and rate of this rise depends on future emission pathways.

B3. On land, impacts on biodiversity and ecosystems, including **species loss** and **extinction**, are projected to be lower at 1.5°C of global warming compared to 2°C ...

B4. Limiting global warming to 1.5°C ...**reduces increases in ocean temperature, ... ocean acidity and decreases in ocean oxygen levels...** Consequently, ...reducing risks to marine biodiversity, fisheries, and ecosystems, and their functions and services to humans...

Emission Pathways Consistent with 1.5°C Global Warming

C1. In model pathways ... global net anthropogenic CO₂ emissions decline by about 45% from 2010 levels by 2030 ...reaching net zero around 2050.

C2. Pathways limiting global warming to 1.5°C ...**require rapid and far-reaching transitions in energy, land, urban and infrastructure, and industrial systems.** These system transitions ... imply **deep emissions reductions in all sectors**

C3. All pathways that limit global warming to 1.5°C ...project the **use of carbon dioxide removal (CDR) on the order of 100–1000 GtCO₂** over the 21st century.

Some of the models (67%) indicate we can still add about 530 gigatonnes of CO_{2eq} (as of Jan 2019) and limit warming to 1.5°C. At our current rate of burning, humans are adding around 40 gigatonnes of CO₂ per year. So if we do nothing, we will have used the quota for a 1.5°C warmer planet by around 2030.

Time Left - Uncertainties

- "...year-2017 CO₂ emissions [were] about 43 GtCO₂ / yr."
- If we do nothing and continue to dump 43 GtCO₂ / yr, the remaining carbon budget of 570 GtCO₂ (**530 GtCO₂**) will be totally consumed in about 13 (**12**) years starting from 2018 (**2019**).

1.Economic and financial implications of 1.5°C Pathways

Chapter 2 Mitigation pathways compatible with 1.5°C

2.5.2 Economic and financial implications of 1.5°C Pathways

2.5.2.1 Price of carbon emissions

"Based on data available for this special report, the **price of carbon** varies substantially across models and scenarios, and their value increase with mitigation efforts (see Figure 2.26) ...

...for a 1.5°C pathway range from \$135–\$5,500 / tCO_{2-eq} in 2030, \$245–\$13,000 / tCO_{2-eq} in 2050,

"LIFE AFTER WARMING: UN Says Climate Genocide Is Coming. It's Actually Worse Than That."

By David Wallace-Wells OCT. 10, 2018

"... It is so remarkable that the tone of this [IPCC 1.5°C] report is so alarmist. It's not that the news about climate has changed, but that the **scientific community is finally discarding caution in describing the implications of its own finding.**

They have also, thankfully, offered a practical suggestion, **proposing the imposition of a carbon tax many, many times higher than those currently in use or being considered** — they propose raising the cost of a ton of carbon possibly as high \$5,000 by 2030, a price they suggest may have to grow to \$27,000 per ton by 2100. Today, the average price of carbon across 42 major economies is just **\$8 per ton.**

...But a carbon tax is only a spark to action, not action itself. **And the action needed is at a scale and a speed almost unimaginable to most of us.** The IPCC report called it unprecedented. Other activists often see one precedent, in all of human history, **citing the model of how the United States prepared for World War II**, and calling for a global mobilization of that kind — all of the world's rivalrous societies and nationalistic governments and self-interested industries organized around the common pursuit of a stable and comfortable climate as though warming was an existential threat...

To avoid warming of the kind the IPCC now calls catastrophic requires a complete rebuilding of the entire energy infrastructure of the world, a thorough reworking of agricultural practices and diet to entirely eliminate carbon emissions from farming, and a battery of cultural changes to the way those of us in the wealthy West, at least, conduct our lives.

And we need to do all of that in **two or possibly three decades.**"

<http://nymag.com/intelligencer/amp/2018/10/un-says-climate-genocide-coming-but-its-worse-than-that.html>
Carbon Budget - 17 Oct 2018

32

[Concerning Climate Change]

"winning slowly is the same as losing"
... **Bill McKibben, co-founder of 350.org.**

<https://www.rollingstone.com/politics/politics-news/bill-mckibben-winning-slowly-is-the-same-as-losing-198205/>

To be on a path to a 1.5 °C warmer planet, GHG emissions must be reduced by around 50% by 2030 and 100% by 2040-2050 depending on the amount of effort put into creating negative emissions (carbon capture/sequestration). The new awareness of the urgency to respond to this existential climate crisis allows us to re-evaluate current goals that are on the books in Colorado.

- Colorado RES: 20% by 2020 is not very meaningful now; it must be extended to 50% by 2030 or 100% by 2050 to be of value.
- Denver 80 x 50 Plan: 80% by 2050 will actually put Denver residents at a GHG emission rate per capita in 2050 that is equivalent to that of the average citizen of China or India **today**. To be meaningful, Denver's 80x50 plan must become 100x50 with a companion plan of 50x30.

Immediate Action Required – From All Directions.

It is not too late. There are still viable pathways to limit warming to 1.5°C. Because of the urgency, while working to change the social system from the top-down, there must be simultaneous efforts to actually implement change from the bottom-up. Actual changes that can be measured as tonnes of GHG that have been eliminated/avoided must begin now, regardless of the current social system.

Climate science indicates we cannot wait to start changing our ecocidal behavior. It appears that too many people are expecting and waiting for system level programs to solve the problem. These top-down programs, the Green New Deal Resolution being the best vision to emerge at this point, have yet to be designed, legislated and implemented. At best, a politically driven initiative for change will consume 2 to 6 years (depending on the 2020 election). Then it will be several more years to implement these programs before we can expect to actually measure reductions in GHG emissions.

Contrast this with a bottom-up approach, where organizations use the freedom and power they already have and just do it. It took 1 year from the time the project was approved to the moment the First Universalist Zero GHG Emission Energy System was operating and one could verify there was a 100-ton reduction in GHG emissions. (The actual installation work time was less than 1 month, but the installers were delayed because of schedule conflicts caused by the other trades working on the primary renovation project.) Think of this. If the new energy system project had been a stand-alone project, it would have taken 1 month from ATP (authority to proceed) to the moment the energy system stopped doing harm and was in compliance with the Paris Agreement. 1 month, not 1 decade.

Currently, there are no plans being considered, even with the Green New Deal, to directly assist non-

profit faith-based organizations in financing new equipment necessary to actually reduce their carbon emissions to zero. So even after waiting 2-6 years for Green New Deal Programs to be enacted, there still may be no financial assistance from the Federal government that applies to non-profit organizations.

The good news is that faith-based organizations can use their existing freedom and empower themselves to reduce GHG emissions right now. As members of a faith-based group, we can magnify our personal power to bring about larger change from the bottom-up.

Yet Another Example of a Green Building

Here is yet another example of what faith-based organizations can do NOW. The **Unitarian Universalist Society in Coralville, Iowa** dedicated their new Zero Energy facility November 2017.⁶¹

“The congregation aimed to make their new home the "greenest church in Iowa," equipping it with solar panels, energy efficient glass, radiant floor heating, a geothermal ground-source heat pump system, energy recovery ventilation, low-VOC (volatile organic compounds) materials, LED lighting, and charging stations for electric cars. It is sited to



have the least impact on the land and uses native plantings to manage stormwater runoff and toxicity.”

Brief History of the Project

Starting in 2015, a core group of church members, referred to as the Green First Team, became advocates for a zero GHG emissions sustainable energy system for their church in direct response to the climate crisis.

In the Fall of 2015, prior to the capital campaign to raise money for the Building for the Future (BFF) renovation project, solar and geothermal equipment had become an integral part of the remodeling project. Solar and geothermal objectives had been included in the project's design requirements “Sustainability Framework.” Contributions to the BFF project would be financing the new sustainable energy system. The Green First Task Force was elated. Their Ministry for

Part VI: Post Project Reflections

Earth had been incorporated into the renovation project and the church was on a path to zero GHG emissions in response to climate change. Hope was alive and well.

The BFF capital campaign ended around March 2016. The \$3,502,834 raised in pledges fell well short of the estimated \$4.5M cost of the remodeling project. Consequently, to close the gap, the Building Committee reduced the scope of the project to \$4,009,545 and planned to acquire a commercial loan of \$400,000 to make up the difference. This was a difficult time for the BFF Building Committee; nevertheless, they had no choice but to accept the outcome of the capital campaign and deal with it.

Because of the shortfall in pledges, the project was downsized. The new sustainable energy system, some classrooms, and several other items were deleted from the renovation project.

The Green First Team's morale was devastated. Nevertheless, they were given congregational authority to launch their own separate capital raising campaign specifically to finance the new sustainable energy system. The renewable energy system was estimated to cost around \$450,000 and represented 10% of the total renovation project cost.

The small group of advocates/supporters of a 100% Sustainable Energy System slowly grew in number, as well as resolve, during the course of the project. Collectively, the Green First Team and their colleagues identified the obstacles in their path and figured out ways around them.

For several months in the summer of 2016, this growing number of advocates for change worked under the auspices of an ad hoc committee called the Renewable Energy Working Group (REWG). The REWG committee was comprised of representatives from the Board of Trustees; the Building for the Future (BFF) Committee; the Green First Task Force; two Independent Reviewers (engineers from the congregation), and the Senior Minister.

A sustainable energy system design, cost estimate and financing plan evolved and was presented to the Board of Trustees for approval. After several iterations, the Board approved the funding approach in Oct 2016. The proposed revenue-neutral funding approach backed by member donations of over \$200,000 and member loans of \$240,000 was presented to the congregation and approved by a unanimous vote on 6 Nov 2016. The new energy system design and funding

were then added contractually into an ongoing renovation project.

Within seven months, First Universalist had crafted a financing approach to purchase and install a new 100% Sustainable Energy System.

After the funding was in place and approved, members of the Green First Team monitored the detail design and installation of the energy system to assure the needs of the congregation would be met.

Deconstruction/Construction of the BFF remodeling effort began in August 2016. The ten natural gas-fired furnaces and domestic hot water heaters were removed and recycled as part of the Deconstruction Phase to Reuse/Recycle as much as possible. Installation of the geothermal ground loop was delayed until city water was available at the work site in June 2017. Drilling, trenching and installation of the black plastic pipe for the ground heat exchanger was completed in about a week. Circulation pumps and water hook-up to the ten new heat pump furnaces occurred right after the HVAC contractor installed the furnaces in October 2017. When the HVAC control system was installed in Nov 2017, the new geothermal heating and cooling became operational in Dec 2017. General construction was completed sufficiently to utilize the new Sanctuary for the Christmas Eve service on 24 Dec 2017. The lower level of the facility was still under construction in December and completed in February.

Mechanical installation of the solar PV system was delayed pending the installation of foam insulation on the roof. After the insulation was installed, the solar system was completed with a final inspection in March of 2018 - in time for the official dedication of the remodeled facility on 1 April 2018. Excel Energy installed the net meter late in the afternoon of 1 June 2018. City Electric activated the system on 5 June 2018 and the facility began operating using solar power.

Using 21st-century equipment, the church could now harvest inexhaustible emission-free energy (that is already onsite) to operate the renovated facility. With the new energy system, the church can now use the annual sunlight they receive to generate their annual electrical power needs and the thermal energy in the ground beneath them and in the air surrounding them for all heating and cooling purposes. No net energy needs to be imported.



“GreenNotes” Version of the Project

*“If you have built castles in the
air, your work need not be lost;
there is where they should be.
Now put foundations under them.”*
-Henry David Thoreau (Walden)

This is a story of what actually happened. What happened at First Universalist Church is a specific case study and may or may not represent what other faith-based organizations might encounter.

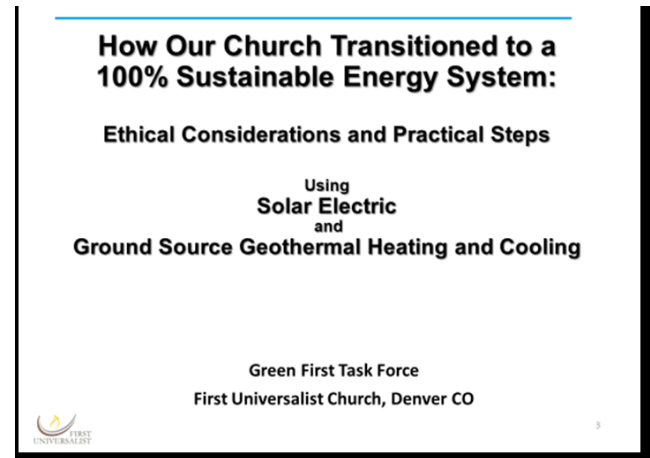
Introduction

The story documents (with gratitude) areas where First Universalist was able to build on the experiences of others who traveled this path earlier and helped light the way (e.g, Mt Vernon Unitarian, Christ the Servant Lutheran, St John’s Episcopal, and Jefferson Unitarian to name a few.)

In general, much of what happened during this project was not anticipated or preplanned. Looking back, what happened was simply the response to member questions and concerns encountered along the way.

In a sense, the members who asked thoughtful questions and who offered their reasons why this project was not possible were the people who actually charted the specific Path to Zero GHG Emissions.

Fortunately, the Green First Team shared the same religious/spiritual values with those church members who were skeptical about the project. By working together, they found a way to navigate around each specific obstacle along the way.



What was the Motivation to Change?

Before describing “How the Church Transitioned to a 100% Sustainable Energy System” to be in compliance with the Paris Agreement, it is important to ask “**What was their Motivation?**”

Upon reflection, it is obvious that “motivation to change” was a key element. Motivation can be reframed as “human energy.” It appeared that focused on human energy was required to bring about this change. Everything else was commercially available, i.e. “on the shelf” ready to be assembled.

In the beginning, except for the handful of people on the Green First Team, there was little motivation (human energy) to respond to global warming/climate change among church members. Most church members were not aware there was anything wrong with how the church was operating. So they wondered why go to the trouble and expense of fixing something that was not broken?

Admittedly, there were a number of members who would have said, “OK, adding solar panels on the roof would be a good thing - as long as it doesn’t cost anything.”

Sources of Motivation

Motivation, or lack thereof, seemed to be one of the first major challenges confronting the Green First Team. The Team found it was prudent to tap into every source of motivation available because a significant amount of this human energy was going to be required to transition from fossil fuel energy to renewable energy.

Based on observations of the First Universalist Church project, motivation is one area where a faith-based organization has a distinct advantage. As a

Part VI: Post Project Reflections

group, all members of the church have a common religious/spiritual belief. These shared values can be the foundation for building relationships and solving problems (i.e managing conflicts) that occur along the way.

Note: The project also identified a number of areas where religious organizations (and other non-profits) have distinct disadvantages (e.g. particularly in the financial area) as discussed later.

The following list identifies sources of motivation observed to be useful in garnering support for their project.

- Religion/Spirituality – (Religious Values e.g. Creation Care; Ethics/ Morality.)
- Science - (Reason & Logic/Factual Evidence / Physical Reality.)
- Economics - (Classical, Pigovian.)
- Environmentalism/Ecology – (Environmental Justice, Interdependent web of life, Avoiding the 6th Mass Extinction)
- Nurturing Instincts – (Parenthood / Grandparenthood, Empathy, Altruism, Common Good, Do No Harm, Non-violence, Possibility, and Hope)
- Cosmological Reverence – (13.7 Billion Years of Deep History, 3.5 Billion years of Evolution and an expanding consciousness that humans are threatening to end within another century)
- Social instincts/Collective Consciousness / Biomimicry
- Subconscious Intuition/Survival instincts – (Present Peril; Imminent Threat, Situational Awareness)

The following is an attempt to generalize observations from the First Universalist Case Study so they might be applicable to other faith-based organizations.

Religious, Spiritual and Ethical Values.

The Green First Team helped identify and align their congregation with inherent motivations embedded in their faith-based organization.

As a general observation, each faith-based organization (including indigenous people) has a unique way of expressing their beliefs about creation care and right relations. Each denomination has deeply held values that relate to their response to climate change. These values can be acknowledged, discussed and used to the fullest measure. One place to start this

search for Faith-Based Statements on Climate Change is a publication by Citizen Climate Lobby and Citizens' Climate Education, Coronado, CA, 2015 (second edition). Statements from 22 different denominations are included in this work. See:

<https://issuu.com/citizensclimatelobby/docs/faith-based-statments>.

Based on this case study at First Universalist, their renewable energy transition project emerged because enough people involved were motivated by common guiding principles. In this case, the UU Seventh Principle: "Respect for the interdependent web of all existence of which we are a part" served as a common deeply-held source of motivation. Becoming aware of the actual harm they were currently doing to the web of life became a powerful motivation for some members of the congregation to change.

The Green First Team also identified "Statements of Conscience" from the larger Unitarian Universalist Association pertaining to climate change, divesting in fossil fuels and transitioning to renewable energy.

There are many other sources of motivation related to ethics and morality that can be brought to light also.

The following identifies secular sources of motivation the Green First Team found useful to connect with a larger number of their fellow congregants.

Science-based motivations.

They found 'reason and logic' was a powerful source of motivation for many congregants. For those members who have a science background, climate science is a significant motivator. These members are deeply moved by the overwhelming evidence that links extraction, transport, and burning of ancient hydrocarbons to the increase in greenhouse gases in our atmosphere. They understand the physics of infrared absorption of electromagnetic energy passing through the atmosphere. They understand how infrared energy is absorbed by certain molecules (characterized as greenhouse gases) and converted into thermal energy (i.e. temperature). The Green First Team used the new story of what is happening as told in the language of science because it was a powerful motivation for change for some church members.

Global Citizen Responsibility (e.g. 2015 Paris Agreement/2018 IPCC 1.5°C Report)

It was also observed that some people will join the ranks of an energy transition project (intended to stop doing harm) out of a pure sense of duty as a responsible adult and global citizen.

This awareness “that something is not right and human behavior is contributing to these events” is a global concern. More and more people are demanding that something is done to change human behavior.

The problem is simple. Human behavior is degrading the habitability of the planet for all living species. The quantification and verification of the problem are complex and difficult. The solution is simple. For the long term survival (beyond the next century) humans must stop introducing CO₂, CH₄, and other GHG into the atmosphere. That, of course, requires a new way of thinking, and it requires courage (motivation) to change. But there is strength in numbers and 195 countries came together and signed the 2015 Paris Agreement to limit global warming to 2°C with every effort to limit it to 1.5°C and the 2018 IPCC 1.5°C Report⁶² provided a new awareness of the urgency of changing human behavior.

According to the 2018 IPCC Special Report, to be on a path to a 1.5 °C warmer planet, GHG emissions must be reduced by around 50% by 2030 and 100% by 2040-2050 depending on the amount of effort put into creating negative emissions (carbon capture/sequestration).

Using several workshops, the Green First Team encouraged the use of personal freedom and power to reduce GHG emissions in the member’s personal lives. Every local change is a global change. Members were encouraged to join groups where they could magnify their personal power to bring about a larger change in organizations.

Economics and Financial gain.

The Green First Team observed that becoming fiscally responsible investor was important to some church members and especially the Board of Trustees and Senior Minister.

By doing their homework, the Green First Team was able to reframe “We cannot afford it” to “We cannot afford to continue to use a fossil fuel energy system.” to “We don’t know how to finance the transition, yet” to “Oh! There is a way to transition to renewable energy and it is actually less expensive than burning fossil fuel!”

For example, as discussed in the main body of this document, the Green First Team found that over the

past 20 years natural gas prices in Colorado have doubled – i.e. increased an average of 5%/year.

As the finite supply of fossil fuel is depleted, there is a good reason to believe the price of fossil fuel will continue to increase over the coming 20 years. (This, of course, is not the case for energy derived from wind and solar that is expected to decrease in cost over time.)

The Green First Team conducted a 20-year Life Cycle Analysis (LCA) to compare the life cycle cost of the existing fossil fuel based energy system with the life cycle cost of the proposed renewable energy system. Assuming a 3-4% annual increase in fossil fuel costs, they found there is a financial gain in transitioning to renewable energy when a Life Cycle Cost Analysis is performed. Details are provided in the detailed Case Study.

Environmental Justice, Empathy for Others.

The Green First Team observed that for some members, the environmental injustice associated with continuing to burn ancient hydrocarbons was unconscionable and a motivation to change behavior. It was deeply disturbing to acknowledge that the most detrimental impact seems to be to those who pollute the least. In their presentations, the Green first Team included Article 2 of 2015 Paris Agreement that addresses the commitment to **Stop Adding** greenhouse gases to our atmosphere; and Article 3 that expresses a commitment to **Start Helping** developing countries who have been negatively affected by our (developed countries) past industrialization.

The Green First team used IPCC and EPA data to remind members that the average American dumps 5 times more CO₂ into the atmosphere than the average Chinese citizen. China and India are understandingly trying to catch up and become “developed nations.” As Article 3 suggests, it would be prudent to help them energize their countries using renewable energy that does not contribute GHG emissions so there is a minimal increase in global warming as they become more “developed.”

Parent and Grandparent Responsibilities.

The Green First Team understood that envisioning the future of children and living on a less habitable planet moves a number of people to support a clean energy transition project now. They understood because members of the team were themselves parents and grandparents.

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Cosmological Reverence.

The Green First Team observed that for some church members, the awe created by comprehending the 13.7 billion year creation story now being told in the language of science becomes a powerful motivation to change their current ecocidal human behavior. When the profound Universe Story is juxtaposed on the possibility that we 7.5 billion humans can now bring the evolving consciousness of living systems to an end within this next century, the emotional response can be overwhelming. Joining others in a 'project for change' is a healthy, constructive way to harness and redirect this paralyzing angst.

Biomimicry.

It was observed that a number of members had strong attachments to the natural world. In their case, the idea of Biomimicry was a valuable guide to right relations and sustainable living. By adding leaves to the roof of the church (solar panels) the church would be able to capture/harvest sunlight as a source of energy. By growing some roots (inserting some pipes into the ground) the church could exchange heat (thermal energy) with the Earth to stay cool in the summer and warm in the winter. Using biomimicry, congregants became integrated with their sustainable facility to form an evolved living system. Taken as a whole, people and facility harvest sunlight to grow spiritually and bear fruit (carry out a mission).

Possibility and Hope.

The Green First Team also observed a less defined source of motivation that can only be described as optimism. There are some church members, who are not scientists, not financial experts, may not be considered as environmentalists or naturalists. Yet they do understand there is a climate crisis and there is a solution. They do understand the transition of the church to renewable energy is part of the solution. They are hopeful and willing to help as they are able and be a part of the solution. If you ask them, they will help. With all this awareness combined with the possibility for change, there is certainly reason for hope.

Situational Awareness

It can also be observed there are members with good situational awareness. It is as if there are familiar with the NOAA compilation of "severe weather" related damage for the past several years. In 2017, the cost of severe weather was over \$300 Billion (the year

of Hurricane Sandy.) The weather-related damage for 2018 was only \$91 Billion.⁶³

Situational awareness is being aware of:

- extreme weather events (intensity of hurricanes, storm surges, rainfall, flooding, mudslides);
- drought, crop and livestock losses, fires);
- glacial and polar ice melt, sea level rise, etc.;
- extreme temperatures hot & cold;
- displacement of the island and coastal populations;

This awareness is unsettling. Records are being broken on a continuing basis. Something is going on that is not in the direction of goodness. This situational awareness can become a motivation for change.

Path to Zero GHG Emissions

Although the 2018 IPCC Special Report was published after the First Universalist renewable energy system was installed and in operation, the goal of the Green First Team had been to install a 100% sustainable energy system that had zero GHG emissions – especially after the 2015 Paris Agreement. Replacing the fossil fuel energy system was the first major priority on the path to zero emissions for the facility.

The Green First Team had tried to make their perspective clear from the beginning of the project.

Climate change is the most complicated global level existential issue homo sapiens have ever faced. The scientific issues and method of avoiding a human-caused mass extinction is **well established and verified** by climate scientists around the world. Although understanding the complex interaction of all the relevant phenomena is extremely difficult thereby making climate change modeling complicated, **the solution to this existential crisis is simple.**

- **STOP** adding CO₂ and other GHG to our common atmosphere.
- **ACCELERATE** the inevitable transition **from** extracting/burning hydrocarbons as an energy source **to** harvesting inexhaustible sources of energy (solar, wind, hydro, geothermal, ...)

There is Good News. The Universe is giving us sustainable sources of energy that are inexhaustible. These alternatives to fossil fuel are energy sources that do not add GHG to our atmosphere. Today,

these inexhaustible energy sources are actually less costly than extracting & burning ancient hydrocarbons.

So how does a faith-based organization get onto a path that leads to zero GHG emissions? There are many paths to zero emissions. Each organization has its own unique starting point; however, the steps may have similarities.

Looking back along the path First Universalist Church took, it appears their approach can be summarized as 10 steps listed in Figure 43.

Transitioning to Sustainable Energy



Figure 44 Steps Along the Path to Zero GHG Emissions

1. Assembly a Group of Advocates – a ‘Green Team’

First, they formed a group of advocates – a Green Team. First Universalist called their group the ‘Green First Task Force’ or the ‘Green First Team.’ The Green First Team was formed several years before taking on this project to transition to a 100% sustainable energy system.⁶⁴ So this small group had already built working relationships on top their shared religious values.

The Green First Team started advocating for a rooftop solar PV system in 2011 but were asked by the Board to delay their initiative until the church had an opportunity to assess long-range plans for the aging

facility. Options at that time ranged from moving to a new location to scraping the existing lot and rebuilding a new facility, to remodeling the existing facility.

There was also much happening in the larger community. Climate change awareness was expanding. Consciousness was evolving. Environmental concerns were overlapping with broader concerns about living sustainably on a finite planet. The Occupy Wall Street movement in 2011 had identified fundamental issues within the U.S. social system – specifically the economic system. The message of Bill McKibben and 350.org had grown into a formidable challenge to the Keystone XL oil pipeline project. More and more people were becoming aware that any human effort that enabled the further extraction/production of any fossil fuel, especially tars sands oil, was a fool’s folly. Naomi Klein had reframed the climate crisis as “This Changes Everything: Capitalism vs the Climate.”

It was not until 2015 that a decision was made about the future of the church facility. The congregation decided to remodel/renovate the existing building. By then several members of the Green First Team had installed rooftop solar on their homes, one had replaced their gas furnace with a heat pump, and several others were driving plug-in electric vehicles.

At this point, the Green First Team was comprised of around a half dozen thoughtful committed people. They became the initial engine of change.

Based on the experience of the Green First Team, several suggestions are offered:

- a) Do invite a few STEM folks to be on the team – there will be some climate science, some energy technology, some project engineering and some financial mathematics involved along the path to zero emissions,
- b) Anyone concerned about the climate crisis and living sustainably is encouraged to be a part of “Green Team.” Other helpful skills to have on the Green Team include legal, graphics, media & communication, artistic and conflict management to name a few.

2. Do Some Homework. Define What is Needed & Why. Motivate.

The Green First Team completed some homework to be good stewards of the church’s financial resources. They also wanted to enhance effective communication with architects,

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engineers, installers and other professionals who would eventually be contracted to perform the work.

Some of the early homework was simply to be able to envision the range of technology options available for their application. They quickly learned there was adequate energy already onsite in the form of sunlight for generating all the electrical power they needed. They learned there was definitely enough thermal energy (in the air or in the ground) for all their heating and cooling needs. The STEM team members were able to assess the available roof area, parking lot area and general grounds for solar and ground source heat exchange potential. They looked into local, city, county, state and utility regulations that may restrict or constrain their project. They did not find any major externally imposed obstacles (e.g. historical preservation constraints) preventing the project from proceeding. Nor did they find any significant public sponsored incentives.

So the homework continued to determine what was needed.

Assemble the Total Operating Cost of the existing fossil fuel energy system

The Green First Team collected a year's worth of energy-related utility bills and separated the electric and natural gas costs. They used the actual utility bills to define annual costs because that expense defined what a revenue neutral funding model must replicate.

The Green First Team was told by a Board member that any funding approach for a new system that increased the annual cost of utilities was a non-starter. Here is an example of what the Green Team found:

- **The church was spending about \$16,000/year for gas and electric.**
- **The average age of their 10 gas-fired furnaces was about 15 years, so the estimated annual replacement cost of aging equipment was close to \$3250.**
- **The church was currently spending \$19,250 annually for the fossil fuel based energy system**
- **A cost escalation factor of 3-5% / year was assumed to project these costs into the future**

A simple spreadsheet model was used to illustrate how the \$19,250 utility cost can be expected to increase over the next 20-25 years.

The new system annual cost must not exceed the annual fossil fuel cost

(Board Ground-rule)

Identify and quantify the amount of harm the current fossil fuel system is doing in terms of GHG emissions. The Green Team quantified the amount of harm the church was causing in terms of the amount of greenhouse gas (GHG) being dumped into the atmosphere each year. Using the techniques described in this detailed Case Study, they quantified the harm.

- **The church was responsible for dumping about 124 tons (112 metric tonnes) of CO₂ eq/year into the atmosphere.**

Create a graphical image that depicts the GHG emissions.

As shown in Figure 45, the Green First Team used "black smoke plumes" to represent the GHG emissions coming from each furnace flue in the building and one large smoke plume in the background to represent GHG emissions from the nearest Xcel Energy fossil fuel power generating plant.

First Universalist Was Doing Harm in 2016

- **Fossil Fuel Based Energy System**
 - Bought Electric and Natural Gas from Xcel
 - Burned Natural Gas for heating (10 gas fired furnaces)
 - Dumped 112 tonnes of CO₂ into the atmosphere annually
 - **We were doing harm (and not living our values)**

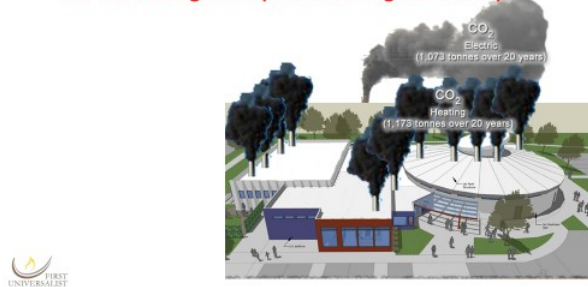


Figure 45 illustration of the GHG emissions from First Universalist Church in 2016

Include externalities (Ignored social costs)

[A detailed discussion of Externalities is provided in the Unabridged Case Study. The following is a summary.]

In addition to the harm caused by adding GHG to the atmosphere, the Green First Team was well aware there was additional harm caused by burning fossil fuel. Epstein et. al.⁶⁵ of the Harvard Medical Center conducted an analysis of the true cost of the electric generated by a coal-fired plant. Epstein's group considered a dozen externalized (ignored) social costs.

For example Land disturbances, methane emissions, carcinogens, air pollution (resulting in respiratory disease, asthma), mercury emissions (resulting in mental retardation, cardiovascular disease). Epstein et. al. monetized this short list of ignored social costs and concluded the true cost of electricity generated by a coal-fired plant should be increased by \$0.18 to \$0.27/kWh. The true cost of coal-generated electricity is a factor of 2.5 to 3.3 times its current market price, clear evidence today's economic measuring system in the U.S. is broken. Let's just say that when the free market is not grounded in reality but uses fictitious prices to compare various forms of energy, even Adam Smith's invisible hand cannot be expected to find the most efficient option.

As a result of using a broken measuring stick, the current economic system is influencing good people to make bad (ecocidal) decisions.

If ignored costs are included in the "cost analysis" (i.e. externalities are internalized), it is overwhelmingly obvious that fossil fuel is so much more expensive than renewable energy, everyone would be transitioning to solar, etc. in a heartbeat.

The Green First Team presented this perspective of externalities to the Building Committee and Board and were told not to show them again in future presentations. The Green First Team quickly decided the issue of externalities was a hill too steep to climb – it certainly was not a hill to die on. Therefore, they continued to use the classical economic frame of reference in all "cost" discussions.

Envision a New Energy System with Zero GHG Emissions

Using open source tools described in this detailed Case Study, the Green First Team developed their own "Ball-Park" estimate of a new energy system requirements based on the past year's usage. For a net-zero facility, they estimated the church would need the following equipment:

- Solar PV System: 57 kW rated system (180 panels/modules)
- Heating and Cooling System: Replace 10 natural gas furnaces with 10 ground source (geothermal) heat pump furnaces. (Total: 45 Ton rating)

Knowing the size of the new energy system, the Green First Team estimated the cost of buying and installing the new system and arrived at the following:

- Initial Cost Estimate: ~\$450,000 (Solar plus Geothermal)

[10% of the larger remodeling project would stop doing harm]

- Operating Cost: Minimal Service Charge & Connect Fee (TBD).
- Expected financial gain after 20-25 years: \$150,000 to 200,000 (plus possible Xcel Rebates?)

Now the challenge was to devise a viable financing plan under the following assumptions:

- No tax benefits /subsidies for a non-profit organization
- No change in the church operating budget (Revenue-Neutral),
- No up-front money,
- No future balloon payments.

At this point, the Green First Team had to acknowledge non-profits do not have access to the same financial incentives for transitioning to renewable energy available to homeowners and "for-profit" business.

They could see there was "money to be made" in solar, but not so much in geothermal because natural gas was so inexpensive (using classical economics with ignored costs.)

The Green Team made the following decisions:

- **Keep solar and geothermal together as an energy system.** The combination eliminates all GHG emissions, provides a path to zero emissions and should still be profitable,
- Solar-only is not a path to zero GHG emissions. Solar-only now may even make it harder to get on a path to zero emissions later.
- Think about making an offer the Board can't refuse (non-violence only),
- Identify & examine common values, ethics, beliefs. This common ground becomes a bond that helps everyone involved stay together and work together toward a win-win solution when the going gets rough,
- Stop importing energy; Start honorably harvesting energy already onsite.
- Determine a 20-year "Should Cost" as a baseline. (assume a 3-4 % annual increase in hydrocarbon energy costs). This baseline cost can be used to evaluate Power Purchase Agreements, Leases, etc.

The Green First Team found it was easy to convince the Building Committee to include energy efficiency upgrades such as better windows, more insulation, better air sealing, more efficient lighting (LEDs instead

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of compact fluorescent). However, it was a challenge to convince them to buy and install a new sustainable energy system. Installing rooftop solar was an easier sell “as long as it didn’t cost anything.” However, replacing the “perfectly good gas furnaces” with new geothermal heat pumps met with much resistance.

The Green First Team found it is prudent to establish a baseline Life Cycle Cost analysis assuming they could simply purchase all the equipment without borrowing money and incurring usury fees. Then they could compare various options: Power Purchase Agreements (PPA), Lease agreements, Community Solar Gardens, Pre-paid PPAs, financing with commercial loans and a number of other options with the baseline cost.

The Green First Team also found it prudent to craft a response to “Frequently Asked Questions.” A sample list from the First Universalist experience is provided in an Appendix J. They quickly learned it was important to develop a response to the common comment “We cannot afford it.” Another common response was “What’s the payback time?” They also learned to draft a response to “How can we even think about replacing our perfectly good gas-fired [Furnace, Boiler, Water Heater, Cook stove]? Let’s just wait until they wear out in 10-20 years.” Hint: Build an awareness (a new frame) that tells the truth “There is no such thing as a good natural gas [Furnace, Boiler,....] no matter how efficient or how new it is.” Knowing what we know today if it burns fossil fuel, it is adding GHG to the atmosphere. Everything associated with burning fossil fuel is now obsolete and unethical based on today’s consciousness. The Green First Team would often remind folks there are numerous sustainable applications for ancient hydrocarbons (e.g. adding carbon to iron to make steel. Steel can be 100% recycled indefinitely; using carbon to make carbon fibers for lightweight materials – particularly for transportation, etc. The carbon materials can be recycled.) But humans must stop **burning** these finite supplies of ancient hydrocarbons.

3. Inform, Educate the Board/Congregation about the Climate Crisis.

One of the more important roles of the Green Team is to share their understanding of global warming/climate change with their fellow congregants. Everyone deserves to be informed of the existential nature of the climate crisis and the urgency to respond in a meaningful way.

As illustrated in this detailed Case Study, the process of increasing awareness of this threat to the well-being of all life on our Planet can occur in a number of ways.

For example, the Green First Team provided Workshops, Science Meetings, a Geothermal 101 Presentation, Town Hall style meetings, and even conducted several Sunday morning services (including sermons) to help fellow congregants become more aware of today’s climate crisis. Members of the Green First Team also met several times with the architects and mechanical designers to assure their green goals and objectives were being incorporated into the building design.

Whenever the Green First Team learned there was a specific church member who was skeptical about the project (and there was a wide range of concerns), a member of the Green First Team would personally contact them and listen to their concerns. Almost always, the skeptical church member’s concerns were resolved and they too become moral supporters and even financial supporters.

The Green First Team also considered it important for their clergy (Senior Minister) and staff to be involved in this “bottom-up” action that responded to climate change. Without their support, an energy transition project involving the entire congregation would not be possible. Clergy can serve as subtle (or not so subtle) advocates for the project in the pulpit and behind the scenes. Clerics understand that if their church, synagogue, or mosque is in right relations with its surroundings, it becomes a guiding light within the community. The Green First Team observed that gaining clergy support can be challenging unless the financial model is revenue-neutral and does not drawdown the church budget or detract from the organization’s operating budget (to be discussed later).

Another role of the Green First Team was to provide new ways of thinking.

*“We can’t solve problems
by using the same kind of thinking
we used when we created them.”*

... Albert Einstein

To introduce new ways of thinking, members of the Green First Team had introduced ideas from the Unitarian Universalist Ministry for Earth Green

Sanctuary Program to the congregation about 5 years earlier.

More recently they introduced updated ways of thinking to the congregation such as:

- Ideas from the Occupy Wall Street Movement and economists like David Korten, Robert Reich, Joseph Stiglitz, Paul Krugman and Gregory Mankiw who are questioning today's financial sector,
- Ideas from environmentalist such as Bill McKibben and 350.org, the Sierra Club, etc. expressing concern about the amount of GHG humans are adding to the atmosphere,
- Scientific evidence from climate scientists like James Hansen, Michael Mann and the thousands of climate experts who form the International Panel on Climate Change (IPCC) warning us of the imminent danger of global warming. The IPCC indicates the remaining carbon budget is around 530 gigatonnes of CO₂ to limit warming to 1.5°C. [The IPCC Special Report is discussed earlier in the body of this document]
- Importance of properly "framing" an issue using the research of George Lakoff as documented in **"Don't think of an Elephant."** See Appendix E for more details.
- Ideas about different approaches to investing. For example, Woody Cash was invited to talk about his book "Slow Money" and socially responsible investing.
- Ideas from Lynne Twist's **"The Soul of Money."** She writes, *"We've made money more important than God or spirit. We've given it more power than the most powerful thing we know which is love, or spirit or relationship with one another."*
- Ideas from Naomi Klein's **"This Changes Everything-Capitalism v The Climate,"** Klein writes: *"Climate Change pits what the planet needs to maintain stability against what our current economic model needs to sustain itself. The Climate Justice fight is not just an ecological fight. It is a fight for a new economy, a new energy system, a new democracy, a new relationship to our planet and each other, for land, water, and food sovereignty, for Indigenous peoples rights, human dignity and rights for all."*

Indeed, it was from these different ways of thinking that the Green First Team found their path to zero GHG emissions and was able to grow their circle of support within their congregation.

4. Develop a Revenue Neutral Funding Model

This may be the single most important role for a Green Team.

Installing a sustainable energy system requires a significant investment in new capital equipment; so there will be a significant initial cost for the new system. Both the existing and proposed energy systems will have operating costs generally described as annual costs; the operating cost for the fossil fuel system is significant. When the initial and operating costs are added up over 20-25 years, the renewable energy system life-cycle cost will be less. There will be a financial gain in transitioning to renewable energy. How do you know there will be a financial gain?

"The best way to predict your future is to create it."
... "Inventing the Future" by Dennis Gabor, 1963
(also attributed to Abraham Lincoln by many)

There will be a financial gain because the Green First Team can develop a financing approach that creates the gain.

This detailed Case Study describes the technique First Universalist used to construct a funding approach that:

- 1) Does not require the church to pay an upfront cost, and
- 2) Maintains the same annual costs as the current fossil fuel system, and
- 3) Results in a financial gain over a 20-25 year period, and most importantly
- 4) Allows the church to stop contributing to global warming now - not 5 or 10 years from now when the existing fossil fuel equipment wears out.

The Green First Team found that if you can present a funding model to the Board/Vestry/Council for a new zero GHG emissions energy system that is "revenue neutral" (i.e. an approach that does not require a change in the organization's budget), you will have the Board's immediate attention. So, that can become the goal. Any plan that increases the organization's operating budget will make the path steeper to climb.

A "Revenue Neutral" funding approach serves as a baseline Life Cycle Cost estimate for comparison with other clever funding approaches involving third parties (Power Purchase Agreements, Leases, PACE, Commercial Loans, etc.). The baseline also identifies

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the amount of sacrifice required by the congregation (if any).

A relatively simple financial spreadsheet model similar to that shown in Figure 45 was used to develop a “Revenue Neutral” funding plan. The final model that was found to be workable for the Green First Team actually grew out of ideas developed earlier by Christ the Servant Lutheran and St. John’s Episcopal Church. After searching for the better part of a year for a third party investor to fund their new ‘energy system’ that included both solar and geothermal equipment, without success, the Green First Team finally gave up. Using the self-funding examples of the Lutheran and Episcopal congregations, the Green First team considered using an LLC made up of church members. It turned out that the LLC approach did not work as well at First Universalist because the congregational demographics did not identify enough members with ‘passive income’ for the amount of capital they needed to raise. Nevertheless, the idea of self-funding was still a good idea and the LLC morphed into a Partnership as explained in this detailed Case Study. It is fair to say, First Universalist would not have found their path without the new ways of thinking opened up by Christ the Servant Lutheran and St. John’s Episcopal.

Key steps in designing a “Revenue Neutral” funding plan include:

- A. Analyze the cost of operating the existing fossil-fuel-based energy system.
 - a. Include the monthly bills for the past year
 - b. Include all maintenance and replacement costs for the past year. For greater accuracy, you can look at the age and service life of the existing equipment (furnaces and A/C units) and determine the forward-looking replacement costs and use that instead.
 - c. Include a 3-4% escalation in the hydrocarbon-based energy costs.
- B. Estimate the size of the sustainable energy system. Knowing the size of the solar system and heat pump system required, it is possible to estimate the installation and operating costs.
- C. Assume it is possible to solicit low interest (e.g. 1.5% interest) member loans from the

congregation. Envision the money in the church budget earmarked for utility expenses being used in a different way. Envision that same amount of money used instead to finance a new sustainable energy system, specifically to service a loan repayment schedule. Determine the size of a 1.5% loan that can be repaid using the existing “utility” budget. Assume a 10 to 15-year term for the member loans.

- D. Subtract the loan value from the total cost of the energy system to define the size of the member donations and public grants required to create a Revenue Neutral funding model.

The spreadsheet model shown in Figure 45 will perform all these calculations when you input the basic costs.

At this point, the Green First Team began to solicit grants, donations, and loans. After a few weeks of soliciting for a new sustainable energy system (that does no harm and is consistent with the congregation’s faith-based values and the different secular motivations of each individual member), there will be a sense of how things are going.

- E. If the amount of capital to be raised in the form of grants and donations far exceeds what can ever be solicited, then a revenue-neutral approach is probably not possible. At that point, a Plan B would have to be created.

RENEWABLE ENERGY SYSTEM PROPOSAL - NOVEMBER 2016										
MEMBER LENDER FINANCING "TRADITIONAL LOAN REPAYMENT"					\$208,400 GREEN GRANTS (DONATIONS)					
FOSSIL FUEL ENERGY SYSTEM COSTS					RENEWABLE ENERGY SYSTEM COSTS					
Current Electric Annual Bill	13,146	(2012-2016 Average)	Solar Electric (55kW)	\$125,000	Base Fees - Xcel	\$660				
Current Gas Utility Annual Bill	3,372	(2016 Actuals)	Geothermal + 2 ERVs, etc.	\$318,400	Equipment servicing	\$650				
New building saving	12%	(1,926)	Total Equipment Budget	\$443,400	Annual O & M	\$1,310				
Annualized Equipment Replacement Cost	2,913	Average	2016 Church Budget	\$828,870						
Total	17,505									
"TRADITIONAL LOAN SERVICING" SCENARIO										
100% Sustainable Energy System Cost	443,400									
Dedicated Grants/Donations for Energy System	208,400	(47%)								
Financing with Member Energy Loan	235,000	(53%)								
Interest	27,574	15 year term @	1.5% Interest Rate							
Total Financing Cost	262,574									
Annual Loan Payments (Traditional)	17,505									
20 Year Life Cycle Cost (Renewable)	298,817									
20 Year Life Cycle Cost (Fossil Fuel)	484,476	3.0% Energy Escalation Rate								
20 Year Cost Reduction with Solar/Geothermal	185,659									
	Year	Old Utility Bill plus Replacement	New Operating Cost	Member Loan Servicing	Cum Disbursement to Members	Renewable Energy Utility Bill	Cum Utility Cost	Reduction in Energy Expenses (Resources for other Programs)	Cum Cost Reduction	Energy % of Church Total Budget
1	2017	\$18,030	1,349	\$17,505	\$17,505	\$18,854	\$18,854	(\$824)	(\$824)	2.3%
2	2018	\$18,571	1,389	\$17,505	\$35,010	\$18,894	\$37,748	(\$323)	(\$1,147)	2.2%
3	2019	\$19,128	1,431	\$17,505	\$52,515	\$18,936	\$56,684	\$192	(\$955)	2.2%
4	2020	\$19,702	1,474	\$17,505	\$70,020	\$18,979	\$75,663	\$723	(\$232)	2.1%
5	2021	\$20,293	1,518	\$17,505	\$87,525	\$19,023	\$94,686	\$1,270	\$1,038	2.0%
6	2022	\$20,902	1,564	\$17,505	\$105,030	\$19,069	\$113,755	\$1,833	\$2,871	2.0%
7	2023	\$21,529	1,611	\$17,505	\$122,535	\$19,116	\$132,871	\$2,413	\$5,284	1.9%
8	2024	\$22,175	1,659	\$17,505	\$140,040	\$19,164	\$152,035	\$3,011	\$8,295	1.9%
9	2025	\$22,840	1,709	\$17,505	\$157,545	\$19,214	\$171,249	\$3,626	\$11,921	1.8%
10	2026	\$23,525	1,760	\$17,505	\$175,050	\$19,265	\$190,514	\$4,260	\$16,181	1.8%
11	2027	\$24,231	1,813	\$17,505	\$192,554	\$19,318	\$209,831	\$4,913	\$21,095	1.7%
12	2028	\$24,958	1,867	\$17,505	\$210,059	\$19,372	\$229,203	\$5,586	\$26,681	1.7%
13	2029	\$25,707	1,923	\$17,505	\$227,564	\$19,428	\$248,631	\$6,279	\$32,960	1.6%
14	2030	\$26,478	1,981	\$17,505	\$245,069	\$19,486	\$268,117	\$6,992	\$39,952	1.6%
15	2031	\$27,272	2,040	\$17,505	\$262,574	\$19,545	\$287,662	\$7,727	\$47,679	1.6%
16	2032	\$28,090	2,101	\$0	\$262,574	\$2,101	\$289,763	\$25,989	\$73,668	0.2%
17	2033	\$28,933	2,164	\$0	\$262,574	\$2,164	\$291,927	\$26,769	\$100,437	0.2%
18	2034	\$29,801	2,229	\$0	\$262,574	\$2,229	\$294,156	\$27,572	\$128,009	0.2%
19	2035	\$30,695	2,296	\$0	\$262,574	\$2,296	\$296,452	\$28,399	\$156,408	0.2%
20	2036	\$31,616	2,365	\$0	\$262,574	\$2,365	\$298,817	\$29,251	\$185,659	0.2%
		\$484,476	36,243	\$262,574		\$298,817		\$185,659		
		Total 20 yr Fossil Fuel Costs		Total Loan Payments		Total 20 yr Renewable Energy Costs		Total Cost Reduction		

Figure 46 A 20 Year Life Cycle Cost Assessment Used for the First Universalist Sustainable Energy System Project.

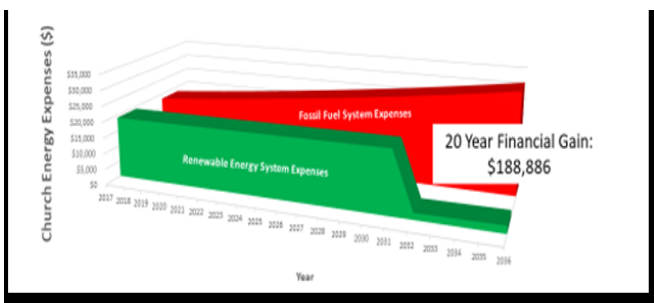


Figure 47 Comparison of Annual Expenses for operating a Fossil Fuel Energy System (RED) vs a Renewable Energy System (GREEN) using a 20-year Perspective.

1.5% Interest Loan Discussion within the Green Team

Using a combination of donations and low interest (i.e. 1.5% interest) member loans seemed to be emerging as a viable financing approach for First Universalist.

Background. The Green First team was being encouraged to divest from enterprises that operated unsustainably including coal, oil, and gas related enterprises by the prior UUA General Assembly Resolutions of 2006, 2013, 2014 and 2015 described earlier. Other environmental advocacy groups (e.g. 350.org – Fossil Free; Sierra Club – Beyond Coal,...) were even suggesting Total Divestment. Total divestment means you stop feeding the monster financially completely. Total Divestment means you stop buying their stocks, bonds AND unsustainable products – a choice consistent with transitioning to zero GHG emission renewable energy sources.

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For First Universalist, this meant:

a) stop investing in their stocks & bonds (The UUA had already reviewed its investments and eliminated its involvement in the fossil fuel burning industry),

b) stop buying fossil-fuel generated electrical power (the local utility company still generated 80% of its power by burning coal and natural gas), and

c) stop buying/burning natural gas for heating the facility.

Members of the Green First team had been influenced by the “Occupy Wall Street” movement in 2011. Occupy identified a number of economic injustices and introduced a number of alternative investment strategies. For example: divesting in Wall Street financial institutions (that were comingling banking functions and risky investment strategies); reinvesting using the concept of Slow Money (Socially Responsible Investing), and considering local institutions (e.g. local Credit Unions) and State Banks (e.g. North Dakota.) for banking functions. Keeping capital local to stimulate the local economy had become a thinkable alternative. So why not keep the financing for the new energy system local? Why not keep the working capital within the church community itself? Members could charge themselves low usury fees and keep the capital/wealth circulating locally.

Divesting totally from the fossil fuel burning industry and operating the church with renewable energy were seeds planted the previous year at a First Universalist Climate Change Workshop, “**Personal Response to Climate Change.**” Although the 2015 workshop focused on the personal level and what individuals can do to divest from and transition to renewable energy, the attendees spoke out during the closing feedback session. A few (3-4) asked why these same ideas were not being applied to the church renovation project that has just been initiated?

Discussion. The low-interest member loan approach was aligned with a number of ideas advocated by the members of the congregation. For example:

- Income inequality and wealth inequality are already crippling this country. Avoid feeding Wall Street where possible.
- Avoid commercial usury rates where possible. Look for socially responsible investors who want to “put their money to good use” and invest in efforts that consistent with their values.

- Look for member investors & lenders who are not focused on “making money” but instead “want to promote a good cause that represents their values.”
- Try to keep wealth within the local community where it provides local jobs. Better yet, keep the entire financial gain within the church community. If you have to pay any usury fees, pay it to yourself – to your church members.

An informal poll by the Green First team indicated that members were “tapped out” as far as making further donations to the church. That same poll indicated some members would be willing to “loan” money to the church if they at least got back their principle.

The Green First Team attempted to assure their BFF Building Committee colleagues they were not in competition because the Green First Team was planning on soliciting members for loans, not donations. The Green First Team contended that member loans were considered as an investment (not a donation) and came from a different pocket.

Three Green First team members had been involved for several months over the 2015-2016 winter trying to figure out how to make a third party LLC funding model work for their congregation. This LLC approach was patterned after a model developed locally by St. John’s Episcopal Church in Boulder. The St. John’s congregation created an LLC to fund their rooftop solar system that would provide 30% of electrical power requirements. The Green First Team had set a goal to fund a 100% solar system plus 100% heating & cooling system. The geothermal system made the traditional economics less attractive, but the Green First Team was insisting on an “all in” system now.

As they struggled to find an LLC funding approach work for First Universalist, the team became aware of how onerous high-interest rate loans can be. The team could only make an LLC model work if their “investors” were willing to accept a minimal return on their investment (ROI). [Minimal means zero to 1%]

As recalled by one Green First team member:

“After the Science Presentation, we put together a new cash flow model that included a donation option, a commercial loan option, and a member loan (1.5%) option. After trying various arrangements of donations/loans we finally stumbled on a possible

solution that seemed to work. It involved donations for about 40-50% of the capital required to buy the new energy system and the remainder as member loans at 1.5% interest rate. The end result was a monthly repayment plan comparable to the current monthly budget for gas & electric.⁶⁶ A few changes were made and a new spreadsheet funding model was created to define the cash flow over the next 20 years. The funding model confirmed there would be a significant financial gain by the church over a 20-year time frame and the plan was ‘revenue neutral’ meaning it did not increase the church operating budget.”

Before moving forward to solicit church members for loans, the approach needed to be reviewed by the entire Green First Team, the BFF Committee, the Board of Trustees and the Staff to get their suggestions and approval.

Final Spreadsheet Analysis of the Funding Model.

The final financial assessment available for the November 2016 Congregational Meeting is provided in the Table below. As indicated, the total cost of 100% sustainable energy system comprised of a 57 kW solar PV system and a 45 Ton rated ground source geothermal heating and cooling system and two ERVs was \$443,000. \$208,000 was raised as church member donations (and the member donors were able to use their donations as charitable deductions on their personal taxes). The remainder of the capital required for the energy system (\$235,000) was derived from member lenders who loaned the church money at a 1.5% interest rate repayable over a 15-year term.

This funding approach is considered to be “revenue neutral” from a church operating perspective. In other words, the church is currently spending a certain amount of money on gas and electric. There is a line item in the operating budget to cover these energy-related expenses based on gas and electric purchases from the local utility company, Xcel Energy. Using a fuel mix of approximately 80% fossil fuel generated and 20% from renewable energy sources, the church utility bills based on a fossil fuel energy system was around \$16,520 for electric and natural gas plus \$2910 for annualized equipment replacement costs for a total of \$19,430.

Based on the heat load analysis of the renovated building, the church expects to save money by switching from compact fluorescent to LED lighting and the new windows and added insulation should reduce

heating/cooling costs so they expect at least a \$2,000 reduction in energy costs due to New Building Savings.

The renovated facility must comply with the current building code that now includes a new fresh air ventilation requirement for public spaces. This requirement increases energy usage.

The adjusted utility cost going forward with the renovated building was estimated to be \$17,430. This is an important number to start with because it determines the size of the loan that the church can service without changing the budget.

The goal was to create a financial model that was revenue neutral – meaning there would be no upfront down payment and no change in the church operating budget.

The spreadsheet model allows the user to stipulate the current annual utility bill and the cost of installing a new renewable energy system (e.g. a 100% sustainable system with zero GHG emissions) and then calculate the amount of donations/grants that are required to end up with a “revenue neutral” funding model.

Revenue Neutral Funding Model

<http://coloradointerfaithgreenbuilding.org/Solar-GeoFundingModelA.pdf>



<http://coloradointerfaithgreenbuilding.org/Solar-GeoFundingModelA.xlsx>



The model is simple. It can be “reverse engineered” just by inspection or downloaded. Here’s how it works.

1. Input current electric and natural gas annual costs. Input the estimated cost of the new energy system (solar system and heat pump system). Input expected annual operation and maintenance cost, input estimate annual cost to replace aging equipment.
2. If the new energy system is being installed along with some energy conservation/ energy efficiency improvement, estimate the annual savings,
3. Start with a plan to use low interest (e.g. 1.5%) member loans to finance a portion of the new energy system. Depending on your member lenders, a 10, 15 or 20-year term for the member loans can be selected (e.g. start with 15 years)
4. Assume an escalation rate for the cost of fossil fuel derived energy. Colorado data has shown a 4-5%

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annual increase over the past 20 years – it is reasonable it can increase that much over the next 20 years.

5. Examine the model results. The yellow cell indicates the amount that must be raised in the form of donations/grants/rebates to reduce the effective cost of the system sufficiently to allow the balance to be covered by low-interest loans defined in the green cell below the yellow cell. The summation of

the yellow cell and the green cell should be the total cost of the new energy system.

6. The gold cell at the bottom of the table provides an estimate of the expected financial gain in transitioning to renewable energy – in this instance over \$185,000.

RENEWABLE ENERGY SYSTEM PROPOSAL - REVENUE NEUTRAL									
MEMBER LENDER FINANCING "TRADITIONAL LOAN REPAYMENT"					RENEWABLE ENERGY SYSTEM COSTS				
FOSSIL FUEL ENERGY SYSTEM COSTS					RENEWABLE ENERGY SYSTEM COSTS				
Current Electric Annual Bill	13,146	(2012-2016 Average)	Solar Electric (55KW)	\$125,000	Base Grid Fees	\$660			
Current Gas Utility Annual Bill	3,372	(2016 Actuals)	Geothermal + 2 ERVs, etc.	\$318,400	Equip. Servicing	\$650			
New building saving	12%	(1,926)	Total Equipment Budget	\$443,400	Annual O & M	\$1,310			
Annualized Equipment Replacement Cost	17,505	Average	Organization's Total Budget	\$828,870	(Optional)				
Total	17,505								
"TRADITIONAL LOAN SERVICING" SCENARIO									
100% Sustainable Energy System Cost	443,400								
Dedicated Grants/Donations for Energy System	208,400	(47%)							
Financing with Member Energy Loan	235,000	(53%)							
Interest	27,574	15 year term @ 1.5% Interest Rate							
Total Financing Cost	262,574								
Annual Loan Payments (Traditional)	17,505								
20 Year Life Cycle Cost (Renewable)	298,817								
20 Year Life Cycle Cost (Fossil Fuel)	484,476	3.0% Inflation / Energy Escalation Rate							
20 Year Cost Reduction with Solar/Geothermal	185,659								

Year	Old Utility Bill plus Replacement	New Operating Cost	Member Loan Servicing	Cum Disbursement to Members	Renewable Energy Utility Bill	Cum Utility Cost	Reduction in Energy Expenses (Resources for other Programs)	Cum Cost Reduction	Energy % of Church Total Budget
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9	\$22,840	1,709	\$17,505	\$157,545	\$19,214	\$171,249	\$3,626	\$11,921	1.8%
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16	\$28,090	2,101	\$0	\$262,574	\$2,101	\$289,763	\$25,989	\$73,668	0.2%
17	\$28,933	2,164	\$0	\$262,574	\$2,164	\$291,927	\$26,769	\$100,437	0.2%
18	\$29,801	2,229	\$0	\$262,574	\$2,229	\$294,156	\$27,572	\$128,009	0.2%
19	\$30,695	2,296	\$0	\$262,574	\$2,296	\$296,452	\$28,399	\$156,408	0.2%
20	\$31,616	2,365	\$0	\$262,574	\$2,365	\$298,817	\$29,251	\$185,659	0.2%
Total 20 yr Fossil Fuel Costs	\$484,476	36,243	\$262,574	\$262,574	\$298,817	Total 20 yr Renewable Energy Costs	\$185,659	Total Cost Reduction/Financial Gain	

USER INSTRUCTIONS

- 1) Blue Cells indicate user inputs
- 2) Yellow Cell indicates calculated amount of capital to be raised in the form of donations/grants/rebates to transition to a Renewable Energy System.
- 3) Green Cell below the Yellow Cell indicates the calculated amount of member loans that are consistent with a revenue neutral financing model
- 4) Gold Cell in the bottom row highlights the financial gain in switching to renewable energy

5. Solicit Funds: Donations/Loans/Leases

Based on the Green First Team experience, it appears that members of the Green Team are likely to be involved in soliciting funds for their new zero GHG emission energy equipment.

As expected, the commitment and resolve of the Green First Team translated into significant financial support by these few members. They provided a disproportionate, but critical, amount of support that launched the capital campaign for the new energy system with a notable lift-off.

At First Universalist, the congregation had just finished a major fundraising campaign to raise funds for a \$4.5 M renovation project. That campaign ended with a shortfall of nearly \$1M. In response to that shortfall, the new sustainable energy system was deleted from the remodeling project.

Now, the Green First Team was re-soliciting the congregation for funds to install a new energy system. Many members questioned this new energy project because they believed, "There is nothing wrong with the perfectly good gas furnaces we are now using."

The Green First Team members involved in soliciting funds would approach potential donors personally. When asked to support the new energy system, many church members said, "Sorry. We know this is a good cause, but we are tapped out for donations." So the "ask" turned into, "Would you be able to loan the church money at a low-interest rate?" - as a low risk socially responsible investment? Surprisingly, there was often a positive response to that request. In fact, so much so that pledges for loans to the church exceeded the amount that could be serviced by "utility costs." However, the total amount raised was getting closer to the goal. Ironically, as the amount raised got closer to the goal, more congregants found they too could make a donation.

The Green Team encouraged members to divest from fossil fuel enterprises and related infrastructure and re-invest locally e.g. in helping the church transition to a 100% sustainable energy system.

When the amount raised reached 80-90% of the goal, The Green First Team decided to take their proposal for a new sustainable energy system to the Board for review and possible approval. It took several trips.

The Green First Team was persistent and consistent. Every chance they had to communicate with their fellow congregants, their message would be the same. They started with a reminder of their common faith-based values and then appealed to secular motivations appropriate for that individual. The Green First Team did spend a significant effort describing how it was possible to renovate the existing facility to be consistent with the professed values they all had in common. In effect, they described what was required to make the facility sacred.⁶⁷

In many cases, it was appropriate to explain the Life Cycle Cost analysis because it indicated this project was a "smart" investment as well as the "right thing to do." The Green Team would explain how members could finance this project if they are willing to be Socially Responsible Investors interested in having their money used wisely for a good cause. They mentioned that it appeared to be possible to finance this project without commercial loans - without involving Wall Street. They pointed out that this church project would create new local jobs and help keep the money they pledged (donated or loaned) circulating locally.

6. Obtain Board/Congregation Approval

Obtaining the approval of the Board/Vestry/Council is probably a requirement for all faith-based and mission-oriented non-profit organizations.

At First Universalist Church, the process of obtaining approval from the Board of Trustees to transition from fossil fuel to renewable energy was difficult. Half of The Green First Team had served on the Board in the past; none had proposed such a large project to the Board before. In that sense, the Green Team was inexperienced. The approval process was probably more difficult than necessary because the Green Team did not initially discuss an approach or strategy for gaining Board approval. They simply jumped in, tried something and then responded to the Board feedback.

Characteristics of the New Energy System Proposal.

In retrospect, based on what eventually evolved, the Green First Team would have had an easier time if the initial proposal for a new energy system included the following characteristics at the very beginning rather than the end:

A proposal that allows the organization to operate in a manner that is consistent with the denomination's faith-based values (i.e. "living your values") is difficult for the Board to reject.

A proposal that does not require up-front money and does not change the church operating budget is difficult for the Board to reject.

A proposal that transitions from fossil fuel to renewable energy and results in financial gain for the church is difficult for the Board to turn down.

A proposal that has a uniqueness that the congregation can hold up with pride and a sense of accomplishment will attract positive attention from the Board. For example, a "100% Sustainable Energy System"; a "Zero GHG Emission Energy System"; a (Net) "Zero Carbon Emission System" to suggest a few, makes the project notable and more attractive.

A proposal that allows the congregation to proudly proclaim, "We are still in" [the Paris Agreement] also sends a positive, affirmative message to the youth in the congregation. Such a proposal indicates the church is extending itself for the spiritual growth of its children.⁶⁸ This is also hard for the Board to reject.

Although the final proposal submitted to the Board eventually contained these elements, it would have been easier if the initial proposal had included these elements at the beginning.

Board/Green Team Interaction & Communication.

Although the renewable energy system was a separate project, it was folded into a larger renovation project for project management purposes. As a result, the Green First Team first had to seek approval from the Building Committee before getting approval from the Board. This was problematic as explained in this detailed Case Study.

Nevertheless, the first presentation the Green First Team made was a proposal for a 100% sustainable energy system to the Building Committee. Several Board members attended. After the presentation, one Board member volunteered to help the Green First Team modify their proposal so that it would be more

acceptable to the Board.⁶⁹ Having a liaison with the Board turned out to be invaluable.

After the first formal presentation to the full Board, another Board member volunteered to help coordinate issues between the Building Committee and the Green First Team as well as between the Board and the Green Team. This offer to help evolved into an ad hoc committee called the Renewable Energy Working Group (REWG) chaired by a Board member. The REWG was comprised of representatives from the Board, the Staff, the Board's two Independent Reviewers, the Building Committee and the Green Team.

As a result, several Board members were now directly involved in finalizing the design of the new energy system as well as developing the financing approach. This ongoing involvement of Board members in preparing the final proposal to the Board was a key factor in gaining Board approval.

Approval Strategy.

The relatively inexperienced Green First Team did not discuss their approach or strategy for seeking Board approval.⁷⁰

The Green Team did, of course, share the same faith-based or mission-oriented values. Beyond that, the Board's perspectives and the Green Team's perspective were different - initially.

Based on the First Universalist experiences, it appears helpful to:

- Include a Board member, at least informally, on your Green Team. They will be invaluable in preparing your proposal to the Board.⁷¹
- In the event, the Board does not include STEM members, suggest they solicit several STEM congregants to serve as Independent Reviewers of the project who report directly to the Board.
- Plan on numerous briefings /meetings /and email exchanges to address the Board's questions and concerns.
- Make a list of Frequently Asked Questions (FAQ) with appropriate Answers. This will save some time and correspondence.
- Cite examples of similar organizations (e.g. churches) who have successfully installed similar systems.

Understand the Board's Perspective.

Part VI: Post Project Reflections

Based on the Green First Team's experiences, it appears important to understand the perspective of the Board/Vestry /Council for effective communication. Based on observation, it appears the Green First Team spent little if any time understanding the Board's perspective.

For example, it was difficult for the Green First Team to acknowledge the Board's primary focus was on the current year budget - not the long-range 20-year perspective that the Green Team was focused on and prepared to present.

- When the Green First Team presented their proposal to the Board, the Board was already struggling with a budget shortfall in the operating budget of around \$40,000 for the current year.
- In 2 years, most if not all of these members will not be serving on the Board/Vestry/Council, so the 20-year perspective is not their primary concern.

The Green First Team did not appear to acknowledge that some members of the Board were not financial experts. As a result, the Team did not provide an adequate explanation of a Life Cycle Cost analysis.⁷² So part of the challenge for a Green Team is to introduce to the Board the importance of a life-cycle cost assessment.

Presentation to the Board of Trustees (5 Jul 2016)

Prior to this presentation, the Board had received the Green First teams' written response to their questions the day before. The amount of time to

present the proposed energy system and funding plan was very limited. Because the Board Meetings generally have a full agenda, the Green First Team selected a single spokesperson to provide the same information presented two weeks earlier to the BFF Committee and two Board representatives.

In the past three weeks, additional donations and loan commitments had been made. The "Approach" chart and spreadsheet model were updated to reflect these new pledges. As indicated, donations now totaled \$105,000 and member loans were now \$220,000. **Two-thirds (2/3) of the capital required for a new energy system had now been pledged.**

The Green First Team was elated.

Approach



- Lease Solar (Pre- Paid PPA) & Buy Geothermal
- We have \$105,000 in pledges as "seed money"
 - **We plan to raise an additional \$40,000**
- We will need \$335,000 in loans
 - Spread sheet assumes \$270,000 in member loans at 1.5% interest
 - We have loan commitments for \$220,000.
 - **We plan to get at least \$50,000 more member loans.**
 - **We anticipate borrowing \$65,000 commercially at 5.0 % interest** (Board Action Required)
- Current "utility bills" (\$19,875 / year) will be redirected to loan payments
- See cash flow spreadsheets for details for 20 years



4

The spreadsheet model in Table 4 illustrates the 20-year cash flow with this funding model.

Figure 33 summarized the 20-year cost assessment an annual payment. profile that was designed to be the same as the projected utility bills. A 4%/year escalation in expenses was assumed (sum of inflation and rising energy prices.) This became a very contentious assumption as discussed later.

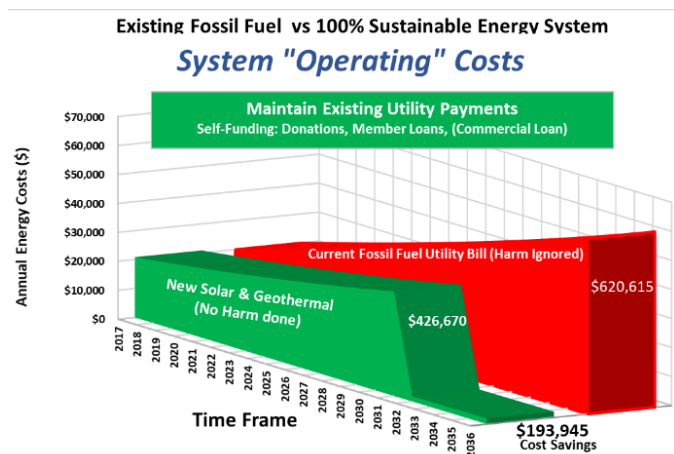


Figure 48 Summary of the proposed energy system 20-year cost profile compared to fossil fuel system cost.

Summary and Conclusions



- Lease Solar & Buy Geothermal and finance with member contributions & loans and, if necessary, supplement with commercial loans.
 - \$105,000 contributions and \$220,000 loans committed to date.
- Green First unanimously recommends maintaining both the solar and geothermal components
 - Our stated financial commitments would have to be reexamined without the geothermal component
 - We should be as responsible as many other UU churches (and IKEA).
- We think there should be an opportunity for everyone to contribute something, no matter how small.
- The church will have a stable and predictable “utility budget” protected against fuel cost growth, carbon taxes, etc.
- Installing a 100% Sustainable Energy System (at no added cost to church operations) will give our UU youth hope that adults are actually doing something to reduce climate change/global warming.



After this presentation to the Board and the meeting was adjourned, one Board member approached a small group of the Green First team and indicated that he would be willing to help them work things out with the Board. Two members of the 10 member Board now seemed to see merit in the proposed sustainable energy system plus two of the six members of the Building Committee.

The circle of support was growing slowly. Roughly 2/3 of the capital had been pledged.

Preparation for the Congregational Meeting

After approval of the Board/Vestry /Council Obtaining, the approval of the Congregation is expected to be less challenging. By now, a significant number of the congregants had already become aware of the proposed solar and geothermal energy system because they had been asked to support it financially. Roughly 10% of the members had donated to or invested in the new energy system.

However, taking nothing for granted, a series of three Town Hall meetings were scheduled after the Sunday service specifically to address any congregants concerns. Members who wanted to learn more about the proposed sustainable energy system could attend any one of these meetings, ask questions, and express their concerns.

The Green First Team also sponsored a Geothermal 101 workshop as a Community Forum for those members who were just curious about how a geothermal heat pump works. (Spoiler Alert: They were underwhelmed to learn the proposed heat pump technology was nothing more than a larger version of their refrigerator at home, with a reversing valve so it could provide heating as well as cooling. Sometimes being underwhelmed is a good thing; this was one of those times.

These “Informational/Educational” events were attended by 20-30 congregants. People who were curious or concerned about the proposed new energy system attended and asked good questions.

The Green First Team judged the Town Hall meetings and other like events to be successful, because, on November 6, 2016, **the congregation voted unanimously to go forward with the 100% sustainable energy system.**

7. Select Certified Designers and Installers

After Congregational approval, the Team effort began focusing on finalizing the financing approach and the detail design of the energy system so construction and commissioning could proceed.

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After the Congregational approval, two activities were set into motion:

1. a separate contract was finalized for installing the solar PV system, and,
2. the construction contract was modified to install the geothermal system.

The Green First team emphasis changed from convincing others this is “the right thing to do” to actually making it happen and “doing the thing right.” In other words, the focus turned to the technical aspects of the project – the final design, procurement, permitting, construction, and commissioning of the new energy system.

Solar photovoltaic technology is well established globally. Reputable, experienced solar PV installers can be readily found in the area. The solar modules (panels) are typically imported from Asia and Europe at the moment. Workmanship inspections by public building inspectors are performed as an integral part of the construction permitting process.

The Heat Pump technology is well established in European countries, but less so in the U.S. Nevertheless, certified, experienced installers can be found locally for both air-source heat pump systems and ground-source (geothermal) heat pump heating and cooling systems. There is an International Ground-Source Heat Pump Association (IGSHPA) that provides a certification program. The Green First Team insisted on using IGSHPA certified designers and installers. The normal construction permitting process does not include workmanship inspection of the geothermal system, so an independent Commissioning Agent was hired by the Green First Team to verify the installation

8. Utilize Experienced Commissioning Agents

Solar and Geothermal systems are relatively complex technologies. Validation of workmanship and operational performance is best done by experienced personnel. The Commissioning team identified numerous HVAC control issues that were then resolved as in-scope work.

The need for a Commissioning Agent was not identified until late in the project and became a contract add-on.

9. Monitor System performance carefully for a year

It is important to monitor the energy system performance, at least initially, to assure it is

operating properly. Although the energy system operation was verified by a separate Commissioning Agent, several minor adjustments were made later.

The Green First Team did not think far enough ahead in the area of Operation and Maintenance of the new energy system. As a result, the installation contract did not include a comprehensive performance monitoring system. A performance monitoring system was added after commissioning to observe the system operation and help manage/conserves energy.

Fortunately, by the end of the project, there were enough STEM members of the congregation that were now advocates of the new energy system that it was possible to use in-house talent to install a monitoring system (in retrospect, this was probably a less expensive approach because it used volunteer labor.)

After the building was fully inspected and certified for occupancy, several members of the Green First Team installed the energy system performance monitoring instrumentation. Cat 5 wires had been pulled to each of the ten furnaces and five ERVs the previous fall before drywalling was completed in anticipation of the monitoring systems.

Two monitoring systems were installed to observe the performance of the energy system.

- **eGauge** for measuring the power usage of key items.
See egauge41397.egaug.es
- **Web Energy Logger (WEL)** for measuring/recording geothermal system temperatures. See www.welserver.com/WEL1022/

Over the course of approximately one week in April 2018, 70 sensors were installed to monitor air and water temperatures. In May of 2018, eighty (80) CTs (current transformers) were installed in five circuit panels around the facility to measure power usage from major energy users.

City Electric activated the solar system on 6 June 2018 and the new energy system began producing electrical power.

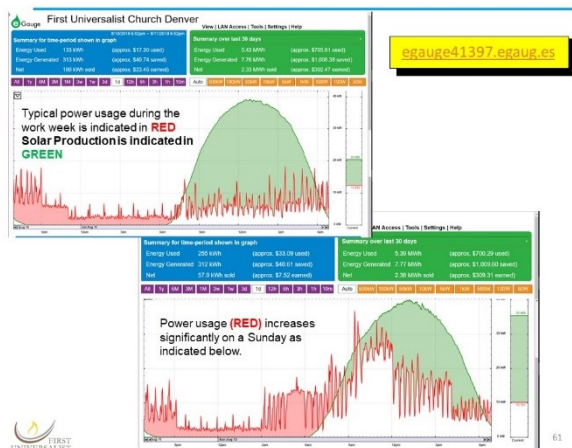


Figure 49 eGauge display showing Energy Usage midweek and on Sunday in RED. Solar PV power generation is shown in GREEN

The eGauge monitoring system records and displays the power generation and usage of the church. The green profile in Figure 48 illustrates the power (green) generated by the rooftop solar PV system over a 24-hour period. The red profile is a record of the total power usage of the church facility during that day.

The upper half of the chart shows a typical August weekday. The lower chart illustrates the increased usage associated with the Sunday morning services. Although the solar production is similar (i.e. peaks at just under 40 kW around 1:00 pm), the energy usage is significantly higher on Sunday as expected. For that particular week, the net energy was positive – i.e. the church harvested sunlight and generated more electrical power than it used.

The WEL monitoring system records and displays operating temperatures of the ten heat pump furnaces and five Energy Recovery Ventilators (ERVs) throughout the facility. Incoming and outgoing water and air temperatures are measured, recorded and displayed on a web site. The information is then displayed real-time (and available via the internet) on the graphic shown in Figure 50.

10. Pay it Forward.

Do help pay it forward and serve as a resource for other organizations who are thinking about reducing their emissions. Even if you have just started along the path to zero GHG emissions, your story is worth sharing – particularly with those who have yet to start.

There are countless ways to pay it forward; only a handful will be mentioned here as examples:

- Tell your story to others in your faith denomination – your experiences can be translated easily to their congregation because they will understand your faith-based motivations;
- Document your story for publication in your denomination’s newsletters;
- Offer to speak about your successes to groups in other congregations including interfaith groups;
- Plan or host seminars, workshops, meetings, conferences where like-minded people can gather and learn about the climate crisis and how they too can transition their facility to operate with zero emissions; using renewable energy
- Offer to help as a consultant or advisor.
- If you have started, you are leading the way for others we have not.

GreenNotes Conclusions

- Transitioning to a 100% sustainable (renewable) energy system results in financial gain – even for non-profit organizations.
- Replace all GHG emission sources together as a total system.
- Seriously consider local/member financing. Keep the jobs and the wealth in your community.
- Do not hesitate to ask for help from other non-profit organizations who are on their path to zero GHG emissions.
- Do not forget to share your difficulties and successes with others.

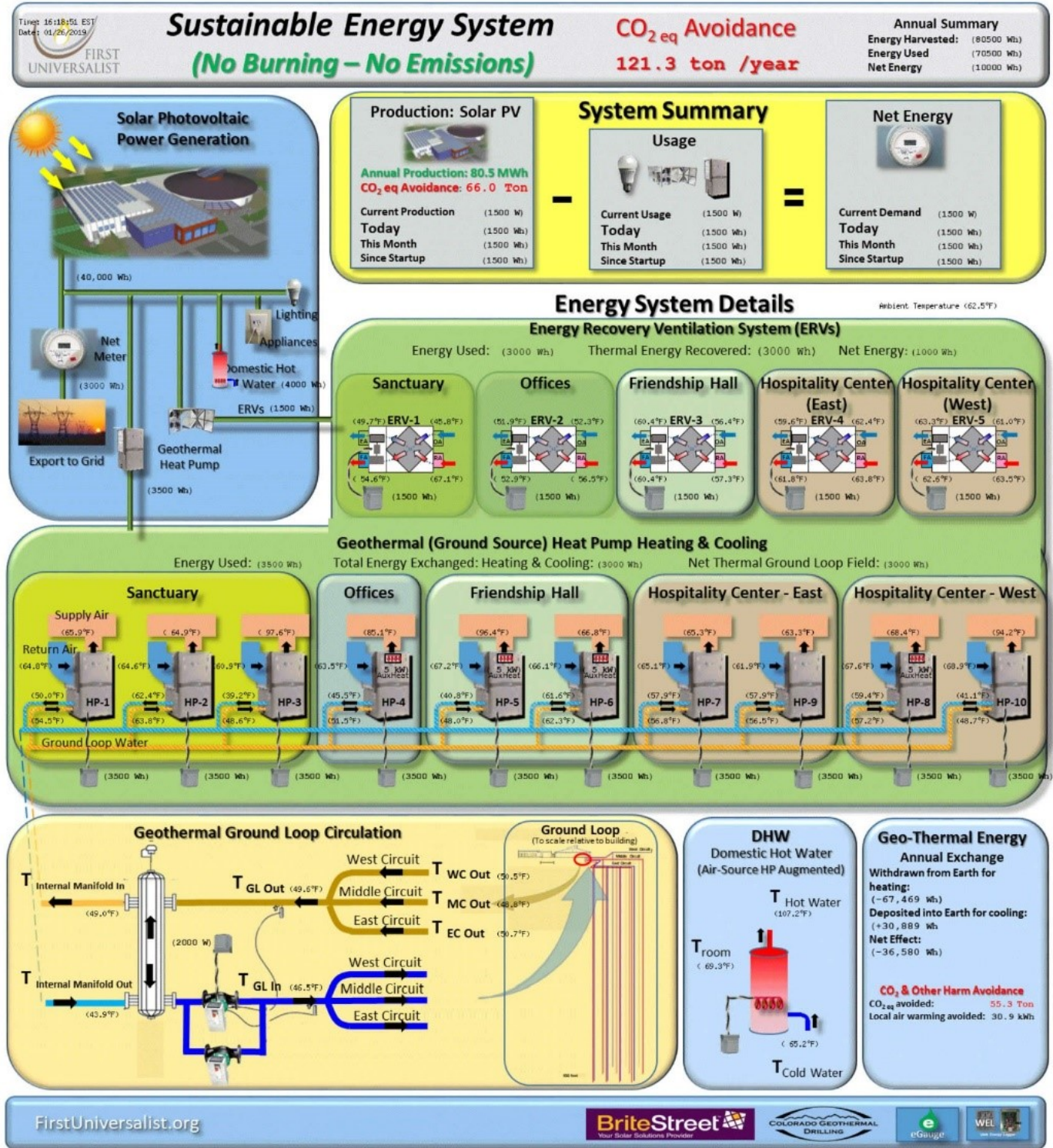
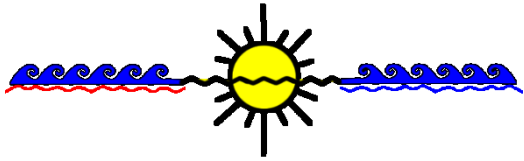


Figure 50 WEL Temperature Monitoring System



Conclusions / Summary

“If you have built castles in the air, your work need not be lost; there is where they should be. Now put foundations under them.”
-Henry David Thoreau (Walden)



The Green First Task Force began exploring the addition of rooftop solar on the church in 2011. That effort was put on hold because discussions were initiated to make major changes to the church facility. Persistent roof leaks, parking lot repairs, aging equipment, lack of space for growing church membership, etc. initiated serious discussions ranging from selling the building and buying another, to scraping the current lot and building a new building, to remodeling the existing building. A committee to explore options was formed in Feb 2013. Their assessment recommended a major remodeling project for the existing facility. In May 2014, the congregation voted to launch a building renovation effort.

In August 2014, the Building for the Future (BFF) Committee began soliciting input from the church members to construct a Vision Statement. Among the many suggestions from members, was a more sustainable church in terms of energy efficiency (LED lighting, more insulation, better windows, etc.). The use of sustainable construction materials was also suggested. Green First Task Force members provided their input to this member survey suggesting that rooftop solar and a ground source (geothermal) heating and cooling system be added to the renovation project.

A Sustainability Subcommittee was formed to advise the BFF leadership. Although a solar PV system was on the initial request list, a geothermal/ground-source heat pump heating and cooling system to replace the ten natural gas burning furnaces was not

added as a renovation consideration until August of 2015 – a year later. In September 2015, the BFF Building Committee drew up a new “Sustainability Framework” that included both solar electric and geothermal heating and cooling.

The fundraising campaign to raise the capital for the remodeling project successfully raised what a UUA consultant from Boston had estimated the church could expect. However, the amount of money pledged was significantly less than the total cost of the proposed remodeling project. As a result, several features were deleted from the building project to reduce the cost. The renewable energy system was among those items that were removed. On April 3, 2016, the congregation voted to move forward with the revised remodeling project without financing a new energy system. However, that same vote authorized the pursuit of third-party financing for a sustainable energy system.

The Green First Task Force took on the challenge of pursuing third-party funding, and after evaluating several possible financing scenarios found one that appeared promising. A member of the Board of Trustees advised the Green First Task Force that the funding approach must be considered ‘revenue neutral’ and not require any change to the annual operating budget. An ad hoc Renewable Energy Working Group (REWG) was formed and chaired by a Board member. The REWG worked to resolve remaining technical and make adjustments to the financial approach, so it was agreeable with the Staff and Board of Trustees.

The Board approved the proposed funding approach in Oct 2016. The necessary capital was raised internally using a combination of member donations and low-interest member loans. The loan repayment plan, designed to be lower than the current operating budget for utilities, was taken back to the congregation for approval – which they did unanimously on November 6, 2016.

The congregation moved out of the existing facility in August of 2016 and the congregation began meeting at Hamilton Elementary School in South Denver. Deconstruction started immediately to reuse/recycle as much of the facility as possible. Demolition including the removal of the concrete roof on the original round structure built in the 1960s and recycling the 10 natural gas furnaces and A/C units.

Construction of the new energy system began June 21, 2017, with the drilling of the first borehole for

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the external ground loop for the geothermal system. The ground-loop heat exchanger system was complete within a week. The internal equipment for the geothermal system was installed and connected to the heat pump furnaces in October 2017. The renovation was sufficiently completed by 24 December 2017 to move back in and hold the Christmas Eve service.

The solar PV system was installed in Mar 2018. Xcel installed the net meter on June 1, 2018. The solar PV system was activated by City Electric and began producing power on June 6, 2018.

Transitioning to a solar and geothermal energy system is expected to reduce the 20-year life-cycle operating cost (for electrical power plus heating and cooling) by over \$180,000.

The new sustainable energy system has zero carbon emissions. As a result, the congregation avoids dumping over 100 tons of CO₂ eq into the atmosphere annually and complies with the 2015 Paris Agreement and the 2018 IPCC 1.5C Report.

First Universalist Church Denver can join those who proclaim, “We are still in” the Paris Agreement to limit global warming to 1.5°C.



Summary of Key Events in this Story

[Concerning Climate Change]

“winning slowly is the same as losing”⁷³

.... Bill McKibben, co-founder of 350.org.

Things that Worked.

1) Pre-Project Environmental Awareness - Background

It is not possible to quantify the influence of the precursory work by the small group of environmentalists (aka the Green First Task Force) on the eventual success of this sustainable energy system project.

When First Universalist was certified as a “Green Sanctuary” under the standards of the UU Ministry for Earth (UUMFE) in August of 2010, actual physical changes had been made in the church facility. Certification as a Green Sanctuary also involved an educational component that informed members about the importance of energy conservation, and zero waste, etc. In any case, the BFF project was able to

build on this pre-existing foundation of environmental awareness.

The full resources of the UU Ministry for Earth and a simple affirmation of the UU Seventh Principle (*Respect for the interdependent web of life*) were also available to build on for this project.

2) Green First Task Force – The Green Team

The small group of renewable energy advocates was critical to the outcome of the project. They took on the role of raising the necessary capital to purchase and install the new energy equipment and provided the information need for the church membership to approve the project.

The number of people involved in this effort to transition to a renewable energy system increased over six years – slowly at first. Initially, there was a handful of people, but in 2012, the effort was abandoned over a 3-year hiatus while the congregation struggled with more critical issues – what to do about a leaky roof, inadequate space in the sanctuary, insufficient classrooms, and aging equipment. To move, to scrap the property and rebuild or to remodel the existing facility became the question. In 2015, when the decision was made to renovate the existing building, the Green First Task Force began a renewed advocacy for renewable energy.

The collective energy of the Green First team produced a significant force that influenced the trajectory of the renovation project. To the Green Team, it seemed that those in power to make decisions were regularly presenting reasons why a new sustainable energy system wouldn’t work, was too expensive, should be delayed, was too risky, etc. Nevertheless, they persisted and managed to find a way to circumvent the hurdles in their path. There were at least three times during the year (2016) where the group felt that they had finally encountered a roadblock they could not overcome. Somehow, by working together, they were able to gather enough strength to identify alternative approaches and try again. Several of the deflating email correspondences from the Building Committee and Board that blindsided and deflated them are included in this case study. They grieved over the perceived loss of their initiative several times, but then found ways to continue. Eventually, they received congregational approval to proceed.

One of the Green First members became a part of the larger BFF project to assure one element was

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included (e.g., solar PV). As a result, there was significant support for installing rooftop solar PV from the beginning. Over time, the Green First Team was able to gain the attention of more members of the BFF Committee, the Board of Trustees, and other church members by sponsoring specific events. For example, an EarthDay 2015 panel discussion, a Sunday program Jul 2015, a half-day workshop Aug 2015, and a series of "Living Our Values" tri-fold pamphlets that promoted solar and geothermal along with other aspects of sustainable living.

It was a Green First Team member who presented the vision of a sustainable, comprehensive energy system (Solar Electric/Ground-source Geothermal heating and cooling) to the general architectural team and the BFF building committee in Aug 2015, and then helped the BFF committee develop a "Sustainability Framework."

The support for the effort to transition to a new sustainable energy system was like a rising tide. There were incoming waves of enthusiasm and support and outgoing waves of disappointment and opposition – yet the tide kept rising slowly.

A few members of the Board of Trustees became advocates, directed their energy to the cause, and in turn provided valuable assistance. There seemed to be waves of opposition on the Building Committee, Board of Trustees and general church membership until congregational approval. Several Green First Team members took on the challenge of "confronting the opposition" assertively not aggressively but certainly persistently. If the Green Team learned of a particular member who was concerned about the project, they would immediately contact that member and listen carefully. Almost always the member's concern had sprung out of misinformation or the lack of information that could be remedied by a simple conversation. Sometimes additional research and analysis were required. As the energy system project matured along with the design, so did the support. Eventually, the support grew to where the Board of Trustees approved. A month later, the congregation voted to approve the project.

This small band of 6-8 folks contributed over half of the financing required (loans and donations). Without this human energy, advocacy, lobbying, etc. by members of the Green First Task Force, the project would not have succeeded.

3) Green Team Personal Experiences

Another pre-existing condition in this situation was that several Green First members had personal experiences transitioning from fossil fuel energy to renewable energy at their residence.

One key member had worked for years in the solar PV installation industry. Another key member was a retired scientist who taught climate physics at a nearby university. Several Green First Team members had rooftop solar on their homes; one had invested in a Community Solar Garden, one member had installed ground source geothermal heating & cooling several years prior. Several Green First Team members drove plug-in electric vehicles.

One Green First Team member documented their own personal transition to solar and geothermal in a small book entitled "Living without Fire." So there was actual data, actual evidence that both solar and geothermal alternative sources of energy work, are low risk, and are long term economically sound investments and certainly are in the direction of goodness when it comes to mitigating climate change.

When the proposed comprehensive solar & heat pump energy system was presented to Green First Team members, they immediately became enthusiastic proponents and brought unique skills to the team effort. A project this size requires a group/team effort; a single person cannot be expected to make it happen.

One individual was an essential team member because of their expertise as a lawyer, a homeowner with solar PV, an advocate of Socially Responsible Investing / Slow Money, and local financing. They played a crucial role in helping evaluate Limited Liability Corporations (LLCs) and other third-party entities eligible for tax subsidies that might be useful for this project.

These personal experiences also indicated the amount of time required to make the transition and the actual cost and the type of people to consider in helping make that transition. Along the way, the Building Committee and Board members with solar experience joined in to support the sustainable energy system. Financing options (St. John's LLC, PACE, PPAs, etc.)

One member of the team identified the St. John's LLC model. The team tried vigorously to implement this creative financing model for the First Universalist application. One member of the Team compiled all the information required to apply PACE and explore funding possibilities through that local organization.

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A team member evaluated and selected the winning bidder for the solar PV system. This competitive bid was approved and implemented by the Board. Their knowledge of Xcel billing/charging practice, as well as their financial incentive (e.g., Solar Rewards program), was invaluable.

4) Architect Backing – embedded in the Design process

The Green First team found early on that Barrett Studio Architects were aligned with a renewable energy design philosophy. So “selling” the architects on solar and geothermal was not a difficult task. They were already sold and waiting for a client to ask them to include these technologies in their building.

5) BFF Building Committee Champions

The new energy system project had several champions on the Building Committee who encouraged the Green First team to make this project happen.

At the May 2016 meeting of the Board of Trustees with the Green First Team, one Board member volunteered to work with Green First Team to fashion a “Revenue Neutral” financing approach that he felt the Board of Trustees would approve. So three members of the Green First team met with the Board member at his office and candidly and collaboratively agreed that they would have to reduce the energy escalation factor from 4.5% (recommended and used by the Solar PV industry) to 3% (general inflation). The Green First Team indicated their willingness to try, but it probably would not work if the goal were to keep the cash flow at or below the current utility bills. In the end, they found a way to finance the project that was “revenue neutral” as the Board member advised. Also at that time, the Green First Team had no limit on the number of loans versus donations.

Without the support of this member of the Board of Trustees, the project probably would have failed to move forward.

6) The assistance of the Board of Trustees Independent Technical Reviewers

When the energy system proposal seemed to be gaining some real attention, the Green First Team was informed that the Board of Trustees was going to appoint a team of Independent Reviewers to evaluate the feasibility of the proposed renewable energy system – specifically the geothermal feature of the plan. So within a few days, the Green First Team was

meeting with two new members who were “Independent Reviewers. As it turned out, the independent reviewers were selected because they both were professional engineers working in the field of global water resource projects with well-known engineering companies.

Although the Green First Team was at first apprehensive about having new reviewers introduced onto the team; it turned out to be a pivotal moment. The two reviewers were quick studies, came up to speed immediately, and became avid proponents of the new energy system. It would not be an exaggeration to say that without their help, the project may not have been able to succeed. Their presence and independent assessment added credibility to the project; their presence also helped convince the Board of Trustees (and the general church membership) that transitioning to a sustainable energy system was a low-risk viable endeavor.

7) Leveling the Playing Field with Starter Donations

The initial/starter donations were around \$100,000. Although it was never acknowledged as such, a few donors made significant contributions to get the ball rolling – to level the playing field. These initial donations reduced the effective cost of the system. At that point, traditional economics could take over and influence other members to support a sustainable renewable energy system over a fossil fuel-based energy system.

8) Use of Low-Interest Member Loans

Using various 20-year cash flow excel spreadsheets, the Green First Team became very familiar with the impact of interest rates associated with commercial loans. Although a 5% interest rate sounds reasonable in today’s financial environment, it is eye-opening to calculate the life-cycle cost impact of a 5% loan over 15 years compared to a 1.5% loan.

Using low-interest member loans was a key factor in financing the new energy system.

9) Significant Moments / Turning Points

At a Green First Team meeting on 9 July 2016, it was announced that around \$100,000 in donations and \$100,000 in low-interest loans had been pledged – a total of \$200,000 toward the goal of \$450,000 needed to buy the solar and geothermal equipment.

Near the end of the meeting, a part-time team member passed small slips of paper around to the 6-7

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folks who were in attendance. She asked everyone to write down on the small piece of paper what they would be willing to loan the church at 1.5% interest. The results were tallied up, and just like that, the amount of capital available for the project went from \$200,000 in financing to \$300,000 of capital with the Green First Team member loans. The team was utterly amazed they had already raised nearly 2/3 of the money required. For a brief moment, they began to think that maybe this renewable energy project was financially feasible.

With this “seed” money,” one member took the lead in appealing to the broader church community for the remaining funding. It was as if, once the train left the station and gathered momentum, others were motivated to hop on and help. Even though the Green First Team had been told earlier that church members were “tapped out” for additional donations, they still received another \$100,000 in donations. This response was unexpected – actually, a shock – but it illustrated the power of a lofty goal – namely a 100% sustainable energy system that would allow the church to operate into the future without doing harm to future generations.

At that point, they had \$150,000 in donations and \$290,000 in loans earmarked for a new sustainable energy system. Things were looking good.

10) ad hoc Committee: Renewable Energy Working Group (REWG)

After the first Green Team presentation to the Board of Trustees, one Board member volunteered to help. They mentioned that if there were any further issues with the Building Committee or Board of Trustees to be sure and let them know because they would be willing to help resolve any differences. This Board member later assumed the role of chairperson lead of a newly formed ad hoc committee called the Renewable Energy Working Group (REWG). The REWG was comprised of several Green First members, Board of Trustees representatives, the Senior Minister, and the two Independent Reviewers.

This committee quickly resolved the remaining technical and financial issues.

11) Board Approval October 4, 2016

The Congregation had moved out of the old building, and the Board was meeting at Plymouth Congregational Church. The Board of Trustees invited the Green First Team to attend the October meeting.

The main topic on the agenda was the proposed sustainable energy system.

Before this meeting, the Green First Team had proposed a gradual repayment schedule that would reflect the future utility costs with an escalation factor of 3%. The Senior Minister was reluctant to accept the concept of including inflation into a long-term cash flow business plan and preferred the traditional fixed mortgage payment approach with constant payments. To lock-in, a constant “utility bill” for 15 years reduced the stress on the church governance but prolonged the “repayment schedule” increasing the burden on the congregant donors. This change further reduced the repayment schedule for the member loans. The Green First had responded and incorporated the Board’s requirements. The cost of the new system, of course, remained unchanged – just the financing plan changed.

One of the Independent Reviewers presented the energy system proposal to the Board. It was at that meeting where the Board of Trustees voted to approve the proposed energy system but with a \$240,000 cap on member loans. This was not the first time the Board of Trustees “moved the goal posts.” So the Green First team would now have to reject \$50,000 of the member loans they had solicited and instead take on the difficult challenge of raising an additional \$50,000 in the form of donations.

Nevertheless, the Board of Trustees did approve the new energy system project with the revised financing plan so the project could move forward. This was a significant milestone.

12) Congregational Approval

On November 6, 2016, a special congregational meeting was scheduled to determine the fate of the proposed new energy system. After a brief presentation by one of the Independent Reviewers, the Moderator of the congregation took a vote of the several hundred church members who attended the special congregational meeting. Each member was given a blue card for voting purposes. After the motion was read and seconded, the Board Moderator asked for a vote.

Motion

Whereas on April 3, 2016, the Congregation approved BFF’s church renovation and construction proposal to include “solar and geothermal systems supported by external investments and approved by the Board of Trustees;”

And whereas on October 4, 2016, the Board of Trustees unanimously approved a Net Zero Carbon Sustainable Energy System (attached to this motion as Exhibit 1), including design, cost, and member loan components;

It is therefore moved:

That the congregation of First Universalist Church of Denver authorizes its Board of Trustees to borrow up to \$240,000 from a partnership of individual church members repayable over 15 years at 1.5% interest, without collateral or lien on church property, to complete payment for the Net Zero Carbon Sustainable Energy System.

<http://www.firstuniversalist.org/motion-for-sustainable-energy-system/>

Folks raised their voting cards. It was a sea of blue cards. The Moderator and several others started counting. After a moment of counting this sea of blue cards, the moderator decided to try another approach, “Who is opposed to the motion to approve the renewable energy system?” Everyone looked around. Not one blue voting card was raised in opposition of the motion. **The motion to proceed with the 100% sustainable energy system was approved unanimously.**

When the Board of Trustees chair declared the outcome, there was a loud cheer, and everyone looked around and congratulated their neighbor. This occurred in the auditorium of the Hamilton Middle School South Denver – the interim meeting place for the church while the remodeling construction was underway.

That voting outcome was something that none of those who had been involved for the past year or so could have ever imagined. It was a grand moment, indeed.

The focus immediately turned to make sure the new energy system was properly designed & installed so it would work as intended.

13) Detail Design Review

As it turned out, after congregational approval of a new energy system, the work was not over for the Green First Team. The final design and construction of the new energy system were folded into the larger BFF remodeling project. The detailed design and construction were now under the direction of the BFF

Building Committee. Two STEM members of the Green First Team were concerned about the detail design of the geothermal system as were the Independent Reviewers. As a result, this small group (all were engineers/scientists) was given access to the engineering drawings that were submitted for the permitting process. The implementation plan did not include any formal design reviews of the system by the Green First Team even though they were the financial sponsors. They were allowed to meet with the architect or mechanical designer for one hour in Boulder in September. However, there was insufficient time to review the design in detail or ask questions of the mechanical designer.

At that time, they were focused on the revelation that the new building was modeled and assessed to require around half of the heating & cooling required of the old building – even though additional space was added to the building. This was difficult to fathom. So the focus and questions were centered on the understanding that these modeling results were correct.

The Green First Team was not provided with any more data, but it was agreed with the Building Committee that a second party could / should review the heat load analysis. A small consulting contract was initiated with Lightly Treading who in turn reviewed the input data and concurred that the heat load analysis was accurate to within 10% of their independent assessment.

One Independent Reviewer & one Green First Team member were the only ones who reviewed the geothermal water circulation system design in detail from the owner’s perspective. They identify a significant concern. The baseline design included six components that were characterized as single point failures (SPF). This means that there were six specific hardware components in the system that if any one of these SPF components failed, the entire heating & cooling (i.e., all furnaces) become inoperable. For example, in the initial design, a single water pump was being used to circulate the water in the ground loop heat exchanger. If that one pump failed (and it would at some point in its design life), the entire heating and cooling system (all ten heat pump furnaces) would become inoperable.

From the Green First Team’s perspective, this was an unacceptable design for a church heating and cooling system that hosts several hundred people routinely. The architect and mechanical designer

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resisted changing the heat pump system design, but the reviewers persisted, and the design was changed to include redundant water circulation pumps – the primary concern. Issue resolved.

14) Diverse Owner Team with a Common Bond

The people involved in this project represented a diverse range of values, perspectives, and objectives. Diverse also implies some people supported the project and people who opposed it. Both sides contributed to the project's successful outcome.

The diverse people involved were held together by a common bond; all were members of the same congregation. As a result, they professed some common values, goals, and aspirations. Recognition of their common ground was essential to managing the internal conflicts that occurred.

15) Reducing GHG emissions without Changing the System

This project was a grassroots effort that was able to accomplish its goal of reducing GHG emissions despite the hurdles in place by today's social system. There is still enough freedom for a non-profit faith-based organization to do what is right – to do what is consistent with their values – to comply with the Paris Agreement.

Do not expect a lot, if any, help from the system specifically for a non-profit – i.e., church, temple, synagogue, mosque, university, etc. Donors were able to take advantage of individual tax deductions to charities.

The project did identify aspects of the social system that could be/ should be changed to assist non-profits in transitioning to renewable energy.



Things that Did Not Work.

The path to zero GHG emissions was not a superhighway. There were numerous roadblocks, dirt roads that dead-ended, potholes, detours, and stoplights that seemed to refuse to turn green (obstructionism). A few are listed below:

1. "Geothermal Ready" – Ease into a Transition to Renewable Energy

Strategy: Install the geothermal ground loop heat exchanger now and make the facility "Geothermal Ready." Then add the new heat pump furnaces later as

the old gas-burning furnaces or air conditioning units aged and failed.

The Green First Team first presented this strategy to the Building Committee in Aug 2015. At the time, it sounded like a reasonable approach and seemed to be a minimum cost solution. It did serve as a means of getting folks to buy into the idea of considering a geothermal heating and cooling system. Solar panels were always in the mix but not geothermal.

Unfortunately, the "Geothermal Ready" strategy was not well thought out financially or environmentally. When the Green First Team looked at how this strategy would be implemented, they found "that dog didn't hunt."

The "geothermal ready" scenario would have installed the external ground loop and internal water circulation manifold during the initial construction phase (before drywalling and painting.) The gas lines to the ten furnaces would remain intact, and the gas furnaces would continue to be used. There would be a significant investment in the geothermal equipment buried in the ground, but this investment would not be utilized while the church would still be buying/burning natural gas and contributing to global warming. It would be 15-20 years before First Universalist could claim they had stopped doing harm and stopped contributing to the climate crisis.

The geothermal advocates would be asked to donate around \$75,000 to \$100,000 to make the church "geothermal ready" – but because the geothermal system was still inoperable, there would be no reduction in harmful GHG emissions for this sizeable expenditure. The geothermal donors indicated they would have to back away and understandably donate to a cause that actually reduced GHG emissions.

As the Green First team argued for this approach and thought through it a bit more, they concluded it was not a viable strategy from either a financial or environmental perspective. This strategy did not result in the lowest life-cycle cost, and it maximized the amount of harm the church would do in transitioning to renewable energy. The Green First team provided other reasons why the "geothermal ready" approach would not work in practice.⁷⁴

The Green First Team dropped this strategy but learned that once an idea is introduced and embedded in a project, it might be hard to dispel it. "Geothermal Ready" was one of those strategies and the preferred approach by the BFF Integration Team because it did

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minimize the initial construction cost – their primary concern.

There was also the concern about scrapping our “perfectly good gas furnaces” a few were only around five years old. The average age of the ten furnaces was 15 years. After prolonged discussions, most people were able to realize that with today’s awareness of the climate crisis and the impact of adding more GHG into the atmosphere, there is “no such thing as a perfectly good natural gas furnace” or any other human-made concoction that burns ancient hydrocarbons. Not even a brand new gas furnace that was just wheeled off the showroom floor is a ‘good gas furnace’ because it too burns hydrocarbons – what part of “stop burning” carbon do people not understand?

Several other Building Committee members opposed appending this “expensive” energy system to their original project. They had several reasons. They perceived that the energy system funding was competing with the original renovation project; however, they failed to acknowledge that only after the capital campaign for the main renovation project had been completed and the members had been “tapped out” for donations, did the Green First team begin to solicit loans for the energy system. Member loans would not have helped the BFF campaign because the congregation had set a limit on BFF loans at \$400,000.

The preferred approach by the BFF Integration Team was to make the new facility “geothermal ready” but not install the heat pump furnaces until the existing gas furnaces or air conditioning units failed. This approach sounded reasonable, but when the Green First Team looked at how this plan would be implemented in future years, they found “that dog didn’t hunt.” The “geothermal ready” scenario would have installed the external ground loop and internal water circulation manifold during the initial construction phase (before drywalling and painting.) The gas lines to the ten furnaces would remain intact, and the gas furnaces would continue to be used. There would be a significant investment in the geothermal buried in the ground and not being used while the church would still be buying/burning natural gas and contributing to global warming.

The geothermal advocates would be asked to donate around \$75,000 to \$100,000 to make the church “geothermal ready” – but because the geothermal system still is inoperable, there would be no reduction in harmful GHG emissions for this sizeable expenditure.

The Green First team provided other reasons why the “geothermal ready” approach would not work in practice.

2. Tax subsidies & Utility Company incentives.

From its inception, the Green First team attempted to take advantage of the utility company’s SolarRewards™ program as well as state and federal financial incentives. They understood that by teaming with a for-profit third party, the church could indirectly benefit from Federal tax credits.

One team member provided expertise in the solar financing area and was familiar with the various third-party financial approaches available for installing solar. The team struggled to find third-party investors who would include the geothermal elements as well as solar.

Using a 20-25 year life-cycle cash flow model similar to those used by the solar industry to market solar systems, they looked at various combinations of church donations, commercial loans, PPAs, Xcel incentives, grants, etc.

From October 2015 to April 2016, they struggled to find a third party funding mechanism that would be acceptable to the Board of Trustees.

Not finding any viable participants, the Green First Team eventually abandoned for-profit third parties as a funding source for the total system. That was when they began exploring alternative funding approaches and another door opened that lead to member financing.

The model presented in May 2016 to the Board of Trustees was met with a lukewarm response. Fortunately, one member of the Board of Trustees volunteered to help the Green First Team find a path that might work – a revenue-neutral solution.

3. Commercial Loans

After months of working with cash flow spreadsheet models – particularly the ones involving the LLC models used by St. John’s church in Boulder, it became clear how influential the commercial interest rate was in the financial viability of the proposed energy system. A 5-6% interest rate overwhelmed any advantages of a low escalating energy cost – particularly if forced by the Board of Trustees to limit inflation/energy escalation (and the loan repayment schedule) to 3%. It eventually became clear that low-interest-rate loans (from lenders who were church

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members) were required to make the financial model work.

But it seems the Green First Team had to try all other avenues (that didn't work for their situation) before they gave up on commercial loans (and tax credits) and decided to "just do it."

4. PPAs /PACE/ Commercial Third Party

One member of the Green First team was very knowledgeable in the various funding mechanisms available to the solar world. Each funding approach was evaluated in an attempt to find a viable means of financing the First Universalist energy system. The team demonstrated over and over that if the energy system included only solar PV, they had many viable funding mechanisms. But when the geothermal system was folded in, the financial picture became more difficult.

5. Consideration of Externalities (Social Costs)

The attempt to introduce the idea of externalities in the financial considerations of this project was an utter failure. There was no traction whatsoever to consider using a new economic measuring stick that internalizes ignored social costs – i.e., eliminates externalities.

One of the more disappointing aspects of this project was the extreme difficulty in convincing anyone else that the economic system they are using to make decisions was broken. No one could accept the idea that the free market was not posting the real cost of energy generated by burning ancient hydrocarbons. No one seemed able to hear that the measuring stick they were using to make their life choices were flawed – actually fatally flawed because the broken economic system is influencing good people to make bad (ecocidal) choices.

Talking about the harm caused by the operating the church by burning ancient hydrocarbons and dumping GHG emissions into the atmosphere was not a popular topic.

The Green First Team did not get any traction with the possibility of a future carbon pollution tax. Board of Trustees would not consider it as an argument for transitioning to the inexhaustible energy

After several failed attempts to introduce the notion of externalities (that unequivocally shows a renewable energy system to be less expensive than a

fossil fuel system), the Green First Team abandoned that strategy.

Even members of the Green First Task Force were not able to "buy into" concept of externalities. [See Appendix F Externalities for details]

6. Energy System Contractual Arrangement

The contractual arrangement for the new energy system was complicated and made it challenging to communicate efficiently with designers and installers.

The BFF Committee had one contract with the architect team (Barrett Studio Architects), a separate contract with the general construction contractor (Faurot) and a separate contract with the solar installer (Brite Street), and a separate contract for the commissioning agent (Iconergy). Faurot issued a subcontract to Precise Mechanical for the HVAC work and Precise issued a subcontract to Colorado Geothermal Drilling for the geothermal work.

The BBF Building Committee was solely responsible for funding the architect's contract and managing the general contractor's contract.

The Green First Team was responsible for funding the geothermal portion of the HVAC contract within the general contractor's contract. The Green First Team was responsible for funding the solar installation contract and for funding the contract for commissioning the HVAC / geothermal system.

The architect team had a second-tier contract for the mechanical design that included the mechanical design of the HVAC system and the ground source geothermal system.

The contractual arrangement with the general contractor was probably adequate for a typical remodeling project. In this case, the incorporation of the ground source geothermal heat pumps required the second tier HVAC contractor to hire a third-tier geothermal driller/installer.

Fortunately, a certified and experienced geothermal contractor was selected for the construction phase. However, the contractual arrangement made it difficult for the owner representatives to review the mechanical engineer's design and vet it with the geothermal installer. So the few reviewers/checkers available were prevented from communicating with the designers/analysts/ installers.

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The solar system installation was a separate contract that did not flow through the general contractor.

A retrofit project involving only the energy system would have a much simpler contractual arrangement.

7. Installation of Charging Stations

It was suggested that the remodeling project include one or more electric vehicle charging stations. During the week, these charging stations would be available to the church staff to encourage them to transition to a plug-in car. At this point, the staff drives gasoline-powered vehicles, and their carbon footprint commuting to and from work is linked to the operation of the church.

The charging stations could also be used on Sundays by those members who drive plug-in vehicles to church. Access to the charging stations would be allocated by longest distance traveled. This idea did not receive any traction, but at least it was agreed to install an empty underground conduit from the building to the east parking lot for future use.

There was no interest in adding charging stations.

Adding in the GHG emissions by members driving to church was never seen as a consideration/responsibility of the church. (Note: It was estimated that members/staff add around 35 metric tonnes of GHG to the atmosphere annually driving to and from church services/meetings/etc.)

8. Adding a Monitoring System

It was recommended to the BFF Committee that performance monitoring instrumentation be added to the solar PV system, to appliances that utilized significant amounts of electrical power and to the new geothermal heating & cooling system to allow the staff to observe the daily energy use and performance of the new solar/geothermal system. An approximate cost of this monitoring equipment was identified to be around \$4,000 (approximately 1% increase in the system cost). The BFF Committee determined it did not have any financial resources to apply to install a monitoring system.

The Green First Team felt very strongly that it was not possible to manage energy usage if you don't measure it. They also thought that the new energy system (solar electric, geothermal heating and cooling) was complex enough to warrant some type of monitoring instrumentation not generally included on

a grid powered building with traditional gas burning furnaces.

The Green First Team did find a way to fund the equipment; they also found volunteers to install the monitoring equipment.

9. Sense of Urgency

The urgency identified by the 2015 Paris Agreement (and later the 2018 IPCC 1.5 C Report) never got any traction. Slowly transitioning to renewable energy in 20 years seems to be adequate for most of the congregation.



Hurdles/Obstacles/Delays

The goal of operating a church, temple, synagogue, or mosque in a socially responsible manner seems simple enough. However, modifying the facility to have zero GHG emissions can be a challenge. The path to zero emissions can be blocked by any number of obstacles or hurdles.

This case study tries to identify a few hurdles that were encountered during the First Universalist energy transition project.

Local Hurdles/Obstacles/Delays

Motivation /Lack of Awareness /Lack of Concern

Aside from the Green First Team, the congregation did not appear to be that concerned about climate change issues. Workshop, seminars, and science discussion groups were attended by 20-30 members (out of 450 adult members in the church).

The Green First Task Force had only about 6-8 members who attended meetings regularly. Looking back at this project, it seemed to start when several members of the Green First Team (representing about 1% of the church membership) began advocating for a new energy system. That number grew quickly to include the entire Green First Team (2% of the membership). Slowly the advocacy grew further as several of Building Committee members supported the idea, and then several Board Members. Eventually, there were 44 of the 450 adult members of the church (10% of the congregation) who made financial contributions to this project – either in the form of a donation or a low-interest loan.

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Convincing the entire congregation that 'climate change is the number one priority' is not necessary. Not everyone has to become an environmental advocate.

Because the final Board-approved funding plan was designed to actually lower the church operating budget, the congregation voted unanimously to go forward with the project.

Financial hurdles. This, of course, was the major hurdle. To some degree, this hurdle seemed even higher because the congregation had just completed a fundraising campaign for the \$4.5M renovation project. Asking for more financial support to transition to renewable energy was viewed by some as a fool's errand. To advocates for a new energy system that would stop GHG emissions, spending \$4.5 M on a facility upgrade and not spending an additional 10% to stop doing harm was unconscionable. The advocates had no choice but to try.

Delays. The \$4.5 M "Building for the Future" remodeling project of First Universalist was a relatively small effort that was competing with other large construction projects in the Denver Metro rebounding economy of 2016-2017. As a result, it was difficult for the general contractor to find subcontractors because nearly all of the trades were already busy on larger projects.

In addition, there were unanticipated delays in processing the various building permits with the City & County of Denver. Together, these external influences resulted in a year delay in the completion of the total project. Delays in the larger renovation project caused delays in completing the new energy system.

The sustainable energy project was an independently funded effort embedded within a larger church renovation project. It is still not clear how much this arrangement was a hurdle and how much it was a help. We do know the installation of the solar and geothermal was delayed because of delays in other trades (e.g. roof insulation, electrical, HVAC, and availability of water.)

Communication hurdles. The geothermal system design was a separate option in the building renovation project. The baseline HVAC design was to continue using the existing natural gas furnaces.⁷⁵ The forced-air ducting was the same for the gas furnaces and heat pump furnaces. When the new energy system was approved by the congregation on 6 Nov 2016, a contract change order was processed. The revised

contract replaced the gas furnaces with geothermal heat pump furnaces and the other geothermal equipment became part of the major renovation project. For the Green First Team to communicate with the geothermal installer, the path went through the church BFF Building Committee representative, then to the general contractor and then to the HVAC contractor and then to the geothermal installer. If the Green First Team had questions about the geothermal system design, the communication path went through the church BFF committee representative, then to the architect and then to the mechanical engineer who designed the system. Remember the Green First Team had solicited all of the funding for the geothermal system and was responsible to the church donors and lenders for its successful design and installation.

During the project, there were some significant design and installation issues that had to navigate through this chain of command between the Green First Team and the folks actually doing the work.

National Hurdles.

The project identified a number of other obvious hurdles in the U.S. social system that make it more difficult for non-profit organizations to transition to inexhaustible energy sources. A few will be mentioned:

- **Broken political system.** Polls may indicate the majority of voters prefer renewable energy over burning oil & gas; however, legislation favors the coal, oil & gas industry and their related infrastructure.

Coal, oil & gas money buys influence that trumps democracy. We the people vote for our representatives in this republic, but our elected representatives then vote to appease their major financial backers (wealthy individuals and corporations – including the fossil fuel extraction/processing/ burning industry) who contribute large sums to their election campaigns. We no longer live in a democracy of the people.

This project continued without any changes in the political system hurdles.

- **Broken tax system.** Although the renewable energy sector does enjoy some federal and state subsidies, oil & gas benefits more. Also, there are few if any incentives designed to help non-profit organizations such as churches, synagogues, mosques, universities, etc. Most incentives as

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based on tax deductions/refunds.

The project continued without any changes in the tax code hurdles.

- **Broken economic system.** The current economic measuring stick for determining the market price of coal, oil, natural gas, and electrical power generated by burning this resources, ignores social costs that we the public pay indirectly generally as increased health care costs and as a loss in human productivity.

Today these social costs include repairing the damage associated with weather extremes, flooding, drought, sea level rise, and other events linked to global warming. These ignore costs are called externalities. Because these social costs have been externalized, they are not associated directly with the coal, oil & gas products themselves.

Example: We all know that burning coal, releases mercury vapor into the atmosphere that is now showing up in our food chain. We know that infants who ingest mercury have impaired neurological development and suffer from a loss in human abilities. The cost of remediation and lost opportunity for full participation in social endeavors (productivity) is not included in the cost of electrical power generated by burning coal. If these and other externalities were included, the price of coal-generated electricity could increase from \$0.11/kWh to \$0.36/kWh. (See Harvard Medical Center study.)

There are few, if any, hidden or ignored costs associated with solar, wind and geothermal energy. Yet we continue to use our current economic system with its invalid measuring stick to compare the cost of fossil fuels against renewable energy to make “financial decisions.” We continue to insist on calculating a “payback” time based on deceptively lower costs associated with burning coal, oil and natural gas.

Because of the broken economic system, the financial hurdle was almost too high to get over-the renewable energy system project was nearly terminated at several points. Somehow it managed to circumvent the deceptive economic-based hurdles.

- **Misinformation.** Based on the investigative research of Naomi Oreskes and Erik Conway documented in **Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues**

from Tobacco Smoke to Global Warming, we now understand “keeping the controversy alive” by spreading doubt and confusion after a scientific consensus had been reached, was the basic strategy of those opposing action. ⁷⁶In particular, they say that Fred Seitz, Fred Singer, and a few other contrarian pseudo climate scientists joined forces with conservative politically-motivated think tanks and private economically-motivated corporations to obfuscate the scientific consensus on many contemporary issues – including global warming. ⁷⁷

Contrary to the rhetoric of the “merchants of doubt,” humans are increasing the quantity of GHG in our atmosphere by extracting & burning ancient hydrocarbons. We are causing significant global warming, ocean acidification, sea level rise, extreme weather events, etc. and we are responsible for the dire ramifications of these changes (e.g. flooding and abandonment of island nations and coastal cities; loss of life – human and non-human, and a growing rate of extinction of species in our interdependent web of life.)

Climate change denial arguments and other misinformation were present within the congregation (and possibly within the Board of Trustees.) Fortunately, reason, logic, patience, as well as a free and open exchange of perspectives prevailed to reveal the truth and overcome misinformation hurdles.



Outcomes/“Lessons Learned”

Positive Outcomes

- Designed, Financed, Installed and Commissioned a 100% Sustainable Energy System (solar electric, ground-source geothermal heating, and cooling).
- Solar and Geothermal technologies were embedded into the BFF project as a “Sustainability Framework Statement.”
- Used only local funding to finance the sustainable energy system. No “Wall Street” capital.
- Final funding approach resulted in a significant financial gain for the church – transitioning to renewable energy saves the church money over a 20-25 year timeframe.
- Conducted independent fundraising to raise the capital required to purchase and install the new energy system equipment.

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- The new energy system has zero GHG emissions. First Universalist now complies with the 2015 Global Paris Agreement to “pursue efforts to limit the temperature increase to 1.5 deg C” as well as the 2018 IPCC 1.5°C Report to be on “a path to zero GHG emissions.” “We are still in.”
- Conducted Town Hall meetings to inform members of the congregation.
- Funded and installed a dual monitoring system to observe the real-time operation of the solar and geothermal systems. One system monitors energy usage; the second system monitors geothermal performance using 70 temperature sensors.
- Was assisted by several members of the Board of Trustees
 - A Board representative advised the Green First Team to find a “revenue neutral” solution
 - A Board representative chaired the ad hoc Renewable Energy Working Group
- Was assisted by a Board appointed Independent Review Team
- Was assisted by BFF Committee
- Energy System project was coordinated by an ad hoc Renewable Energy Working Group (REWG) consisting of representatives from the Board, Staff, BFF Committee, Independent Reviewers, and the Green First Task Force
- Obtained approval of funding approach from Board of Trustees
- Obtained Congregational Approval by Unanimous Vote
 - Green First Team representatives were invited to meet with the architects and sit in on a key meeting with the architects.
- “Outsider” suggestions were Incorporated
 - Consideration of local financing
 - Use of a revenue-neutral funding model that did not increase the existing church operating budget
 - Consideration of Socially Responsible Investors (SRI) for sources of capital. These folks are ok with a lower than normal rate of return on their investment if they know their money is being used for the better good.
 - Modification and adaptation of St. John’s Episcopal LLC Model.
 - Use of sister church’s as a positive role model for solar electric and ground source geothermal heating and cooling.
- Persistence & Resilience of Green First Task Force

- Development of a comprehensive list of ‘Frequently Asked Questions & Answers’
- Extensive use of artist concepts and other graphics
- Extensive use of 20-25 year Life Cycle Cash Flow Models, not just Initial Cost Models.

Less than Stellar Outcomes

- This project identified a concern about the level of awareness of the seriousness of climate change within our congregation.
 - Only a fraction of the members has become aware of the overwhelming scientific evidence that continuing to burn ancient hydrocarbons will dramatically increase the concentration of GHG in our Earth’s atmosphere and cause the planet to warm more than 1.5°C above pre-industrial levels. (e.g. CO₂ is now up to 410 ppm and rising rapidly.)
 - Only a fraction of the members is aware that the only way to maintain a habitable planet for future generations is to get on a path to zero GHG emissions now and plan to arrive at zero well before 2040. A 50% reduction by 2030 is necessary.
 - Continuing to burn hydrocarbons when we know there are alternative sources of energy, defies reason and logic.
 - Continuing to do harm and alter the habitability of the planet Earth for all future generations is an existential repudiation of the UU seventh principle.
 - Even for those members who are aware of this ecocidal human behavior, there does not appear to be an appropriate sense of urgency. Non-negotiable laws of nature indicate the remaining carbon budget to limit global warming to 1.5° C is around 530 gigatonnes of CO₂eq. This translates to 10-15 years of burning more hydrocarbons at our current burn rate – see the 2015 Paris Agreement and 2018 IPCC ° C Report for details.
 - Fortunately, with the installation of the new sustainable energy system, First Universalist Denver now complies with the Paris Agreement.
- This project identified a number of concerns with their “Governance Policy” i.e. how the Staff/Board of Trustees relates to the general church membership.

Reporter's Closing Comments

On behalf of the entire Green First Task Force, we welcome further evaluation of this case study.

The new human-hardware system described in this case study now draws its energy directly from inexhaustible sources (from the Sun and the Earth) so in that sense, it appears sustainable.

Considering the combination of the newly renovated church building, the renewed spirit of congregants, ministers and staff and their reconnection to the interdependent natural and spiritual world, a higher order living system could emerge.

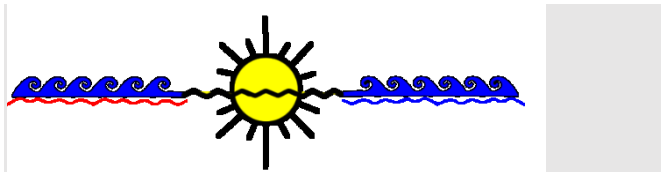
The new 'brick and mortar' portion of this emergence may be just a clever arrangement of star stuff for

honorably harvesting energy from the Sun and Earth to support a spiritual and humanistic mission. What emerged did appear to borrow wisdom from diverse experiences and other successful living systems.

The human elements of this emergence, a group of like-minded yet diverse people are now bound together by common purposes and principles under a renewed covenant.

Is it destined to carry out a renewed mission with renewed human energy and a renewed reverence for the interdependent web of life?

May this Case Study be of value to others looking for their path to zero GHG emissions as they too respond to the climate crisis.



Epilog – Was that an Emergence ?

“Was that really an example of an Emergence that we just experienced?” asked the Scribe.

“Yes, if you define Emergence as the creation of ‘something more’ from ‘nothing but.’” the Sage replied.

“How did it happen?” the Scribe wondered aloud.

“We only partially understand Emergence. But when a dedicated group of people comes together with a common purpose, their human energy can combine synergistically to create a unified force that will form new arrangements/relationships of what already exists. When this happens, ‘Something more’ can emerge. And here it did.” explained the Sage.

“Did this Emergence create a new living system – perhaps of a higher order?” wondered the Scribe.

“Perhaps. You documented the event. It is not yet clear if this emergence is self-replicating or can even be reproduced – a necessary characteristic of an evolved sustainable living system. We have to wait and see.” the Sage concluded.

April 1, 2018 Dedication Ceremony

On this day, April 1, 2018, the First Universalist Congregation came together:

- to celebrate the church’s 127th birthday,
- to dedicate a renovation that utilizes sustainable sources of energy,
- to experience a rebirth, and
- to begin a renewed commitment to the Unitarian Universalist ministry.

Sustainable Emergence is the creation of ‘something more’ [complex and congruent with Nature] from ‘nothing but’ that which already exists [by forming ‘new relationships’ that are brought together by an ‘external source of energy.’] A sustainable emergence includes enough instructions (e.g. DNA) and motivation (e.g. awareness) to replicate and evolve.

By extending the idea of emergence in this manner we acknowledge the ‘new relationships’ that have been formed as part of this project. In re-telling the story, we may become more aware of the ‘external sources of (human) energy’ and the forces involved in this latest

emergence. In re-telling the story, we can observe if this emergence provides enough information and motivation for it to be a sustainable self-replicating emergence.



How Did This Emergence Happen?

Q: “How did the church transition to solar and geothermal sources of energy and stop doing harm?”

A: It is complicated. Details are in this book.

Q: “Can this energy transition project be replicated by other faith-based or non-profit organizations?”

A: Yes. Generic “Lessons Learned” that can be used by other ‘non-profit’ organization are woven into this story.

Q: Was there a guiding light for this project?

A: Yes. It was a multi-color light emanating from faith-based values, scientific awareness, evolving technology and even wisdom borrowed from distant cousins in the phylogenetic tree of life - the interdependent web of life.

Q: So was biomimicry involved?

A: Indirectly. The value system of the people involved in this project included a deep respect for Nature and the interdependent web of life – the Unitarian Universalist version of creation care.

That the proposed sustainable energy system was humbly (albeit crudely) mimicking the energy system of a plant was not lost to the people involved.



Acknowledgements

Acknowledgments

*"The Great Work now,
as we move into a new millennium,
is to carry out the transition from a period of human
devastation of the Earth to a period when humans
would be present to the planet in a mutually
beneficial manner."*

...[Thomas Berry](#), "[The Great Work: Our Way to the Future](#)."

With gratitude, we acknowledge the many who gave their time and talent to put the church on a path of transitioning from unsustainable energy sources (i.e., burning ancient hydrocarbons) to sustainable inexhaustible energy sources (solar and ground source geothermal energy.)

The story documents areas where First Universalist Church Denver was able to build on the experiences of others who traveled this path earlier and helped light the way (e.g., Mt. Vernon Unitarian Church, Alexandria VA; Christ the Servant Lutheran, Louisville, CO; St John's Episcopal, Boulder, CO; and Jefferson Unitarian, Golden, CO to name a few.)

The Unitarian Universalist Society in Coralville (UUSC), Iowa, is a more recent example of what faith-based organizations can do NOW. UUSC dedicated their new Zero Energy facility in November 2017.⁷⁸

"The congregation aimed to make their new home the "greenest church in Iowa," equipping it with solar panels, energy-efficient glass, radiant floor heating, a geothermal ground-source heat pump system, energy recovery ventilation, low-VOC (volatile organic compounds) materials, LED lighting, and charging stations for electric cars. It is sited to have the least impact on the land and uses native plantings to manage stormwater runoff and toxicity."



Figure 51 Unitarian Universalist Society in Coralville, Iowa, Zero Energy facility, November 2017

The good news is that faith-based organizations can use their existing freedom, their spiritual values and empower themselves to reduce GHG emissions now – while others are changing the system to make the transition easier. As members of a religious group, they can magnify our personal power to bring about broader change from the bottom-up.

A project like this does take a village.

The idea for change started with the Green First Task Force that included: Tom Abood, Craig Murray, Toni Nading, John Bringenberg, Milt Hetrick, Jonathan Ormes, Jan Ormes, Tamo Dusk, Rev. Gail Collins-Ranadive, and most recently Linda Baggus, Hilary Morland, and Gary Norton. However without the support of the BFF Building Committee, the Board of Trustees, their Independent Reviewers, the Senior Minister, the church Staff, the 44 financial donors and lenders, and the unanimous approval of the Congregation, this project would not have happened.

A project like this requires a dedicated team of architects. First Universalist employed Barrett Studio Architects.



Our studio is committed to a transition toward a sustainable, green future...

"Whether it's a poetic seed, an impulse to connect, a DNA, or finding the soul of an idea or project, we look to express an inner life manifesting an outward form."

— David Barrett, FAIA

"...to achieve this dream we must look to nature for its bio-logic and its inspiration for form. By holding nature as our teacher, architecture can deliver a sense of vitality that places us in relationship with our surroundings. This awareness of a deep connection to the living, breathing systems is an experience E.O. Wilson termed "biophilia," the love of the living. Living Architecture exceeds the aesthetic of natural harmony; rather, it delves deep within to harmonize with the earth's rhythms—to truly, seamlessly intertwine with nature."

The staff of First Universalist Church of Denver is also acknowledged, specifically Jessica Montgomerie, for assistance in documenting this Case Study. The reporter also wishes to acknowledge the insights, suggestions, and support of his partner, Gail, throughout this project.

Chapter Marker

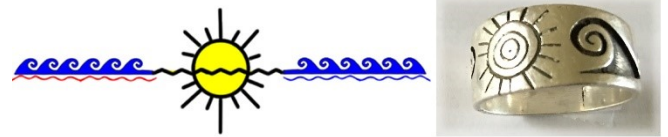


Figure 54 The Chapter Marker was inspired by the reporter's ring – hand-crafted by Hopi silversmith Duane Tawahongva, Mishongnovi Village, Second Mesa, Hopi Reservation, AZ ⁷⁹

It is important to acknowledge that this story draws inspiration and guidance from many sources – from David Barrett's "bio-logic," to E.O. Wilson's "biophilia," to Janine Benyus' "biomimicry," to the wisdom of indigenous peoples who remain spiritually connected to nature.

The chapter marker combines the Hopi symbols for Sun and Water (waves) to remind us of that connection.

Powered by inexhaustible solar energy transformed into electric, the new sustainable energy system circulates water between Earth and the facility for heating and cooling the facility. The undulating lines underscoring the waves denote warm water (red) and cool water (blue) found in the ground-source geothermal heating & cooling system as thermal energy is exchanged between Earth and the facility.



Figure 52 David Barrett, Barrett Studio Architects, standing on the dais of the new Sanctuary of First Universalist Church Denver capturing the pre-Winter Solstice light coming through a portal in the oculus. December 20, 2017

In addition to David Barrett, Sam Nishek, the principal architect for this renovation project helped First Universalist transform their dream of a 100% Sustainable Energy System for the church into a reality.



Architect's Rendition - Oct 2015



Drone Photo - April 2019

Figure 53 Architects Drawing vs Drone photo

We also acknowledge the dedicated professional craft people who applied their design and construction skills to make the goal of a sustainable energy system a reality.

Afterword: 1/2 Year of Operation (21 Jun 2018 – 21 Dec 2018)

First Universalist Church Denver, Sustainable Energy System – 6 Month Performance Report

During the recent “Building for the Future (BFF)” church renovation project of 2015-2018, First Universalist installed new 21st-century energy-related equipment that is consistent with the UU principles and the Paris Agreement of 2015. Based on the first six months of operation, First Universalist can say, “We are still in.”

The goal was, to stop doing harm – to ourselves, as well as our interdependent web of life – now and in the future. By coming together in mind and spirit, and held together by shared values, the congregation was able to find a way to renovate their facility, so it operates more sustainably and reduces GHG emissions to comply with the IPCC 1.5 C Report of October 2018. They found a way to make this transition without a significant impact on the church-operating budget. They are grateful for all who helped make this physical change happen. This project was a group effort. They are thankful for their congregation’s unanimous approval on 6 Nov 2016 that authorized this transition to renewable energy.

So how is the new energy system performing?

There are many features to this energy system, some are obvious, but most of these energy-related features are quietly functioning as designed out of sight but contributing to the total system.

The new windows added insulation, and air sealing reduced heating and cooling needs significantly. The new LED lighting and increased use of natural lighting (e.g., obelisk in the Sanctuary) reduced the amount of electricity now used. The use of beetle-kill pine in the ceiling of the Sanctuary is a gentle reminder to strive for zero waste and 100% recycling/reuse as they proceed into this pivotal century of human existence. The Solstice/Equinox Light in the Sanctuary reminds us seasonally of the life-sustaining energy received from the Sun. And of course, they are grateful for the new equipment that honorably harvests inexhaustible sustainable energy to operate the church – solar energy

from the Sun for generating electrical power and thermal energy from the Earth for heating and cooling the facility.

First Universalist Church also acknowledges they are still experiencing some growing pains learning how to use this new equipment. Based on the first six months of operating and monitoring the performance of the new energy system, they have identified some final adjustments that still need to be made. These “open items” represent the remaining 1-2% of the total effort:

- 1) The air circulation patterns within the round space of the Sanctuary are complex and create temperature variations in the room. The airflow patterns need to be adjusted. A redesign of return air ducts has been initiated.
- 2) The small 2-ton rated furnace that controls the temperature within the office space appears to be undersized and may need to be augmented to maintain a more comfortable working environment, and
- 3) The thermostat settings for the ten different heating & cooling zones are still being optimized.

The good news is that they are pleased with the overall performance of the new system. The solar and geothermal aspects of the energy system seem to be functioning well. The rooftop solar PV system is harvesting sunlight and generating electrical power as predicted by computer models. The ground source geothermal system is successfully exchanging thermal energy with Mother Earth for cooling in the summer and heating in the winter. (Granted there are some adjustments still needed to alter the airflow patterns to make the facility more comfortable.) Fundamentally, the geothermal system has demonstrated a robust capability to transfer thermal energy into and from the Earth as designed.

Are we net-zero energy?

This is an important question. If the church is not harvesting/generating all of the energy it uses to operate, then they must buy power from Xcel Energy. Because of the fuel mix, Xcel continues to use, around 80% of their power is still generated by burning ancient hydrocarbons that dump greenhouse gases and other harmful materials into the atmosphere. If the church buys this energy, First Universalist is then responsible for the harm perpetrated by Xcel generating plants.

After 6 months, a halfway point in the annual cycle, it is possible to look at the period from the

Afterword

Summer solstice to the Winter Solstice and observe “we are very close to meeting our net-zero energy goal.”

Here is what is known quantitatively using an eGauge monitoring system that measures how much electrical power the solar system generates and how much power the facility uses to operate.

The green lines denote daily power generation; the red lines depict power consumption.

As indicated in the Blue summary box of Figure 50, during the first 6 months of operation (from 6/21/2018 to 12/21/2018) the church

harvested/generated 36.0 MWh (megawatt hours) of energy. The church used 37.6 MWh; **that is within 4% of the net-zero target.**

Looking ahead, most of the cold winter months are still to come where the heating demands are high. However, to offset this expected increase in energy usage, the days will be getting longer and the sun will appear higher in the sky so power production will also start to increase. The Green First Team will continue to monitor and fine-tune the system and look for ways to close this small gap and become truly net-zero.

Stay tuned for the next semi-annual update at the summer solstice in June.

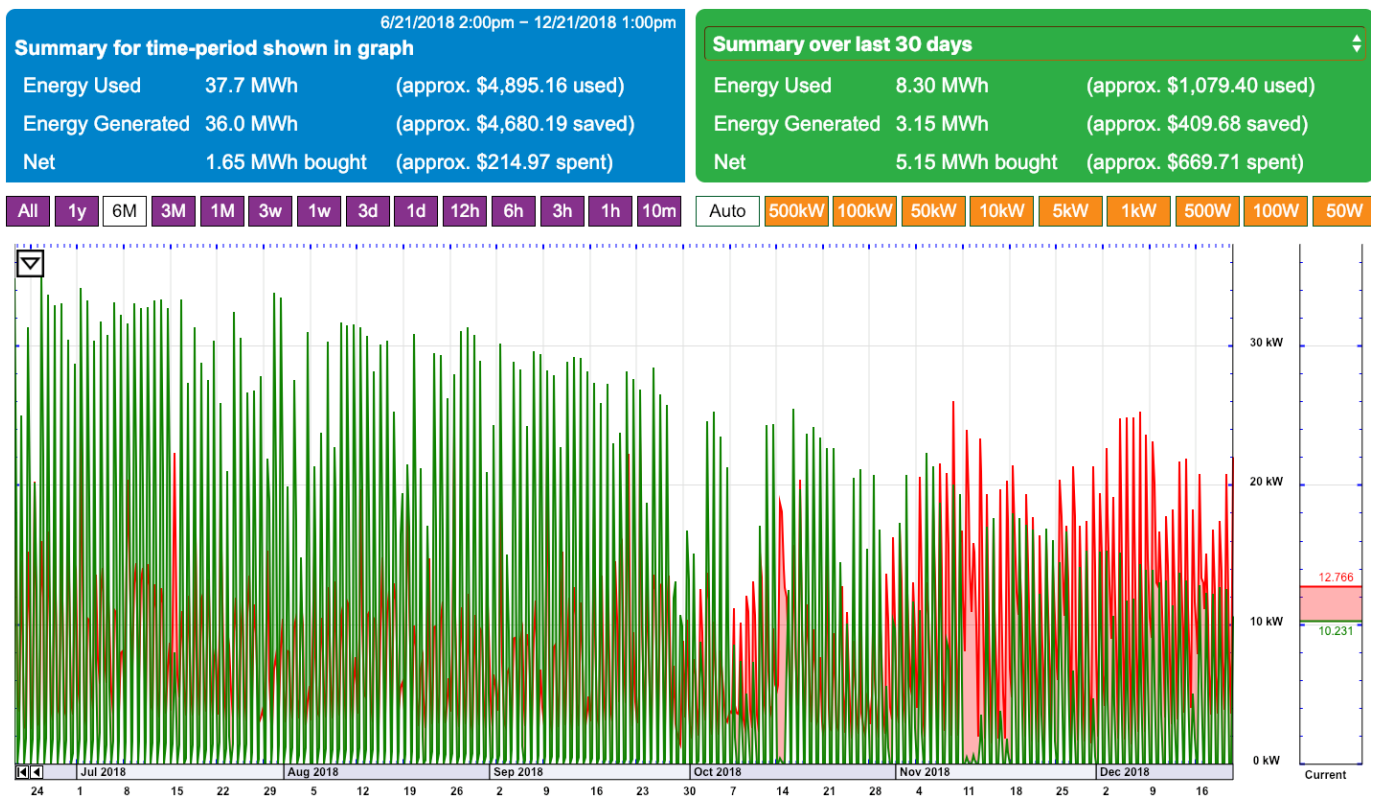


Figure 55 First Universalist Church Sustainable Energy System Performance

Appendix A Factoids

Factoid A.1 PVWATTS SOLAR RADIATION

Denver, CO. Sunlight incident on surface flat on the ground

Month	Solar Radiation Daily	AC Energy	Days/Month	Solar Radiation Monthly
	(kWh / m ² / day)	(kWh)		kWh / m ² / month
January	2.62	64	31	81.2
February	3.55	81	28	99.4
March	4.87	121	31	151.0
April	5.78	135	30	173.4
May	6.63	153	31	205.5
June	7.38	161	30	221.4
July	7.13	158	31	221.0
August	6.25	141	31	193.8
September	5.28	117	30	158.4
October	3.92	91	31	121.5
November	2.97	70	30	89.1
December	2.38	58	31	73.8
Annual	4.9	1,350		1790

Factoid A.2 Sun on 0 deg Tilt Surface (PVWATTS)

RESULTS **1,349 kWh/Year***

[Print Results](#) System output may range from 1,253 to 1,389 kWh per year near this location. Click [HERE](#) for more information.

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)	Value (\$)
January	2.62	64	7
February	3.55	81	9
March	4.87	121	13
April	5.78	135	15
May	6.63	153	17
June	7.38	161	18
July	7.13	158	17
August	6.25	141	16
September	5.28	117	13
October	3.92	91	10
November	2.97	70	8
December	2.38	58	6
Annual	4.90	1,350	\$ 149

Factoid A.3 Sun on 10 deg Tilt Surface (PVWATTS)

RESULTS **1,485 kWh/Year***

[Print Results](#) System output may range from 1,379 to 1,528 kWh per year near this location. Click [HERE](#) for more information.

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)	Value (\$)
January	3.35	85	9
February	4.23	97	11
March	5.44	135	15
April	6.11	142	16
May	6.75	155	17
June	7.41	160	18
July	7.23	159	18
August	6.53	146	16
September	5.81	128	14
October	4.60	108	12
November	3.76	91	10
December	3.12	79	9
Annual	5.36	1,485	\$ 165

Factoid A.4 Sun on 20 deg Tilt Surface (PVWATTS)

RESULTS **1,580 kWh/Year***

[Print Results](#) System output may range from 1,468 to 1,627 kWh per year near this location. Click [HERE](#) for more information.

Month	Solar Radiation (kWh / m ² / day)	AC Energy (kWh)	Value (\$)
January	4.00	102	11
February	4.80	110	12
March	5.87	145	16
April	6.30	146	16
May	6.72	154	17
June	7.25	157	17
July	7.15	157	17
August	6.65	149	16
September	6.20	136	15
October	5.15	120	13
November	4.45	108	12
December	3.78	97	11
Annual	5.69	1,581	\$ 173

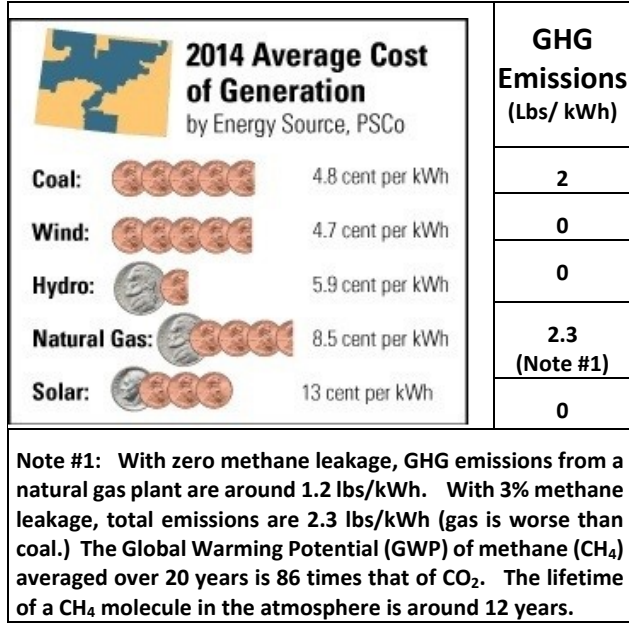
Factoid A.5 Solar Energy Incident on Church Lot

Lot Size
1.7 acres
74,052 ft ²
6,880 m ²

Solar Radiation (PVWATTS)

1790 kWh / m² /year
12,311,156 kWh /year

Factoid A.6 GHG Emissions – Electric Power Generation



Factoid A.7 Historical Price of Colorado Natural Gas

Over the past 4 decades, Colorado natural gas prices for the commercial sector have fluctuated 20-30% annually but have steadily increased at a rate of about \$2 / Thousand Cubic Feet / Decade as indicated in Figure 51. The yellow curve illustrates a 4% annual increase as a reference for comparison.

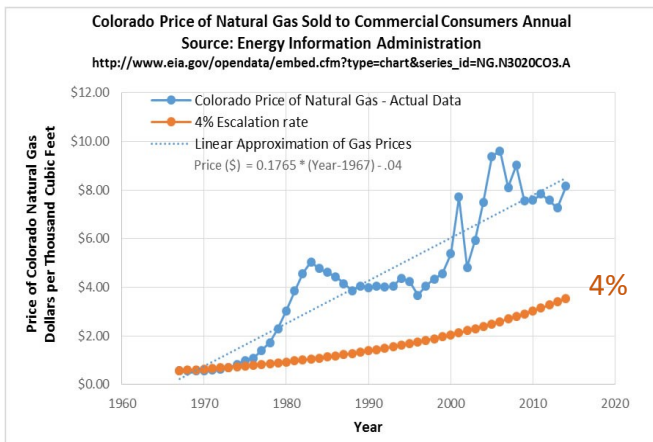


Figure 56 Historical Natural Gas Prices in Colorado

The current natural gas price in Colorado is now around \$8/1000 cubic feet. 20 years ago, the price was \$4. 40 years ago it was around \$1. There is no evidence or rationale for the price of this finite resource (with a rapidly dwindling supply) to decrease.

Factoid A.8 GHG Emissions for Xcel Energy Electric Power Generation

According to the EPA, a typical coal-fired generating plant produces 2 lbs. of CO₂ for every 1 kWh generated. A gas-fired plant produces 1.2 lbs./kWh.

At the time, the “Fuel Mix” for Xcel Energy in Colorado is shown in Figure 52. 53% of their power was generated by burning coal, 25% by burning natural gas and 22% was generated using energy sources with zero emissions.

POWER SUPPLY MIX—Energy sources used in power generation and purchase for all energy customers in the 2014 calendar year:

2014 Energy Mix, PSCO:

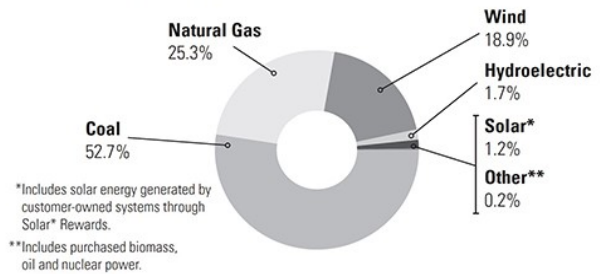


Figure 57 Excel Fuel Mix (2014)

So for 1 kWh of energy generated by Xcel, the composite CO₂ emissions can be computed.

CO₂ Emissions (lbs)/kWh = 0.53 * 2.0 lbs + 0.25 * 1.2 lbs + 0.22 * 0.0 = **1.32 lbs of CO₂/ kWh**, assuming there is zero methane leakage during the drilling/fracking/collecting/transportation processes to get the methane to the site where it will be burned. For 72040 kWh, the GHG emissions with 3% methane leakage is = 47.5 tons =43.2 metric tonnes

We know today that methane (CH₄) leakage is an extremely important consideration because CH₄ is 86 times more potent as a greenhouse gas than CO₂ when averaged over a 20-year period.

We know there is leakage based on actual gas field measurements. The oil and gas industry self-reports a 3% leakage to the EPA; actual measurement

Appendix A Factoids

in gas fields by independent labs has observed a wide range of leakage values from 6% to 17% in one California gas field. 5% leakage is allowed by state regulations in Colorado.

We will use 3% leakage in this case study. when there is 3% or more leakage of methane into the atmosphere, natural gas because worse for global warming than burning coal.

With 3% methane leakage, CO₂ Emissions (lbs)/kWh = $0.53 * 2.0 + 0.25 * 1.2 * 1.93 = 1.64$ lbs of CO₂/ kWh, where 1.93 is the methane multiplier for 3% leakage. For 72,040 kWh, the GHG emissions with 3% methane leakage is = 59.1 tons = 53.7 metric tonnes

With 5% methane leakage, the legal limit in Colorado gas fields, CO₂ emissions (lbs) /kWh = $0.53 * 2.0 + 0.25 * 1.2 * 2.56 = 1.83$ lbs of CO₂/ kWh, where 2.56 is the methane multiplier for 5% leakage. For 72,040 kWh, the GHG emissions with 5% methane leakage is = 65.9 tons = 59.9 metric tonnes

Factoid A.9 How Big is a Ton of CO₂?

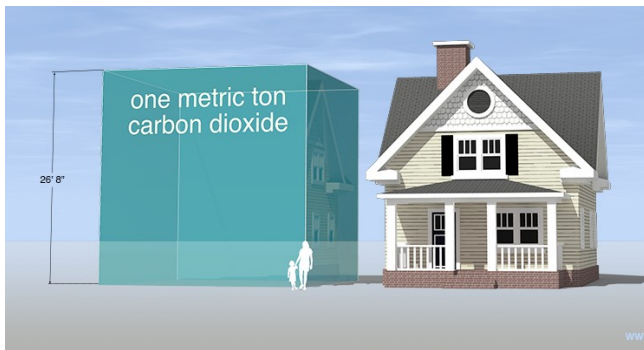


Figure 58 How Big is a Ton of CO₂?

At standard pressure and 15 °C (59 °F) the density of carbon dioxide gas is 1.87 kg/m³ (0.1167 lb/ft³). One metric ton (2,205 lb) of carbon dioxide gas occupies 534.8 m³ (18,885 ft³, 117,631 US gallons). It would fill a cube 8.12 meters high (26' 8" or 28' 5" adjusted for 5,280' altitude (14.7/12.15 psi)) or a sphere 10.07 meters across (33' of 40' adjusted for 5,280' altitude)

Ref: <http://www.carbonvisuals.com/projects/usa-specific-image-set>

Factoid A.10 How Much CO₂ is Created by Burning 1 gallon of gasoline?

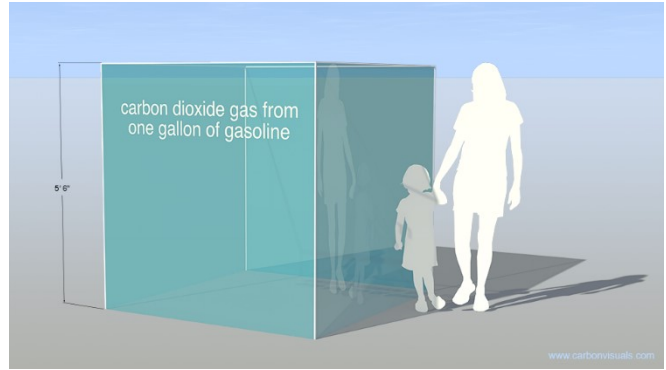


Figure 59 How Much CO₂ is Created by Burning 1 gallon of Gasoline?

Ref: The combustion of one US gallon of gasoline in a passenger car results in emissions of 8.872 kg CO_{2(e)}. At standard pressure and 15 °C (59 °F) the density of carbon dioxide gas is 1.87 kg/m³. 8.872 kg occupies a volume of 4.744 m³ (167.6 ft³) which would fill a cube 5' 6" high or a sphere 6' 10" across. **Source:** Greenhouse Gas Protocol Ref: (<http://www.ghgprotocol.org/calculation-tools/alltools>) accessed via AMEE:

http://discover.amee.com/categories/US_road_transp ort_by_Greenhouse_Gas_Proto col/data/passenger%20car/gasoline/2005-present/result/none/1.0/1;gal?usage=byFuelOnly

Factoid A.11 How Big is a Pound of CO₂?

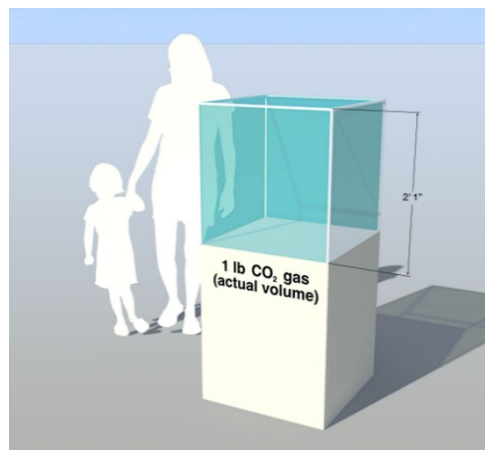


Figure 60 How Big is a Pound of CO₂?

At standard pressure and 15 °C (59 °F) the density of carbon dioxide gas is 1.87 kg/m³ (0.1167 lb/ft³). One pound (454 grams) of carbon dioxide gas occupies 0.2426 m³ (8.566 ft³, 64 US gallons, 243 liters). It would fill a cube 62.4 cm high (24.6") or a sphere 77.4 cm across (30.5")

Factoid A.12 What are the Annual Per Capita Emissions of the U.S. and China?

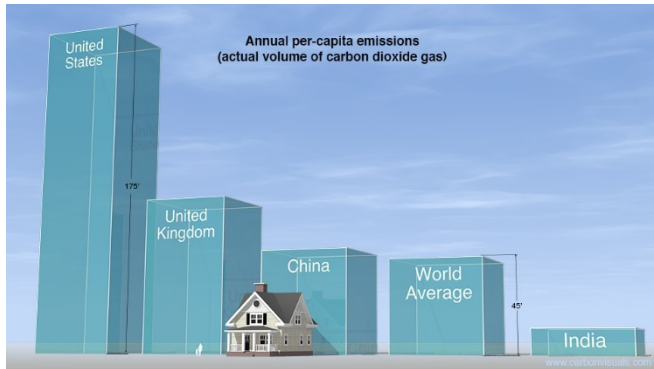


Figure 61 What are the Annual Per Capita Emissions of the U.S. and China?

Annual per-capita emissions in 2008: United States: 18.6 metric tons CO_{2(e)} United Kingdom: 8.4 metric tons CO_{2(e)} China: 5.4 metric tons CO_{2(e)} World Average: 4.8 metric tons CO_{2(e)} (Source: CDIAC) India: 1.3 metric tons CO_{2(e)}

Source: Climate Analysis Indicators Tool, World Resources Institute: <http://cait.wri.org> CDIAC (for world average figure): Boden, T.A., G. Marland, and R.J. Andres. 2012. Global, Regional, and National Fossil-Fuel CO₂ Emissions. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. doi 10.3334/CDIAC/00001_V201



Factoid A.13 What is Life Cycle Cost Analysis (LCCA)?

Before you purchase new assets, practice life cycle costing.

Knowing the life cycle cost, or whole-life cost, of an asset impacts budgeting, product pricing, and decision making.

What is life cycle costing?

Life cycle costing, or whole-life costing is the process of estimating how much money you will spend on an asset over the course of its useful life. Whole-life costing covers an asset's costs from the time you purchase it to the time you get rid of it.

To calculate an asset's life cycle cost, estimate the following expenses:

- Purchase
- Installation
- Operating
- Maintenance
- Financing (e.g., interest)
- Disposal

Add up the expenses for each stage of the life cycle to find your total.

Life cycle cost management depends on your ability to make a smart investment. When you are deciding between two or more assets, consider their overall costs, not just the price tag in front of you.

By using life cycle costing, you can more accurately predict if the asset's return on investment (ROI) is worth the expense. If you only look at the asset's current purchase cost and don't factor in future costs, you will overestimate the ROI.

Reference: "How to Use Life Cycle Costing", Rachel Blakely-Gray, September 13, 2018,

<https://www.patriotsoftware.com/accounting/training/blog/life-cycle-costing-process/>

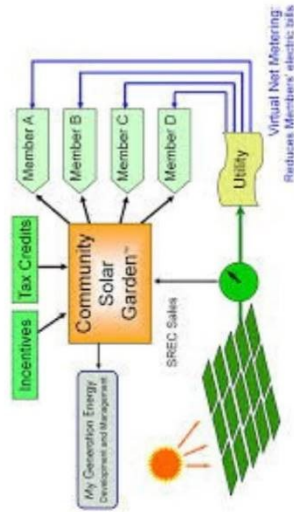
Appendix B Highlights of the BFF Project

- Feb 2013 – Committee formed to explore options; recommends renovating the current site
- May 2014 – Congregation votes to launch building effort
- Jun 2014 – Board appoints Building for Future (BFF) committee
- Jul 2014 – Barret Studio Architects hired
- Aug 2014 – Vision statement crafted
- Fall 2014 – Architects meet with church groups
- Dec 31, 2014 – 1st conceptual drawings presented – too fancy too pricey
- Aug 2015 – Six rounds later, BFF approves the plan
- Sep 13, 2015 – Congregation unanimously supports plan
- Nov 2015 – Faurot Construction hired as a contractor
- Mar 2016 – Capital Campaign concludes; \$3.5 million raised
- Apr 3, 2016 – Congregation approves \$4.0 million budget; provides authority to proceed with third-party funding for a sustainable energy system (solar and geothermal)
- May 15, 2016 – Called a new senior minister
- Jul 2016 - \$100K challenge met
- Aug 2016 – Plans submitted for a city building permit; congregation vacates the building;
- Nov 6, 2016 – Congregation unanimous approval to proceed with Sustainable Energy System (Solar/Geothermal)
- Nov 13, 2016 – David Barrett, architect, interior design briefing
- Dec 2016 – Completion of permit process; the start of construction
- Jun 2017 – Expected completion of construction (Original Plan)
- Aug 2017 – Congregation returns to a new building (Original Plan)
- Dec 24, 2017 – Expected completion of construction and Congregation returns to a new building (Actual - Partial)
- Jan 2018 – Congregation returns to a new building (Actual)
- Mar 2018 – Solar System Installed (Partial)
- April 1, 2018 – Church Dedication Ceremony
- June 6, 2018 – Solar System installation complete, net meter installed and system activated-producing power

Community Solar Gardens

Not everyone can place solar where they live or work. If that is your situation, Community Solar Gardens are an excellent alternative. While your monthly bill credit will be less per kWh than if you had solar on your home, you still get offsets for the amount you own, up to 100% of your average usage.

CSG can be upfront “purchase” or a monthly fee as a PPA, each designed to reduce your overall cost of energy about 10% or more.



How long until pay back?

A common question ... and applies mostly to up-front purchase of solar or community solar. Typically the timing can be 7-11 years. However before letting ROI stand in the way of going green, consider how many years it takes to repay the money spent with your utility. There is never a payback on those dollars!

Also, studies show that on average, homes with solar sell faster and for higher value than homes without.

Further Resources

www.energysage.com/cosea/ Find a dealer, get a quote

Become a Solar CitiSum, free site to keep informed on solar policy and issues www.gosolarcolorado.org



Our energy footprint is not just a bill we try to minimize – but a moral set of choices we make for ourselves ... our progeny ... our planet. Your Green First Task Force provides the information in these brochures to help you make better choices. Reach out to us with your questions.

Your Local Go2 Green Guide:

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Guide to Solar for Your Home



Electricity and Zero Carbon!



FIRST UNIVERSALIST
GREEN FIRST TASK FORCE

PV Solar

There are numerous things to love about Photovoltaic Solar. Lower your energy bill, no moving parts, 25 year warranty, financing programs, reduce CO₂, and \$\$ generated every sunny day for the next 30+ years.

Divest Fossil Fuel / Invest in Solar

Consider divesting in fossil fuel stocks and bonds and reinvesting locally by installing solar PV—either on your own roof or in a community solar garden. A 30% federal tax credit is available to those who purchase solar systems however this important incentive is currently set to expire for residential solar at the end of 2016.

If systems are too expensive for outright purchase (typically \$13k—\$20k), several financing programs are available. Common programs include:

3rd Party Solar Lease or PPA

A popular way to finance solar is using a solar lease or PPA (Power Purchase Agreement) where a 3rd party is the owner of the system on your home for 20 years. The energy offsets a portion of your normal usage reducing your energy bill. That savings combined with your

new monthly Lease or PPA payment typically saves about 10%+ of your current monthly cost. Since we generally anticipate that energy costs will increase in the future as they have in the past, then the savings you achieve in early years should grow. In a 3rd party lease the federal tax credits plus any other ownership incentives flow to



Home Equity or other Energy Loans

In Colorado, Home Equity loans and specialized Energy loans—often subsidized for low interest, - are increasingly popular. As local incentives continue to decline, it is increasingly hard to provide immediate savings with a Lease or PPA.

With a loan, you are now the owner of the system including maintenance responsibility. Upon sale of the home, the loan will become fully paid as part of closing and the next owner will have the system free and clear.

Loans that lower your overall monthly cost tend to be 20+ year terms. Often special first year terms allow prepayment when you receive your 30% federal tax credit. Check with your bank.

Consider a 5 year loan treating the purchase of your long life system like a vehicle. While total cost of reduced energy plus monthly loan payment will now be higher for 60 months, after that you are the 100% owner of the system.

Thermal Solar

Thermal solar has come a long way since the 1970's. Thermal solar is about twice as efficient in converting sunlight into useable energy than PV solar and tends to cost about 25% - 40% less. However, these systems have moving parts, pumps, plumbing, are more difficult to retrofit and have shorter life spans than PV solar. The most common systems offset cost of domestic hot water, with 1-2 panels for a typical home. Larger systems can be effective if you have radiant heat. 30% tax credits apply to the system cost.

Pre-Paid Solar Lease

A pre-paid solar lease - when available—can be a smart move. The entire 20 years of payments are paid in one lump upfront with time value discounting. This may cost about 50% - 75% of the cost of full upfront purchase, however there are no further monthly payments for you or anyone you sell the home to. All energy savings each month flow to the home owner. Thus your monthly savings are maximized.

the 3rd party and their values are structured in to lower the monthly lease cost.

Advantages of having someone else own your system means maintenance and repair are their responsibility for the life of the program. When you sell your home, the lease or PPA can be easily transferred to the next owner, however it does become an encumbrance on the home. Most programs allow the next owner to purchase the system outright however there is typically a penalty cost associated.



Energy-Efficient and Cost Effective

Although installing a geothermal heat pump system is more expensive than installing an air source system of the same heating and cooling capacity, you can recoup the additional costs in energy savings in 5 to 10 years. An average geothermal heat pump system costs about \$2,500 per ton of capacity. If a home requires a 3-ton unit, then it would cost about \$7,500 (plus installation and drilling costs). A comparable ASHP system with air conditioning would cost about \$4,000, but the energy costs could easily equate to the extra cost of installing a geothermal heat pump. Additionally, geothermal heat pump systems installed in new or existing homes by Dec. 31, 2016 are eligible for a 30% federal tax credit. See the *Financial Incentives* box for more information.

Geothermal heat pump systems have an average 20+ year life expectancy for the heat pump itself and 25 to 50 years for the underground infrastructure. Additionally, they move between three and five times the energy they consume between a building's interior space and the ground.

To determine the energy efficiency of a geothermal heat pump, look for: the Energy Efficiency Ratio (EER), and the Coefficient of Performance (COP). The cooling capacity is indicated by the EER while the heating capacity is indicated by the COP.



Geothermal heat pumps are among the most efficient and comfortable heating and cooling technologies available because they use the earth's natural heat to provide heating, cooling, and hot water — **no fossil fuel is required.**

Financial Incentives

Tax credits, incentives, and rebates may be available in your area. For more information, please visit www.energysavers.gov/taxcredits

Further Resources

DOE Energy Savers: Geothermal Heat Pumps
www.energysavers.gov/geothermal_heat_pumps

Energy 101: Geothermal Heat Pumps
www.eere.energy.gov/multimedia/video_geothermal_heat_pumps.html



Your local Go2 Green Guide:
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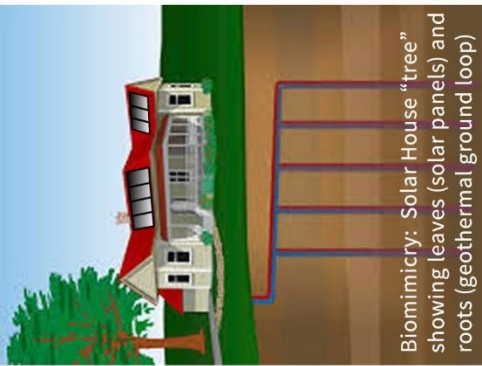
LIVING OUR VALUES SERIES

Guide to Geothermal

Heat Pumps:

heating & cooling without burning fossil fuel





Biomimicry: Solar House “tree” showing leaves (solar panels) and roots (geothermal ground loop)

How Geothermal Heat Pumps Work

Using a heat exchanger, a geothermal heat pump can move heat from one space to another. In summer, the geothermal heat pump extracts heat from a building and transfers it to the ground for cooling. In winter, the geothermal heat pump takes natural heat from the ground and transfers it to the home or building for heating.

Installing a geothermal heat pump system can be the most cost-effective and energy efficient home heating and cooling option. Geothermal heat pumps are a particularly good option if you are building a new home or planning a major renovation to an existing home by replacing, for example, an HVAC system.

About Geothermal Heat Pumps

While many parts of the country experience seasonal temperature extremes – from scorching heat in the summer to sub-zero cold in the winter – a few feet below the earth’s surface the ground remains a relatively constant temperature. The natural ground temperature is cooler than the natural air temperature in summer, and warmer than the natural air temperature in winter. While the margin of variation is small, seasonal changes in ground temperature give geothermal heat pumps a dependable and permanent wintertime heat source and summertime heat sink.

Geothermal heat pumps, also known as ground source heat pumps, geoexchange, earth-coupled, and earth energy heat pumps, take advantage of this resource and represent one of the most efficient and durable options on the market to heat and cool your home.



Types of Geothermal Heat Pumps

Geothermal heat pump heating & cooling systems come in two types of ground loops that transfer heat to or from the ground and your house - horizontal, and vertical.

Choosing the one that is best for your site depends on the climate, soil conditions, available land, and local installation costs at the site.

Horizontal: This type of installation is generally most cost-effective for residential installations, particularly for new construction where sufficient land is available. It requires trenches at least four feet deep.

Vertical: This is often used for larger scale geothermal systems (such as in commercial buildings) where land is limited, or where the soil is too shallow to bury the horizontal loops in the trenches and some form of drilling into the bedrock is necessary. Vertical loop systems can be more expensive, but they use less land and also minimize disturbance to the existing landscape.

Geothermal vs. Air-Source Heat Pumps

While geothermal heat pumps operate similarly to the far more common air-source heat pump (ASHP), geothermal heat pumps are substantially more energy-efficient than even ASHPs because they take advantage of the relatively consistent ground temperatures, which are far more uniform than air temperatures. Geothermal systems can reduce energy consumption by approximately 25% to 50% compared to air source heat pump systems. Geothermal heat pumps reach high efficiencies (300%-600%) on the coldest of winter nights.

Geothermal heat pumps are able to heat, cool, and, if so equipped, supply the house with hot water **with no burning and zero emissions.** Relative to ASHPs, they are quieter, last longer, need little maintenance, and their performance is not affected by the temperature of the outside air.

How Does a Solar PV-Geothermal Energy System Work?

No need to import energy.
All you need is already on-site.

By using solar PV modules, we can harvest the Sun's benevolent inexhaustible energy for all our electrical energy needs. By adding a "ground loop" we can exchange inexhaustible thermal energy with the Earth using heat pump furnaces for heating and cooling. And this sustainable approach saves money.

Yes, today we can harvest all the energy we need to operate our church without burning the dwindling supplies of ancient hydrocarbons - without harming ourselves, our children, future generations and others in our interdependent web of all Life.

How Can We Justify Replacing Perfectly Good Gas Furnaces?

Based on what we know today, there is no such thing as a "good" gas-burning furnace — regardless of its age and prior usage because it produces CO₂. A 'good gas-furnace' is an oxymoron.

However, our current gas furnaces will not go to waste or into a landfill. They will be recycled 100%. The blower motors can be "repurposed" and used in other applications. The cast iron, steel, aluminum, copper, etc. can be 100% recycled and refashioned into sustainable products (including more geothermal heat pumps). Our old furnaces will become the feedstock for new sustainable products.



Ethical and Economical Sources of Energy. Solar PV and Geothermal Heat Pumps allow us to transition immediately from fossil fuel to harvesting inexhaustible sources of clean energy already onsite.

Over a 20 year time frame, these sustainable inexhaustible sources of electrical and thermal energy are less expensive than fossil fuels without considering externalized costs. When externalized costs are considered, fossil fuel derived energy is two to three times more expensive than solar and geothermal.

Further Resources

Further information on the ethics, economics and energy details can be obtained by talking to your **Local Go2 Green First Guides**.

First Universalist Denver

4101 E. Hampden Avenue
Denver, CO 80222
303.759.2770 | office@firstuniversalist.org

LIVING OUR VALUES SERIES

First Universalist

Solar-Geothermal Energy System:

Electrical Power, Heating & Cooling without burning fossil fuel



Why a 21st Century Energy System is in the BFF baseline budget

We have a unique opportunity to transition away from burning fossil fuel for our future energy needs. This is our opportunity to begin to honorably harvest energy from the Sun and the Earth that is already on-site for all our energy needs. This is our opportunity to walk our talk, to live our values, to be in right relations with the interdependent web of life.

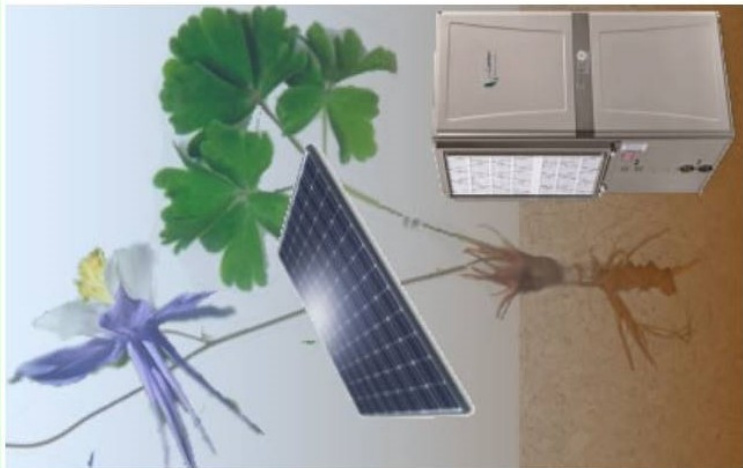
But We Don't Have Enough Money for a Sustainable Energy System.

Actually we do!

If the church continues as is, we can plan to spend around \$500,000 for importing/buying future gas & electric, and replacing gas furnaces over the next 20 years. The unspoken externalized social costs (i.e. harm) related to burning fossil fuels (i.e. according to Harvard Medical Center studies) will be over \$1,500,000.

Avoiding responsibility for these social costs is inconsistent with our UU principles and moral values. So the Green First Task Force coordinated a fund raising campaign to raise the capital required to purchase new energy equipment in the form of member donations and low interest member loans. The new equipment will harvest free inexhaustible solar energy and geothermal energy already on site.

As a result, we remain connected to the grid, but do not need to purchase any electricity or natural gas from Xcel Energy. Instead the "utility bill" payments will be used to repay the low interest member loans over a 15 year period. This Board approved financing approach is considered "revenue-neutral" because it does not increase the church's operating budget. By harvesting our own energy, we expect to spend at least \$150,000 less on energy over the next 20 years.



Modern Energy Generation Systems Begin to Mimic Nature.

By adding Solar PV modules on our church roof to harvest daily energy from the Sun for our electrical needs and a Geothermal/GeoExchange Heat Pump system with a "ground loop" to exchange thermal energy with the Earth for our heating and cooling needs, we are effectively adding "leaves" that look to the Sun for our energy and growing "roots" to exchange thermal energy with the Earth.

This approach is consistent with our UU principles and common objective: Building for Future generations.

Has the UUA Documented a Position on Sustainable Energy Issues?

Yes. The Unitarian Universalist Association (UUA) General Assembly (GA) meets annually and has passed Resolutions pertaining to Energy, Climate Change and Divesting from Fossil Fuels. A few excerpts from recent GAs are provided below:

2006 UUA General Assembly: ... that we will not acquiesce to the ongoing degradation and destruction of life that human actions are leaving to our children and grandchildren. ... we commit to a renewed reverence for life and respect for the interdependent web of all existence.

2014 UUA General Assembly: ... to do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy;

2015 UUA General Assembly: ...to unify and provide ethical and moral leadership for climate action and to do so within our congregations

Precedents

Every day, more and more commercial and residential buildings are being constructed or being remodeled to be net zero energy buildings — around the world. **First Universalist Denver can too.**

IKEA announced that all their stores will be 100% sustainable by 2020. Their local store in Centennial, CO is powered by solar PV and uses geothermal heat pumps for all their heating and cooling.

Jefferson Unitarian (JUC) in Golden, CO uses solar and geothermal for their Mills building.

So more and more people are demonstrating it is possible, practical and prudent to keep the lights on and stay comfortable in summer and winter without importing & consuming fossil fuel. All the energy needed is already on-site.

Appendix D Member Lender Past Experiences

Resource Description

The success or failure of this effort was totally dependent on our ability to finance the sustainable energy system. After months of exploring different funding mechanisms without success, we finally stumbled on one approach that seemed as if it could work. It involved a combination of member donations and low interest (1.5%) member loans that together would raise the necessary capital to purchase and install the solar electric/geothermal heating & cooling system.

But there was one major problem with this plan. We learned there was an unpleasant experience with member loans embedded in the church history. Older members could recall a previous experience with member loans – some 20 years ago - that did not turn out well and left rancor among some members.

During the last remodeling effort, some of the capital for that project was acquired by asking members to loan money to the church at slightly less than the commercial rates. Today, decades removed from this event, member loans are remembered as ‘something to avoid.’ Several long-time members with good memories reminded us of this negative experience. Fortunately, a co-chair of the current BFF committee, B. BFF was also around in those earlier years and remembers the situation (and its root cause) a bit differently.

According to B. BFF, commercial interest rates were quite high at the time – let’s say around 7%. The project was funded by a combination of commercial loans and member loans. The remodeling project was funded and completed successfully. The loans were being paid back on a regular basis until years later, balancing the annual church budget became particularly difficult one year. A suggestion (possibly originating from the Board of Trustees or the Senior Minister/CEO) was to defer repayment of the principle on the member loans (rather than cut salaries or programs or borrow money). Member lenders were contacted by a church representative and asked if they would agree to extend the period of their loan for another year or so. Interest would continue to be paid on the member loans, but payment on the principle

would be deferred. The member lenders agreed – after all, their near 7% return on the church loan was better than the current commercial rates. Payments continued to be made on commercial loans. Apparently, this loan payment deferment was requested several more times by the church leadership to enable the church to balance its annual operating budget. The commercial interest rates continue to drop. As a result, the church was now paying the member lenders interest payments that were significantly higher than the prevailing commercial rates. Even though the interest payments were going to church members who loaned the church money in good faith, these expenditures did not sit well with church members who were not lenders. The prevailing wisdom from this experience was summarized and became written into the church memory as, “Member loans are bad.”

Relevance / Lessons Learned

The root cause of this previous problem rested at the feet of the Senior Minister/CEO and/or the Board of Trustees who creatively requested the loan payment deferrals on the member loans – not the member lenders who entered into an agreement to provide a subprime source of capital for the church – a better deal than a commercial loan. Nevertheless, the member lenders are remembered as ‘taking advantage’ of the members who were not lenders.

To our knowledge, nothing was put in place to prevent the current Board of Trustees or Senior Minister/CEO from doing this again. Nothing was put in place to assure the Board of Trustees took responsibility for this “problem.” Their solution was to be sure the lender members are identified as if that will prevent the CEO or Board of Trustees from creative bookkeeping and failing to balance the budget properly in the future. Identifying the lenders really does nothing but verify they are all church members. These member loans are particularly prone to be abused – although there was talk about paying off these loans early and assurance there was no penalty for early payback, there really is no motivation to pay off a \$240,000 1.5% member loan before paying off a \$400,000 commercial loan @ 5% - In fact the low-interest rate makes it even more probability the Board of Trustees or CEO will try to get an extension of the period of the loan.

Member loans made this project possible

Appendix D Member Lender Past Experiences

The Green First Task Force spent months exploring different funding scenarios. This is explained in an earlier Section. After going down numerous dirt roads only to find dead ends, it became obvious that the “financials” would not work unless certain constraints were changed. The 30% tax credit for renewable energy system offered to commercial organizations and to homeowners has a significant impact on the financial viability. In addition, it became clear the compounding commercial interest rate of 4-6% was also a showstopper from a cash flow perspective.

Once this was understood, cash donations were required to offset the lack of 30% Federal Tax credit. The donor individuals could still use their donation to the church as a tax deduction on their personal income tax. Donations equal to the 30% tax credits as well as the equipment depreciation tax deduction allowances afforded for-profit businesses were needed. As it turned out, cash donations ended up being \$208,000 (Nearly 50% of the Energy system cost) – equally or possibly exceeding the tax benefits of being a for-profit organization.)

We were able to overcome the burden imposed by a typical commercial interest rate by raising capital from low-interest member loans. We raised \$240,000 of the \$420,000 through member loans. (57%)

Keeps wealth internal

Member loans also keep the capital local – within the church community. There is much to be said about local financing – e.g. State banks and Slow Money. Occupy Wall Street taught us that. Putting your money in Wall Street is one way to “make money.” Putting your money in the local community is one way to invest in the Planet – not in letting the rich get richer

On Nov 2, 2016, 11:26 AM, C. Board wrote:

... Last night's Board of Trustees meeting generated a few more edits to the motion and attachment. Also, we heard back from A. Green and Christian O. last night about the lending entity. A. Green and Christian are now recommending that the lenders form a partnership, not an LLC or other entity. The Board of Trustees felt that being specific about the nature of the lending entity was important for the motion and attachment. Finally, A. Board was uncomfortable with some of the language in the motion and I tried to address those concerns. The new language for the motion is embedded below and the revised attachment is attached to this email...

Also, the Board of Trustees thinks it important that **we disclose the names of the lenders at the meeting. This will ensure transparency to the congregation and build trust in the proposal.** I, therefore, recommend that we add a slide to the PowerPoint that names the lenders...

For some reason, the Board believed that the lenders should be identified to ‘ensure transparency to the congregation and build trust in the proposal’ – implying that the member lenders were the source of the earlier problem with member loans. In actuality, the prior history with member loans informs us that it was the former Board/Staff who initiated the abuse of the member loan program in an effort to balance their annual budget. Simply naming the lenders is necessary but not sufficient because identifying the lenders does not address the root cause of the problem encountered in the past. It would have been more appropriate for the current Board to suggest a clause in the member loan agreement that prevents the Board/Staff from extending the loan repayment program without congregational approval. Such a clause would have built trust with the congregation that the problem in the past would not be repeated.

That did not happen; however, this time the church is borrowing money, not from individual lenders but from a ‘partnership’ of 15 lenders. Now if the Board/Staff were to propose a change in the terms of the loan (such as extending the payment period as they did in the past), the partnership agreement requires “written agreement of at least two-thirds (2/3) of all of the Partners holding at least two thirds (2/3) of all of the Partner Interests.” This clause may help prevent the ‘member lender’ problem of the past.

On Nov 2, 2016, at 1:23 PM, Green₅ wrote:

With all due respect, if the Lenders are going to be “acknowledged/outed” to provide “transparency and trust” then it is imperative that the cash donors also be “acknowledged/recognized.” Only because the donors offset nearly half of the cost of this capital improvement subproject, were we able to meet the ground rules of the Board to limit the loans to \$240,000. The proposed PowerPoint chart has to include everyone if you include some. They can be listed under different categories: Lenders & Donors. This was a team effort by a significant number of people. There were significant non-financial contributions that also need to be acknowledged, so we are back to A. Reviewer’s chart that lists everyone involved: Minister, Board of Trustees, BFF committee,

Appendix D Member Lender Past Experiences

Green First Task Force (GF), Renewable Energy Working Group (REWG), etc.

Green₅

On Nov 2, 2016, 1:47 PM C. Board wrote:

Green₅, No one is outing anyone. It is reasonable for the congregation to want to know the names of its creditors. Your choice of language is sometimes puzzlingly aggressive.

I am attempting to get input from all interested parties and to accommodate many views as we move to the final presentation and vote. It is my hope that you can see that.

I have no objection to including a list of donors as you suggest.

C. Board

Appendix E UU Ministry for Earth

Resource Description

About UUMFE

(Excerpts from Website <http://www.uuministryforearth.org/>)

Connecting and inspiring an active community of UUs for environmental justice, spiritual renewal, and shared reverence for our Earth home.

Vision

We envision a world in which reverence, gratitude, and care for the living Earth are central to the lives of all people. Our purpose is to inspire, facilitate, and support individual, congregational, and denominational practices that honor and sustain the Earth and all beings. We affirm and promote the seven principles of the UUA, including: "Respect for the interdependent web of all existence of which we are a part." Although the UU Ministry for Earth has close ties to the UUA, it is a separate not-for-profit 501(c)3 organization with an independent Board of Directors.

UU Ministry for Earth History

The concept began in 1989 with discussions about how to make the Seventh Principle of the UUA more central to members, congregations, and the Association. The Seventh Principle Project was formed and the first edition of the Green Sanctuary Handbook was published in 1991 blending religious celebrations, education, administration, and community action. In 1999, Rev. Fred Small inspired a national environmental program. In 2002, The Seventh Principle Project incorporated and the Green Sanctuary program began accrediting congregations. In 2005, the organization changed its name to Unitarian Universalist Ministry for Earth.

UUMFE was instrumental to the passage of the landmark 2006 Statement of Conscience on the **Threat of Global Warming/Climate Change**. In 2008, UUMFE gave the Green Sanctuary program to the UUA to administer and began refocusing on environmental justice while still providing support to congregations with their Earth ministry. In 2009, in partnership with the UU Office of Advocacy and Witness, Rowan Van Ness became the first Environmental Justice Program Associate in the Washington DC office as an employee of UUMFE. With the UUA reorganization in 2010, Rowan joined the Multicultural Growth and Witness team.

Timeline of UUMFE History

1989 General Assembly, in New Haven, Connecticut, introduces Unitarian Universalists to themes like 'ecology theology' and 'environmental justice.'

1991 Seventh Principle Project publishes the first edition of the **Green Sanctuary Handbook**, blending religious celebrations, religious education, church administration, and community action into one program.

1999 Introduces a Study Action Issue on **Responsible Consumption as a Moral Responsibility** (adopted as a Statement of Conscience in 2001). Seventh Principle Project publishes the second, more comprehensive edition of the **Green Sanctuary Handbook**.

2001 Seventh Principle Project incorporates, is established as an affiliate organization of the UUA, and manages the Green Sanctuary program.

2002 Seventh Principle Project certifies first five congregations as Green Sanctuaries.

2005 Seventh Principle Project becomes Unitarian Universalist Ministry for Earth (UUMFE).

2006 UUMFE leads in the passage of landmark Statement of Conscience on the **Threat of Global Warming/Climate Change**, marking the coming of age of environmental activism in our faith.

2007 Tom Abood and others form the **Green First Task Force** at First Universalist Church Denver

2008 Green Sanctuary Program management transfers to UUA.

2009 UUMFE publishes "**Environmental Justice Green Papers**" online. More than 100 congregations participate in 350 International Day of Climate Change.

2010 More than 150 congregations register their Earth Day activities. Ninety congregations participate in 10/10/10 Global Work Parties. UUMFE convenes UU partners to form Climate Justice Collaborative.

Nov 2010 First Universalist Church Denver completes certification as a UUMFE **Green Sanctuary**

2012 Published **Our Place in the Web of Life, An Introduction to Environmental Justice**.

2013 Began a multi-year focus for Earth Day materials about Sustainable Communities. Contracted with the producers of "Bidder 70" documentary film for the license to allow UU congregations to show the film at a significantly reduced fee. The film is about the courage of Tim DeChristopher who derailed a widely protested federal oil and gas land sale.

2014 UU Ministry for Earth participated in the campaign to pass a UUA Business Resolution on **Divestment from fossil fuel investments**. UUMFE became a 'sponsoring organization' for the multi-year climate justice campaign **Commit2Respond**.

Ann May, an active member of First Universalist Church, Denver in the 1970s and 80s and still a pledging friend, is among those who served on the UUMFE Board of Directors.

Relevance / Lessons Learned

The **Unitarian Universalist Ministry for Earth** (UUMFE) concept began in 1989 with discussions about how to make the Seventh Principle of the UUA more central to its members and the Seventh Principle Project was formed centered around:

"Respect for the interdependent web of all existence of which we are a part."

We at First Universalist found this principle to be a unifying force – something that our congregation could use as a common ground for managing other conflicting perspectives that would be encountered should be implemented. Other faith-based

organizations can reach within their own "creation care" covenants and find a similar unifying message.

The UUMFE has been instrumental at recent UUA General Assemblies in demonstrating there is environmental awareness within our association. Each year members of the UUA, delegates from each of the 240 congregations in North America meet to conduct business, elect officers, join in worship, celebrate diversity and religious tolerance, share in religious education, participate in a broad range of spiritual-related workshop and seminars, listen to keynote speakers and take home new ideas for their home congregations.

In 2006, the UUMFE led the UUA in the passage of landmark Statement of Conscience on the **Threat of Global Warming/Climate Change**, marking the coming of age of environmental activism in our faith.

In 2014, the UUMFE were among the advocates in the campaign to pass a UUA Business Resolution on **Divestment from fossil fuel investments**.

In 2015, the UUMFE helped win the passage of a Business Resolution to **Support a Strong, Compassionate Global Climate Agreement In 2015: Act for a Livable Climate**.

Advocates for a new sustainable energy system at First Universalist relied heavily on these 2006, 2014, 2015 General Assembly Resolutions during the educational and consciousness-raising campaign. The resolutions articulated common values within the UUA for our congregation to rally around and take pride in.

Appendix F S.B. 600 Energy Efficiency Retrofit Pilot Program.

Resource Description

Introduced in Senate (02/26/2015) by [SEN. KLOBUCHAR, AMY \[D-MN\]](#)
114TH CONGRESS
1ST SESSION
S. 600

To require the Secretary of Energy to establish an energy efficiency retrofit pilot program (for non-profit organizations).

IN THE SENATE OF THE UNITED STATES
FEBRUARY 26, 2015

Ms. KLOBUCHAR (for herself, Mr. HOEVEN, Ms. STABENOW, Mr. RISCH, Mr. BLUNT, and Mr. SCHATZ) introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

A BILL

To require the Secretary of Energy to establish an energy efficiency retrofit pilot program.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,
SECTION 1. ENERGY EFFICIENCY RETROFIT PILOT PROGRAM.

(a) DEFINITIONS.—In this section:

- (1) APPLICANT.—The term “applicant” means a nonprofit organization that applies for a grant under this section.
- (2) ENERGY-EFFICIENCY IMPROVEMENT.—
 - (A) IN GENERAL.—The term “energy-efficiency improvement” means an installed measure (including a product, equipment, system, service, or practice) that results in a reduction in use by a nonprofit organization for energy or fuel supplied from outside the nonprofit building.
 - (B) INCLUSIONS.—The term “energy-efficiency improvement” includes an installed measure described in subparagraph (A) involving—
 - (i) repairing, replacing, or installing—
 - (ii) a renewable energy generation or heating system, including a solar,

photovoltaic, wind, geothermal, or biomass (including wood pellet) system or component of the system; and
(iii) any other measure taken to modernize, renovate, or repair a nonprofit building to make the nonprofit building more energy efficient.

(b) ESTABLISHMENT. — *(deleted for brevity)*

(c) GRANTS.— *(deleted for brevity)*

(d) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section \$10,000,000 for each of fiscal years 2016 through 2020, to remain available until expended.

Relevance / Lessons Learned

We began our search for a means of financing/funding a new sustainable energy system that was going to cost on the order of \$500,000.

We soon became aware that the financial incentives for energy conservation and transition to renewable energy offered to homeowners and for-profit businesses did not apply to non-profit organizations. Generally, the financial incentives are in the form of tax deductions/ rebates.

Senate Bill 600 sponsored by Senator Amy Klobuchar (D-MN) and introduced into the 114th congress in 2015 attempted to address this issue and thereby provide incentives for non-profits to transition to renewable energy. The bill languished in committee and was not re-introduced in the 115th or the current 116th Congress.

S.B.600 was drafted to award performance-based grants to non-profits - up to 50% of the total cost of a project.

The lack of financial support for non-profit organizations (e.g. religious organization, colleges & universities, etc.) to transition from fossil fuel to inexhaustible energy is a gross injustice in our current social system. Add this to the list of issues for environmental advocates to address. S.B.600 serves as a model for future reform.

Appendix G UUA Green Sanctuary Program

Resource Description

(Excerpts from website
<http://www.uua.org/environment/sanctuary>)

The UUA **Green Sanctuary Program** provides guidelines for congregational study, reflection, and action pertaining to today's environmental challenges - including climate change and environmental justice.

Successful completion of the program results in Green Sanctuary accreditation: formal recognition of a congregation's service and dedication to UU values, specifically the Seventh Principle: "Respect for the Interdependent web of all existence of which we are a part."

Congregations begin by examining their current environmental impact, then move towards developing sustainable living practices grounded in Unitarian Universalist ethics/values/principles.

There are four focus areas in this program:

1. **Environmental Justice** acknowledges that marginalized communities are affected first and hardest by environmental crisis. In partnering with these communities we are able to address human and environmental needs at the same time. Environmental Justice emphasizes a shift from **providing charity to working in solidarity** with the communities most affected by climate change.
2. **Worship and Celebration** is the heart of Unitarian Universalism. As we work together toward a more just and sustainable world, worship enables us to stay connected to each other and to celebrate the work we have accomplished.
3. **Religious Education** shapes more than just minds; it shapes attitudes and practices.
4. **Sustainable Living** requires us to treat the world more gently by using fewer resources and being mindful of the choices we make.

The Unitarian Universalist Association provides support for this urgent ministry through:

- Monthly conference calls to review the program and answer questions. For more information, contact uua_greensanctuary@uua.org.

- Trained volunteer coaches to support congregational leadership. Coaches are assigned after a congregation completes **Stage 1** of the program.

Relevance / Lessons Learned

In our case, First Universalist had completed the UUA Green Sanctuary Program in November 2010 and was officially accredited by the program's sponsor, the UU Ministry for Earth in 2011, several years before our Sustainable Energy System transition project was initiated as part of the Building for the Future renovation project in 2015.

It is difficult to assess the impact the Green Sanctuary Program had on the congregation and its relevance to the energy transition project.

The Green Sanctuary Program was like dropping a pebble into a pond. The Program had a large impact on a small group of people (on the order of a dozen) who became environmental advocates known as the Green First Task Force. The Green Sanctuary program had a lesser but significant impact on a larger group (several dozen members) who later became part of the donor/lender block of supporters. The program provided a general awareness of today's environmental challenges to most of the 500-some members of the congregation.

We do know that a number of energy conservation and recycling initiatives were implemented as a direct result of the Green Sanctuary Program.

Education and increased awareness were found to be essential to the acceptance and approval of the Sustainable Energy System project. Even with this background, the advocacy team spent a year on orienting the Staff, Board of Trustees and enough members to get authorization to proceed with the transition.

Appendix H Glossary – Reframing

*“We can't solve problems
by using the same kind of thinking
we used when we created them.”*

... *Albert Einstein*

This book documents one case study of a transition to sustainable energy with zero GHG emissions. It did require a change in thinking, a change in a physical structure, a change in human behavior. That change seemed to be the result of a change in thinking that was brought about by a change in how the situation was framed or conceptualized.

The change in thinking paved the way for a change in how people used their financial resources (their investments, their savings.)

To promote a different kind of thinking, different terminology can be used that deserves a bit of explanation. George Lakoff, noted linguist, has published a number of helpful books that illustrate how to reframe political issues.⁸⁰

Ancient Hydrocarbons (aka ~~Fossil Fuel~~)

Where ever possible, we try to avoid the use of the frame ‘Fossil Fuel’ for the following reasons: The word ‘fuel’ immediately invokes an image related to “burning,” “fire,” “combustion,” etc. – that’s what you do with a fuel – you burn it in an engine, in a forest fire, etc. Food is even considered a “fuel” to be burned in our body.

The term ‘Fossil Fuel’ generally is used to refer to ancient hydrocarbons in the form of coal, oil/petroleum, natural gas, shale oil, tar sands oil, etc. These resources are generally found buried below the surface and their origin can be traced back in time several hundred million years.

These ancient resources are chemically concentrated forms of carbon. The carbon is used extensively as a feedstock for many uses including pharmaceuticals and items that can be recycled sustainably (e.g. plastics, carbon fibers, asphalt,...). Referring to these resources as ancient hydrocarbons remind us they have other useful applications than just being a fuel to burn. In fact, burning this concentrated carbon is a shameful practice as voiced 141 years ago

by chemist Dimitri Mendeleev, father of the periodic chart.

“Burning Petroleum as a fuel is akin to firing up a kitchen stove with bank notes.”

- *Dimitri Mendeleev, 1876*

Externalities

(aka Incidental Uncharged Disservices)

Our current economic system allows the fossil fuel burning industry to “externalize” (i.e. ignore) social costs (e.g. health costs of pollution, climate change, mercury contamination, etc.) associated with their products. As a result, the American economic system dishonestly makes it appear that fossil fuels are the cheaper (best) choice when compared to renewable energy alternatives.

100 years ago, economist Arthur Pigou recognized a basic flaw in economic systems and recommended that when a “producer” ignores or externalizes “incidental uncharged disservices,” the people (e.g. via their government) should add a fee to that product to internalize this social cost and correct the market. Today, this correction is called a Pigouvian correction/fee/tax.

The current price of fossil fuel does not reflect the “True Cost” because of externalities.

For further discussion, see **Appendix I Externalities**.

Fossil Gas (aka ‘natural gas’)

Whenever possible try to reframe/replace the term “Natural Gas” with “Fossil Gas” or “Methane.”

The “natural gas” extracted from the ground by drilling and fracking is generally quite complex in that it contains many chemical species – some of which are condensable and become liquid at a standard temperature under a reasonable pressure – e.g. propane. These condensable are separated out and sold separately.

The gaseous product that arrives at our home via a gas line is predominately the methane (CH₄) component of ‘natural gas.’ In fact, the ‘gas’ sold by Xcel Energy that flows through the gas meter is mostly methane, so it would be appropriate to just call the ‘natural gas’ that Xcel sells as methane.

Using the term ‘fossil gas’ differentiates it from recently formed methane gas for example created by

Appendix H Glossary - Reframing

anaerobic composting and cellulose digestion of termites and cattle.

Mental Illness (aka Hoarding)

It is reported that Indigenous People, possible of the Iroquois Confederacy, considered 'hoarding' as a mental illness. They recognized that hoarding wealth, power, possessions, food, etc. was not beneficial to the social order, because the resources that are hoarded are no longer available to benefit the general society.

When a member of their society exhibited this mental illness, i.e. hoarding behavior, an attempt was made to counsel them and help that person get back to mental wellness. If counseling was not successful, the society had no choice but to ban that individual from the Confederacy.

It was as late as the Eisenhower administration that hoarding was discouraged in the U.S. The upper bracket of the tax structure was around 92% in 1952 and 1953 (Corporate taxes were around 52%) and has been on the decline since then – including the latest tax reform of 2017. There was no limit on the amount of income you could receive or the amount of wealth you could accumulate, but beyond a certain level, you would only keep 8% of additional income or savings; the rest was returned to the commons via a hoarding tax. The tax structure did not eliminate the desire to hoard, but it did limit the outcome. As a result, there was much less income and wealth inequality 50-75 years ago.

Today the highest tax bracket for individuals is 37%. Corporate tax was reduced from 35% to 21% in 2018. As a result, the U.S. wealth and income inequality are now among the highest in the world. Hoarding (i.e. becoming a millionaire, billionaire) is actually revered rather than remedied.

Inexhaustible energy (aka ~~Renewable Energy~~)

Whenever possible we try to reframe/replace the term "Renewable Energy" with "Inexhaustible Energy."

There is nothing renewable about sunlight. The fusion of hydrogen to form helium releases energy – some of it is in the form of light that reaches the Earth. Granted, the Sun has enough hydrogen "fuel" to last several more billion years. From a practical human perspective, this is an inexhaustible source of energy but fusion and fission processes are not renewable energy sources.

The Sun's ongoing fusion process is one-time-only as we currently understand the Universe. When the finite supply of hydrogen has been consumed in several billion years, the Sun will transition into a red giant, expand and consume Mercury, Venus and probably the Earth before collapsing into a white dwarf.

To thrive and reproduce, living systems on Earth require an external source of energy. Our Sun provides that source of energy for several million species that have now been documented on Earth. In the language of science, the UU metaphorical "interdependent web of life" also frames the literal connection of species to the Sun, their source of existential life-sustaining energy. The web is the diverse network by which energy flows from the Sun to each member species within the web. Indigenous cultures speak of honorably harvesting resources for life – that means being present within the web of living systems without doing harm to the web by breaking a link or eliminating a node (i.e. without causing the extinction of a given species.)

The use of the frame 'inexhaustible energy' to denote solar, wind, geothermal and hydro sources of energy allows us to compare these sources with the 'finite energy' reserves of ancient hydrocarbons on our planet, Spaceship Earth. There is a high level of confidence that the sum total of these finite reserves of ancient hydrocarbons is less than 8 trillion Barrels of Oil Equivalent (BOE). Using simple math, at the rate humans are consuming these hydrocarbons, for all practical purposes they will be depleted in less than 100 years. Children being born today will live to see the end of the ancient hydrocarbons unless humans change their 'burning' behavior.

Life Cycle Cost (aka ~~Cost~~)

Too often choices are made based on a dangerous misleading comparison of 'retail costs' or 'initial costs.'

'Cost' was the single most difficult hurdle to overcome in this case study.

Frame: (Initial) Cost. Transitioning from an existing hydrocarbon burning/GHG emitting energy system to an inexhaustible/zero emissions energy system requires the acquisition of new 21st-century energy equipment. There is a significant initial/ upfront cost.

Continuing to burn ancient hydrocarbons requires little to no new equipment. There is no initial/upfront cost.

Appendix H Glossary

Using this frame, the choice is simple. Go with the zero cost option.

Frame: (Life Cycle) Cost.

The Life-Cycle Cost Analysis (LCCA) and Assessment (LCA) create a broader/more comprehensive frame.

Life-cycle cost analysis (LCCA)⁸¹ is a tool to determine the most cost-effective option among different competing alternatives to purchase, own, operate, maintain and, finally, dispose of an object or process, when each is equally appropriate to be implemented on technical grounds.

Life-cycle assessment (LCA),⁸² also known as **life-cycle analysis**, **ecobalance**, and **cradle-to-grave analysis**) is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. Designers use this process to help critique their products. LCAs can help avoid a narrow outlook on environmental concerns by:

- Compiling an inventory of relevant energy and material inputs and environmental releases;
- Evaluating the potential impacts associated with identified inputs and releases;
- Interpreting the results to help make a more informed decision.^[2]

"We estimate that the life cycle effects of coal and the waste stream generated are costing the U.S. public a third to over one-half of a trillion dollars annually.

Accounting for the damages conservatively doubles to triples the price of electricity from coal per kWh generated, making wind, solar, and other forms of non-fossil fuel power generation, along with investments in efficiency and electricity conservation methods, economically competitive."

"Life cycle analysis, examining all stages in using a resource, is central to the full cost accounting needed to guide public policy and private investment."

"This work strives to derive monetary values for these externalities so that they can be used to inform policymaking."

"Our comprehensive review finds that the best estimate for the total economically quantifiable costs,

based on a conservative weighting of many of the study findings,...to be close to **17.8¢ /kWh** ...the upper bounds of electricity generated from coal could add close to 26.89¢ /kWh....These and the more difficult to quantify externalities are borne by the general public."⁹¹

Appendix I Externalities

What are externalities?

Externalities are ignored or hidden costs.

In the energy sector, our current economic system allows utility companies to hide/ignore social costs that are so numerous it is hard to even identify and list them.

In the detailed study by Epstein et.al. cited below there are a dozen ignored social costs identified and monetized specifically for coal-generated electricity:

- Land disturbance
- Methane emissions from mines
- Carcinogens (mostly in water from waste)
- Public health burden of Appalachia communities
- Fatalities in the public due to coal transport
- Emissions of air pollutants from combustion
- Lost productivity from mercury emissions
- Excess mental retardation cases from mercury emissions
- Excess cardiovascular disease from mercury emissions
- Climate damage from combustion emissions of CO₂ and N₂O
- Climate damages from combustion emissions of black carbon

The results of this study will be discussed in more detail later.

Background

That this “energy transition project” even happened within the current social system is still somewhat a mystery.

The economic subsystem was providing indicators not to change. The economic system was influencing the congregation to continue burning ancient hydrocarbons as a source of energy to operate the church facility. The economic system was telling the congregation “You cannot afford to transition to renewable energy sources.”

Yet there is evidence to the contrary and knowledge that continuing to dump 100 tons of GHG into the atmosphere annually is not a good thing – in fact, such behavior is ecocidal. How can that be? What is real?

The “Laws” observed in the Universe (Nature) are Real. The “laws” developed by humans are real. There made be a conflict between “Real World” (Nature) and the human-created “real world” but there is no contest. Mother Nature does not compromise; does not negotiate; does not make a deal; does not lie or even try to deceive, deny or discriminate.

“Mother Nature always bats last, and she always bats 1,000,”

---Rob Watson, Environmentalist

Hypothesis: Our current economic system is Broken.

Argument: Why? The current economic system is influencing us to make certain choices.

(That is what a social system is intended to do. No problem.)

But the preferred choices according to the economic system result in ecocidal outcomes.

(That is now an existential problem. We are being influenced to make choices that put us on a path to the Sixth Mass Extinction on planet Earth – this one is anthropogenic.)

Example: Our current economic system allows many types of producers (including the oil & gas industry and 'for-profit' Utility Corporations) to ignore/externalize social costs of their products. As a result, the free market is not properly informed of the true cost /total cost of that product. Good people follow the rules and end up making bad (ecocidal) choices.

Conclusion: An economic system that puts us on a path toward extinction is a broken system.

Fixing a Broken Economic System - Identifying and Eliminating Externalities

Let us re-examine our current unsustainable economic system and try to envision what a sustainable world would look like.

In a “sustainable world, ” the human-created economic system used to influence people’s choices requires that ALL human-created “products ” identify the full and true cost of their production and their use **without externalities, because:**

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- In a “sustainable world ” the economic subsystem does not tolerate deliberate lies and deceptions such as “externalities. ” Externalities are conveniently ignored costs that are deceptively deferred to someone else (generally the public) so the “producer” can fraudulently make a larger financial profit.
- In a “sustainable world” the economic system assigns the true & total cost (private and public) to products so the free market is properly informed and thereby is able to find the most efficient option.

Background / Economic Principles

An economic system that tolerates externalities is a broken system because it distorts the market.

In 1920, economist Arthur C. Pigou⁸³ recognized that “industrialists” will always put their private interests above the public interests and attempt to **externalize** costs associated with their products to make their product appear more affordable, more profitable in the marketplace. When this occurs, Pigou suggested that the public respond (via the government) by adding a fee/tax to the product to correct for any externalities should they exist.

In brief, Pigou observed that:

- “Industrialists will seek their own private interest.”
- “When the social interest diverges from the private interest, the industrialist has no incentive to internalize the social cost”
- As a result, there are “**incidental uncharged disservices**” embedded in the free-market system (using Pigou’s terminology)
- Today’s economists call these disservices “**externalities**”
- Pigou recommended a tax on the ‘offending product’ to adjust the market and bring the economy back to a healthy equilibrium.

A Pigovian correction can be justified if it accurately represents the actual (Real World) cost of the “incidental uncharged disservice.” For example, a Pigovian correction for the energy sector would cover costs of reparation for any damage caused by the extraction/burning of ancient hydrocarbons.

A ‘carbon burning fee ’ has been suggested by economists as a means of internalizing the externalities in the ‘ancient hydrocarbon’ burning industry. This is often referred to as “putting a price on carbon.”

Legislation has been proposed several times in different forms to the U.S. Congress. The Citizens Climate Lobby (CCL) continues to be an advocate for a market-based Carbon Fee/Dividend program for the past decade. In its current form, it is a market-based, revenue-neutral carbon fee program. It is intended to be a Pigovian correction for our broken energy-related economic system and pay to repair the damage caused by the CO₂ that is produced and dumped into our global atmosphere that in turn is contributing to climate change.

N. Gregory Mankiw, professor of economics at Harvard and former Chair of the Council of Economic Advisors to President George W. Bush addresses the externalities of the fossil fuel industry and asks:

“...how do we, as a society, ensure that we all make the right decisions, taking into account both the personal impact of our actions and the externalities ?”⁸⁴

Mankiw suggests there are three approaches:

- 1) “One approach is to appeal to individuals’ sense of social responsibilityUnrealistic.”
- 2) “Use government regulation to change the decisions that people make... huge bureaucratic nightmare.”
- 3) “**Internalize the externality**” by charging a fee (commensurate of the disservice) for burning carbon, - effectively putting a price on carbon “that fee would be built into the prices of products and lifestyles... people would naturally look at the prices they face and, in effect, take into account the global impact of their choices.” (a **Market-Based** correction)

According to Mankiw, “I am confident that the economics profession has it right. The hard part is persuading the public and the politicians.”

Pigovian Correction – Putting a Price on Carbon - Market-Based Approach

A market-based solution is favored by a number of conservatives:

Art Laffer, Reagan’s economic advisor

Greg Mankiw, advisor to George W. Bush and Mitt Romney

George Shultz, Secretary of State under Reagan

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These conservatives embrace a revenue-neutral carbon burning-fee because the approach asks the fossil fuel sector to be responsible for their externalities. It corrects the distortion in the free market that currently gives carbon-based energy an edge over alternative technology by ignoring the real costs of using their product.

Once this correction is in place, the market will be influenced to move away from fossil fuels and towards other sources of energy, (and conveniently reduce greenhouse gas emissions in the process.)

Returning the carbon-burning fee revenue to households will enable Americans to make this transition without economic pain. A market-based approach is preferable to having government agencies impose more EPA regulations on burning ancient hydrocarbons.

According to Mankiw, “Among economists, the issue is largely a no-brainer.” In December 2011, the IGM Forum⁸⁵ asked a panel of 41 prominent economists about this statement: “A tax on the carbon content of fuels would be a less expensive way to reduce carbon-dioxide emissions than would a collection of policies such as ‘corporate average fuel economy’ requirements for automobiles.” Ninety percent of the panelists agreed.

Although this idea of a Pigovian Correction has not yet seen very much light in the U.S., it has taken the form of a carbon tax and has already been initiated in a number of other countries including Australia and Canada.

Over a dozen countries have successfully initiated a Carbon fee/ tax – including Canada. Using a carbon tax, British Columbia reduced their dependence on fossil fuels by 18% in the past 4 years – with no ill effect on their economy.

Proposed Solution. Greg Mankiw, the conservative economist, initiated the Pigou Club, an “elite group of economists and pundits” in favor of a Pigouvian tax on emissions from burning carbon. The Club now has over 50 members. **Citizens Climate Lobby (CCL)**⁸⁶, a grassroots organization is also advocating legislation to initiate a market-based revenue-neutral carbon fee-dividend program.

The carbon fee program would be market-based rather than regulation-based. The program would be

revenue-neutral so all revenue is equally distributed as a dividend to all taxpayers. This prevents any growth in government. An average carbon user breaks even at the end of the year. People who insist on driving a gas guzzling vehicle can still do so. They will just pay more in carbon fees at the gas pump than they receive back in their dividend check at the end of the year.

Basis for a Price on Carbon – Reparation & Replacement.

The major elements of a Pigovian correction would be to add the **Reparation Costs and the Replacement Costs** to all ancient hydrocarbons that henceforth are extracted from Earth for the purpose of burning.

Pigovian Correction = Reparation Costs + Replacement Costs

Let us examine each of these cost categories in more detail.

Reparation Costs.

Although it is possible to identify at least four subcategories for Reparation Costs (Extraction, Transport, Refinement, and Burning) in the life cycle of these products that result in pollution/emissions, we will examine only one here for illustration purposes. Let us focus on externalities associated with the **Burning** process.

In a “sustainable” world, products are produced, services are rendered, systems are created, with little or no violence to the interdependent network of Life. So Reparation Costs are minimal to none.

However, In the case of burning ancient hydrocarbons (and other refined products), there are significant Reparation Costs.

When a barrel of oil is burned, it produces about 0.43 metric tonnes of CO₂.⁸⁷ To sequester the CO₂ from a coal-fired electrical generating plant requires between \$50/ton of CO₂ for a gas-fired plant to \$168/ton of CO₂ for a coal-fired plant.⁸⁸ We will use \$100/ton of CO₂ for this example.

With these ground rules and assumptions, the calculated “Reparation Cost” (i.e. to “repair” the damage to the atmosphere) for burning a barrel of oil, would then be about **\$43/barrel**.

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As responsible adults, when we realize we are doing harm (and have done harm in the past since the beginning of the Industrial Revolution) by continuing to burn ancient hydrocarbons, we would stop that behavior and make amends. This is where faith-based communities have a distinct advantage.

Replacement Costs

Ancient hydrocarbons are a finite, one-time-only resource. When these resources are burned/consumed, they are no longer available to future generations. As a result, in a sustainable world, the extractor would be required to add the replacement cost (for a like kind and amount of energy) of this item to the price of the product before it gets to the market.

How does one arrive at a replacement cost for a barrel of petroleum? A ton of coal? A cubic foot of natural gas? By using the current cost to harvest an equivalent amount of energy from inexhaustible sources such as solar, wind, hydro, etc.

For this simple example, the replacement cost of one barrel of oil will be estimated by using the cost to harvest an equivalent amount of energy generated with a simple rooftop solar photovoltaic system

- Assume a barrel of Crude Oil contains about 5,800,000 BTU (1700 kWh)⁸⁹
- Assume that the cost of harvesting sunlight using solar PV modules to make electrical power is \$0.11/kWh.⁹⁰

Today's utility-scale solar PV plants and wind farms have brought the cost down to \$0.05 to \$0.06/kWh

With these ground rules and assumptions, the calculated "Replacement Cost" for extracting/burning one barrel of oil would be around **\$80-\$100/barrel**.

In summary, to fix our current economic system by using a Pigovian Correction that internalizes just two of the several known externalities associated with the extraction/burning of oil, a carbon burning fee of at least **\$120-140/barrel** would be paid into the carbon escrow fund. The payment is due when that barrel of oil is extracted from the well or crosses the U.S. border, by pipeline, tanker truck, rail, or ship.

This carbon-burning fee would be added to the direct costs of extracting/transporting a barrel of oil – currently around \$75-\$100/barrel. At the end of the year, all funds in the carbon burning fee escrow fund

would be redistributed evenly to all taxpayers/households.

So in a sustainable world, the price of oil – including the carbon burning fee correction, would be at least \$195 - \$240/ barrel. This is over three times its deceptively low market price today.

Remember, we can currently generate the same amount of energy in a barrel of oil by using solar PV for about \$80-\$100/barrel (with no subsidies and no pollution and no replacement cost because the Sun is an inexhaustible source of energy). The cost is a bit less if we use wind turbines to generate this same amount of energy.

Now that the marketplace reflects the true cost of burning oil (externalities have internalized thanks to the imposition of a carbon-burning fee,) what will a buyer in the free market choose?

- Option U (for Unsustainable) burns ancient hydrocarbon (oil) and costs \$310-\$335/barrel.
- Options S (for Sustainable) uses solar PV to generate the same amount of energy but costs only \$80-\$100?

A financially responsible person would obviously choose the renewable energy option if just one of the broken features of our current economic system is fixed.

This is our choice. We can continue to steal Earth's finite resources from our children and future generations with no intention of replacing these resources. We can continue to do harm to our interdependent web/network of life and make our planet less habitable for future generations. OR we can pay our own way through life and practice sustainable living. Attempting to identify, monetize & internalize "externalities" is a good place to start. Then we can see clearly what the sustainable choices really are.

Continuing to burn one-time-only ancient hydrocarbons to generate thermal energy has two major unsustainable ramifications:

- 1) The combustion products are doing harm to all Life on the Planet
- 2) The continued consumption of these ancient hydrocarbons is depleting the finite reserves - and we are not replacing this stored energy for future generations.

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Currently, 93% of the energy used to operate the church is withdrawn from the Earth's finite energy account in the form of dwindling reserves of ancient hydrocarbons. In effect, for the past century, humans have been digging, scraping, drilling, blasting, fracking, extracting ancient hydrocarbons from the depths of our planet. We have reverted to suckling infants feeding off our Mother Earth. When instead we could look around and see there are over 2 million other living species who have learned to thrive as an integral part of an energy network that traces back to Sun. We too can begin to mimic our living cousins and live as responsible adults honorably, sustainably harvesting the energy we need for the lifestyle we prefer.

It is time to make amends and either replace the one-time-use energy (make deposits into the Earth's energy account) or at least pay the Replacement Cost to future generations.

Internalizing externalities is a good place to start in bringing the human-created "real world" into harmony with Nature's Real World.

Excerpts from "Full cost accounting for the life cycle of coal"

Studies are emerging, such as "**Full cost accounting for the life cycle of coal**" by Paul R. Epstein, et.al.⁹¹ that begin to estimate the monetary cost to repair the damage our fossil fuel (e.g. coal) burning behavior is causing. We refer to this as the **Reparation Cost**. Because over 50% of the electrical power used at First Universalist is generated by burning coal, the Epstein study can help estimate the monetary cost of the harm we at First Universalist are currently doing.

"We estimate that the life cycle effects of coal and the waste stream generated are costing the U.S. public a third to over one-half of a trillion dollars annually. **Accounting for the damages conservatively doubles to triples the price of electricity from coal per kWh generated**, making wind, solar, and other forms of non-fossil fuel power generation, along with investments in efficiency and electricity conservation methods, economically competitive."

"Life cycle analysis, examining all stages in using a resource, is central to the full cost accounting needed to guide public policy and private investment."

"In order to rigorously examine these different damage endpoints, we examined the many stages in the life cycle of coal, using a framework of environmental externalities, or "hidden costs." Externalities occur when the activity of one agent affects the well-being of another agent outside of any type of market mechanism—these are often not taken into account in decision making and when they are not accounted for, they can distort the decision-making process and reduce the welfare of society.

This work strives to derive monetary values for these externalities so that they can be used to inform policymaking."

"Our comprehensive review finds that the best estimate for the total economically quantifiable costs, based on a conservative weighting of many of the study findings,...to be close to **17.8¢ /kWh** ...the upper bounds of electricity generated from coal could add close to 26.89¢ /kWh...These and the more difficult to quantify externalities are borne by the general public."

Social Costs of Burning Fossil Fuels (Externalities)

The largest single source of GHG emissions is linked to burning ancient hydrocarbons for generating electrical power.

It has been known for some time that coal-fired power generating plants have hidden/ignored costs referred to as externalities that are not included in the true cost of coal-generated electricity.

Each stage in the life cycle of coal (extraction, transport, processing, and combustion) generates a waste stream and carries multiple hazards for health and the environment.

A detailed study by Epstein et.al.⁹¹ (Harvard Medical Center) identified and monetized a dozen ignored costs linked specifically to coal-generated electricity:

- Climate damage from combustion emissions of CO₂ and N₂O
- Climate damages from combustion emissions of black carbon
- Carcinogens (mostly to water from waste)
- Public health burden of communities in Appalachia
- Fatalities in the public due to coal transport

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- Emissions of air pollutants from combustion – nanoparticles
- Lost productivity from mercury emissions
- Excess mental retardation cases from mercury emissions
- Excess cardiovascular disease from mercury emissions
- Land disturbance
- Methane emissions from mines

The Harvard study group then proceeded to monetize these ignored costs/ externalities. They found that the life cycle effects of burning coal cost the U.S. society \$300B to \$500B annually.

They concluded that the true cost of coal-generated electric should be increased from the current \$0.11/kWh to around \$0.33 kWh (a three-fold increase) to account for the known damage it causes society. Internalizing ignored costs is considered a Pigovian correction.⁹²

Quotes from the Epstein Study:

- These costs are external to the coal industry and are thus considered “externalities.”
- The life cycle effects of coal and the waste stream generated cost the U.S. public \$300 B - \$500 B annually.
- Accounting for the damages doubles (2 x) to triples (3 x) the price of electricity from coal per kWh generated.
- (e.g. electricity goes from \$0.11/kWh to \$0.33/kWh)
- Fix economic system by imposing a carbon burning fee/tax commensurate to the monetized harm the energy source causes.
- We know that 1 lb of coal produces 1 kWh of electrical energy and 2.86 lbs of CO₂. Assessing a carbon fee of \$170/tonne of CO₂ would cause the price of electricity to increase from \$0.11/kWh to \$0.33/kWh
- Wind, solar, and other forms of non-fossil fuel power generation, along with investments in efficiency and electricity conservation methods, are then economically competitive.

A National Response is required to fix our broken Economic Social System and eliminate “externalities” (ignored costs) in the fossil fuel burning industry.

Appendix J Questions and Responses (Nov 2015)

ETHICAL / MORAL / SPIRITUAL ISSUES

Has the UUA Documented a Position on Sustainable Energy Issues?

Response: Yes. The Unitarian Universalist Association (UUA) “Purposes and Principles” express a fundamental concern and respect for all Life. For example, their living tradition draws on many sources including direct experience of that transcending mystery and wonder... which moves one to a renewal of spirit and an openness to forces that create and uphold life. These eclectic sources of spiritual wisdom include all established world religions as well as the spiritual teachings of the Earth-centered traditions known to celebrate the sacred circle of life and instruct one to live in harmony with the rhythms of nature. More specifically the UU Seventh Principle encourages “Respect for the interdependent web of all existence of which we are a part.” But most if not all of the religious community has their own version of ‘creation care.’

Among its many ministries, the UUA sponsors the efforts of the UU Ministry for Earth (UUMFE). In addition to providing support and resources, the UUMFE periodically takes the pulse of the larger UU community to determine their position on environmental issues such as climate change/global warming/sustainable living. Within the past decade there have been at least three such “resolutions” pertaining to climate change that were agreed upon by the several thousand delegates attending the annual General Assemblies (GA) of the UUA:

1. THREAT OF GLOBAL WARMING/CLIMATE CHANGE, GA 2006 Statement of Conscience, <http://www.uua.org/statements/threat-global-warmingclimate-change>
2. FOSSIL FUEL DIVESTMENT, GA 2014 Business Resolution, <http://www.uua.org/statements/fossil-fuel-divestment>
3. ACT FOR A LIVABLE CLIMATE, Support a Strong, Compassionate Global Climate Agreement, GA 2015 Resolution,

<http://www.uua.org/statements/support-strong-compassionate-global-climate-agreement-2015-act-livable-climate>

Was the Church Doing Harm?

Response: Unequivocally Yes. The church was doing harm in the past when it was purchasing electricity generated by burning ancient hydrocarbons and it was heating the building by burning natural gas – harm that can be avoided with a sustainable energy system.

Green House Gas Emissions. Invisible to the human eye, but visible to infrared sensors (and probably some other living species), the church was dumping a steady stream of waste materials into the atmosphere that subsequently endangers the well-being of future generations. By using different lenses, Figure 62 illustrates what the church would look like after spending \$4M to remodel (including new windows and additional insulation) without changing the old energy system.

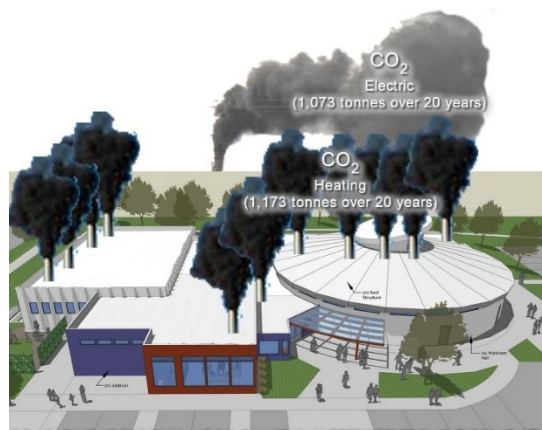


Figure 62 First Universalist's 2016 Contribution to Climate Change

When someone flipped on any switch in the church to provide light (incandescent, fluorescent, or LED) or power on our office equipment, a plume of combustion products emerged from an Xcel power generating plant off somewhere off in the distance. In the background, Xcel Energy was burning fossil fuel to generate the electrical power used by the church.

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As indicated in Figure 63, in 2015 Xcel generated nearly 80% of our electrical power by burning ancient hydrocarbons (Coal & Natural Gas).

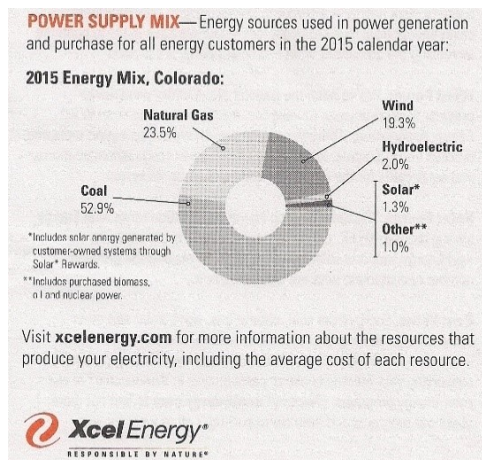


Figure 63 Xcel 2015 Energy Mix

Nearly two (2) pounds of CO₂ are dumped into the atmosphere for every 1 kWh of electrical energy sold by Xcel. Based on last year's electric usage of 72,040 kWh (for air conditioning, lighting, office equipment, sound system, etc.), the church was responsible for dumping 53 metric tonnes of CO₂ into the atmosphere each year.

In addition, in past years the church purchased 5196 therms (equivalent to 152,243 kWh) of natural gas that was burned in the 10 gas furnaces to heat the church. The 10 gas furnaces dumped an additional 58 metric tonnes of CO₂ into the atmosphere each year as depicted in the foreground of Figure 62. Total emissions were over 100 metric tonnes of CO₂ per year.

As a result, the church would dump a total of 2,243 tonnes of CO₂ into the atmosphere over the next 20 years and contribute directly to global warming and climate change.

Water Consumption associated with fossil fuel electric. According to the National Renewable Energy Lab (NREL) in Golden, generating 1 kWh of energy using a fossil fuel-fired plant consumes 2 gallons of (fresh) water. Over the next 20 years, the church would be responsible for the consumption of 2,881,600 gallons of precious western water related to the use of fossil fuel to generate its electrical power.

How Has the Church Worked to Stop/Mitigate the Harm?

Response: As a part of its Social Justice Ministry, First Universalist Church Denver was actively involved in environmental issues through its Green First Task Force.

For example, during 2015, initiatives focused on mitigating further climate change are listed below:

Sunday Program Committee: Green_{6,7}, 5 July 2015

Social Justice: Green First Task Force, Green₂, Chair

Science Discussion Group – Green₆

National Ice Core Presentation & Lab Tour, Federal Center, Denver

Class on Climate Change, Life Long Learning Academy – 8 weeks

Responding to Climate Change - BFF

Community Forums, Climate Reality Project, Paddy McClelland

Panel Discussion, Earth Day 2015: Kat; Green_{1,4,5}; Alec

“Living Our Values” Trifold Pamphlets, Green_{1,2,3,4,5,6}

Workshops:

Responding to Climate Change: A Personal Planning Workshop, Green_{1,5,9} August 2015

Resilient Investor Workshop, Green₁, 5 Nov 2015

Many of the environmental efforts during 2016 and 2017 were focused on assisting the BFF Committee with the detail design and installation of a new sustainable energy system. The system consists of a 57kW solar PV system and a ground source geothermal heating and cooling system. Both systems have zero carbon emissions allowing the congregation to operate the church facility in the future without doing further harm to the planet.

SUSTAINABLE ENERGY ISSUES

What were the Energy Needs of First Universalist?

The energy usage was in the form of electrical energy and thermal energy derived by burning natural gas, all purchased from the Xcel Energy Corporation.

Over a recent 12 month period (8/29/14 - 7/30/15) the energy usage/bill was the following:

Table 6 First Universalist Energy Usage for 2015

Energy Form	Annual Usage (BTU)	Annual Usage (kWh)	Direct Costs
Electric	2.46 x 10 ⁸ BTU ¹	72,040 kWh ³	\$12,795
Natural Gas	5196 Therms ² 5.196 x 10 ⁸ BTU	152,243 kWh	\$3,830
TOTALS	7.66 x 10 ⁸ BTU	224,283 kWh	\$16,625

- 1) 1 BTU = .000293 kWh
- 2) 1 Therm = 10⁵ BTUs
- 3) 1 kWh = 1 kilowatt-hour = ten(10) one hundred (100) watt light bulbs burning for one hour

As shown in the chart above, 2/3 of the energy used by First Universalist was derived from burning natural gas for thermal energy to heat the facility. 1/3 of the energy consumed was in the form of electrical power used for lighting, office equipment, sound system, computers, air conditioning, etc.

How much of First Universalist Energy was Generated Sustainably?

According to the information available on the Xcel web site, see Figure 64, 78 % of the electrical power bought from Xcel Energy was generated unsustainably by burning ancient hydrocarbons.

Only 21.8 % was generated by wind, hydroelectric and solar.

POWER SUPPLY MIX—Energy sources used in power generation and purchase for all energy customers in the 2014 calendar year:

2014 Energy Mix, PSCO:

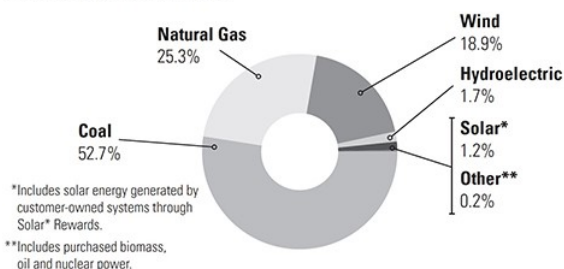


Figure 64 Xcel 2014 Energy Mix

As a result, less than 7% of the energy First Universalist used to operate was derived from

sustainable sources. Values & principles demanded a change – it was about the children and their children.

We can do better.



A New Energy Awareness

What is the Vision for a Sustainable Energy Generation System for First Universalist?

The “Energy System” envisioned for the BFF remodeling project consists of Energy Conservation and Energy Generation. Energy Conservation is discussed in more detail through architectural design. The use of additional insulation throughout the building, the use of natural lighting, zone heating, repurposed materials, LED lighting, etc. all reduce the amount of physical energy required to operate the new facility.

Our focus in this document is on the Energy Generation System – our sources of energy used to operate the facility. A sustainable “Energy Generation System” for First Universalist is envisioned as two major elements:

- 1) Solar Photovoltaic Modules (panels) that honorably harvest solar energy from the Sun and transform sunlight into electrical power. This will replace the current power we buy from Xcel that is generated by burning coal and natural gas.
- 2) Geothermal/Geoexchange Heat Pumps that honorably harvest/exchange (free) thermal energy with the Earth to provide heating and cooling to replace the natural gas we currently burn to heat our building.

Can We Find Alternative Sources of Energy That Are Sustainable?

There are a number of sustainable alternative energy systems available today that can replace our current fossil fuel system and stop doing harm to the interdependent web of life. These alternative sources of energy provide clean energy with no consumption of water.

These alternative energy sources have zero GHG emissions and are inexhaustible – namely Solar and Geothermal Energy. We can honorably harvest these

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sources of energy and do little-to-no harm to our interdependent web of life and do no harm to future generations.

Harvesting Solar Energy to Generate Electrical Power.

By adding solar PV to the flat portion of the church roof, we can sustainably generate our own electrical power. With a Solar PV system, 32% of the church’s energy needs will be generated sustainably as illustrated in Figure 65.

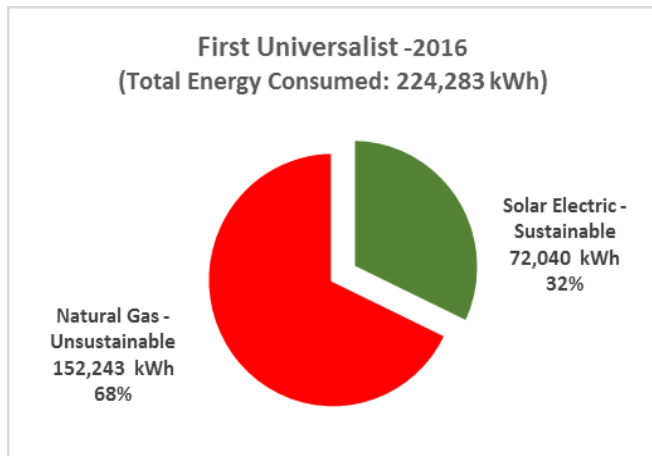


Figure 65 Solar PV Provides 32% of the Church’s Energy Needs Sustainably

As a result, of adding a solar PV system, we will eliminate the 1,073 tonnes of CO₂ emissions shown in Figure 62. A Solar PV system reduces our GHG emissions by 48%. We will also avoid consuming 2,881,600 gallons of Colorado water.

However, as depicted in Figure 66, the church will still be emitting 1,173 tonnes of CO₂ from its gas furnace exhaust flues as a result of continuing to burn natural gas for heating purposes over the next 20 years.



Figure 66 First Universalist’s Contribution to Climate Change after Adding Solar PV

Exchanging Thermal Energy with Earth for Heating and Cooling.

Fortunately, there are clean, sustainable ways to provide heating and cooling for the church using today’s commercial off-the-shelf technology.

Exchanging thermal energy with the Earth (Geothermal Energy) is our preferred sustainable approach for heating and cooling the church. See Figure 67.

Although we could add more solar modules and heat the church with electric furnaces, a more efficient and cost-effective approach is to transition to a geothermal/geoexchange (ground source) heating and cooling system.

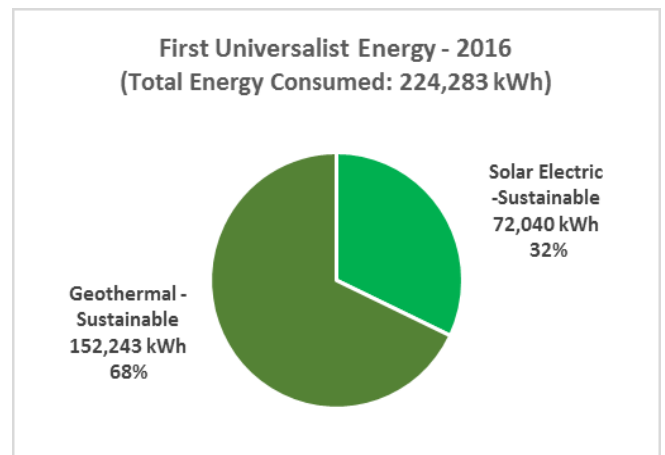


Figure 67 Solar PV and Geothermal Provide a 100% Sustainable Energy System

In this case, our natural gas furnaces and external A/C units would be replaced with geothermal heat pump furnaces that provide both heating and cooling –

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sustainably. One unit of energy (solar electric) is used to drive the heat pump compressor that in turn will exchange 4-5 units of free energy (thermal energy) between the building and the Earth.



Figure 68 Using Solar and Geothermal Energy, Our Church Can Transition to Zero Carbon Emissions.

Thermal energy will be extracted from the Earth during the winter to heat the church. Excess heat from the building will be stored in the Earth during the summer to cool the building.

As illustrated in Figure 68, a ground source geothermal heating and cooling system requires a ground loop heat exchange system underground.

What are the Opportunities here?

“... do everything in our power to bring about a swift transition from fossil fuels to a sustainable energy economy...”

... GA 2014 Business Resolution. FOSSIL FUEL DIVESTMENT,
<http://www.uua.org/statements/fossil-fuel-divestment>

“Building for the Future” is a great opportunity in our church’s history to transform our building into a facility that truly reflects our UU values by transitioning away from unsustainable burning of fossil fuel.

The size of the property owned by First Universalist is more than adequate to harvest enough solar energy from the Sun to generate all our electrical power. The land owned by First Universalist is more than enough needed to exchange enough thermal

energy with the Earth for all our heating and cooling energy needs.

First Universalist has an opportunity to end its unsustainable behavior of importing energy and instead honorably harvest inexhaustible energy that is already onsite (solar energy & ground source thermal energy)

What are the Obstacles?

As a non-profit organization, we are unable to benefit from tax credits provided to homeowners and for-profit businesses. Other obstacles are of course those that are self-imposed based on our internal First Universalist economic arguments; we will re-examine these financial obstacles. Other obstacles include obsolete paradigms and ways of thinking. We will re-examine these old “frames” that influence how we think about energy.

Has the ‘Building For the Future’ (BFF) Committee Documented an Energy Plan for the First Universalist Remodeling Project?

Yes. A flyer entitled, “**Planning Framework for Energy Sustainability**” provides background motivation citing our vision statement for a Green Building. Excerpts from two UUA General Assembly resolutions in 2014 reminding us that “we have a moral responsibility to do everything in our power to bring about a swift transition from fossil fuels to sustainable energy” and in 2015 a GA resolution calling on us to “unify and provide ethical and moral leadership for climate action.”

The BFF flyer goes on to document proposed building design goals including Conservation; Harvesting Solar Energy; Replacing our natural gas heating and cooling system with a Geothermal/GeoExchange system; and other green design features.

The following Questions & Answers are intended to add more specific information related to current energy usage and the proposed energy system we envision for the future.

1. BFF Flyer (Available from the BFF Committee)

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2. GA 2014 Business Resolution. FOSSIL FUEL DIVESTMENT, <http://www.uua.org/statements/fossil-fuel-divestment>

3. GA 2015 Resolution, ACT FOR A LIVABLE CLIMATE, Support a Strong, Compassionate Global Climate Agreement, http://uusi.net/wp/wp-content/uploads/2009/07/AIW_2015-global-April-V4.pdf

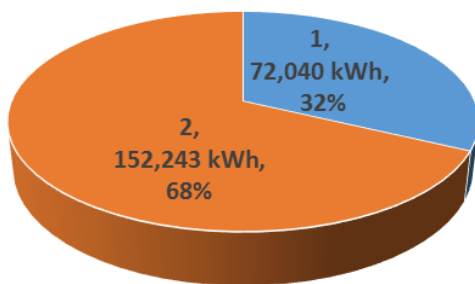
Benefits of a Sustainable Energy System.

Once the total sustainable energy system is installed, the church no longer needs to buy electricity or natural gas from Xcel Energy for its energy needs. We can be energy self-sufficient with zero emissions as illustrated in Figure 6. After the new equipment has been installed, the monthly/annual Xcel energy-related utility bills essentially go to zero. There will still be a small monthly Xcel “service charge” to remain connected to the electrical grid for energy storage purposes.

Operating a Sustainable Energy System

The solar PV system is sized to harvest enough solar energy to generate excess power during the day and during the summer months of the year. This excess energy is stored as an energy credit with the utility company under the net metering approach. So in the evening and during the shorter winter days, we withdraw some of those energy credits to operate our church. Assuming the system is adequately sized, there will be no need to purchase any electrical power from Xcel on an annual basis. The natural gas line can be capped off.

Annual Energy Usage - Current
(Expressed as kWh)



If We Do Nothing Different Now, What Will the Energy Picture Look Like in 20 years?

If First Universalist continues to do the same thing they are doing today and expect Xcel Energy to change, what does this energy picture look like in 20 years? As described elsewhere, the architectural design team incorporated “Green” features into the BFF project such as using building materials that are sustainable and design principles that conserve energy and utilize natural sunlight. As a result, the design team believes, based on the conceptual design and preliminary assessments, that the new facility, although larger, will consume less energy than before – possibly 30%-40% less.

What does the future look like?

By 2035 the Colorado Renewable Energy Standard (RES) requires Xcel to generate 40% of its electrical power from the renewable energy source, so First Universalist will automatically be 13% sustainable in 20 years.

If we continue buying electrical power and natural gas from Xcel Energy, our 7% sustainable rating will increase to 13% sustainable in 20 years.

Fortunately, we can create a much better future.

We have already incorporated enough “green” features into the BFF plans. We don’t need a new energy system.

Many “green” features have been incorporated into the new plans – LEDs, natural lighting, carpet tiles that can be easily replaced, more insulation, a “Living Wall” around the church, a glass walkway for natural lighting for the lower level, and we plan on leasing our roof to a third party to offset 90% of electrical usage, etc.

Reducing the amount of energy consumed is normally considered a good thing – particularly when the energy is being generated unsustainably by burning fossil fuel. But we must be careful not to let “conservation” become a displacement issue. Consuming less fossil fuel is a good thing, but the end result is still consuming fossil fuel.

The real issue in front of us today is the transition away from burning any fossil fuel. The proposed 100% sustainable energy generation system will do just that

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– and be less expensive over a 20 year period than continuing to burn fossil fuel.

We do need to invest in new equipment that allows us to be sustainable energy farmers/harvesters. Our current implements are not designed to do that. We need to invest in new equipment for a 100% sustainable energy system.

What does a Sustainable Energy System for First Universalist Look Like and Cost?”

Fortunately, there are viable alternatives to the unsustainable fossil fuel energy system we currently have and use. Let’s examine what sustainable energy looks like and costs.

The architectural team envisions an energy system that harvests sustainable energy from the Sun to generate electrical power and harvests/exchanges sustainable thermal energy from the Earth for heating & cooling. No burning is required. There will be zero emissions.

Conceptual Design. The design team envisions solar photovoltaic modules on the flat roof of the new complex and possibly on the new south facing a wall of the church and possible some solar canopies in the East parking lot – along Hampden. This additional equipment would be able to generate all of our electrical energy needs. To exchange thermal energy for heating and cooling with the Earth, we would install a heat exchange ground loop under approximately ½ of the North parking lot. It would not be visible. Black plastic tubing would be placed underground to circulate water to transport thermal energy between the Earth and the newly remodeled building.

In effect, we would be using biomimicry to transform our facility into a “tree.” Just as a tree’s leaves look at the Sun and capture/harvest sunlight essential for the growth and sustenance of the tree, our solar collectors on the roof will look to the Sun and harvest the energy we need to operate our facility for our mission. Just as a tree grows tap roots to extract water and minerals with Earth to sustain itself, a ground loop will serve as our root system allowing us to exchange thermal energy with Earth (no water or minerals are required).

Existing “roots” leading back to the Denver Water Department’s grid will remain as is for our water needs, but the natural gas line can

eventually be capped off as we complete this transition away from burning natural gas.

Power lines will remain intact even though we will be generating all the power we need on an annual basis. Staying connected to the electrical grid allows us to use the utility company as our energy bank. We will harvest more energy than we can use during the day (and during the summer) and deposit the excess in the grid (energy bank). At night (and in the winter) we will withdraw our energy from the grid (energy bank).

SUSTAINABLE ENERGY SYSTEM CONCEPT		
First Universalist Energy Costs – 20 Year Forecast		
(Including Maintenance)		
Function	Equipment/Item	Preliminary Cost Estimate (20 year period)
Electrical Power		
Power (Solar PV) Flat Roof	138 modules @ \$3.50/W (44 kW)	\$154,560
Power (Solar PV) South Wall	32 modules @ \$3.50/W (10 kW)	\$35,840
Heating & Cooling		
Thermal Energy	Ground Loop (20 bores)	\$90,000
	Geothermal Heat Pumps (10-4 Ton)	\$150,000
	SUBTOTAL	\$430,400
	Maintenance (\$1250/Year)	\$25,000
	Reparation Costs	0
	Replacement Costs	0
	Water Consumption	0
	GHG Emissions	0
	Monthly Utility Bill	~ \$200/month (Grid Connection)

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		/Demand Charge)
	TOTAL	\$455,427

Concept

- 138 modules on flat roof
- 32 modules on the South Wall
- 10 Geothermal Heat Pump Furnaces
- Complete Ground Loop

Is it Practical to Transition to 100% Renewable Energy?

During a meeting between First Universalist BFF Committee members and Barrett Architects and their energy consultants, a BFF committee member asked an energy consultant, "Is it practical to get to 100% Renewable Energy?" There was a long pause and the consultant responded, "It is certainly possible and in your case here at First Universalist it is definitely feasible. But it probably depends on how you define 'practical,' because 'practical' is related to your values. And I don't know what your values are."

The consultant continued. Are you asking, "Is there is a payback to investing in renewable energy?" He explained that with the current (temporary) low cost of natural gas, the payback for the geothermal investment was probably going to be 10-15 years, whereas the payback on a solar system will be less than that. But there is a payback period. The investment in geothermal & solar actually pays for itself. [Note: we provide a financial assessment that supports this claim.]

The consultants pointed out that the geothermal heat pump system has a much longer service life than natural gas furnaces. The portion of the geothermal system that is buried in the ground (i.e. the ground loop) has a design life of 50+ years (and estimated service life of 200 years). The portion of the system that is housed in the various mechanical rooms in place of the current gas furnaces is typically warranted for 20 years. Heat pump furnaces include the heat pump compressor that is typically warranted for 20-25 years; whereas the typical service life of gas furnaces might be closer to 12 years before they need to be replaced. The consultants indicated that if we are building for the future, it's likely we will replace our gas furnaces twice

before we replace your GeoExchange heat pumps once.

The term 'practical' is often used to mean: 1) guided by practical experience and observation rather than theory or 2) concerned with actual use or practice. See: **Who Else Uses Geothermal Heat Pumps that I Might Know?**

Why Use a GeoThermal Heat Pump Furnace?

Q: Why geothermal? Aren't there other ways to heat and cool the church?

A: Yes, there are many sustainable options available today for heating and cooling buildings. A tour of NREL in Golden, Colorado introduces the visitor to dozens of technologies being explored – some more mature than others. Because our roof area is limited, it is not cost effective to harvest sunlight just to convert it into low-grade thermal energy. We can get thermal energy from the Earth instead of using ground source heat pumps power by solar-generated electricity. Air-based heat pumps are not able to provide efficient heating in the winter when the air temperature drops below 30 degrees. So for our region, ground source geothermal is a preferred approach and provides both heating and cooling.

Geothermal (ground source) heat pump furnaces are being suggested as a replacement for our unsustainable fossil fuel (natural gas) furnaces because the fundamental technology is low risk, and has been around as long as the first refrigerator was developed 100 years ago. In addition, the U.S. Department of Energy has this to say:

"GeoThermal/GeoExchange (ground source) heat pumps are among the most efficient and comfortable heating and cooling technologies available today because they use the Earth's natural heat to provide heating, cooling, and hot water."¹

No fossil fuel is required. There are zero emissions. Water is used as a heat transfer fluid, but recycled constantly in a closed loop and not consumed.

A Geothermal Heat Pump does not contribute to global warming/climate change.

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Exchanging thermal energy with the Earth is a sustainable, environmentally sound and financially prudent method of heating and cooling our buildings.

Indigenous People would describe a GeoExchange Heat Pump system powered by solar electric as a method that can **Honorably Harvest**² energy from the Earth using the energy provided by the Sun.

1. Energy 101: Geothermal Heat Pumps
http://www.eere.energy.gov/multimedia/video_geothermal_heat_pumps.html
2. "Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants," **The Honorable Harvest**, by Robin Wall Kimmerer, Aug 11, 2015. Pg 175.

What is a GeoThermal Heat Pump Furnace?

GeoThermal heat pumps are also known as ground source, GeoExchange, earth-coupled, or earth energy heat pumps.

For a given heating/cooling rating, the geothermal heat pump furnace is about the same size as the natural gas furnace. This is convenient because it is easy to transition from fossil fuel to geothermal easily – the gas furnace is pulled out and the geothermal heat pump is moved into the same space.

A geothermal heating-cooling system consists of two basic subsystems – a ground loop and a heat pump furnace.

The ground loop for a typical 4 Ton rated heating/cooling system consists of two (2) 4"- 5" inch diameter boreholes about 300 feet deep. Black plastic tubing in the shape of a 300 foot long "U-shaped" tube is inserted into each borehole. Water can then be circulated through the tubing for heat transfer purposes. There is no water consumption because it is a closed loop system. The water is simply used to transport the thermal energy between the building and the Earth.

The GeoExchange heat pump is similar in size to a typical natural gas furnace. Approximately ½ of the unit is used to enclose the forced air blower. In a natural gas furnace, the firebox/heat exchanger is housed in the other ½ of the furnace. For the geothermal heat pump, the heat pump compressor/heat exchanger replaces the firebox/heat

exchanger. There is no burning involved in a heat pump, thus there are no GHG emissions.

How Does a Geothermal Heat Pump Work

A geothermal heat pump uses the same technology and thermodynamic principles as your refrigerator; this 'technology' has been around for over 100 years.

Using a heat exchanger, a geothermal heat pump can move heat (thermal energy) from one space to another. In summer, the geothermal heat pump extracts excess heat from a building and transfers it to the ground for cooling. In winter, the geothermal heat pump takes natural heat from the ground and transfers it to the building for heating.

Installing a geothermal heat pump system can be the most cost-effective and energy-efficient building heating and cooling option. Geothermal heat pumps are a particularly good option if you are planning a major renovation to an existing building that still consumes fossil fuel.

While many parts of the country experience seasonal temperature extremes – from scorching heat in the summer to sub-zero cold in the winter, a few feet below the earth's surface the ground remains a relatively constant temperature. In the Denver Metro area, the ground temperature remains around 50-55 degrees Fahrenheit. The natural ground temperature is cooler than the natural air temperature in summer and warmer than the natural air temperature in winter. While the margin of variation is small, seasonal changes in ground temperature give geothermal heat pumps a dependable and permanent wintertime heat source and summertime heat sink. Geothermal heat pumps take advantage of this natural source of thermal energy and represent one of the most efficient and durable options on the market to heat and cool your building.

Who Else Uses Geothermal Heat Pumps that I Might Know?

On a commercial scale, the IKEA store at Park Meadows shopping center in Centennial, Colorado uses a geothermal heat pump system for all their heating and cooling needs.⁹³

The ground loop to support the IKEA GeoExchange heating and cooling system required 130 boreholes each 500 feet deep. Their ground loop is located under

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their store's footprint. IKEA does not have a natural gas line coming into their store. There is no burning and there are zero emissions from their Centennial store. In addition, their rooftop is nearly covered with solar PV modules. According to the huge mural on display at the entrance to their store, by 2020, IKEA will be harvesting all of their energy sustainably from the Sun and the Earth.

The Jefferson Unitarian Church (JUC) in Golden uses geothermal heating and cooling for one of their buildings. They have also installed some solar PV – a 10 kW system.⁹⁴

The UU church in Mt Vernon, Virginia (Kate Walker, a former intern ordained at First Universalist is their senior minister) also has a GeoThermal/GeoExchange heating and cooling system. Mt Vernon church is powered by solar-generated electricity.⁹⁵

At least one First Universalist member's home uses a geothermal heat pump for all their heating and cooling needs.⁹⁶ That home is also powered 100% by solar-generated electrical power. There is no burning of fossil fuel; in fact, the natural gas line to this home was capped off 4 years ago. Because the home runs solely on solar power, there are zero carbon emissions. The rooftop solar PV system on this home provides enough additional electrical power for their plug-in hybrid to drive 10,000 miles/year on electric only – also zero emissions.)

Solar PV and GeoThermal Heat pumps are being used successfully to sustainably provide energy for large commercial buildings as well as small residential applications. Scaling is not an issue.

Geothermal Heat Pumps Are Too Risky.

Actually, the technology used in today's Geothermal/GeoExchange heat pumps is the same technology that has been used in our refrigerators for the past 100 years.^{97,98} The technology is well understood from a physics and thermodynamics perspective. Manufacturing processes are well established and heat pumps are generally warranted for 20 years or more.

Residential and commercial ground source heat pumps require a ground loop for exchanging thermal energy with the Earth.⁹⁹ The ground loop consists of black plastic tubing placed at least 6- 8 feet underground where the ground temperature remains between 50-55 degree Fahrenheit year round

independent of the time of day or the season of the year. There are no moving parts associated with the ground loop and it is often warranted for 50+ years. A small water circulation pump located within or near the heat pump furnace is used to circulate the water through the ground loop. In the event the water pump goes out/fails, it is readily accessible, inexpensive and easily replaced.

There is no burning associated with a geothermal heat pump furnace. Therefore there are zero emissions. There is no possibility of flammable gas leakage, gas explosions, carbon monoxide poisoning, CO₂ emissions or other greenhouse gas (GHG) emissions, NO_x emissions, no issues with gas extraction/ drilling/ toxic and carcinogenic fracking fluids. There are no issues with tank trucks or rail cars derailing/exploding, killing people. All the thermal energy needed for heating and cooling a home or commercial building is borrowed/exchanged from the Earth nearby.



A New Recycling Awareness

How Can We Justify Replacing Perfectly Good Gas Furnaces?

Q: Shouldn't we replace these gas furnaces slowly and only as they "wear out" rather than all at once?

A: Based on what we know today and our current awareness of the effect humans are having on our planet by continuing to burn ancient hydrocarbons, **there is no such thing as a "good" gas-burning furnace** — regardless of its age, efficiency, Energy Star rating, price, or prior usage.

The phrase 'good gas-furnace' has become an oxymoron.

Our three to four-year-old furnaces in the basement of Markham Hall are not "perfectly good furnaces" – even though there are relatively new. All of our current furnaces burn natural gas. Some of the newer ones do so very efficiently but they still dump 12 lbs of CO₂ into the atmosphere for every therm of gas burned.¹⁰⁰ We burn 5196 therms a year and our furnaces contribute significantly to further climate change.

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Each year we at First Universalist add 27 metric tonnes of CO₂ to our Earth's atmosphere using our gas burning furnaces.

In addition, the drilling /fracking /collection /transport of natural gas (i.e. methane) results in some leakage of this potent greenhouse gas into the atmosphere. Methane is 86 times worse than CO₂ from a global warming/climate change perspective. Self-reporting by the gas industry estimates this leakage is around 3% of the total amount produced. Because of its high Global Warming Potential(GWP), 3% leakage effectively doubles the equivalent amount of CO₂ produced by burning natural gas. Leakage levels as high as 17% have been measured in gas fields in California. Using a 3% leakage rate, in 20 years our gas furnaces will add 1066 metric tonnes of CO₂ equivalence to the climate change peril facing our children and their children.

Regardless of their age, not one of our current furnaces is a "good" furnace. They are not good for us, for our children or for their children.

But 'good' furnaces do exist. We just don't have any at First Universalist yet.

What is a "Good" Furnace

A good furnace is one that provides heating and cooling functions with no burning has zero emissions and does not consume precious ancient hydrocarbons.

Right now, whenever our so-called "perfectly good" natural gas furnaces are activated and begin burning fossil fuel, they also do harm to all of Life.

When we use our furnaces, they spewing out tons of CO₂ that alters the planet's heat balance and contributes to anthropogenic climate change.

One class of a "good furnace" is called a GeoThermal/GeoExchange (or ground source) heat pump furnace. Geothermal heat pumps are well suited for the Denver area because they utilize the fact our ground temperature remains between 50-55 degrees year round. More details to follow.

What Do We Do with Our Old Gas Furnaces?

They will be recycled - 100%.

Rest assured our current unsustainable gas furnaces would not go to waste or be dumped into a landfill when replaced with sustainable equipment.

- The blower motors can be "repurposed" and used in other applications.
- The cast iron, steel, aluminum, copper, etc. can be 100% recycled and refashioned into sustainable products (including more geothermal heat pumps).

Our old unsustainable furnaces will become the feedstock for new sustainable products.

The Earth's resources (e.g. iron, steel, copper, aluminum, etc.) that are tied up in the form/shape of a gas furnace are being inappropriately used. The combined amount of metal in the ten gas furnaces used to heat and cool our facility are equivalent to ½ of an average car in the U.S. Fortunately the iron and steel and copper and aluminum can be 100% recycled with a minimal amount of energy and re-fashioned into sustainable tools and technology and appliances – such as a geothermal exchange heat pump.

Recycling even a relatively new gas furnace is not a waste of money or energy or resources. It is the right thing to do. Recycling will put these Earth's resources into a form that provides a sustainable purpose – rather than remain in an unsustainable form doing harm to all life on the planet. As long as a natural gas furnace continues to operate, it is doing harm. These resources can be reshaped into viable sustainable alternatives.

Let's do our unsustainable natural gas furnaces a favor and help them become transformed into sustainable geothermal heat pumps or some other sustainable use for humankind.

Who Will Recycle Our Old Furnaces

The gas furnaces are only one of many items that will be recycled during the BFF remodeling project.

Recycling gas furnaces will be folded into a larger recycling effort referred to as a **Deconstruction Service** offered upon request by more and more construction companies.

The actual organization that will repurpose/reuse/recycle furnaces, doors, windows, lighting, wiring, plumbing, etc. has yet to be selected.

For perspective, a typical gas furnace weighs around 200-300 pounds. We have ten furnaces. The total weight of all of our furnaces is around 2000-3000 pounds. According to the EPA, the average car in the U.S. weighs around 4000 lbs, so the total amount of

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metal involved in our 10 gas furnaces is equivalent to around ½ of a typical car.

So What are Deconstruction Services?

The Center for ReSource Conservation is a good place to start:

<http://conservationcenter.org/resource/>

With many partners in the building community, ReSource plays an integral role in the support of green building practices through our [Deconstruction Services](#). Co-located with Eco-Cycle's [CHARM](#) program, a mission-aligned partner who is one of the largest nonprofit recyclers in the U.S., ReSource provides a full complement of sustainable services for the building trades, homeowners, makers, and DIYers of all types.

Deconstruction involves carefully dismantling a building and salvaging the parts that can be reused. Materials coming from Deconstruction often include, but are not limited to, lumber, doors, windows, cabinetry, hardwood flooring, lighting and heating, and cooling equipment.

By choosing Deconstruction (rather than traditional demolition), homeowners and builders can save resources and help divert material from the landfill.

ReSource offers deconstruction assessments for renovation projects along the Front Range and helps divert over 4 million pounds of materials from landfills each year.

To learn more, or schedule an appointment for a Deconstruction Assessment, please call Brandon at ReSource, 303.419.5418 x 102, or email him directly: bhill@resourceyard.org.

What is a Deconstruction Assessment

Deconstruction assessments include:

- One-on-one deconstruction education
- On-site visit and assessment
- Deconstruction plan (if applicable)
- Itemized material inventory list
- Qualified deconstruction contractor referral

Denver City and County Deconstruction Requirements

It is not known at this point if Denver has any “Deconstruction Requirements” along the lines of Boulder.

See the deconstruction requirements of the

[The city of Boulder Green Points C&D Material Diversion](#)

and

[Boulder County BuildSmart Material Diversion](#)

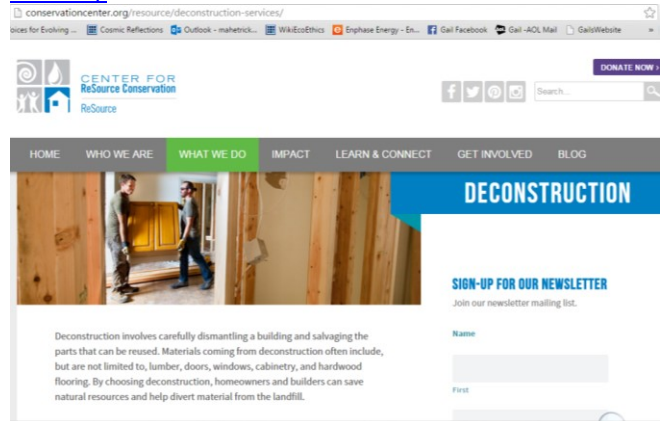
programs.

Where to Start

We can start with our architect, Barrett Studios, to see if they already have Deconstruction Services under consideration. Secondly, we can consider integrating a “Deconstruction Requirement” into our bid specifications for the project. A growing number of construction companies now understand deconstruction requests but the construction specifications and contracts must specify this service.

Deconstruction Service Companies (Examples)

<http://conservationcenter.org/resource/deconstruction-services/>



The screenshot shows the website for the Center for ReSource Conservation. The page features a navigation menu with links for HOME, WHO WE ARE, WHAT WE DO, IMPACT, LEARN & CONNECT, GET INVOLVED, and BLOG. A prominent banner for "DECONSTRUCTION" includes a "SIGN-UP FOR OUR NEWSLETTER" form with fields for Name and First. Below the form, a text box explains that deconstruction involves carefully dismantling a building and salvaging reusable parts like lumber, doors, windows, and hardwood flooring, which can save natural resources and divert material from landfills.

<http://www.ecocycle.org/a-zguide/construction-materials-and-deconstruction-services>

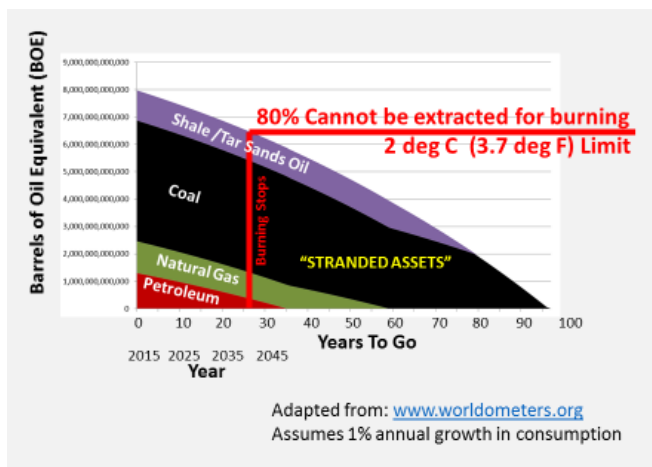


The screenshot displays the Eco-Cycle website's "A-Z Recycling Guide" for construction materials and deconstruction services. The page is titled "City and County of Boulder" and provides details for a "Clean Wood Waste Drop-off" located at Western Disposal, 5800 Butte Mill Rd, Boulder, CO 80301. It lists the hours as Monday-Friday, 7am-5pm, and Saturday, 7am-2pm. The guide notes that clean, unpainted, and untreated dimensional lumber, pallets, wood, and cedar shake shingles are accepted, while cut-offs from construction or demolition projects are not. A note states that there is no charge for Boulder residents, but Boulder businesses will be charged 50% less than the standard rate.

ECONOMIC / FINANCIAL ISSUES

There's plenty of fossil fuel. Let's save our money and spend it on other things we want.

Children being born today will likely live long enough to see the practical end of fossil fuel – unless we change our current burning behavior. The known reserves of coal, oil, natural gas, tar sands oil, and shale oil, when measured in equivalent energy units of “Barrels of Oil” (BOE) total around 8 trillion BOE. At our current consumption rate with an annual increase of 1% (the global population continues to increase at just over 1% annually), we can see in the graph below that within 100 years the entire world's supply of ancient hydrocarbons will be gone.



What is perhaps more disconcerting is that climate science is telling us that to maintain a 2 degree C increase in global temperature, 80% of these reserves cannot be burned – in effect must be left in the ground. As shown, that observation indicates that within 25 years we humans must stop burning hydrocarbons. We live on a spherical planet that has finite resources and there is only enough fossil fuel for 3-4 more generations at the current rate we are burning it. Gray-haired people do not have to worry. Preschool children (and every one thereafter) do.

Fossil fuel is cheap. Let's save our money and spend it on other things we want.

Fossil fuel is currently underpriced in our broken economic systems thanks to Externalities (Hidden & Ignored costs).

By deliberately ignoring reparation and replacement costs, fossil fuel has artificially been made

to appear inexpensive. See detailed discussion of “Externalities.”

What are Our Energy Costs Currently?

There are two categories of cost to consider:

- 1) Direct costs that are transacted in the public sector using the rules of the current economic system.
- 2) The indirect cost that is unspoken, hidden, and ignored in setting the price of goods and services in today's economic system. These real but ignored costs are called “externalities.”

Direct Costs

The direct costs of energy used by First Universalist for the past twelve months (8/29/2014 – 7/30/2015) are summarized in Table 7 First Universalist Energy Usage for 2015 for a total of **\$16,625.**

Table 7 First Universalist Energy Costs - 20 Year Forecast

First Universalist Energy Costs – 20 Year Forecast ¹⁰¹	
	Direct Costs (20 year period)
Electric Bill	\$343,000 to \$423,000
Natural Gas Bill	\$103,000 to \$126,000
SUBTOTALS	\$446,000 to \$549,000
Maintenance	\$110,000
TOTALS	\$556,000 to \$659,000

If no changes are made, in 20 years the annual church utility bill is expected to be between \$29,000 and \$42,000 - depending on whether you assume a 3% or 5% annual rate of increase in energy prices.¹⁰² As indicated in Table 8, in 20 years the church office will have a stack of paid utility bills totally at least \$446,000 to \$549,000.

The aging existing furnaces would have to be replaced during the next 20 years so there would be an estimated \$110,000 in equipment maintenance bills as indicated in the table below. In 20 years, we will have replaced all of our natural gas furnaces and air conditioning units at least once, some twice. So, we will also have a stack of paid HVAC repair receipts for **\$110,000.**¹⁰³ The total outlay of direct costs after 20 years will be \$556,000 to \$659,000.

Indirect Costs -“What are “Externalities?”

Externalities refer to ignored or hidden costs.

There are other costs our current economic system conveniently chooses to ignore – so-called “externalities” also referred to as “social costs.”

These social costs linked to the fossil fuel products are paid by the society at large (additional health care, neurological impairment, diminished physical capability & mental acuity, shortened life span).

In the energy sector, our current economic system allows utility companies to hide/ignore specific costs that are so numerous it is hard to even identify and list them. In the detailed study by Epstein et.al.⁹¹, there is a dozen ignored costs that are identified and monetized specifically for coal-generated electricity:

- Land disturbance
- Methane emissions from mines
- Carcinogens (mostly to water from waste)
- Public health burden of communities in Appalachia
- Fatalities in the public due to coal transport
- Emissions of air pollutants from combustion
- Lost productivity from mercury emissions
- Excess mental retardation cases from mercury emissions
- Excess cardiovascular disease from mercury emissions
- Climate damages from combustion emissions of black carbon
- Climate damage from combustion emissions of CO₂ and N₂O

Reparation Costs

For illustration purposes, only one of the many fossil fuel related externalities will be singled out and examined in more detail - CO₂ emissions - the last item in Epstein’s list.

If we insist on continuing to do harm by dumping CO₂ into that air, what is the cost of making amends and capturing/sequestering it?

This Reparation Cost is the cost associated with restoring the planet to a condition our generation received it in. That is something that can be done for the sake of maintaining a habitable planet for future generations.

Burning ancient hydrocarbons (coal, oil, natural gas, etc.) generates CO₂, a greenhouse gas

(GHG). The CO₂, in turn, alters the Earth’s energy balance with the Sun and results in global warming and climate change among other things. Suppose the cost to recapture and sequester this CO₂ is added to the price of the fossil fuel product. What would the price of the fuel be?

Reparation for Burning Natural Gas.

First Universalist burned 5196 therms annually. According to the EPA¹⁰⁴, this will dump 27.4 tonnes of CO₂ into the air each year. Over the 20 years of operation, First Universalist gas furnaces will add 551 metric tonnes of CO₂ into the atmosphere that alter the Earth’s heat balance and cause further global warming and climate change.

To make amends, First Universalist can simply remove or pay to remove those 551 tonnes of CO₂. As responsible adults, for the sake of our children and grandchildren, we would be happy to pay a carbon pollution fee to cover the cost of reparation.

However, there is more. With what we know today, the drilling /fracking /collection /transportation processes involved in producing/delivering natural gas to the burner results in some leakage of the natural gas (methane) into the atmosphere. The oil and gas industry self-report that methane leakage is equivalent to about 3% of the gas produced. [Measurements of methane in the gas fields by independent sources indicates the actual leakage can be 6-17%.] Based on the recent IPCC reports, we know today that the “climate change potential” for methane is 86 times that of CO₂ when averaged over a 20-year time frame. (20 years is used because the lifetime of a methane molecule in our atmosphere is 10-15 years).

Assuming 3% leakage during the “production” process, 3% of the 5196 therms or 156 therms leaked into the air as methane. Normally those 156 therms, if burned, would have produced 0.83 tonnes of CO₂ but unburned methane is 86 times worse than CO₂, so the CO₂ equivalence = 0.83 tonnes x 86 = 71.3 tonnes of CO₂. So the total harm would be 27.4 + 71.3 = 98.7 tonnes of CO₂ eq each year. Over 20 years that is 1973 tonnes of CO₂ eq.

Carbon dioxide capturing and sequestering (CCS) processes are available and according to an IPCC study could cost between \$33 - \$57/metric ton of CO₂.¹⁰⁵ So if we internalize this specific externality, we can add another **\$65,109 to \$112,461** to the stack of paid bills

Appendix J Questions & Responses

in our church office filed away as “Restoration Costs-Burning Natural Gas.”

Reparation for Burning Coal to Generate Electrical Power.

Over the next 20 years, we will continue to buy electrical power from Xcel Energy generated by burning coal and natural gas. According to the EPA,¹⁰⁶ Xcel Energy will have dumped 1310 metric tonnes of CO₂ into the atmosphere to generate our electrical power during that timeframe. According to a detailed study, “**Full cost accounting for the life cycle of coal,**” by Paul R. Epstein, et. al. the true cost of coal-produced electrical power must be increased by \$0.094 to \$0.27 cents/kWh with a best estimate of \$0.18/kWh to account for some of the major externalities.^{91,107} 72,040 kWh/ year x 20 years x \$0.18/kWh = **\$259,344** reparation cost associated with coal-fired generation of electrical power that we will owe future generations.

Replacement Costs.

Then there is the acknowledgment that the ancient hydrocarbons we dig, drill, and frack to extract (so we can burn/ consume them) for our energy uses are a one-time-use resource. In addition, these reserves of ancient hydrocarbons are finite and dwindling quickly. Children being born today will live to see the practical end of these ancient hydrocarbons at the rate we are consuming them today.¹⁰⁸ So as responsible adults, we will internalize the “Replacement Cost” of these one-time-only hydrocarbon resources by assuming responsibility for replacing this energy (in like-kind & quantity).

Over the 20 year period we are envisioning, we would have consumed 224,283 kWh/year x 20 years = 4,485,660 kWh. Using inexhaustible supplies of either wind or solar we can harvest an equivalent amount of renewable energy to replace the fossil fuel we consumed. (How we store it for future generations has yet to be determined – first, we have to harvest it). If wind energy and solar energy are used to generate and replace the electrical power generated by our burning fossil fuel, it will cost around \$0.10/kWh without any subsidies, rebates, or tax credits. Sustainably replacing the 4.5 MWh of energy consumed (during 20 years of operating our existing natural gas furnaces and buying Xcel electrical power generated from fossil fuel) would cost around \$448,566. Because of this unsustainable behavior for 20 years, to make amends, First

Universalist would deposit this sum into an escrow account for use by future generations.

Other Social Costs Not Monetized.

Again the list is large, but we will mention just one that is important here in the Southwest U.S.

The generation of electrical power by burning ancient hydrocarbons to release thermal energy (heat) to boil water to make steam to drive turbines that drive generators does by its very nature uses a significant amount of precious fresh potable water. Although much of the steam is re-condensed and recycled, some is lost into the atmosphere. We refer to the amount of “lost” water as water consumption.

NREL has estimated that electric generation by fossil fuel burning “consumes” 1 to 2 gallons of water per kWh generated. Obviously, the water is not really lost – it still is a part of the planet and will eventually become some form of precipitation (rain, hail, snow) and fall onto the land or into the oceans. When we say lost or consumed, we simply mean it is no longer available for human or non-human life in the near term. 72,040 kWh of electrical power is generated annually by Xcel Energy to operate First Universalist. According to NREL, this power generation using a fossil fuel plant may consume up to 144,080 gallons of water a year. Over 20 years, 2,881,600 gallons of water will be extracted from the Platte River that therefore becomes unavailable to cities and farmers and ranchers downstream. That is an example of an un-monetized externality.

What is our 20 Year Energy Cost Forecast?

It seemed appropriate to compare the cost of continuing to use an unsustainable fossil fuel energy with the cost of transitioning and using a sustainable renewable energy system. A life-cycle cost analysis is the only reasonable way to make such a comparison – we are dealing with capital equipment that has significant operating expenses.

Table 8 Unsustainable Energy System vs Sustainable Energy System Cost Comparison

	UNSUSTAINABLE ENERGY SYSTEM		SUSTAINABLE ENERGY SYSTEM CONCEPT	
	First Universalist Energy Costs – 20 Year Forecast (Including Maintenance & Externalities)		First Universalist Energy Costs – 20 Year Forecast (Including Maintenance)	
Function	Equipment Item	Direct & Indirect Costs (20 year period)	Equipment Item	Direct & Indirect Costs (20 year period)
Electrical Power	Grid	\$522,373	Solar PV	\$140,000
Heating/DHW	Natural Gas Furnaces		Ground Source Geothermal Heat Pumps	\$300,000
	Maintenance	\$110,421		\$25,000
SUBTOTAL – DIRECT COSTS		\$632,794		\$465,000
Acknowledging Monetized Externalities				
Reparation Costs		\$472,253	N/A	\$0
Energy Replacement Cost		\$665,829	N/A	\$0
SUBTOTAL – EXTERNALIZED COSTS		\$1,105,047		\$0
TOTAL		\$1,770,876		\$465,000
Acknowledging Un-Monetized Externalities				
Water Consumed @ 1-2 gal/kWh		2,881,600 gallons		0 gallons
GHG Emissions		2139 metric tonnes CO ₂		0 tonnes

Conclusions. If no change is made in the energy system, First Universalist will spend between \$596,000 and \$699,000 for energy over the next 20 years. Because of the externalized costs associated with burning coal and natural gas for electrical and heating needs, First Universalist can avoid paying but ethically will owe future generations an additional \$796,695 for Reparation and Replacement costs for the energy they consume by burning ancient hydrocarbons for another 20 years.

If a UN Conference on Climate Change ever reaches an agreement to put a price on “carbon pollution,” there will be a correction to the global economic system that better reflects the true cost of further burning of ancient hydrocarbons. As a result, First Universalist, as will everyone else, pay more for energy generated from burning fossil fuel than currently projected.

In brief, with the current hydrocarbon-based energy system, First Universalist will spend nearly \$0.5 M on direct energy costs over the next 20 years and end up ethically owing their children at least an additional \$1.0 M for Reparation and Replacement costs.

Although one can argue over the actual cost numbers for the ignored costs associated with burning natural gas and coal for heating and electrical power needs, one must agree that the current “economic system” used to make daily choices is tragically, deliberately, and fatally broken. The economic measuring stick used by the BFF Committee, the Board of Trustees, and the by the Senior Minister to decide if the congregation “could afford” to replace the old unsustainable 20th century fossil fuel burning energy technology with a new sustainable 21st century energy system (using solar energy from the Sun and sustainable thermal energy from the Earth) was/is fatally flawed and is influencing people in positions of power to make ecocidal decisions.

Fortunately, we do have alternatives if we choose to consider them. See “What Does a Sustainable Energy System Look Like and Cost?”

100% Sustainable Energy System

The cost of transitioning our church to 100% renewable energy and operating it sustainably for 20-

25 years is around \$455,000. That’s less than 12% of the total rebuilding project budget of \$4 M – a reasonable price to pay to be 100% sustainable if we are building for a **habitable** future.

We cannot afford to continue burning fossil fuel for our church’s energy needs.

Transitioning to a 100% Sustainable Energy system makes sense (logically & ethically) and also makes cents (economically).

“We Do Not Have Enough Money for a Sustainable Energy System”

This supposed statement of fact is nearly correct. There are just two letters missing, U & N. A correct version reads: “We Don’t Have Enough Money to Devote to an **Unsustainable** Energy System for Our Church” See the discussion: **What are Our Current Energy Costs? ...Our Energy Costs over 20 years?** Those comments are summarized in the table below.

Current Unsustainable Energy System.

If we continue to operate First Universalist Church unsustainably as it is currently configured, knowing what we know today, the 20-year operating **direct** cost will be \$633,000 (see Subtotal in the above Table) and we will have added 2139 metric tonnes of CO₂ to our planet’s atmosphere and consumed 2,881,600 gallons of scarce Western water – thereby helping to create a less habitable world for future generations. As responsible adults, we would make amends of \$1,105,047 to acknowledge that our current economic system is broken. Because it is riddled with externalities, the **true cost** of continuing to operate First Universalist for another 20 years as we are today is actually closer to \$1.8 M. That’s what we cannot afford.

Q&A for the solar geothermal Green First proposal prepared by Green₆ (4 Jul 2016)

Question: How did you determine the church's "utility bill" for the future?

We took the current year's gas and electric bills (\$16,019 for 2015-2016) and inflated them at 4% per year. Then we added the cost of replacing the current furnaces and AC units assuming they fail at a rate of one every two years (cost \$3250/year, also inflated at 4%/year).

Question: The inflation rate determines the cost of the church's utility bill for the next 15 years. How did you choose the inflation rate?

The baseline plan presented is to use 4%. Green₄'s commercial sources are using 3.5%. 4% is less than the long-term historical increase in the cost of natural gas. In the past few years, however, the costs have risen more slowly. Our position is that 4% is reasonable and is high enough to protect the interests of the church's lenders. We set a ground rule of paying the members back within 15 years. If we can raise all the required money from member loans, we may be able to lower the inflation to 3.5%/year. Another way to reduce the inflation rate would be to tie any commercial loan to the other loans of the church at 4.5% interest and use a 20-year term for the commercial loan. Our proposal is sensitive to the inflation rate and to the assumed starting costs of the utilities.

Question: What is the biggest downside to this proposal?

The largest uncertainty is the willingness of the church to finance with member loans. The Board of Trustees is to meet on July 5th to decide the member loan question.

Question: How does the geothermal part work?

The ground is used as a thermal source/sink. Thermal energy is taken out during the cold months and put back in during the warm months. The heat pump technology has been around for over 100 years and is identical to that used in today's refrigerators. The heat pump furnace differs from a refrigerator in that it has a "reversing valve" that allows it to be used for both heating and cooling. The heat exchange coils normally found under the

refrigerator (or in the back) are placed underground for better heat transfer efficiency. The coils are referred to as the "ground loop." Water is circulated between the heat pump furnace and the ground loop to move heat to and from the building. The ground loop pipes can be installed horizontally or vertically. The design for our system uses 12 vertical boreholes that extend 400 feet deep. Below 5-10 feet, the ground temperature remains at around 50 to 55 degrees Fahrenheit year round.

Question: How do we know we will not have to dig up the ground loop at great expense?

If installed properly, the ground loop should have a lifetime of greater than 50 years. All the moving parts, valves, controls, etc. are inside the building associated with the heat pumps, which are accessible. We must make sure the ground loop is installed by a certified geothermal contractor. It is recommended that we hire an independent expert to oversee the installation.

Question: How long will the heat pumps last? Solar panels?

The heat pumps have a service life of around 20 years. They will not all need replacement at the same time. This is one reason for setting the repayment schedule at 15 years, after which the utility costs will drop dramatically. Prudent management suggests some of the savings should be set aside for replacements.

Similar lifetime and remarks apply to the solar.

Question: Will the church own the solar equipment on the roof?

Yes.

Question: Does the solar array performance degrade with time?

Yes, there is a slight degradation (about 0.5%) of performance each year. After 20 years, the performance will be approximately 90% of the original performance.

Question: How reliable are the costs?

The costs for the geothermal portion will be updated when the contractor gives us new numbers. To date, we are using the numbers given to the BFF committee at a meeting on May 4 with the contractor. C. BFF says these numbers are the best we can do now. We believe they are higher than

they should be and we currently hold a \$7,800 contingency. We are using a commercial quote for the solar portion.

Question: Have you included the cost of being connected to Xcel for winter, cloudy days and nighttime?

Yes, we have projected a cost for the Xcel hookup fee and inflated it at the same rate as the general inflation.

Question: What would the carbon footprint of the church be if we do this?

We will avoid 50 tonnes of carbon with solar and 50 tonnes with geothermal. A typical household uses 2 tonnes of carbon (7.5 tonnes of CO₂) for its utilities annually.

Question: How will these systems be serviced?

The solar installer will service the solar panels and the hookup to Xcel.

We have included an annual service fee for the heat pumps, thermostats, etc. for the heating and cooling. Such servicing should be part of our annual checkup of the furnaces currently but we did not include such a cost in our estimate of current utilities.

Questions: What happens if we purchase the heat pumps gradually as our current furnaces wear out?

We have examined such a cost scenario. It was one of the original ideas, but it does not work with the current plan. We take the cost of the gas to run the furnaces out of the “utility bill” and put in the cost of new heat pumps spread over a 20-year period. In this case, it takes 22 years to pay back the member loans. This was not acceptable to our “lenders”. If we do this, a completely different financing plan would need to be developed.

Question: Could it ever get so cold or hot that our geothermal system cannot handle it? What do we do then?

The heating and cooling requirements of the newly remodeled facility were determined by the BFF mechanical engineer (and verified by an independent third party). This assessment used historical records for “degree days” in the Denver, Colorado area including some margin for occasional extreme days. The building is divided into 10 zones. The heating and cooling requirements for each zone

determine the size of the furnace that will service that zone. For example, one zone may require a 4-Ton rated furnace.

The geothermal/ground source heat pump furnaces are commercially available with a range of heating & cooling capability just like natural gas furnaces and external A/C units. A 4-Ton natural gas furnace and a 4-Ton geothermal heat pump furnace provide the same heating capability (4 Ton x 12,000 BTU/hr/Ton = 48,000 BTU/hr.) Correspondingly, the ground loop heat exchange system is designed to a specified heat transfer rating based on the annual heat load calculations.

If the hot/cold problem persists, the specified furnace for that zone was improperly rated and should be upgraded. If the hot/cold problem only occurs occasionally due to extreme temperatures, supplemental fans or heaters could be used on a temporary basis.

Question: How will we get our hot water? Is this included in your system?

Not currently, but we can use one or two of our heat pumps, specially outfitted at a few thousand dollars, to produce the hot water. The solar panels would provide power to the water heaters. It might be wise to consider flash heaters where the volume used is small (e.g. in the washrooms) and have a larger supply for the dishwasher and/or shower. This needs further study.

Question: What happens if a tax on carbon is imposed or the price of natural gas changes dramatically?

The church’s utility cost (electric & gas) will not be affected by any future carbon tax because it will no longer be burning hydrocarbons as a source of energy. The costs are established at installation. This energy system and financing plan have a built-in guarantee against cost escalation.

Appendix K Story About the Kitchen

BFF₁ asked why natural gas was still being used in the kitchen. Green₄ responded and cited concerns that an electric stovetop, the oven would increase the “electrical demand” and possibly increase the monthly

Appendix L PACE

Xcel bill. Green₆, BFF₃, Reviewer₂, Architect₂ and Mechanical Engineer₁ agreed.

There were only two dissenting votes from Green₁ and Green₅ who were advocates for demonstrating it was possible to design a sustainable kitchen that did not burn hydrocarbons; they did not prevail. The kitchen design was not part of “Sustainable Energy System” approved by the congregation on 6 Nov 2016. It was designed/funded by the BFF Committee. But that’s another story.

Appendix L PACE

What is Colorado C-PACE?

Colorado Commercial Property Assessed Clean Energy (C-PACE) Program

C-PACE enables owners of eligible commercial and industrial buildings to finance up to 100% of energy efficiency, renewable energy, and water conservation eligible improvements. Financing is provided by private capital providers at competitive rates (e.g. 4-5%) with repayment terms up to 25 years.

With a third party source of upfront capital, building owners are empowered to modernize building energy infrastructure, increase building comfort, increase asset value and lower energy costs. Ideally, the energy savings will offset the cost of borrowing money so there is positive cash flow. C-PACE projects also advance public policy goals to create local jobs, reduce greenhouse gas emissions and increase renewable energy deployment.

C-PACE Assessment and Repayment

C-PACE financing repayment is facilitated through the County property tax assessment process. A voluntary assessment (similar to a sewer district assessment) is placed on the building owner’s property tax bill. The assessment is repaid over the financing term (up to 25 years). In most cases, the annual energy cost savings will exceed the annual assessment payment, thereby enabling capital intensive equipment upgrades. The C-PACE assessment obligation runs with the property. The assessment transfers to the next owner when the property is sold.

Program Administration

Sustainable Real Estate Solutions, Inc. (SRS) has responsibility for C-PACE program administration.

Program Administration Fee

Colorado C-PACE is designed to be a self-sustaining program. To ensure that the program fees charged to program participants are sufficient to cover the operating costs associated with administering the program, a program administration fee equal to 2.5% of the project finance amount (not to exceed \$50,000 per project) will be assigned to each C-PACE project.

County Servicing Fee

Each Colorado county that participates in the C-PACE program has agreed to collect the C-PACE assessment payments from participating property owners via the property tax collection system and then remit those funds to the District (or its designated fiduciary) for distribution to the private capital provider that financed the project.

The county will levy a C-PACE assessment servicing fee of up to 1% of the PACE assessment amount, including on the building owners property tax bill. This county servicing fee, to cover the county tax assessors support services, is paid by the property owner over the term of the C-PACE financing in the normal course of paying their property tax bill.

About The Reporter

The reporter, Milt Hetrick, was a member of the Green First Task Force and a retired engineer/physicist. He is not affiliated with any political party nor employed by anyone. He enjoys stepping out of the unsustainable sandbox he played in most of his life to “reframe” what he observes happening today.



Envisioning a sustainable future and changing his behavior to live more sustainably have become his life's work.

An earlier book, “**Living without Fire: Just the Sun and the Earth, Illustrating a way to retrofit a 1974 home for more sustainable living**” documented a year in his life when he was learning to ‘live without fire.’ The first step was to become solar energy and geothermal energy farmer. What started as a personal experiment (to stop burning finite reserves of ancient hydrocarbons, and instead look to the Sun and to the Earth for inexhaustible sources of energy) turned out to be a new way of living. Since 2011, Milt and his partner, Gail have been living comfortably without fire (i.e. without burning stuff) as he documents in his book.

The lessons learned from transitioning his home from burning ancient hydrocarbons to 100% solar electric and ground source geothermal heating & cooling provided confidence his residential energy system could be scaled up for the church application – particularly after taking a Sierra Club sponsored tour of a local IKEA store in Centennial, CO. The tour included a trip to the roof of the building to walk through a sea of solar modules covering the store's entire flat roof. The IKEA facilities manager pointed out that the arrays were not bolted down to the roof (which would have put holes in the rubber membrane and introduced the possibility of leaks) but instead were held in place by ballast – concrete blocks. (First Universalist used a similar mounting approach on their flat roof).

During a tour of the IKEA “mechanical room” under the store, they were able to see first-hand commercial geothermal heat pumps that provide heating and cooling. No natural gas is burned to operate the IKEA facility. (First Universalist has done

likewise). The IKEA ground loop heat exchanger consists of 130 boreholes 500 feet deep. (The First Universalist ground loop has 12 holes 400 feet deep).

Knowing that there are viable sustainable energy alternatives to burning ancient hydrocarbons, and being both an “independent observer” and an integral member of the interdependent network of life on planet Earth, Milt remains confident that we can summon the will to stop burning hydrocarbons as an energy source and use solar, wind, geothermal, and hydro sources of energy instead.

He is optimistic that we can continue to thrive on this planet for hundreds of millions of years – but only if humanity comes together and creates a new ethic grounded in the Universe Story – some call this new ethic **Ecomorality: the Ethics of Sustainability and Evolving Consciousness**.

Like a growing number of others, Milt believes our challenge is learning to use a new way of thinking and a new morality (based on sustainable living in the Real World with finite resources and limits to further physical growth, not political ideology based in the ‘real world’). Our human-created ‘real world’ systems must be updated to be consistent with Real World evidence. A 21st-century Ecomorality can then be used to revise our economic /political /agricultural /educational /informational social systems. Each of these dimensions must influence us to make choices that result in sustainable behaviors that are of mutual benefit to all Life.

With this new Ecomorality and updated social systems, we will be influenced to change our current “Ecocidal” behavior. Then we can continue to enjoy our individual freedoms, extend democracy to include representation for all Life, evolve in the collective consciousness, and express unlimited sustainable creativity in concert with the Cosmos. *What an exciting foreseeable future, should we as a species choose to live sustainably – at this point the only viable choice.*

*"The Great Work now,
as we move into a new millennium,
is to carry out the transition from a period of human
devastation of the Earth to a period when humans would
be present to the planet in a mutually beneficial
manner."*

...[Thomas Berry](#). "[The Great Work: Our Way to the Future](#)"

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¹ There are an estimated 800,000 Unitarian Universalists around the world; around 200,000 in the U.S.

² S.B.600 was introduced in the Senate (02/26/2015) by [Sen. Klobuchar, Amy \[D-MN\]](#) 114TH CONGRESS.

³ UU Seventh Principle: "Respect for the interdependent web of all existence of which we are a part."

<https://www.uua.org/beliefs/what-we-believe/principles/7th>

⁴ The new church kitchen was not considered a part of the building's "Energy System" and was designed and funded by the BFF Committee not the Green First Task Force. The kitchen operation is unsustainable because it uses appliances that burn natural gas. The decision to use gas appliances for cooking and for heating exhaust vent make-up air did include input from the Green First Task Force and resulted in some internal conflict among members. To some Green First members it seemed disrespectful to members who were vegetarians and vegan and striving to eat sustainably but have their food prepared in an unsustainable kitchen. Natural gas appliances were recommended by the architect team simply to minimize construction cost and supposedly operating costs. The decision to use natural gas in the kitchen was approved by the building committee (PC) with concurrence from two Green First members and one independent reviewer. Because there was so much effort being expended to get agreement on a sustainable geothermal heating and cooling system, the several opposing Green First members considered the kitchen as 'one of those hills not worth dying on.'

⁵ Emergence is an understanding that has in fact been around for some time. See O'Conner, Timothy, and Wong, Hong Yu (2002). 'Emergent Properties', in Stanford Encyclopedia of Philosophy; <https://plato.stanford.edu/entries/properties-emergent/> "[a] familiar phrase for stating this understanding is to say that 'the whole is greater than the sum of its parts'. A second phrasing is to say that as one moves 'up' in levels of scale, one encounters 'something more from nothing but' or, less euphoniously but more accurately, 'something else from nothing but'—since the point is not that one encounters something greater or something more, but that one encounters something else altogether. Importantly, this something else can, in turn, participate in generating a new something else at a different level of organization. That is, today's something else may be tomorrow's nothing but. The now widely adopted term to describe such dynamics is **emergence**....

....So, a successful life outcome is to promote the transmission of information conducive to maintaining the emergent dynamical logic that gives it its meaning— that is, to promote the production of emergent outcomes (called traits in biology) that collectively make their own continuation more likely. It is traits that rule; genes follow in their wake. Traits common to all organisms include such non-depressing and religiously fertile capacities as end-directedness and identity maintenance. Traits common to all animals include awareness and the capacity for pleasure and suffering; traits common to social beings include co-operation and meaning making. Traits common to birds and mammals include bonding and nurturance. Traits common to humans include language and its capacity to share subjective experiences, and thus to know love. " Goodenough, Ursula and Deacon, Terrence W., "The Sacred Emergence of Nature" (2008). Biology Faculty Publications & Presentations. Paper 67.

http://openscholarship.wustl.edu/bio_facpubs/67 ,

Originally published as Chapter 50: "The Sacred Emergence of Nature" in The Oxford handbook of religion and science / edited by Philip Clayton and Zachary Simpson. Oxford ; New York : Oxford University Press, 2008. Chapter 50, pg 860.

⁶ Fusion of hydrogen into helium is a simple example of emergence – creating 'something more' (helium, atomic number two) from 'nothing but' (two atoms of hydrogen, atomic number one)

⁷ There are many versions of this same common Story including: The Great Story [http://www.thegreatstory.org/what_is.html] , the New Story [http://www.journeyoftheuniverse.org/storage/The_New_Story.pdf] , The Universe Story [<http://www.amazon.com/Universe-Story-Primordial-Era-Celebration/dp/0062508350>] , The Epic of Evolution [http://en.wikipedia.org/wiki/The_Great_Story] , The History of Nature [<http://www.amazon.com/Sacred-Depths-Nature-Ursula-Goodenough/dp/0195136292>] , and the Big History [<http://www.bighistoryproject.com/>] as well as Everybody's Story. [<http://www.amazon.com/Everybodys-Story-Evolution-Philosophy-Biology/dp/0791443922>] It is humanity's common creation story. It is Life's creation story.

⁸ The four forces of nature are the strong and weak nuclear forces, gravity, and the electromagnetic force.

⁹ An estimated number of current living species ranges from 2 million to 1 trillion. Nearly 2 million have been documented.

More than 99 percent of all species that ever lived on Earth are estimated to have gone extinct.

https://en.wikipedia.org/wiki/Global_biodiversity

"Researchers find that Earth may be home to 1 trillion species". *NSF*. 2 May 2016. Retrieved 6 May 2016,

https://www.nsf.gov/news/news_summ.jsp?cntn_id=138446&WT.mc

¹⁰ "Alexa, How far away is the Sun?" 11/17/2018.

¹¹ The Last Universal Common Ancestor (LUCA) is the most recent common ancestor of all current life on Earth. While there is no specific fossil evidence of LUCA, it is estimated to have lived some 3.5 to 3.8 billion years ago, a few hundred million years after the earliest evidence of life on Earth, for which there are several candidates.

https://en.wikipedia.org/wiki/Last_universal_common_ancestor/

¹² The observatory is under the Earth System Research Laboratory that is part of the National Oceanic and Atmospheric Administration (NOAA).

(Continued)

End Notes

¹³ Europa, one of Jupiter's moons might be our next best bet for finding other living systems. It is covered entirely by frozen water. No land. But if you are a sea creature that doesn't require any oxygen to survive and you stay sufficiently below the surface for protection from the intense natural radiation surround Jupiter that will destroy an unprotected spacecraft in a few months, Europa may support some forms of life now.

¹⁴ See Factoid A.5

¹⁵ The ratio of the molecular weight of CO₂ (44) to C (12) = 44/12 = 3.67. 1 tonne of C is equivalent to 3.67 tonnes of CO₂

¹⁶ See NASA/NOAA Announce Major Weather Forecasting Advancement,

https://www.nasa.gov/vision/earth/environment/weather_forecast.html

¹⁷ Meadows, Donella H; Meadows, Dennis L; Randers, Jørgen; Behrens III, William W (1972). *The Limits to Growth; A Report for the Club of Rome's Project on the Predicament of Mankind* (PDF). New York: Universe Books. ISBN 0876631650. Retrieved 26 November 2017.

¹⁸ "[Symposium: Already Beyond? - 40 Years Limits to Growth](#)". Volkswagen Stiftung. 28 November 2012. Retrieved 2017-11-28.

¹⁹ Nørgård, Jørgen Stig; Peet, John; Ragnarsdóttir, Kristín Vala (March 2010). "[The History of The Limits to Growth](#)". *The Solutions Journal*. 1 (2): 59–63. Retrieved 1 July 2014.

²⁰ Farley, Joshua C. "The Limits to growth debate". The University of Vermont. Retrieved 1 December 2017.

²¹ Turner, Graham (2008). "A Comparison of 'The Limits to Growth' with Thirty Years of Reality". *Socio-Economics and the Environment in Discussion (SEED)*. CSIRO Working Paper Series. Commonwealth Scientific and Industrial Research Organisation (CSIRO). 2008-09: 52. doi:10.1016/j.gloenvcha.2008.05.001. ISSN 1834-5638. Retrieved 1 July 2014.

²² Edwards, Paul N. (2010) *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* MIT Press ISBN 9780262290715 pp. 366–71

²³ Forrester, Jay Wright (1971). *World Dynamics*. Wright-Allen Press. ISBN 0262560186.

²⁴ Peter A. Victor (2008). *Managing Without Growth*, Edward Elgar Publishing, pp. 92–93, ISBN 978-1-84720-078-5

²⁵ <https://www.uua.org/environment/sanctuary/old/steps/justice/293262.shtml>

²⁶ <https://www.uua.org/environment/sanctuary/steps/plan/290993.shtml>

²⁷ <https://www.uua.org/environment/sanctuary/steps/plan/292488.shtml>

²⁸ <https://www.uua.org/environment/sanctuary/steps/plan/292494.shtml>

²⁹ "**Living without Fire – Just the Sun and Earth: Illustrating a way to retrofit a 1974 home for more sustainable living**" by Milt Hetrick, 2014. The book documents the author's positive experience transitioning his home from burning ancient hydrocarbons (aka fossil fuels) to harvesting solar energy to generate electrical power. In addition, he replaced the natural gas furnace and traditional air conditioner with a ground source geothermal heat pump that operates using the power from the rooftop solar PV system. Hence, no burning required.

³⁰ Occupy Wall Street, https://en.wikipedia.org/wiki/Occupy_Wall_Street

³¹ Taibbi, Matt (October 25, 2011). "[Wall Street Isn't Winning – It's Cheating](#)". Rolling Stone Magazine. Archived from [the original](#) on May 3, 2014.

³² Reference: ***Faith-Based Statements on Climate Change***, published by Citizen Climate Lobby and Citizens' Climate Education, Coronado, CA, 2015 (second edition). https://issuu.com/citizensclimatelobby/docs/faith-based_statments

³³ On October 4, 2016, five years later, the Board approved a financing plan for a solar/ geothermal energy system

³⁴ How prophetic. It took Green₄ six years and a lot of work on his part to see his dream become a reality.

³⁵ Kirsten K.

³⁶ <http://www.bbc.co.uk/news/world-15391515>

³⁷ National Ice Core Laboratory

³⁸ Naomi Kline, <https://thischangeseverything.org/naomi-klein/>

³⁹ <http://www.amazon.com/Living-without-Fire-Illustrating-sustainable/dp/1499141203>

⁴⁰ It wasn't until May 2016, when the contractors submitted their cost estimates that the BFF committee adjusted their cost numbers to around \$270,000 for the geothermal system, \$130,000 for the solar PV system, plus \$44,000 for two ERVs. The total cost of this sustainable energy system was \$440,000. Current building codes require active ventilation in public buildings. ERVs are currently used. Five were required for the facility. This was an unexpected cost. Although the five ERVs were required for ventilation regardless of whether the HVAC was natural gas or geothermal, the Green First Task Force agreed to include two of the five ERVs in their geothermal budget – that was \$44,000. The ground loop drilling and installation was around \$90,000 of the \$270,000.

⁴¹ This turned out to be a prophetic comment by the D___ family, because by Mar 2016, the capital campaign had come to an end with a significant shortfall. The sustainable energy system was deleted from the scope of the project to balance the building project budget.

⁴² 'To honorably harvest' is a term borrowed from our indigenous cousins. See "Braiding Sweetgrass: Indigenous Wisdom, Scientific Knowledge and the Teachings of Plants," by Robin Wall Kimmerer, Milkweed Editions, 2013. Pg 183.

⁴³ The 100% sustainable energy system consists of a 57 kW solar PV subsystem expected to produce around 80,000 kWh initially (72,000 kWh at end-of-life 20 years later) and a geothermal heating and cooling subsystem rated at 45 Ton.

(Continued)

End Notes

⁴⁴ St John's Episcopal Church, Boulder, Colorado, <http://www.stjohnsboulder.org/index.php>

⁴⁵ Note: Nature's autotrophic species in the deep past found a clever way to store about one month's worth of sunlight as chemical energy in the form of ancient hydrocarbons/biomass in the Earth's crust. We might ask, how much of the Sun's daily gift of Sun energy have we homo sapiens learned to put aside as a reserve?

⁴⁶ Recent Naomi – Harvard Study about ExxonMobil. Also “Merchants of Doubt”

⁴⁷ For more information see: read more: <http://climate-l.iisd.org/news/indc-analyses-show-improvement-need-for-radical-action/>

⁴⁸ On 8 Oct 2018, the IPCC published an update to their 2015 AR5 report.

⁴⁹ Sources Of Our Living Tradition, <https://www.uua.org/beliefs/what-we-believe/sources>

⁵⁰ We can see biomimicry behind a story in Greek mythology where master craftsman Daedalus, wanting to escape imprisonment by King Minos, devised two pairs of wings (for himself and his son Icarus) by adhering feathers to a wooden frame with wax. As they made their escape, unfortunately the hubris of Icarus took him too close to the Sun, the wax melted and Icarus plunged to his death. Biomimicry still provided a clever idea to escape.

⁵¹ Biomimicry Institute. Applying nature's strategies. We need sustainable solutions to solve pressing local and global challenges. Researchers are finding that solutions to many of today's problems already exist in nature. Biomimicry is the practice of looking to nature for strategies to solve human challenges. <https://ecorise.org>

⁵² https://www.fujielectric.com/company/research_development/theme/heatpump.html, Fuji Electric.

⁵³ They could understand why there were no third party funders. The geothermal system was not yet “plug and play” or “out of the box” but required some site specific design effort by a different skill set than traditional HVAC.

⁵⁴ Someone later commented that what they observed was right up there with “the fishes and the loaves.”

⁵⁵ One (1) metric tonne = 1000 kg = 2204.6 lbs. A U.S. ton is 2000 lbs. So a metric tonne = 1.1 tons.

⁵⁶ This is true. The church energy costs did go down from 2015 to 2016 based on a cursory tally of utility bills. What the Board and Staff failed to consider however is that the decrease was due to a temporary windfall. A local Community Solar Garden upstart (friends of Green₄) still had some unallocated solar panels so they generously temporally assigned that production to First Universalist to offset the church utility bill (otherwise the unallocated production would have defaulted to the utility company). Bottom line: **The unit cost of energy did not go down nor did the church usage decrease, between 2015 to 2016.** That data cannot be used to project energy costs in the future – it was a one-time only gift.

⁵⁷ **Reporter:** Rather than “banking/storing” excess green electric power that is generated during the day by the church and allowing the church to withdraw it in the evening or on cloudy days, physically the extra power is pushed back into the grid and used by the nearest neighbor. Xcel Energy meters this excess free green power going into their grid, adds their profit margin and sells it immediately to the nearest neighbor(s) instead.

So, picture a small pile of unburned coal at the Xcel generating plant equivalent to the amount of excess power the church generated, put on the grid and Xcel sold to the nearest neighbor. This unburned pile of coal has the neighbor's name on it; it was not burned for the neighbor because the church's green power was used for them instead. At night, when the church asks for their excess energy back, Xcel burns the neighbor's leftover pile of coal that was not burned during the day and the church gets its “stored” power back. No **additional** coal/carbon was burned to provide the power the church requested at night. It is not disingenuous to call a properly-sized solar PV system connected to the grid a “carbon neutral (or zero carbon emission)” approach to electrical power. It is a fact.

⁵⁸ **Reporter:** Although battery storage costs continue to decrease, adding enough battery storage to get off the grid today would probably double the cost of the system with little to no financial or environmental gain. However, batteries may be a good investment if used to level the peak demand load and lower the demand based surcharge. After the first year of operation, the church will have usage data to re-evaluate the role of battery storage.

⁵⁹ The Xcel Investors web site can be found at <http://investors.xcelenergy.com/>

⁶⁰ Permitting and other contractual paperwork vary from state to state and from county to county within each state. Within a given county, different cities may have different building codes. Some European countries (such as Germany) have a standard federal permitting process that significantly reduces the “soft” (non-hardware) installation cost compared to U.S. installation cost.

⁶¹ **UU World**, Spring 2019. <https://www.uuworld.org/articles/spiritual-landmark-spring-2019>

⁶² IPCC Global Warming of 1.5°C, <https://www.ipcc.ch/report/sr15/>

⁶³ Billion-Dollar Weather and Climate Disasters: Overview, <https://www.ncdc.noaa.gov/billions/>

⁶⁴ The Green First team was formed around 2007 as part of an initiative to raise the awareness of the congregation about sustainable living by engaging in the UUA Green Sanctuary accreditation program. To become a certified Green Sanctuary, requires educational as well operational changes within the church. First Universalist completed their accreditation program in 2010.

⁶⁵ **“Full cost accounting for the life cycle of coal”** Paul R. Epstein, Jonathan J. Buonocore, Kevin Eckerle, Michael Hendryx, Benjamin M. Stout III, Richard Heinberg, Richard W. Clapp, Beverly May, Nancy L. Reinhart, Melissa M. Ahern, Samir K. Doshi, and
(Continued)

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Leslie Glustrom. 2011. in "Ecological Economics Reviews." Robert Costanza, Karin Limburg & Ida Kubiszewski, Eds. Ann. N.Y. Acad. Sci. 1219: 73–98.

⁶⁶ This approach incorporate three suggestions from church members. 1) consider "Slow Money," 2) consider local capital, and 3) consider a "revenue neutral" approach that did not require a change in the church operating budget.

⁶⁷ The origin of the word sacrifice can be traced back to Latin sacrificium; sacred + facere to make. To sacrifice is to make sacred. A dictionary meaning of sacrifice is "anything of value given away to secure something of still higher value..." Certainly, a donation for a new sustainable energy system would be a worthy sacrifice. It does not appear that the Green First Team ever used the idea of sacrifice overtly. There is a possibility that the inappropriate use of the concept may even be counterproductive.

⁶⁸ M. Scott Peck's definition of love "...extending one's self for the purpose of nurturing ...another's spiritual growth."

⁶⁹ However, the day after the presentation, the Building Committee sent out an email indicating their preferred approach was "Solar Only, but Geothermal Ready" – meaning the geothermal ground loop would be installed, but the church would still operate using natural gas furnaces. When a furnace needed to be replaced, the church would buy a heat pump and hook it up to the existing ground loop heat exchanger. Despite the preference of the Building Committee, the Board representative encouraged the Green First Team to continue proposing a complete energy system to the Board.

⁷⁰ In retrospect, they may have benefited by viewing the situation as a conflict between the Green First Team (advocates for a Green facility) and the Board (elected to provide governance of the congregation.) Classical conflict management practices remind us that a conflict can be framed as People involved in a common Problem. Ideally, management of the conflict then becomes one of building working relationships between the People so they can work together to solve the Problem.

⁷¹ In the First Universalist case, a Board member agreed to serve as a liaison between the Board and the Green First Team. The Green Team was fortunate, because this Board member was a sceptic and thought a geothermal heating & cooling system was too risky for the church to be considered. By addressing their specific concerns directly, including a site visit to see a geothermal system in operation, and using their advice that the funding model must not increase the church operating budget, the Green Team was better able to craft a proposal to the Board that addressed many of the Board's major concerns.

⁷² Without talking down to anyone, explain that the term "cost" will be used in several different contexts. There is an 'Initial Cost' of the new system; there is an ongoing 'Operating Cost' of the existing and the new energy system, and there is the 'Life Cycle Cost' that is the sum of the initial cost and ongoing operating costs. As Board members and stewards of the congregation's finances, they are making a decision about capital equipment (that has a useful life of at least 20-25 years) and that decision generally requires a Life Cycle Cost analysis. That is what the Green Team can provide.

⁷³ <https://www.rollingstone.com/politics/politics-news/bill-mckibben-winning-slowly-is-the-same-as-losing-198205/>

⁷⁴ From the perspective of the Board of Trustees, the church is "geothermal ready" and a year or so down the road, an air conditioning unit for one of the gas furnaces fails. You look at your options: 1) replace the AC unit for \$5,000 or 2) or invest in a heat pump furnace that provides cooling and heating for \$15,000. The church already has a shortfall in the operating budget of \$40,000 for the year. Chances are the Board will decide to just replace the \$5,000 AC unit and defer investing in geothermal equipment until the financial situation gets better. And the same situation will occur next year.

⁷⁵ According to a "Reserve Study" by a consultant, Miller & Dodson, the average age of the existing 10 natural gas furnaces was 15 years.

⁷⁶ Steketee, Mike (November 20, 2010). "*Some sceptics make it a habit to be wrong*". *The Australian*.

⁷⁷ Oreskes, Naomi; Conway, Erik M. (2010). *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. Bloomsbury Press. p. 6. ISBN 978-1-59691-610-4. merchantsofdoubt.org

⁷⁸ **UU World**, Spring 2019. <https://www.uuworld.org/articles/spiritual-landmark-spring-2019>

⁷⁹ **Duane Tawahongva**, <https://hopiartstrail.com/members/silversmiths/duane-tawahongva>

⁸⁰ Recommended works of linguist George Lakoff include: [<https://georgelakoff.com/books/>]

a) "The ALL NEW Don't Think of an Elephant!: Know Your Values and Frame the Debate"

Called the "father of framing" by The New York Times, Lakoff explains how framing is about ideas—ideas that come before policy, ideas that make sense of facts, ideas that are proactive not reactive, positive not negative, ideas that need to be communicated out loud every day in public. The **ALL NEW Don't Think of an Elephant!** picks up where the original book left off—delving deeper into how framing works, how framing has evolved in the past decade, how to speak to people who harbor elements of both progressive and conservative worldviews, how to counter propaganda and slogans, and more. In this updated and expanded edition, Lakoff, urges progressives to go beyond the typical laundry list of facts, policies, and programs and present a clear moral vision to the country—one that is traditionally American and can become a guidepost for developing compassionate, effective policy that upholds citizens' well-being and freedom.

b) "The Little Blue Book: The Essential Guide to Thinking and Talking Democratic"

Voters cast their ballots for what they believe is right, for the things that make moral sense. Yet Democrats have too often failed to use language linking their moral values with their policies. The Little Blue Book demonstrates how to make that connection clearly and forcefully, with hands-on advice for discussing the most pressing issues of our time: the economy, health care, women's issues, energy and environmental policy, education, food policy, and more.

(Continued)

c) **Moral Politics: How Liberals and Conservatives Think**
(Continued)

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In this classic text, the first full-scale application of cognitive science to politics, George Lakoff analyzes the unconscious and rhetorical worldviews of liberals and conservatives, discovering radically different but remarkably consistent conceptions of morality on both the left and right. For this new edition, Lakoff adds a preface and an afterword extending his observations to major ideological conflicts since the book's original publication, from the impeachment of Bill Clinton to the 2000 presidential election and its aftermath.

For a complete list of his work see: <https://georgelakoff.com/writings/> To our knowledge, he has not written a book or paper dealing with reframing the climate crisis Lakoff did publish a paper "On Environmental Communication"

[https://www.huffingtonpost.com/george-lakoff/on-environmental-communic_b_741306.html].

⁸¹ See: https://en.wikipedia.org/wiki/Life-cycle_cost_analysis, https://www.nist.gov/customcf/get_pdf.cfm?pub_id=907459

⁸² See: https://en.wikipedia.org/wiki/Life-cycle_assessment or "[Defining Life Cycle Assessment \(LCA\)](https://www.epa.gov/lca/defining-life-cycle-assessment-lca)." US Environmental Protection Agency. 17 October 2010. [<http://www.gdrc.org/uem/lca/lca-define.html>]

⁸³ *The Economics of Welfare* Arthur C. Pigou, . London: Macmillan. 1920. http://en.wikipedia.org/wiki/Pigovian_tax

⁸⁴ "A Carbon Tax That America Could Live With," N. Gregory Mankiw, New York Times, August 31, 2013,

http://mobile.nytimes.com/2013/09/01/business/a-carbon-tax-that-america-could-live-with.html?emc=edit_tnt_20130831&tntemail0=y&

⁸⁵ IGM Forum asked a panel http://www.igmchicago.org/igm-economic-experts-panel/poll-results?SurveyID=SV_9Rezb430SESUA4Y

⁸⁶ see www.CitizensClimateLobby.org

⁸⁷ EPA <http://www.epa.gov/cleanenergy/energy-resources/refs.html>

⁸⁸ *The Cost Of Carbon Capture*, Jeremy David and Howard Herzog, Massachusetts Institute of Technology (MIT), Cambridge, MA, USA http://sequestration.mit.edu/pdf/David_and_Herzog.pdf

⁸⁹ http://en.wikipedia.org/wiki/Oil_sands

⁹⁰ From my personal experience installing rooftop solar on our home as documented in an earlier section, with federal and utility company subsidies included, my net cost of producing electrical power turns out to be \$0.05 kWh for 20 years (expected operational life of the system).

⁹¹ "**Full cost accounting for the life cycle of coal**" Paul R. Epstein, Jonathan J. Buonocore, Kevin Eckerle, Michael Hendryx, Benjamin M. Stout III, Richard Heinberg, Richard W. Clapp, Beverly May, Nancy L. Reinhart, Melissa M. Ahern, Samir K. Doshi, and Leslie Glustrom. 2011. in "Ecological Economics Reviews." Robert Costanza, Karin Limburg & Ida Kubiszewski, Eds. Ann. N.Y. Acad. Sci. 1219: 73–98.

⁹² A Pigovian correction is typically a fee or tax imposed to correct the market price of a good or service to reflect that product's true cost to society. Arthur Pigou, British economist, first recognized this (fatal) flaw in economic systems in the early 1900s

⁹³ **Geothermal Groundwork Complete on Denver-area IKEA Store:** IKEA Centennial will be the State of Colorado's Largest Geothermal Building, <http://www.saundersci.com/news-articles/IKEA-Geothermal.html>

⁹⁴ Personal Conversation with Ron Larson, Jefferson Unitarian Church (JUC),

⁹⁵ **Solar Energy and Geothermal Heating and Cooling Systems at MVUC.** "MVUC's [sustainable energy project incorporates solar panels](http://mvuc.org/social-justice/our-solar-geothermal-energy-program/) to generate electricity, combined with heating and cooling by geothermal heat pumps, which require much less energy than the former conventional units." <http://mvuc.org/social-justice/our-solar-geothermal-energy-program/>

⁹⁶ "Living without Fire - Just the Sun and Earth," by Milt Hetrick, 2014.

⁹⁷ Refrigeration. <https://en.wikipedia.org/wiki/Refrigeration>

⁹⁸ In **1913**, refrigerators for home use were invented. In **1923** Frigidaire introduced the first self-contained unit. The introduction of Freon in the **1920s** expanded the refrigerator market during the **1930s**. Home freezers as separate compartments (larger than necessary just for ice cubes) were introduced in **1940**.

⁹⁹ Air source heat pumps are commonly used for residential heating and cooling in moderate temperature zones. Although easier to install than a ground source heat pump, the air source systems are less efficient and are not able to provide heating when the ambient temperature is below 30 degrees Fahrenheit.

¹⁰⁰ **0.005302 metric tons CO₂/therm = 11.66 pounds /therm** <http://www.epa.gov/cleanenergy/energy-resources/refs.html>

¹⁰¹ [Note: There is a very real possibility that the rate of increase in the cost of fossil fuel will increase much more rapidly because of the ongoing effort to "put a price on carbon pollution." There is a growing coalition of conservative economists and environmentalists. Their common objective is to implement a revenue-neutral Pigovian correction to the current economic system by adding a carbon-burning fee to fossil fuels based on the amount of CO₂ they produce when burned. The plan is to start slowly with a fee of \$10 / metric tonne of CO₂ and increase the fee each year by \$10 for at least 20 years. This is considered a market-based approach because the "dirtier" fuels (e.g. coal) will be assessed a higher fee than cleaner fuel (e.g. natural gas). The market will be able to see the true cost of various fuels and respond accordingly. The current plan is to return 100% of these fees as a "dividend" check to all household evenly.

An economic assessment of this plan has been reported by REMI who indicate this carbon fee will actually stimulate more activity in the economy - the loss in fossil fuel jobs is smaller than the gain on jobs in the renewable energy sector. For more information, see www.CitizensClimateLobby.org .]

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¹⁰² The U.S. average increase in electric costs from 2013 to 2014 was 3.2%. The annual increase in the Mountain States was 4.5%. Ref: <http://www.eia.gov/todayinenergy/detail.cfm?id=17791> The rate of increase in natural gas cost over the next 20-25 years is estimated by EAI to be 3.5%. Ref: <http://www.eia.gov/forecasts/aeo/pdf/tbla3.pdf>

¹⁰³ Assume a 4 Ton A/C unit costs around \$5000, a 4 Ton 95% AFUE(High Efficiency) gas furnace costs about \$4000. To replace all 10 furnaces & A/C units at today's prices would be \$90,000. Assume a service life of 12 years. 20 years is 1.67 service lives. Using \$9000 per furnace & A/C unit, we would expect a replacement cost of around \$150,000 over 20 years.

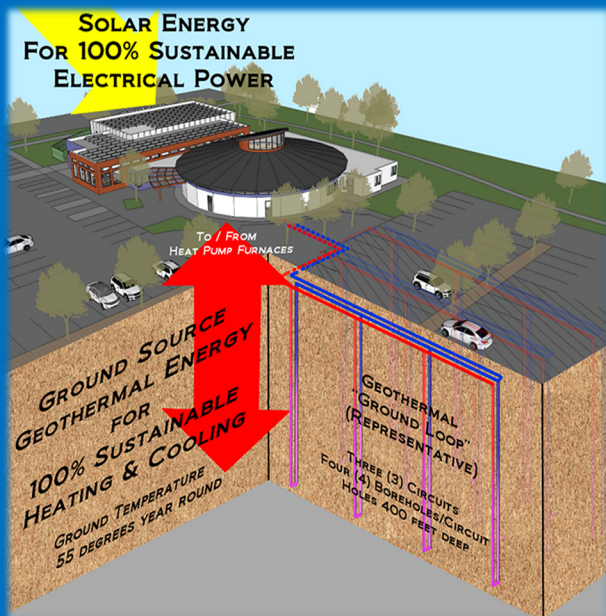
¹⁰⁴ 1 therm = 0.0053 metric tons CO₂ Ref: <http://www.epa.gov/cleanenergy/energy-resources/refs.html>; 1 kWh = 2 lbs CO₂

¹⁰⁵ Manuela Loos, Leo Meyer, Prepared by Working Group III of the Intergovernmental Panel. See also MIT study on removing CO₂ from the atmosphere. For this assessment we will use a sequestration cost of \$57 / tonne of CO₂. Ref: http://sequestration.mit.edu/pdf/economics_in_technology.pdf

¹⁰⁶ **IPCC Special Report on Carbon Dioxide Capture and Storage**, Edited by Bert Metz, Ogunlade Davidson, Heleen de Coninck, Manuela Loos, Leo Meyer, Prepared by Working Group III of the Intergovernmental Panel. See also MIT study on removing CO₂ from the atmosphere. For this assessment we will use a sequestration cost of \$57 / tonne of CO₂. Ref: http://sequestration.mit.edu/pdf/economics_in_technology.pdf

¹⁰⁷ According to a detailed study, "**Full cost accounting for the life cycle of coal,**" by Paul R. Epstein, et. al. a dollar value can be assigned to a number of externalities associated with burning coal. To compensate for these social costs, the actual price of electricity should be increased by as much as \$0.27 / kWh above the current national average of around \$0.11-0.12 / kWh. " The details of this study were published in the *Annals Of The New York Academy Of Sciences*, ISSN 0077-8923, Issue: *Ecological Economics Reviews*, 2011. http://www.chgeharvard.org/sites/default/files/epstein_full%20cost%20of%20coal.pdf

¹⁰⁸ For example, "The oft-repeated claim of a "200 year supply" of U.S. coal does not appear to be grounded on thorough analysis of economically recoverable coal supplies. Reviews of existing coal mine lifespan and economic recoverability reveal serious constraints on existing coal production and numerous constraints facing future coal mine expansion. Depending on the resolution of the geologic, economic, legal, and transportation constraints facing future coal mine expansion, the planning horizon for moving beyond coal **may be as short as 20–30 years.**" Ref: "**Full cost accounting for the life cycle of coal,**" by Paul R. Epstein, et. al. published in the *Annals Of The New York Academy Of Sciences*, ISSN 0077-8923, Issue: *Ecological Economics Reviews*, 2011. http://www.chgeharvard.org/sites/default/files/epstein_full%20cost%20of%20coal.pdf



This is a creation-care story about a bottom up (grass roots) initiative started by a small group of concerned church members who were committed to preserving a habitable planet for future generations. They were committed to the 2015 Paris Agreement to limit global warming to less than 2°C.

This story begins as a renovation project at First Universalist Church Denver. The project goals were:

- Fix a leaky roof,
- Accommodate more people in a larger Sanctuary,
- Provide more classroom space,
- Replace aging equipment, and
- Use less energy - install new windows, add insulation, new lighting.

But something else occurred and the renovation project grew.

A small group of people within the congregation, sensing an impending anthropogenic global crisis in the near future, introduced a new concern and an additional goal. That goal was to stop doing harm by transitioning to a sustainable renewable energy system for the church. A sustainable energy system with zero Greenhouse gas emissions required new 21st century equipment. The new energy equipment required even more financial resources - actually about 10% more. The prevailing attitude at the mere mention of this idea was, "We cannot afford it."

When the capital campaign to raise money for the renovation project ended with a significant shortfall, the new energy system was deleted from the renovation. The Green First Team took on the challenge to find financing for the new sustainable energy equipment. Their story is real. The church is real. The people are real but not identified in the story to protect their privacy.

This Unbridged Version of the First Universalist Case Study documents many of the unavoidable conflicts that occurred among the diverse parties involved and how these differences were generally resolved or at least managed. The story is told by the people involved using their presentations, financial worksheets, posters, white papers, and even significant redacted email .

A member of the Board of Trustees, advised the Green First Task Force that the funding approach must be 'revenue neutral' and not require any change to the annual operating budget. The necessary capital was raised internally using a combination of member donations and low interest member loans. The loan repayment plan was designed to be lower than the current operating budget for utilities. This financing approach was approved unanimously by the congregation on November 6, 2016.

Transitioning to a solar and geothermal energy system is expected to reduce the 20-year life cycle operating cost (for electrical power plus heating and cooling) by over \$150,000.

The new sustainable energy system has zero carbon emissions. As a result, the congregation avoids dumping over 100 tons of CO₂ eq into the atmosphere annually and complies with the 2015 Paris Agreement and the 2018 IPCC 1.5C Report.

First Universalist Church Denver can join those who proclaim, "We are still in" the Paris Agreement to limit global warming to 1.5°C.

