From the Ground Up

Transitioning a Faith-Based Facility to Sustainable Energy Using Solar Electric and Ground-Source Heating & Cooling

Abridged Case Study: First Universalist Church Denver, Colorado

Assembled and Reported by:
Milt Hetrick

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Green First Task Force
First Universalist Church Denver, Colorado

10 9 8 7 6 5 4 3 2

ISBN-13: 978-1-0866-0744-4

Dedication

To all those who shared their experiences to help us build this vision into a reality,

To indigenous peoples - who show us how to live connected to Mother Earth,

To 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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Preface

The following is a story of a recent renovation project at First Universalist Church Denver. The project accomplished its initial goals:

- Fix a leaky roof,
- Accommodate more people in a larger Sanctuary,
- Provide more classroom space,
- Replace aging equipment, and
- Use less energy to operate with windows and added insulation.

But there was more. Some describe it as an Emergence.

A small group of people within the congregation (referred to as the Green First Team), sensing an impending anthropogenic global crisis in the near future, introduced a new concern and an additional goal for the renovation project. The additional goal was to stop doing harm by transitioning to a sustainable renewable energy operating system for the church. This new goal was not well received at first, because it required even more financial resources (actually 10% more). The prevailing attitude at the mere mention of this idea was, "We cannot afford it."

There were numerous times where hurdles and obstacles to reaching this goal seemed to be insurmountable. However, during those difficult times, something seemed to hold the Green First Team of advocates together, and they were able to "work around" most of the obstacles.

The story is real. The church is real. The people are real, but not identified to protect their privacy. The story documents the inevitable conflicts that occurred among the diverse & passionate parties involved and how these differences were generally resolved or at least managed.

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

The Church included the congregation at large (church members and friends), and sub-groups:

- the church leadership consisting of the Ministers, staff and the 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 four 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 (10% of the adult membership) who provided the capital required to purchase the new energy equipment (solar and geothermal).

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

- the architectural design team (Barrett Studio Architects)
- 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 apparent the "Church" and "Contractors" are embedded in a ubiquitous social structure intended to influence its members/citizens in a way that creates a civil society 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.)

During this project, it became obvious the current social system is not designed to influence citizens to make sustainable choices. New ways of thinking were needed.

Although our current social system in the U.S. attempts to financially incentivize and encourage homeowners and business owners to invest in sustainable/renewable energy, there are few if any such incentives for the non-profit sector. The story identifies techniques to level the playing field for churches and other non-profit groups unable to benefit from tax-based financial incentives.

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. The project was a team effort.

Finally, although this story involves a specific faith-based community that has its roots in the Judeo-Christian framework, motivation for this project was based on a general "creation care" principle embedded in most world religions. Other religious communities can replace the UU Seventh Principle[1] with their own creation care story and sense of stewardship for Earth. But it is essential to find a common thread (i.e., a set of values) to bind the group together as they navigate a path around the inevitable obstacles on this journey.

Executive Summary

After approximately a year of internal discussion and discord, 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.

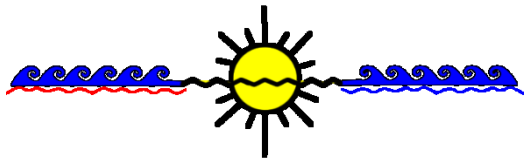
The church was closed for remodeling in August of 2016 and partially reopened for the Christmas Eve program 2017. Installation of the rooftop solar system was completed in March 2018. The new energy system became fully operational in June 2018.

The sustainable energy system has zero carbon emissions and avoids dumping 100 tons of CO_2 into the atmosphere annually. Also, 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.

The Congregation takes pride in being able to join the ranks of those who declare, "We are Still In" the Paris Agreement despite what the current federal administration has decided. First Universalist is well along the Path to Zero GHG Emissions – a mandatory goal as we currently understand climate science and the laws of physics if we are to leave a habitable planet for future generations.



Introduction

"Story telling is the oldest form of education."

…Terry Tempest Williams

Where does this story begin? With today's scientific awareness, "Once upon a time" can now take our minds back 13.7 billion years along a continuous golden thread of connectedness that is "Everybody's Story."[2]

Everybody's Creation Story (Scientific Point of View)

To be alive today and able to reach back that far into the deep past is a profound historical privilege never experienced by previous generations. Thanks to brilliant minds who peer outward through eyeglasses like the Hubble Telescope and meticulously observe what they can still see in the expanding Universe, we have a better understanding of not only our origin but also where we are headed. We can now see innumerable examples (from among an estimated 100 billion galaxies each containing as many as 100 billion stars / solar systems) of our Mother Star, likely a Supernova, that gave birth to our solar system.

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 nature.[3]

When we turn our telescopes around and use them as microscopes, we can see 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 (some call it the Goldilocks planet because conditions for life are just right), we are now aware of continuous threads of evolving complexity of

diverse arrangements of basic star stuff[4] depicted in today's phylogenetic Tree of Life.[5] Sharing the planet with us today are now more than 2 million unique living species.[6]

We now have phylogenetic evidence that all living systems have a last universal common ancestor (LUCA) dating back 3.5 to 3.8 billion years ago[7.] In the language of science, all living species on Earth are connected by remarkably similar DNA - evidence Life on planet Earth is one extended family.[8]

This is everybody's creation story. It is the creation story told by Religious Naturalists.[9] Indigenous people have their version. All world religions have their versions. Regardless of the language used to tell the story, it is sacred. The story is so profound it borders on the mysterious.

Even more intriguing is that this story of evolution is also a story of emergence[10] throughout the Universe – at the cosmological scale down to the subatomic level. The creation of something more (complex and conscious) from nothing but (what already exists) – it is the story of evolving consciousness.

Today's Setting

We are now aware, in the language of science, that without a continuous connection to an external source of energy, living systems on Earth return to a pile of stardust and become available to be re-purposed into another living system.

We know we would not be alive were it not for the interdependent web of life that allows the flow of life-sustaining energy from Sunlight (electromagnetic energy) to biomass/hydrocarbons (chemical energy) we call food.[11] If a significant portion of the energy network (read as the food chain) becomes disrupted, life further along the chain can no longer thrive and may even become extinct.

Foretelling

Just as our evolving consciousness fills us with a sense of awe and oneness within all Life, climate science shocks us back into reality with evidence there is an unprecedented perfect storm on the horizon (i.e., the Sixth Mass Extinction).[12]

Climate science informs us this imminent storm is gathering strength as the result of an exploding population of homo sapiens (over 7.6 billion in

2018 and growing one percent/year) who are engaged in collective ecocidal behavior. This storm encompasses the entire planet and threatens our whole global family – be they on land and in the ocean.

That our species is capable of triggering a sixth mass extinction is disconcerting to hear and challenging to comprehend. But after more than two decades of intense study, observation, research, and analysis, climate experts around the world indicate the science is clear.

The living conditions on our "just right" planet are being altered because homo sapiens are dumping enormous amounts of greenhouse gases into the common atmosphere daily.

From a scientific perspective, the root cause of this increase in CO_2 is known and has been verified by actual measurement around the world. The solution is also simple; humans must stop burning ancient hydrocarbons and dumping the combustion products that include CO_2 (a GHG) into the atmosphere. From a technology perspective, it is possible to stop using ancient hydrocarbons as a source of thermal energy by using/ harvesting other energy sources: wind, solar, geothermal, and hydro.

We are currently adding around 40 gigatonnes of CO_2 to the atmosphere each year, making the thermal blanket thicker and thicker. As a result, the laws of physics tell us the average surface temperature of the Earth will continue to increase. Burning hydrocarbons is ecocidal behavior. We must stop dumping greenhouse gases into the atmosphere to leave a habitable planet for future generations.

Responding to Everybody's Story

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. Life scientists have described Earth as a Goldilocks planet, i.e., it is "just right" for life to evolve and thrive. (Especially 2.6diverse, 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 our technology. The combustion process that releases energy in the form of heat (thermal energy) also dumps CO_2 and other GHG into our atmosphere. The Keeling Curve shown in Figure 1 is updated daily by the Mauna Los Observatory.[13] It clearly shows the level of CO_2 in our atmosphere continues to increase relentlessly over the past six decades. As reinforced by the 2018 IPCC SR 1.5 deg C Report, this upward trend must stop, level off, and start to decline within the next decade if we hope to leave a habitable planet for complex land species in the future.

Everyone on this planet is subject to the same laws of physics as they strive to live sustainably. Pure and simple, that means learning to live with zero GHG emissions or perish. There is not any other choice at this late date. There are no exceptions for economic status, for nationality, age or gender.

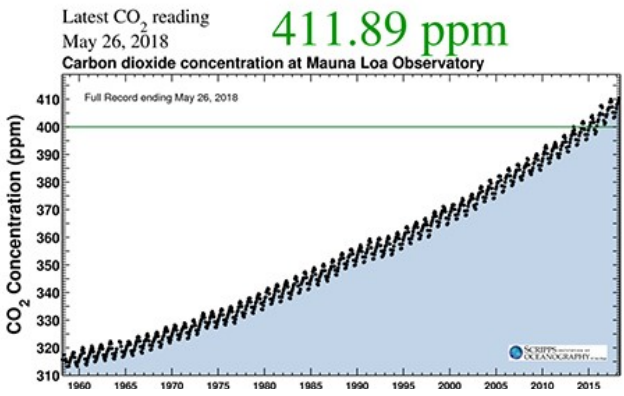


Figure 1 Global CO_2 Levels Continue to Increase

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

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. They 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, and be reduced to net zero within 15-20 years to limit warming to 1.5 deg C.

As a religious denomination, the Unitarian Universalist Association (as well as other faith-based organizations), has expressed its concern about global warming. So this story describes some UUA initiatives (General Assembly Resolutions in 2006, 2013, 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 CO_2 caused by burning ancient hydrocarbons for energy.

The story then begins to get more specific. Requests are made. Agreements are formed, bent, and broken. Goals are set and moved. Skepticism, fiduciary responsibility, values, UU purpose, and principles are re-examined, conflicts arise and are managed if not resolved, BUT eventually, a congregational level response emerges. And that's the story.

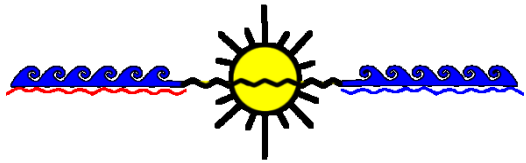
It is not clear how it came together; but in the end, the renovated church facility made the transition to a sustainable energy system. By using solar energy and ground-source geothermal energy instead of burning hydrocarbons, the church facility no longer does harm to the planet or the future of its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

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 to make unsustainable choices.

What this story is about

This story is a condensed (abridged) version of a more detailed case study, "Transitioning to Sustainable Energy: Using Solar Electric / Ground Source Geothermal Energy Heating & Cooling." A Case Study: First Universalist Church, Denver, Colorado.



Part I: An Awakening- a Growing Awareness- (Pre 2016)

"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 four chronological segments. Part I recalls some recent history that set the stage for this project.

For those, past and present, who contributed to building the foundation for this project, we acknowledge and honor their early awakening. Today our collective consciousness and environmental awareness is the accumulation of the heroic efforts by those who came before us.

Rachel Carson's Silent Spring (1962) – an early 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 (1968) – a profound awareness of Spaceship Earth

Figure 2 EarthRise as Seen from Lunar Orbit December 1968

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. 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 no power lines are coming to us bringing electricity. There are no pipelines transporting oil or gas from outer space. No water pipes are 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.

Learning how over seven billion homo sapiens can live sustainably on such a finite planet has become one of today's foremost existential issues.

"Vast loneliness" acknowledges that the barren lunar landscape in the foreground of Figure 2 is unable to sustain life as it is. Not shown (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. Perhaps because of overfamiliarity, we fail to appreciate the daily gift of energy that supports the interdependent web of life on planet Earth.

Blue Marble-Apollo 17 (Dec 1972)

Later ventures into space captured images of the entire Earth's surface – as seen in daylight (see Figure 3).

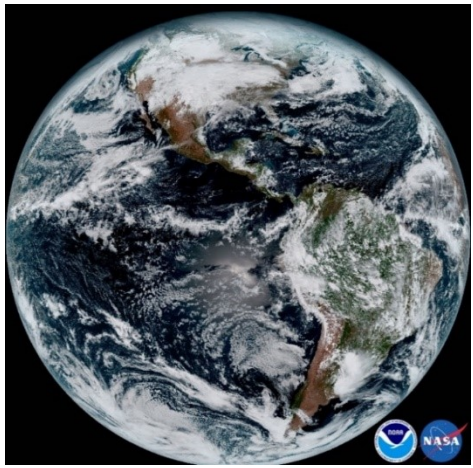


Figure 3 Earth by Day

What our eyes see in the photo 'Earth by Day' is actually 'current sunlight' reflecting off various areas of our planet called albedo. The dark areas of the oceans indicate nearly all the Sun's energy is absorbed by the ocean. The white clouds indicate the Sun's energy is being reflected into space.

Limits to Growth (1972)

Limits to Growth was published by Donella H. Meadows, Dennis L. Meadows, Jørgen Randers, and William W. Behrens III in 1972.

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

The book continues to generate intense 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.[14,15,16]

UU Ministry for Earth (UUMFE) (1989)

The mission statement of the UU Ministry for Earth (UUMFE) is: "Connecting and inspiring an active community of Unitarian Universalists for environmental justice, spiritual renewal, and shared reverence for our Earth home."

Their vision is a world in which reverence, gratitude, and care for the living Earth are central to the lives of all people. Their purpose is to inspire, facilitate, and support individual, congregational, and denominational practices that honor and sustain the Earth and all beings. They 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."

In 1991, the **Green Sanctuary Handbook** was published blending religious celebrations, education, administration, and community action. In 1999, Rev. Fred Small inspired a national environmental program. In 2002, the Green Sanctuary program began accrediting congregations. UUMFE was instrumental to the passage of the landmark 2006 Statement of Conscience on the Threat of Global Warming/Climate Change.

NOTE: First Universalist Church Denver completed certification as a Green Sanctuary in 2010

The Green Sanctuary Program

The Green Sanctuary Program provides a path for congregational study, reflection, and action in response to environmental challenges, including 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 Justice[17] acknowledges that marginalized communities are often hit first and hardest by environmental crisis. In partnering with these communities, we can 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 Celebration[18] 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 Education[19] shapes more than just minds. It shapes attitudes and practices.

Sustainable Living[20] requires us to treat the world more gently by using fewer resources and being mindful of the choices we make.

UUA General Assemblies: Ethical / Moral / Spiritual Issues

Congregations that are members of the Unitarian Universalist Association generally adopt and adhere to the UUA Purposes and Principles: see https://www.uua.org/beliefs/what-we-believe/principles.

Has the Unitarian Universalist Association documented a position on climate change and sustainable energy issues?

Yes. In 2006[1] and again in 2013[21], 2014[2] and 2015[3], the Unitarian Universalist Association (UUA) General Assembly (GA) democratically voted and passed Resolutions about Energy, Climate Change and Divesting from Fossil Fuels. A few excerpts are provided:

Statement of Conscience: 2006 UUA General Assembly

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;
- 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;

Divestment from the Fossil Fuel Industry - 2013 Action of Immediate Witness: 2013 UUA General Assembly

BECAUSE the Sources of Unitarian Universalism counsel us to heed the guidance of reason and the results of science;

BECAUSE Unitarian Universalist congregations covenant, in their Seventh Principle, to respect the interdependent web of all existence of which we are a part, and member congregations have demonstrated their commitment to this Principle in various ways, including by Green Sanctuary certification;

BECAUSE the 2006 Unitarian Universalist Association (UUA) Statement of Conscience calls on Unitarian Universalist congregations to "use congregational financial resources to positively address the global warming/climate change crisis"; and

BECAUSE the "UUA Socially Responsible Investment Guidelines" (2008) state that investments in companies engaged in negative global impact activities are to be avoided;

WHEREAS, we understand our lives are tied up in the consumption of energy;

WHEREAS, the fossil fuel industry currently controls fossil fuel reserves that, if burned, will produce more than five times the amount of greenhouse gas emissions required to raise global temperatures beyond 2º C, the level that leaders of 167 countries, including the United States, have agreed represents a threshold beyond which civilization cannot survive without enormous suffering;

WHEREAS, the global and growing movement 350.org is calling upon universities, pension funds, public entities, and religious institutions to divest their investments in 200 fossil fuel companies…;

WHEREAS, given the reality of climate change, passively profiting from business as usual in carbon-intensive fossil fuel companies is an abdication of our responsibility and thus morally wrong;

THEREFORE, BE IT RESOLVED that the 2013 General Assembly of the Unitarian Universalist Association calls upon delegates to begin a denomination-wide conversation within their congregations about divesting from fossil fuels or exercising shareholder influence. Congregations might discuss the following:

1. Stopping any new direct investments in fossil fuel companies, as listed in Carbon Tracker reports;

2. Divesting of all direct securities holdings in fossil fuel companies within the next five years;
3. Investing in diversified, socially responsible, and climate-friendly securities, and securities in the renewable energy and efficiency sector;
4. Investing in making their own facilities more energy efficient, make widespread use of renewable energy, adopt conservation and efficiency measures;
5. Evaluating the effectiveness of shareholder advocacy; and
6. Retaining the option of owning the minimum number of shares necessary to be an activist shareholder. These shares would be considered "influence payments" and not investments.

Fossil Fuel Divestment - Business Resolution: 2014 UUA General Assembly

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, 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 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, 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 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

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, 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 disproportionally affected by climate disruption;

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.

It should be mentioned that the above UUA statements about 'creation

care' have related counterparts in all of the world's religions.[22]

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

A Green First Task Force member wrote the following on 11/15/2011

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.

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 then.

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

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

As the workshop facilitators fielded 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 burning 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 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.' " [23]

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 sustainable project, 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 essential to include in the remodeling project.

Sustainability Presentation to Architects (21 Aug 2015)

It is strange how the Universe works sometimes. The following week two Green First Team members were invited to travel to Boulder for the next scheduled status meeting on 21 Aug 2015 with the BBF building 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 intent of this meeting was to 1) review / summarize all of the sustainability features the church wanted the architects to consider in their

design activities and 2) to explore the feasibility of adding solar electric and geothermal heating & cooling to the scope of the renovation project.

At the end, the presenter requested feedback from the architects. "What are the architectural issues of geothermal heating/cooling?"

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. The Building Committee could then decide later about whether to retain the existing natural gas furnaces or invest in new geothermal heat pump furnaces.

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.

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.

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."**

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's mechanical design.

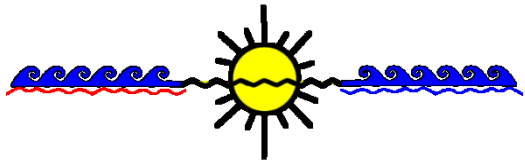
This affirmation of the feasibility of geothermal was a high point for the Green First Team advocates striving to transition from unsustainable natural gas to an inexhaustible, clean energy alternative.

In retrospect, this presentation was a significant coordination event for

several reasons.

Although the Sustainability Subcommittee briefing was intended to coordinate First Universalist goals with the architects early in the design process, it 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 about transitioning from fossil fuel to renewable energy.

It seemed that starting 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. On the 45 minute ride home from the architect meeting, the carpool had a lively conversation about energy technology and especially geothermal heating & cooling. One of the BFF committee members captured the key elements of the conversation and developed a "Sustainability Framework" that included solar and geothermal as project goals. It was published on a separate flyer that became part of the official BFF literature/handouts during the capital campaign that began at the end of 2015 and continued into March of 2016.



Part II Energy System Capital Campaign (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, the solar and geothermal equipment had become an integral part of the Building for the Future (BFF) remodeling project. Contributions to the BFF project would be financing the new sustainable energy system. Solar and geothermal objectives had been included in the project's design requirements "Sustainability Framework." The Green First Task Force was elated. Their Ministry for 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. It was a difficult time for the BFF 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 by deleting the new sustainable energy system, some classrooms, and several other items.

The renewable energy system was estimated to cost around $450,000 and represented 10% of the total project cost.

Congregational Approval of Revised Building Project (3 April 2016)

At a congregational meeting on April 3, 2016, it was formally announced that there would be no funding allocated to a renewable energy system and that several classrooms had also been deleted from the project because the capital campaign had ended with a significant shortfall.

Parents with children enrolled in the youth religious education (RE) program, another vital ministry of the church, were upset. They had pledged to the project, thinking their children would have an enhanced religious education program; these parents were now learning the additional classrooms would not be built.

For the Green First team, the mere thought that the baseline project would continue to use the existing natural gas furnaces and continue to buy/burn natural gas for heating the church was devastating. But this was not just a thought. It was a reality. It was the first major low point in the morale of the Green First Team.

After an intricate discussion of the revised renovation plan, a motion was placed on the floor for a vote. It was moved that the congregation approve the revised building project with five stipulations.

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.

The motion was seconded and with some "No" votes, was approved. Condition # 4 of the motion was of particular interest to the Green First team.

"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."

When the Congregation approved the motion to reduce the scope of the building renovation project and closed the door on a new sustainable energy system, stipulation #4 of the motion opened a new door. The Green First Task Force had been authorized to pursue external/third-party funding for the "solar and geothermal systems" subject to Board approval.

At the time, the Green First Task Force 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 – a subproject,
b) the Green First Team must/could pursue funding from other sources they might be able to locate, and
c) the Green First Team must submit any funding plan to the Board for approval.

The capital campaign had officially ended. The Building Committee, of course, had to readjust their dream and become concerned that the money allocated for the project (that now included a $400,000 mortgage) was going to be enough to finish the job.

This bend in the road created internal conflict. 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.

The Green First Team rebounded and began looking for external/third-party investors in renewable energy using SolarCity, SunRun, Sungevity as examples.

They soon found that these sources of funding would indeed front the money to install a rooftop solar PV system (with a range of possible financing options), BUT when the Green First Team tried to include the geothermal heating and cooling system in the financing plan, all bets were off.

Finding the capital for a new energy system was not going to be easy.

Science Presentation-First Universalist Response to Climate Change:

It became apparent that a new campaign to gain support for a new energy system was going to be required and difficult.

One of the Green First Task Force members, 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. He decided to line up a speaker to discuss the BFF Project, specifically the sustainable energy system, from a science perspective. He found a candidate speaker, and fellow scientist, who happened to also be on the Green First Team willing to take on this challenge.

There were around 15-20 attendees (all church members) at this "Science" presentation on 17 May 2016

The presenter, a retired engineer/physicist, had been a member of the church for 40 years and had served on the Board and was a former Moderator in the 1980s. More recently, he was 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.[24]

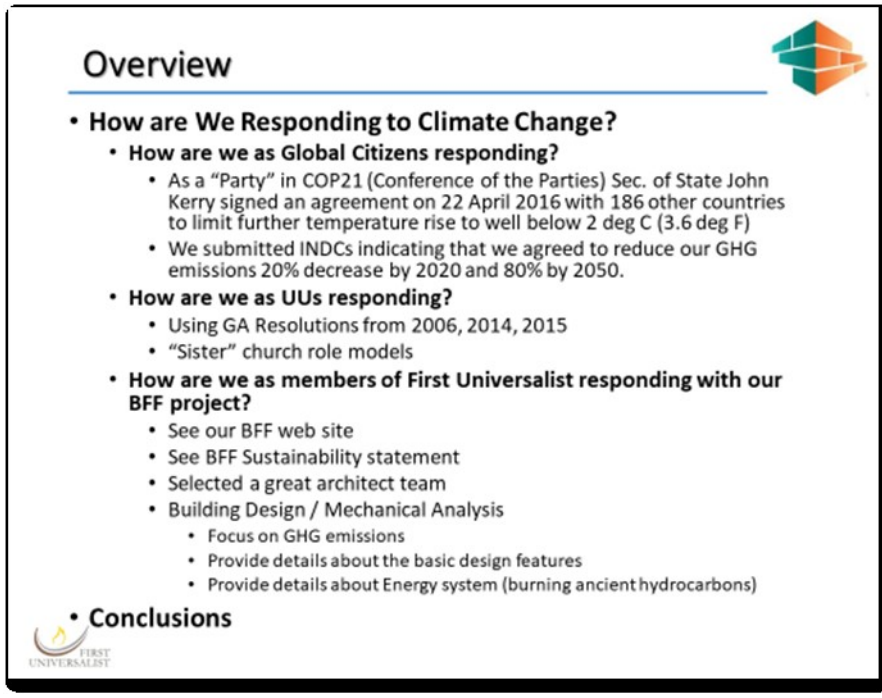
The presenter made a deliberate attempt to focus only on the science perspective of the building project and avoid all mention of the ongoing contentious financial issues. The Green First team was still reeling emotionally from the fact that none of the money raised during the capital campaign was going to be used for transitioning to renewable energy.

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**.

Some of the science presentation charts are provided below. The entire presentation can be found at the link below:

Science Presentation: How We are Responding to Climate Change		
http://coloradointerfaithgreenbuilding.org/HowWeAreRespondingScience.pdf	PDF	43 pgs



How are we as Global Citizens responding to Climate Change?

COP21 Paris Agreement.

Since 1994, the global community has been meeting annually to develop a response to climate change under the auspices/framework of the United Nations Framework Convention on Climate Change (UNFCCC). There were significant events at each annual Conference of Parties (COP), but at COP21 in December of 2015, we see a significant milestone known as the Paris Agreement.[25] The 195 "parties" that attended expressed concern about the harm humans 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:

PARIS AGREEMENT (Excerpts)

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 CO_2 and other greenhouse gases. Each party was to submit their goals along with a timeline for implementing its 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 deeper reductions in GHG emissions would be required[26] than those voluntarily submitted on the first round.

There is no question that what was happening in the global community contributed to the enthusiasm and motivation of the Green First Task Force to push forward with their proposal for a zero GHG emissions energy system to operate the church.

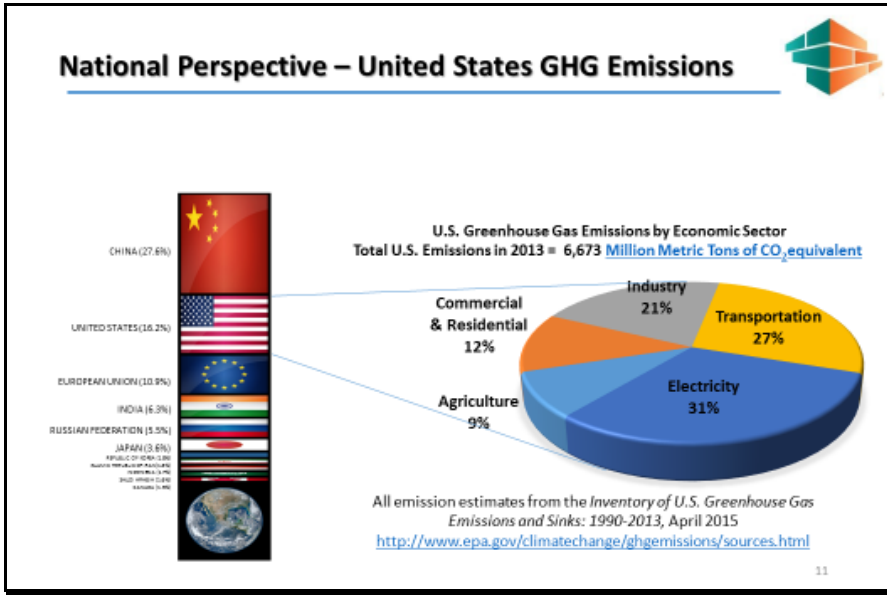


Figure 4 Global and National Greenhouse Gas Emissions

The presenter included Figure 4 Global and National Greenhouse Gas Emissions that 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 CO_2 and other greenhouse gases into the atmosphere. By adding the next eight 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.

As indicated by the pie chart, U.S. emissions are around 7 billion metric tonnes. The generation of electrical power makes up over 30% of the country's GHG emissions.

IPCC Fifth Assessment Report

The next exhibit in the science presentation was Table 2.2 of the IPCC Assessment Report (AR5),[27] found on page 64. When it was published in 2015, the table provided the current understanding of the correlation between the amount of additional CO_2 we can add to our atmosphere and the resulting average Earth temperature. (See Table 1 Carbon budget for a 1.5, 2, and 3 degrees C warmer planet.)

Table 1 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	
For 66% model agreement	Carbon budget in $GtCO_2$			
Carbon Budget Remaining[a]	243		843	
No. of years remaining [b]	6.0		20.9	
Stranded Assets (Unburnable fossil fuel reserves) [c]	95%	-2% +2%	84%	-7% +4%
For 50% model agreement	Carbon budget in $GtCO_2$			
Carbon Budget Remaining	393	2015 Goal	1143	
No. of years remaining	9.8		28.4	
Stranded Assets (Unburnable fossil fuel reserves)	93%	-4% +1%	79%	-10% +5%
For 33% model agreement	Carbon budget in $GtCO_2$			
Carbon Budget Remaining	693		1343	
No. of years remaining	17.2		33.3	
Stranded Assets (Unburnable fossil fuel reserves)	87%	-6% +3%	75%	-12% +6%

[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

Starting in the middle of the table with the "less than (<) 1.5 deg C" column, it shows 50% of the current climate change computer models (there are several dozen) predict there are only 393 gigatonnes in the remaining CO_2 budget to limit warming to 1.5 deg C. This amount was valid in 2015. Because humans are dumping CO_2 into the atmosphere at a rate of around 40 gigatonnes/year, if we do nothing and continue to burn hydrocarbons at this rate, the remaining budget will be used up in 10 years (2025). If we miss that opportunity and keep burning as we are today, we will have used the 2.0 deg C budget by 2045. We don't want to envision a 3 degrees C warmer planet, because there will be no ice at the poles or glaciers in the mountains. Sea level will be 25 meters (80 feet) higher than it is now. Island nations and coastal cities will be gone.

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. (See Figure 5 Paths to Zero GHG Emissions.)

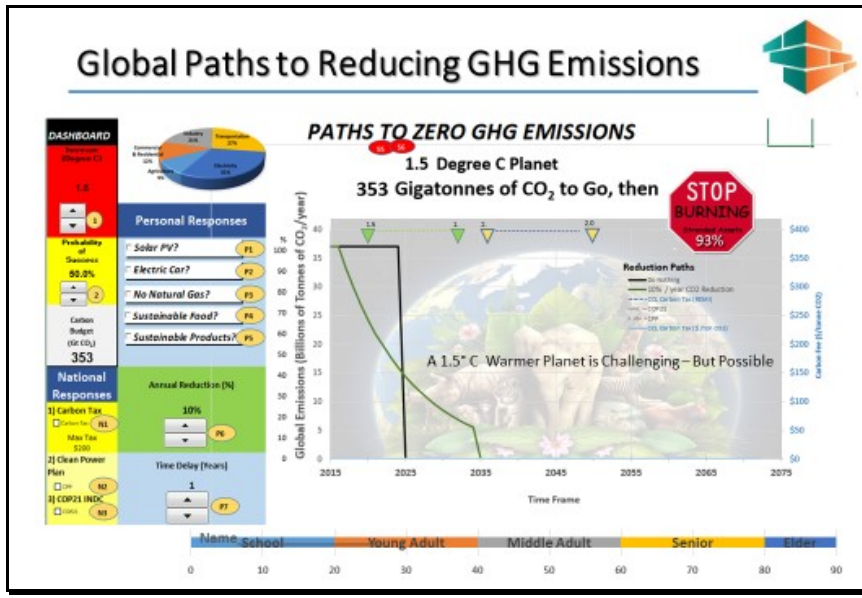


Figure 5 Paths to Zero GHG Emissions

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 solid black line shows the path we are currently on.

As shown, 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. 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 solid green line. That plan seems doable. A 10% reduction in GHG emissions per year buys us an additional ten years before we use up the budget and have to stop completely for a 1.5 deg C warmer planet.

The red stop sign near the upper top right corner indicates 93% of the known reserves of "fossil fuel" 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.

No longer burning hydrocarbons does not mean we have to go back to living in caves or straw huts. It merely means we have to harvest the amount of energy that we need to support our 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 merely reducing the burning of hydrocarbons and increasing the use of solar, etc.

How are we as UUs responding to Climate Change?

Unitarian Universalist Association Response

Most, if not all, religious denominations around the world have their 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… that moves one to a renewal of spirit and an openness to forces that create and uphold life.[28]

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 broader 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 four such position statements or resolutions about climate change 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
- **DIVESTMENT FROM FOSSIL FUEL INDUSTRY**, Act of Immediate Witness, UUA GENERAL ASSEMBLY 2013, https://www.uua.org/action/statements/consider-divestment-fossil-fuel-industry
- **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 four "Statements of Conscience /Resolutions" were presented earlier and will not be repeated here; however, they were discussed in more detail in this science presentation.

Response by "Sister Churches"

Jefferson Unitarian Church (JUC), Golden, CO utilizes both solar PV and geothermal heating/cooling.

Mount Vernon Unitarian Church in VA (Rev. Kate Walker, ordained at First Universalist, is their Senior Minister). Mt. Vernon Unitarian utilizes both solar PV and geothermal heating/cooling. https://mvuc.org/about-us/history-mount-vernon-church-alexandria-va/

How are we, 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 several operational changes. 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.

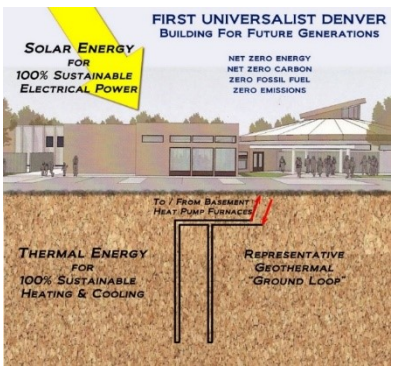


Figure 6 Early Vision of a 100% Sustainable Energy System

First Universalist Vision

An earlier 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.

Is There Enough Solar Energy Available to Operate the Church facility?

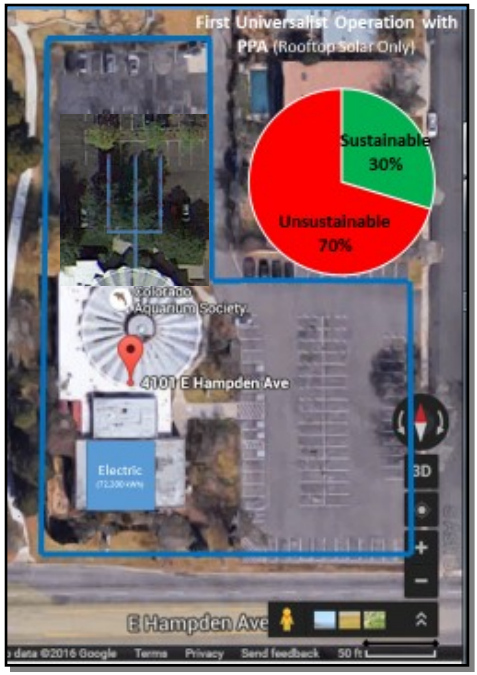


Figure 7 First Universalist Property Plot

The solid blue lines in Figure 7 denote the property lines of the First Universalist lot. The surface area within the blue lines encompasses about 1.7 acres (74,000 ft^2) (6880 m^2). The church is the steward of the building and grounds within these virtual boundaries. It would be good stewardship to use the property to maximize negative emissions/carbon sequestering.

The Sun provides a gift of 1790 kWh / m^2 on these grounds each year – that's 12,300,000 kWh /year.[29] A 1 kW solar panel laying flat will generate 1349 kWh /year.

Approximately 242,000 kWh was 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 already available onsite each 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. Using 345 Watt Sunpower PV modules as an example, 143 modules covering 3240 ft^2 (a 57' x 57' square) are required to generate 72,040 kWh annually. This area 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 of Figure 7 First Universalist Property Plot.)

Adding solar is necessary but not sufficient to be 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.

> *FACT: There is no reason to insist on burning the world's precious finite supply of ancient hydrocarbons as a source of energy to operate the church facility. There is plenty of energy already onsite. By burning ancient hydrocarbons, the church was responsible for dumping 100 tons of harmful GHG into the atmosphere each year.*

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 heat pump.)

2) **Solar thermal heating i**s 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 create 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 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;[30] 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 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., thermal energy in the air or 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 fridge 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 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. Average ground temperature is around 55 deg F in this area.

   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 several 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 several years as the old equipment 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 has 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 7 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 the same as that used in our refrigerators today except:

1) It is physically bigger 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 8 &

Figure 9.

The clever thing about a heat pump is the reversing valve that allows the heat pump to provide both heating and cooling.

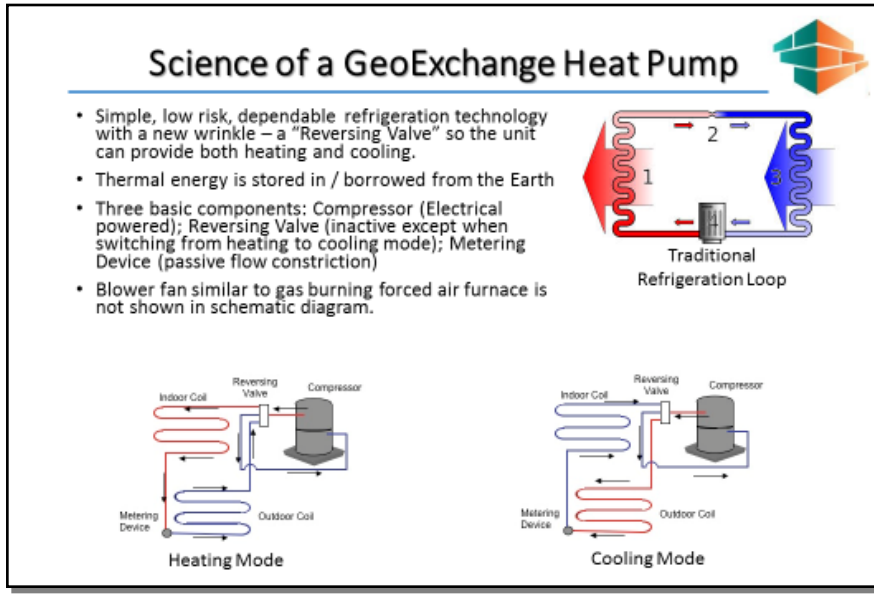


Figure 8 Science of a GeoExchange Heat Pump

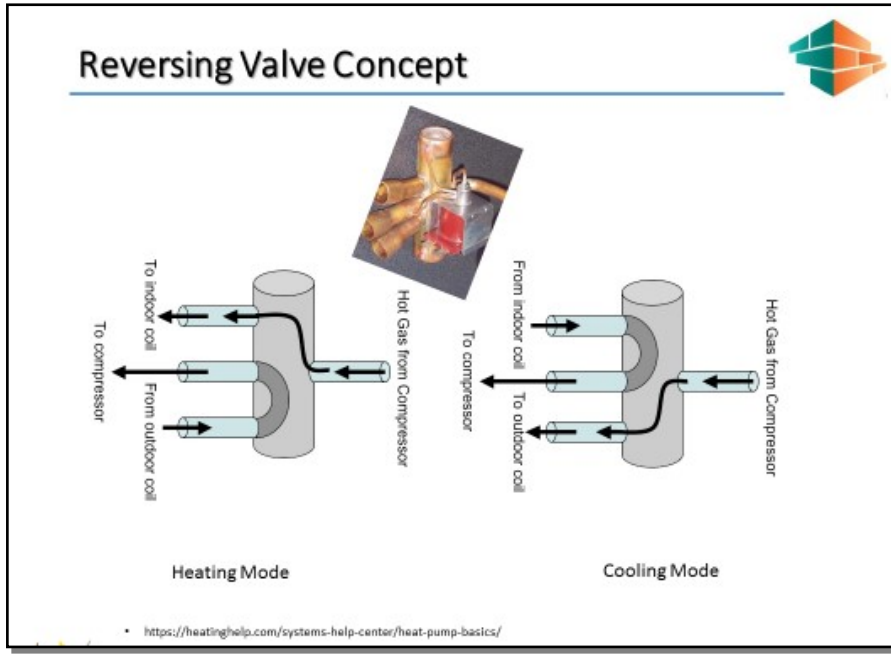


Figure 9 Reversing Valve Concept

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. Seven billion people currently consume 18.5 TeraWatt-years of energy – most of it derived from buying and burning ancient hydrocarbons. To live sustainably, we 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 within the next 10-20 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 530 gigatonnes of CO_{2eq} as of 2019. If more greenhouse gas than the remaining budget is added, the thermal blanket will become thicker and cause even more warming.
- The science indicated that 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 an excellent opportunity to get in right relationship with our independent web of life and to stop harming future generations. A new sustainable energy system seems to save the church money in operating expenses.
- The challenge is finding a way to finance the new energy equipment.

Post Presentation 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, the presenter provided the following answer to the curious 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 undoubtedly clean, and the solar energy source is virtually 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,
- When the financial spreadsheet model was modified to evaluate the "all-electric" case, the 20-year cash flow indicated an all-electric heating and cooling system appears 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) was still less expensive than continuing to burn fossil fuel (assuming the historical 3-4 % annual increase in fossil fuel costs.)

Post Presentation 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 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. [31]
- The lack of funding would fail 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, one member of the Building Committee, also a long-time member, was able to provide more information about the history of those past member loans. No member lender lost any money. Further discussion of member loans can be found in Appendix D.

After the science presentation had ended, the BFF Building Committee co-chair approached the science presenter and said simply, "We have to make this [sustainable energy system project] happen."

The Building Committee co-chair then requested a proposal from the Green First Team for a member-financed approach to a sustainable energy system. The Green First Team agreed to provide a 20-year cash flow spreadsheet analysis that illustrated how such a member-funded scenario could be constructed. It was reaffirmed that any member solicitation should be proceeded by authorization from the BFF Committee and then the church Board. The BFF Co-chair agreed to take the member sponsored funding concept to the Board for their review.

Other third-party funding approaches were being pursued as well. One member of the Green First Team was exploring funding possibilities using the Property Assessed Clean Energy (PACE) program. The initial PACE results were expected within a week or so and could be compared to the member financed approaches.

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 at the end. As a result of this unexpected feedback, 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 locate 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. The project ended up using a "Prepaid Power Purchase Agreement" with a third party for the solar system equipment. Total payment for the solar system and the ground source geothermal system was due up front.

"Borrowing" money from members at a low-interest rate still seemed to be a viable, if not a preferred, option after the "Science Presentation."

It was thought that "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

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.

For First Universalist, this meant:

a) stop investing in their stocks & bonds (The UUA had already reviewed its investments and eliminated its evolvement in the fossil fuel burning industry),

b) at the church level, 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 several ideas advocated by the members of the congregation. For example:

- Income inequality & 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, retain 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 showed 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 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 that would 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 result was a monthly repayment plan comparable to the current monthly budget for gas & electric.[32] 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 had 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.

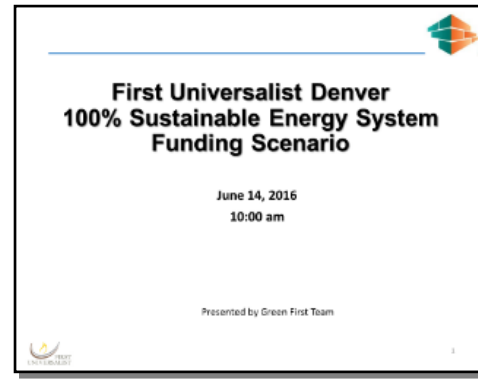
Green First Presentation to BFF Committee / Board Reps (14 Jun 2016)

The Green First Team decided to break the presentation up into three parts. One member would present Part I that provided the history of the proposed 100% Sustainable Energy System. A second member then would present Part II, the proposed baseline funding approach. A third member would follow-up with Part III, an alternative funding model using commercial loans.

Representative charts are discussed below. The complete three-part

presentation can be found at the following link.

100% Sustainable Energy System Funding Scenario		
http://coloradointerfaithgreenbuilding.org/BFF_Energy SystemMeetingJune14Composite.pdf	PDF	34 pgs



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 two members of 10 person Board of Trustees. One hour was allocated for the meeting.

Background

Several charts were available that provided a history of significant events over the past year.

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 primary challenge.

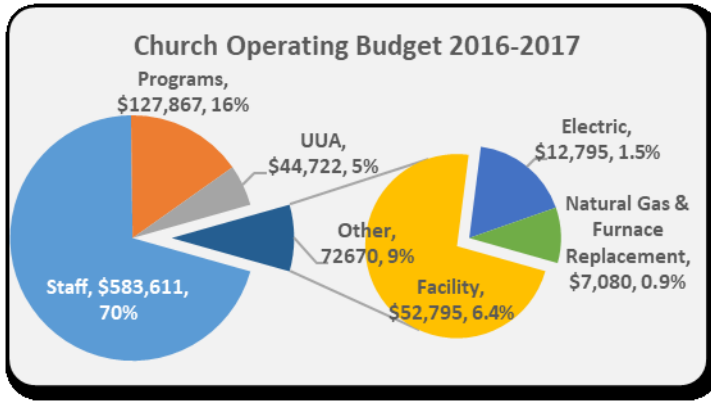


Figure 10 Perspective of Church Operating budget (2016-2017)

For perspective, Figure 10 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. Therefore, 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.

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 were 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 primary concern. Any new proposal that even hints at increasing the front-end construction cost causes a significant problem and frankly is unacceptable (if it is 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 promised to 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.

Instead, the following 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 11 and Figure 12.) Assuming a nominal 4% annual escalation rate, operating costs would be expected to double over the next two decades. Yearly gas and electric bills that are now $20,000 can be expected to be around $40,000 in 20 years.

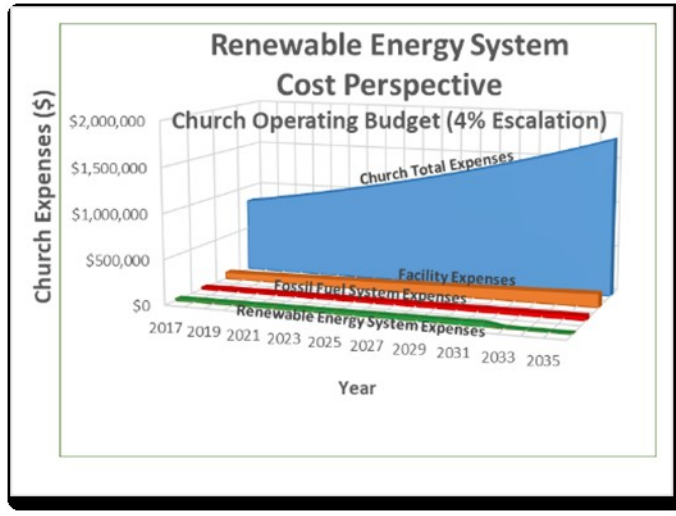


Figure 11 Expected Growth in Operating Budget Over 20 years

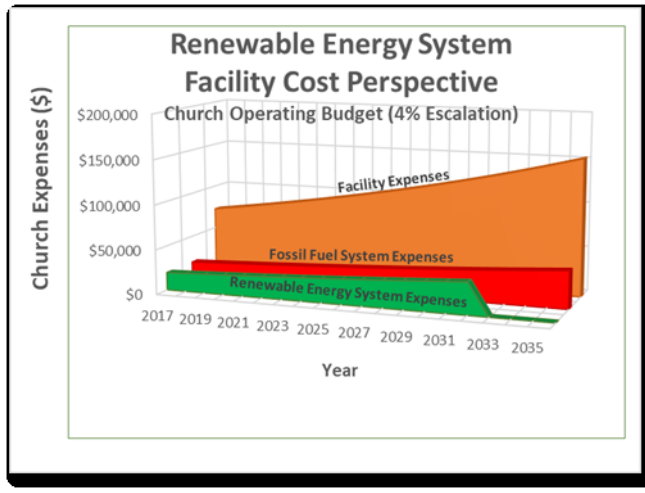


Figure 12 Facility Cost Perspective. Renewable Energy vs. Fossil Fuel costs

The green profile in Figure 12, represents the operating cost of the new sustainable energy system designed to replicate the monthly expense 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 13; the intent of this chart was two-fold.

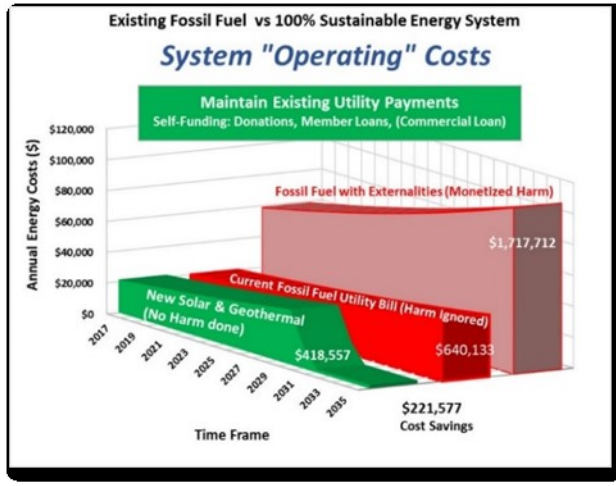


Figure 13 New Energy System Operating Cost

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 accurate comparison with the operating cost of a green renewable energy system. The true cost includes the hidden social costs (See **Appendix F Externalities** for details) and is based on the work of Paul Epstein et al. of the Harvard Medical Center for Health and the Global Environment.[33] 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)
- The public health burden of communities in Appalachia
- Fatalities 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 CO_2 and N_2O
- Climate damages from combustion emissions of black carbon

"… This work strives to derive monetary values for these externalities so that they can be used to inform policymaking."

"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."

> *"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 18¢ /kWh…*
> *...the upper bounds of electricity generated from coal could add close to 27¢ /kWh...These [costs] and the more difficult to quantify externalities are borne by the general public [and global community.]"*

Epstein's study results are incorporated in the last row of the chart in Figure 13 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 F 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 harming the interdependent web of life. To them, eliminating this self-inflicted harmful behavior is not only possible, but it is also mandatory. To them, our current ecocidal practice was recognized as an existential threat to human life (and 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.

Start with 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 Green First 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 Figure 14

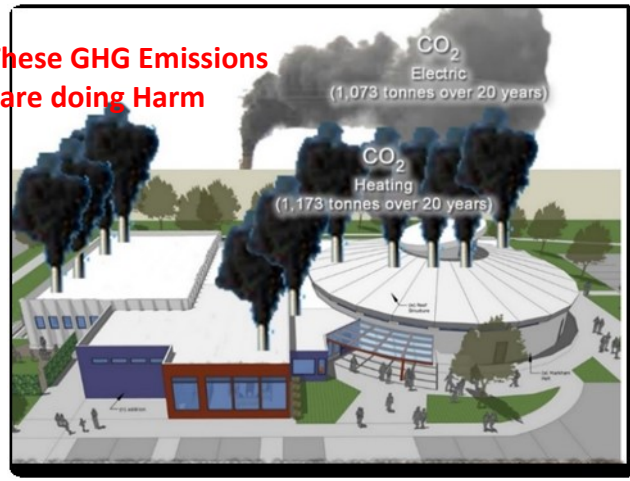


Figure 14 Quantifying the Harm Caused by Burning Ancient Hydrocarbons

(Notice the distant Xcel generating plant pictured on the horizon spewing out a massive plume of CO_2.)

Figure 14 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 $CO_{2\ eq}$ into the atmosphere annually. That is 1,073 tonnes of $CO_{2\ eq}$ 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 CO_2 per year to the atmosphere. That would be 1,173 tonnes of CO_2 over 20 years as graphically indicated in

Figure 14.

In summary, the existing church facility at the time was contributing about 113 tonnes of $CO_{2\ eq}$ 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.[34] Figure 15 illustrates how much volume 1 metric tonne of CO_2 would occupy at sea level pressure. See Factoid A.5. Can you picture 113 of these blocks of CO_2 stacked up in the parking lot at the end of each year – waiting for carbon to be recycled sustainably?

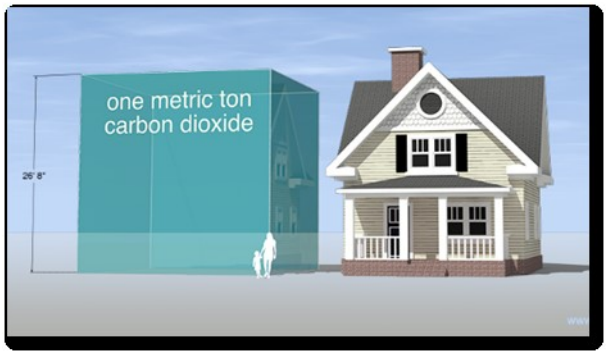


Figure 15 One Metric Tonne of CO_2 (sea level pressure)
Ref: Carbon Visuals.[35]

The Green First Team found that if the church only added rooftop solar to avoid the Xcel CO_2 emissions linked to generating 72,040 kWh per year, they would only be "greening" 32% of their energy usage as shown in

Figure 16.

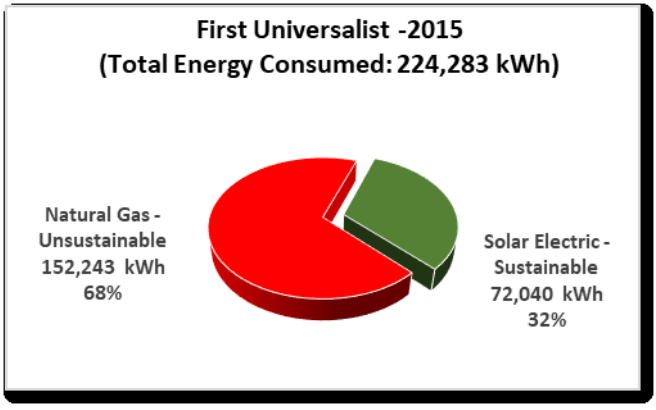


Figure 16 Greening Electric Energy Usage

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 17.

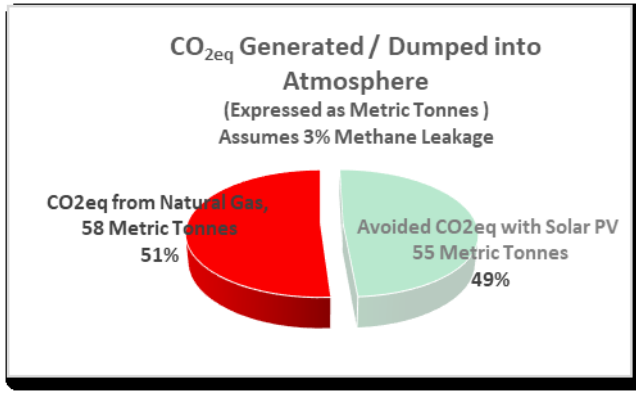


Figure 17 CO_{2eq} Remaining with a Solar Only Transition.

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 18.

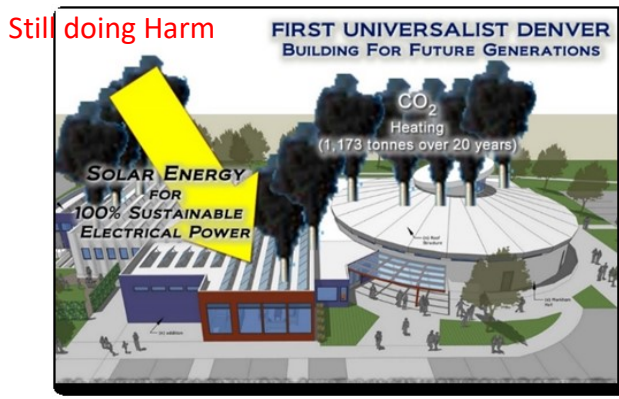


Figure 18 Adding Solar PV would reduce GHG Emissions by 50%.

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 derived from burning ancient hydrocarbons and begin "harvesting" local energy that was already on site.

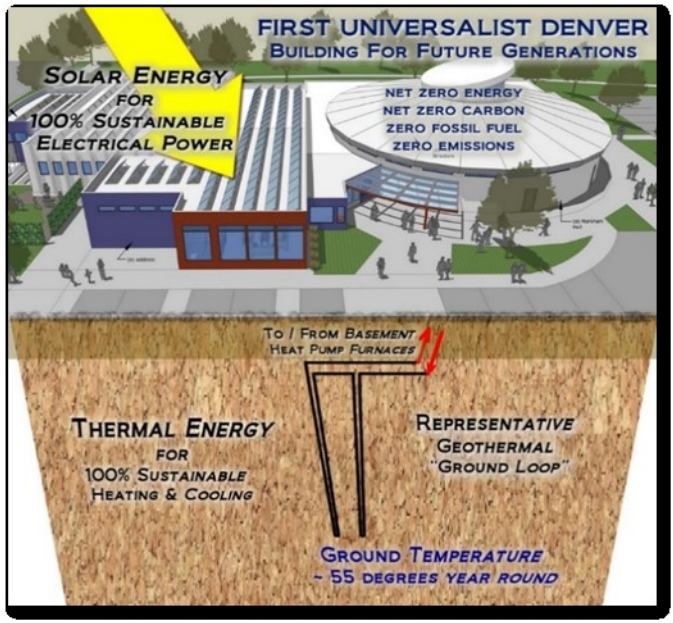


Figure 19 Envisioning a Proposed 100% Sustainable Energy System for First Universalist.

The presenter concluded with a **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. See Figure 19.

CONCLUSIONS.

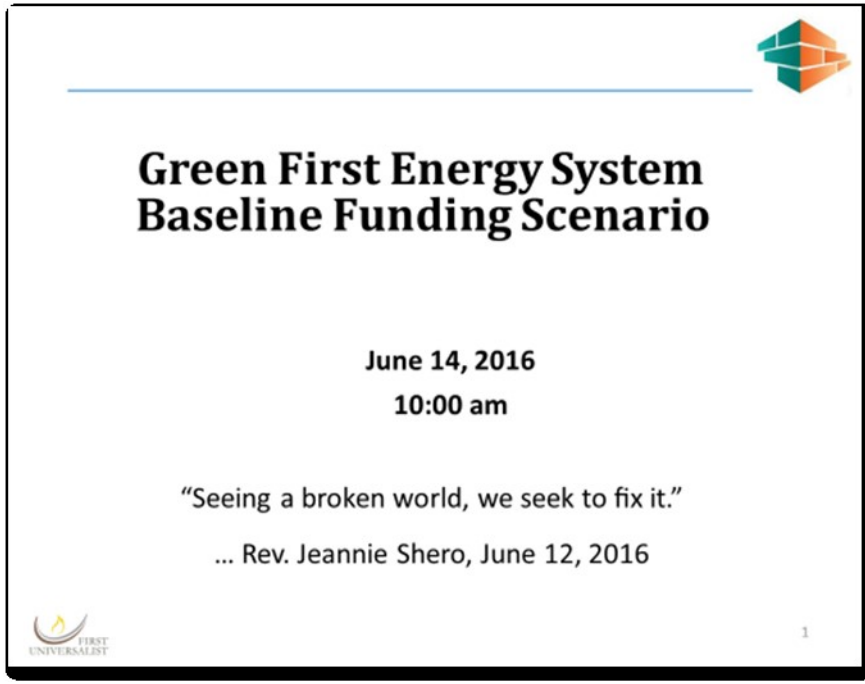
- A 100% Sustainable Energy System that does no harm is consistent with our UU principles and our responsibilities as Global Citizens, as Parents.
- Compared to our current fossil fuel burning system, a renewable energy system will save money for the church over the next 15-25 years.
- An assessment 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 upfront cost, 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 (14 Jun 2016)

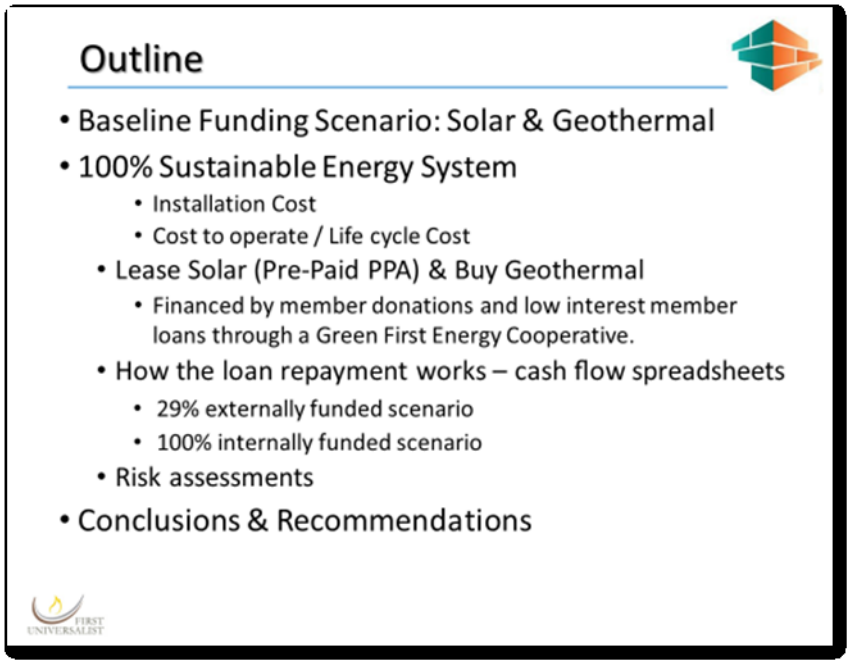
Another member of the Green First Team presented Part II. After a few introductory charts, he provided a detailed discussion of the funding approach for the proposed 100% Sustainable Energy System.

Again the complete presentation can be found in the file in the Table below:

100% Sustainable Energy System Funding Scenario		
http://coloradointerfaithgreenbuilding.org/BFF_Energy_SystemMeetingJune14Composite.pdf	PDF	34 pgs



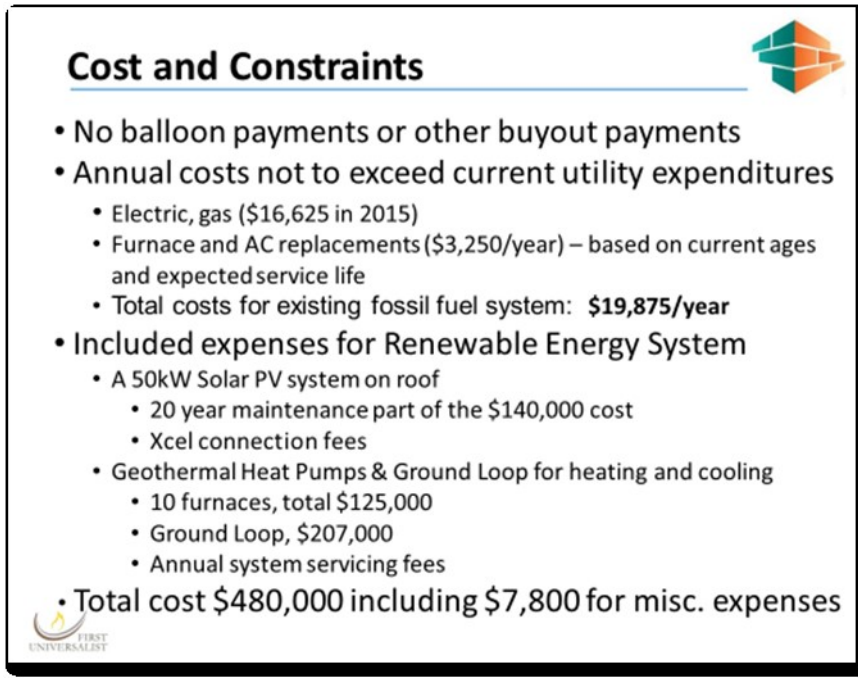
The "Outline" chart indicated there would be a presentation of the System's installation costs as well as the operating costs.

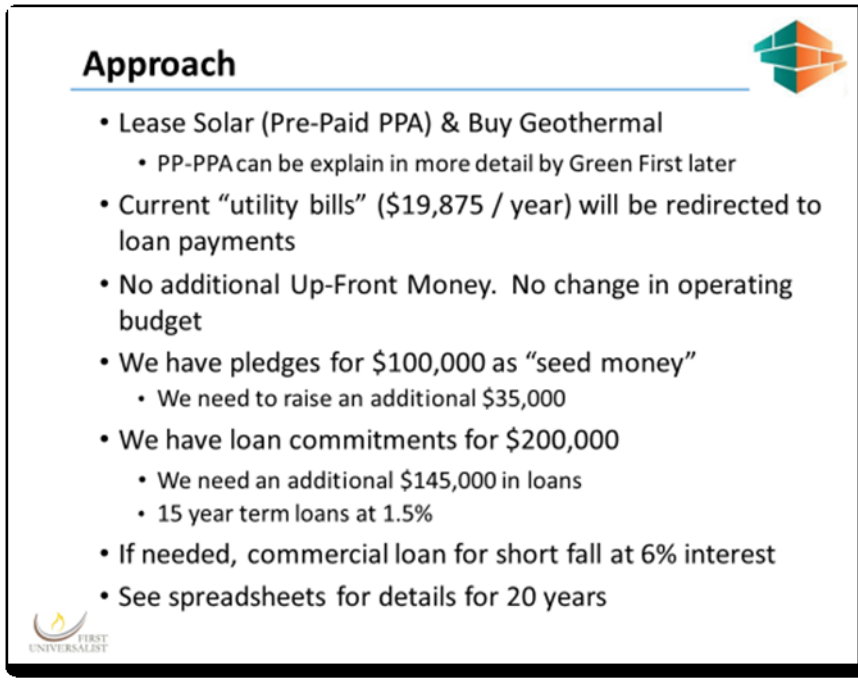


The decision had been made to use a Pre-Paid Power Purchase Agreement with a third party (who could qualify for the Federal Investment Tax Credit and equipment depreciation for tax deductions) to acquire the Solar PV system thereby minimizing the church cost to under $2.50 / Watt. The Green First team did not identify a third party willing to take on the funding of the Geothermal Heat Pump HVAC system, so the decision was made just to buy it and try to finance it internally.

The presentation described the cash flow spreadsheet model that further explains the funding approach. Conclusions and recommendations would follow a brief description of potential risks.

As indicated in the chart below, there were several 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





At this point, the Cash Flow Spreadsheet Model was presented for Case # 1 that represented the current status of the Green First campaign to solicit

funds for the new energy system.

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.

The total "***System cost***" was estimated to be $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, members have agreed to loan the church money $245,000 identified as "***Financed by Member Energy Loans***." The terms of the member loans are 15 years 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 probably at a 6% interest rate.

Table 2 CASE # 1 Member 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)			Xcel hookup	$660
Annualized Equipment Replacement Cost	$3,250	ear (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		
	$445,000					
Dedicated Pledges for Energy System	$100,000	(21%)	2%	Inflation rate		
	$345,000		2%	Fuel cost escalation		
Financed by Member Energy Loan	$245,000	71%	for 15 years @ 1.5%	Interest Rate	$273,748	$28,748 (Member Lender Gain)
Financed by Commercial Energy Loan	$100,000	29%	for 15 years @ 6.0%	Interest Rate	$151,894	$51,894 (Wal Street Gain)
20 Year Life Cycle Cost (Renewable)	$458,108			Total Loans	$425,642	
20 Year Life Cycle Cost (Fossil Fuel)	$640,133					
20 Year Savings with Solar/Geothermal	$182,025					

Current outlays - utility

System Costs

Loans

Financial Gain

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			$18,306	$20,105	($18,306)		$450,548	$273,748	$75
2033	$40,263	$1,834			$0	$1,834	$0		$452,382	$273,748	$0
2034	$41,874	$1,871			$0	$1,871	$0		$454,253	$273,748	$0
2035	$43,549	$1,908			$0	$1,908	$0		$456,161	$273,748	$0
2036	$45,291	$1,947			$0	$1,947	N/A paid		$458,108	$273,748	$0
	$640,133	$32,466	$151,894	$273,748	$273,748	$458,108	$0	$26,825			
		Total Loan Payments	$425,642		Savings	$182,025					

Table 3 CASE # 2 Member 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	ear (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		
	$445,000						
Dedicated Pledges for Energy System	$100,000	(21%)		2%	Inflation rate		
	$345,000			2%	Fuel cost escalation		
Financed by Member Energy Loan	$345,000	100%	for 15 years @	1.5%	Interest Rate	$385,481	$40,481 (Member Lender Gain)
Financed by Commercial Energy Loan	$0	0%	for 15 years @	6.0%	Interest Rate	$0	$0 (Wall Street Gain)
20 Year Life Cycle Cost (Renewable)	$417,948				Total Loans	$385,481	
20 Year Life Cycle Cost (Fossil Fuel)	$640,133						
20 Year Savings with Solar/Geothermal	$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	$1,798	$0		$410,387	$385,481	$0
2033	$40,263	$1,834			$0	$1,834	$0		$412,221	$385,481	$0
2034	$41,874	$1,871			$0	$1,871	$0		$414,093	$385,481	$0
2035	$43,549	$1,908			$0	$1,908	$0		$416,001	$385,481	$0
2036	$45,291	$1,947			$0	$1,947	N/A loans paid		$417,948	$385,481	$0
	$640,133	$32,466	$0	$385,481	$385,481	$417,948	$0	$40,481			
		Total Loan Payments	$385,481		Savings	$222,186					

Financial Gain

Case # 2 illustrates the difference if the commercial loan (@6% interest) is replaced with low-interest member loans (@1.5% interest). The plan is still "revenue neutral," but the church would see a financial gain of $222 K compared to a financial gain of $182 K using a commercial loan – a $40,000 difference for a $100,000 loan.

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.

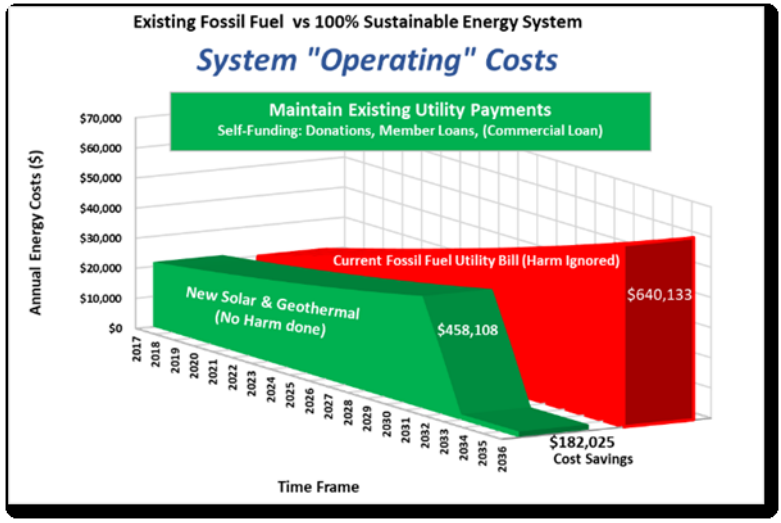


Figure 20 CASE # 1 71% Member Loans; 29% Commercial Loans

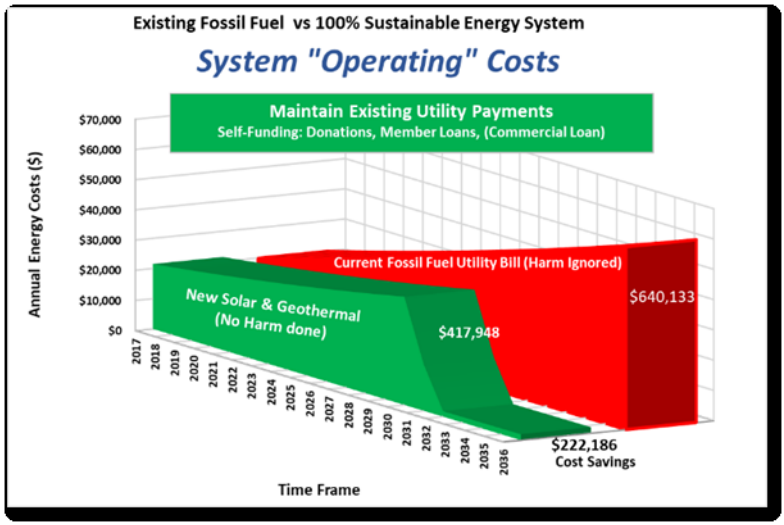
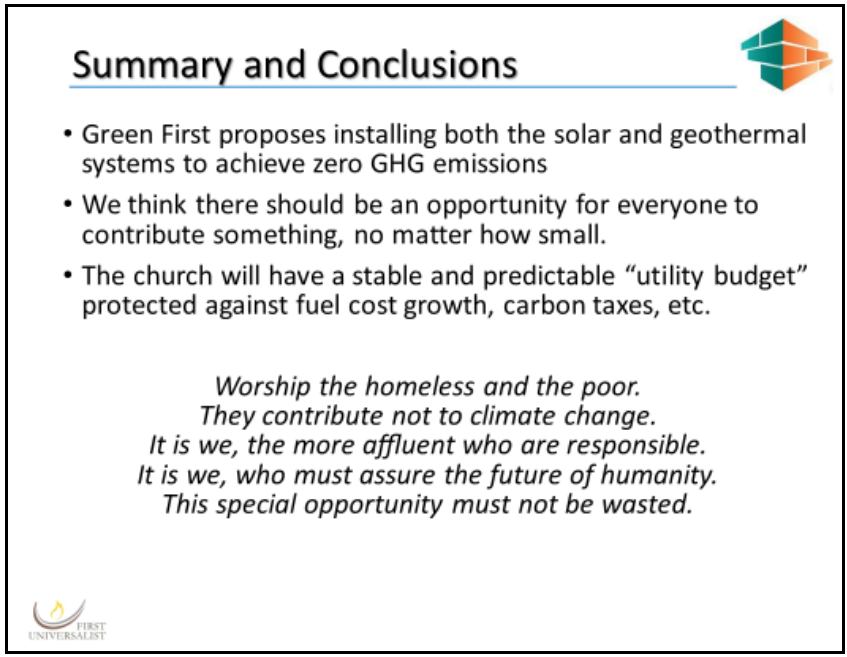


Figure 21 CASE #2 100% Member Loans

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 CO_2 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

FIRST UNIVERSALIST



Backup Funding (PACE)

Part III of the presentation was provided by the third member of the Green First Task Force. The Property Assessed Clean Energy (PACE) Program is an alternative method of financing the project. 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 20 years 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.

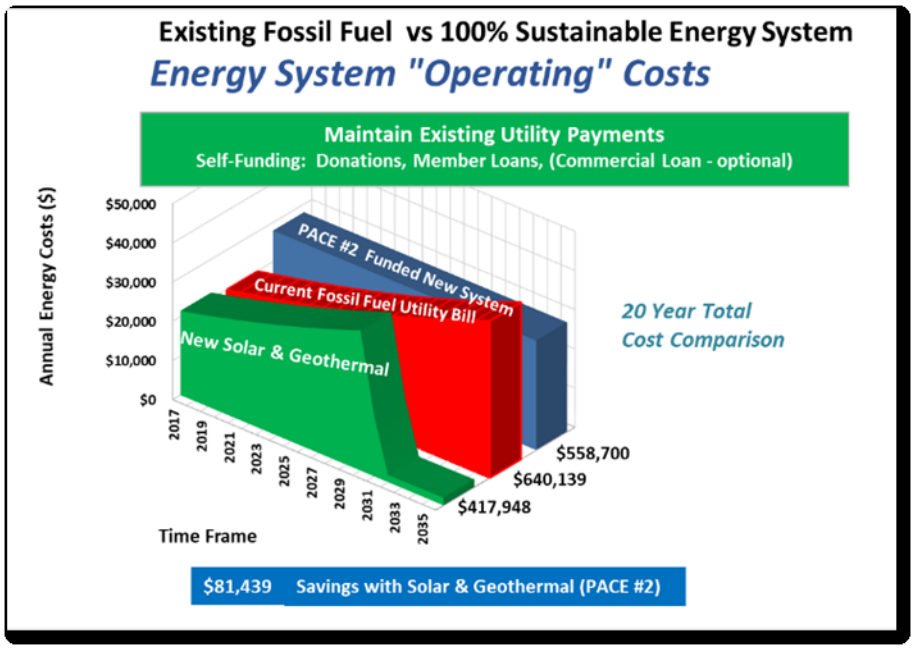


Figure 22 A PACE Funded Transition to Renewable Energy is less expensive than continuing to burn fossil fuel

Post Presentation Observations

After the presentation, the Green First team was encouraged. It appeared the response from the Board of Trustees was positive. At the end of the presentation, one Board member 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 reasonable 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.

Presentation to the Board of Trustees (5 Jul 2016)

Before 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 minimal. 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.

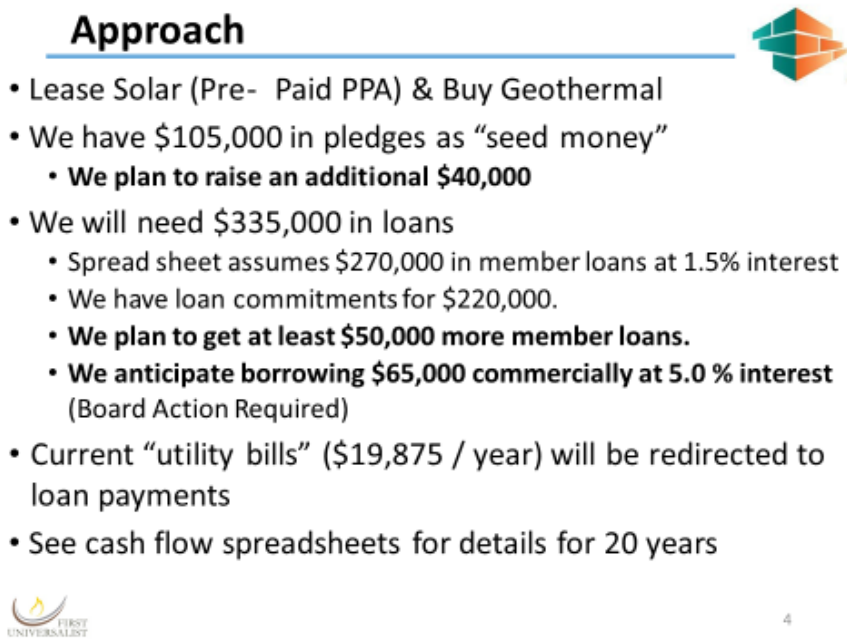


Table 4 Baseline Proposal to Board Showing a Plan with 81% Member Financing (81%) and a Commercial Loan (19%)

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	$660
Annualized Equipment Replacement Cost	$3,250	ear (Ref: ASHRAE)			Equip servicing	$650
Total	$19,269				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	$40,000			1%	Additional Cash Contributions from BFF			
	$440,000							
Dedicated Pledges for Energy System	$105,000	(22%)		2%	Inflation rate			
	$335,000			2%	Fuel cost escalation			
Financed by Member Energy Loan	$270,000	81%	for 15 years @	1.5%	Interest Rate	$301,681	$31,681	(Member Lender Gain)
Financed by Commercial Energy Loan	$65,000	19%	for 15 years @	5.0%	Interest Rate	$92,523	$27,523	(Wall Street Gair)
20 Year Life Cycle Cost (Renewable)	$426,670				Total Loans	$394,204		
20 Year Life Cycle Cost (Fossil Fuel)	$620,615							
20 Year Savings with Solar/Geothermal	$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	$36,083	$8,040	$2,956	$417,311	$301,681	$104
2032	$37,534	$1,798			$0	$1,798	$0		$419,110	$301,681	$0
2033	$39,035	$1,834			$0	$1,834	$0		$420,944	$301,681	$0
2034	$40,597	$1,871			$0	$1,871	$0		$422,815	$301,681	$0
2035	$42,221	$1,908			$0	$1,908	$0		$424,724	$301,681	$0
2036	$43,910	$1,947			$0	$1,947	N/A loans paic		$426,670	$301,681	$0
	$620,615	$32,466	$92,523	$301,681	$301,681	$426,670	$0	$31,681			
		Total Loan Payments	$394,204		Savings	$193,945					

The spreadsheet model in Table 4 illustrates the 20-year cash flow with this funding model.

Figure 23 summarized the 20-year cost assessment. The annual payment 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 escalation rate became a very contentious assumption, as discussed later.

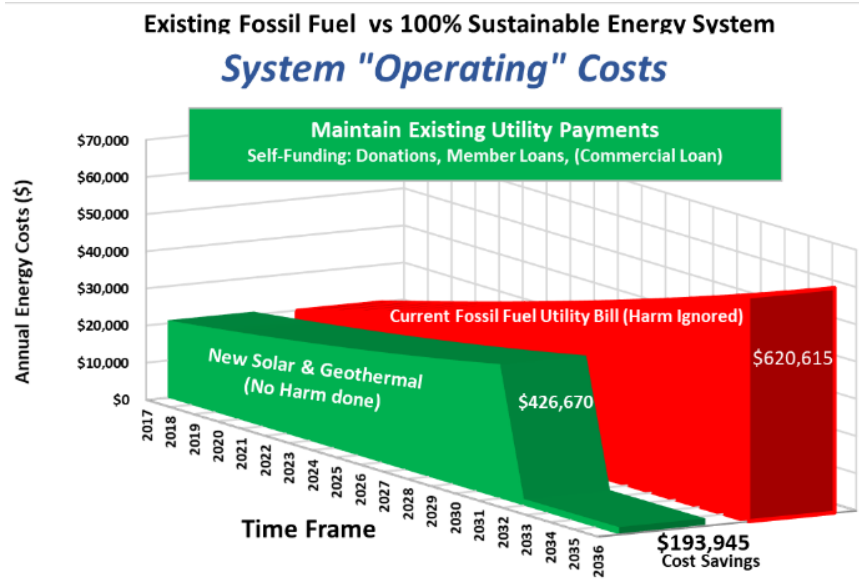
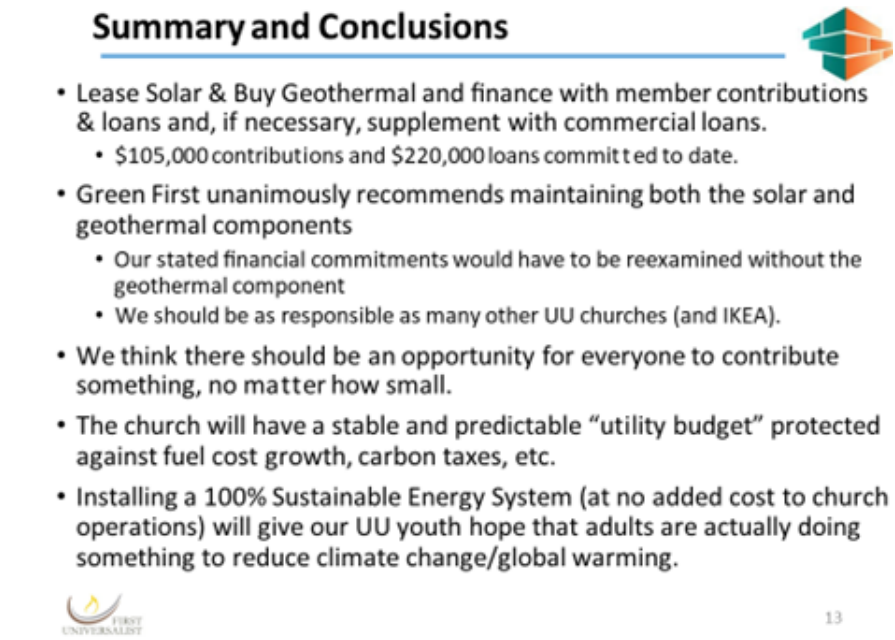


Figure 23 Summary of the proposed 'sustainable energy system' 20-year cost profile compared to the 'fossil fuel system' cost.



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. By not hearing any significant dissent from the Board, the Green First Team interpreted their silence as encouraging and a reason 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. Two members of the ten 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.

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. Although the Green First team did have several science and technology savvy members, these independent reviewers turned out to be a very valuable addition to the team. They soon became advocates for the new energy system, widened the circle of support, played a crucial role in moving this project forward, and contributed to the success of the project.

One of the independent reviewers 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 July 2016 presentation to the Board, The Board provided assistance by creating an ad hoc committee that took on the name of the Renewable Energy Working Group (REWG); It was chaired by a Board member.

The REWG was comprised of several Board members, a member of the Staff, several members of the BFF Building Committee, several members of the Green First Team and the Independent Reviewers.

This small ad hoc committee was formed to coordinate the remaining design effort and finalize the funding approach for the renewable energy system. The committee met during July, August, Sept, and October 2016. The chair reported back to the Board of Trustees.

This ad hoc committee was instrumental 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.

The REWG focused explicitly on the energy system so the construction contract could be updated/finalized. The BFF Committee had to delay any decision about a geothermal heating and cooling system until the funding mechanism had been approved (or rejected) by the Board and the Congregation.

When the work of the ad hoc REWG was completed, the committee was quietly dissolved after the congregational vote.

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, our team's legal counsel, drafted an LLC document to illustrate what an Operating Agreement for an LLC might work.

This "LLC" eventually morphed into a simple "Partnership."

OPERATING AGREEMENT
OF
SEVENTH PRINCIPLE RENEWABLES, LLC
(A Colorado Member Managed LLC)

This Operating Agreement ("Agreement") is entered into on August 1, 2016, by and among the parties identified on **Exhibit A** attached and made part of this Agreement (individually referred to as a "Member" and collectively with any additional parties admitted as the "Members").

RECITALS

The Members are all either members or friends of First Universalist Church of Denver ("Church") who, because of climate change and global warming and the Seventh UU Principle, believe it is the Church's ethical and moral obligation to purchase solar and geothermal renewable energy systems ("Renewables") as part of the Church's Building For the Future ("BFF") campaign to enable the Church to divest from using fossil fuels.

The Members are forming this Seventh Principle Renewables, LLC ("Company") with the sole purpose defined in Article 2 below and Company shall be managed by the Members pursuant to the terms of this Agreement.

The Members desire to set forth in writing their understandings and agreements in this Operating Agreement and agree as follows:

ARTICLE 1
Formation, Name, Location, Registered Office

1.1 Formation. The Company's articles of organization were filed with the Colorado Secretary of State on August 1, 2016.

1.2 Name. The name of the Company shall be "Seventh Principle Re

1.3 Place of Business. The principal office of the Company shall be l

SAMPLE

REWG Email (2 Sep 2016)

From: REWG Chair
Sent: Friday, September 2, 2016, 9:21 AM
To: Green First Team, BFF Building Committee, Senior Minister; Board Members, Independent Reviewers

Good Morning All,

Just a quick recap of last night's renewable energy meeting.

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 the BFF Building Committee for facilitating several important discussions with Faurot, Barrett, and DMA. The Green First Team for getting critical solar bids. And the Independent Reviewers 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 email was sent from the Board that had a significant impact on the Green First Team.

> [Ed: Bold text was added to the email by the reporter to highlight the comments that indicate a substantial misunderstanding between the Board and the Green First Task Force. The source of the disagreement was in part due to 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: Board Chair
Date: Wednesday, September 7, 2016
To: Green First Team, BFF Building Committee, Senior Minister; Board Members, Independent Reviewers
Subject: Re: Renewable Energy Working Group Meeting Tonight from 5 pm to 6:30 pm.

Part II: Energy System Capital Campaign

All,

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 $Board_1$ and $Board_5$, 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 three 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.

Board Chair[3]

[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. 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 a 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.

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*" relative to the current fossil fuel utility cost had an emotionally devastating impact on the Green First Task Force.

This moment was probably the lowest point in the morale of the Green First group.

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 obstacles.

To the Green First Team, this latest hurdle seemed different, arbitrary, even mean spirited and possibly insurmountable. Also, it seemed apparent that the voice coming from the Board "**[The cost of the energy system] may also represent lost opportunity in other areas of ministry and church support"** had the effect of marginalizing their ministry for Earth, if not negating, their "respect for the interdependent web of all existence" (Seventh UU Principle.) What they heard was a rejection of their underlying value system that cut deeply into the group's psyche.

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 of the Green First Team 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 over which they seemed to have no influence. They acknowledged that a few people wielded power to decide the fate of their Ministry for Earth and there was no solution in sight for these latest demands of the Board. They expressed gratitude to each other and the mutual understanding that existed within this small group.

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: they shared UU values and their shared 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 new Board requirement to "reduce the cost to the church."

"Energy and persistence alter all things."
-- Benjamin Franklin

Outsiders Perspective

The latest Board communication 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 or other sources of capital 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.

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 significant existential issue.

The financial issue involved 2.4% of the church budget (the annual fossil fuel cost was just 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 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 fossil fuel generated electricity for power or natural gas for heating from Xcel Energy. By installing new sustainable energy equipment, the church would be spending their money on local contractors and be creating local jobs rather than sending it to Minnesota–based Xcel Energy for the next 20 years.

The church will remain "on the grid," and the church will still pay Xcel Energy a "connect" fee. The grid will no longer be the source of energy, but it becomes an energy storage system (an e-bank). During the day, the solar PV system will generate excess power. A "net meter" measures the excess energy that is "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 was 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.[36] 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 (SPR) to repay the low-interest member loans used to buy all the new solar and geothermal equipment for the church.

With the new system in place, the church will pay $20,000 (or less) annually to Seventh Principle Renewables for 15 years. At that point, the

borrowed money will be repaid to the member lenders.

That's how the proposed solar & geothermal systems would be financed – by diverting monthly payments to a socially responsible member LLC or Partnership.

Saying the "***solar and geothermal systems as currently financed are simply too expensive for the church to afford"*** is like 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 [the Board's] 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 several things:

1) The Board did not understand how the new energy system was being financed, and
2) The Green First team did not explain the funding approach to the Board adequately.

Furthermore,

1) The Board did not understand that the church is currently doing harm and transitioning to sustainable energy sources is itself an essential church ministry, and
2) The Green First Team did not explain that the UU Ministry for Earth (UUMFE) is a sanctioned vital UUA ministry.

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 24, 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).

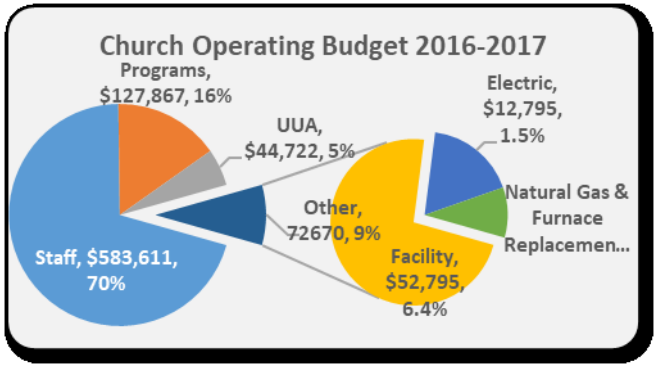


Figure 24 Perspective of Church Operating budget (2016-2017)

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 the Green First Team perspective, the primary reason for investing in this new energy-related equipment was to stop doing harm to our children and their children. The church is currently dumping over 100 tons of CO_2 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 (even unintentionally) the Green First Team's ministry (that is sacred to them) was inappropriate and an indication of a lack of communication and understanding between the two groups. That can easily be corrected in the future.

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 comment "*significantly more efficient building*"

because it is an excellent point. Indeed, the new windows, the added insulation in the walls and on the roof will reduce the heating and cooling requirements. 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.4 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 requested that the escalation rate be reduced to 3%; the Green First team complied with this request 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 essential factor in developing 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. A slower than necessary repayment schedule incurs more interest expenses to the Congregation. An unnecessarily prolonged repayment is not fair to the church 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 either. So a realistic assessment of future fossil fuel costs is appropriate.

The assumed fuel price escalation rate or the general inflation rate does not affect the actual cost of the energy system – only the repayment schedule. The church signs a contract and purchases the equipment now. So inflation/future fuel cost does not affect the 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).

The escalation rate was not explained adequately by the Green First Team.

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 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 necessary 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. As a result, the revenue stream for repaying the loans was reduced by $2000, making it more difficult to service the loans.

Now there was a lower threshold for the number of low-interest loans that could be serviced and an increased number of donations required to make the financing work. All this could be figured out quickly using the spreadsheet Funding 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 dropping as well.

Some of the member lenders agreed to "convert" their loan to a smaller donation over three years.

Time was running out, but enthusiasm to make it to the finish line was growing again. Folks were starting to believe a 100% Sustainable Energy System with zero GHG emissions was a real possibility.

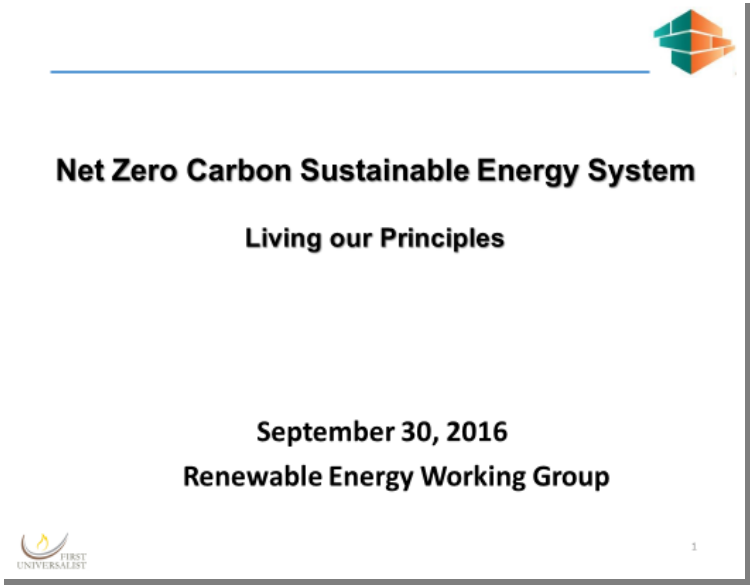
Somehow, all these factors came together. Work continued, and a new Funding Plan evolved that was 95% funded when it was time to present the plan to the Board for Approval.

There was no guarantee the Board would approve the revised financial plan. So tensions were high as the next Board Meeting approached.

Board of Trustee Funding Approval Meeting (4 Oct 2016)

The Board meeting was held at the nearby Plymouth Congregational church (who generously provided meeting space to First Universalist during the renovation.)

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 of the Independent Reviewers was selected to present the revised proposal to the Board. This new voice, trusted by the Board, helped to manage any subliminal animosity that may have existed between the Board members and the Green First Team members. The Independent Reviewer put together an excellent straight forward PowerPoint presentation.


Net Zero Carbon Sustainable Energy System
Living our Principles
September 30, 2016
Renewable Energy Working Group
FIRST UNIVERSALIST
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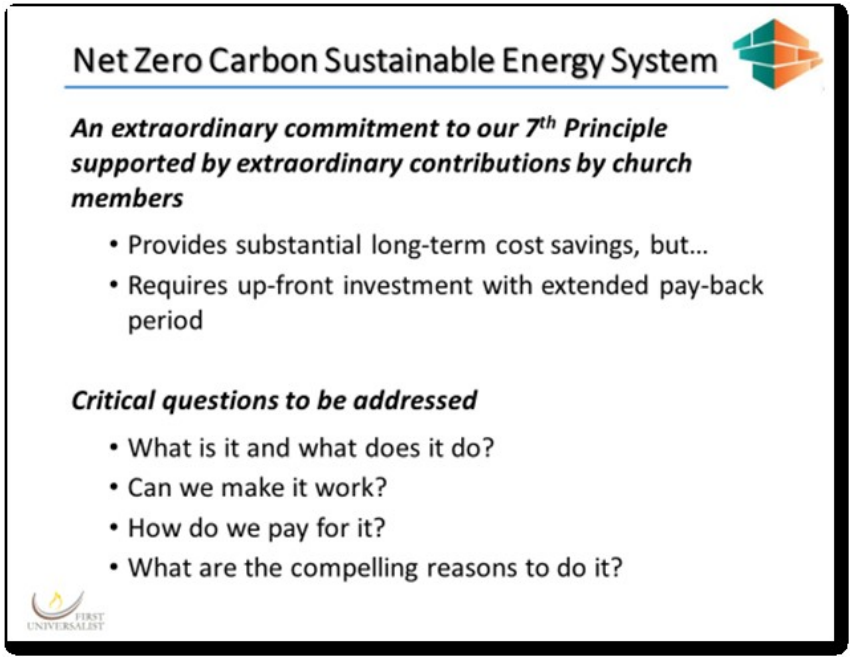
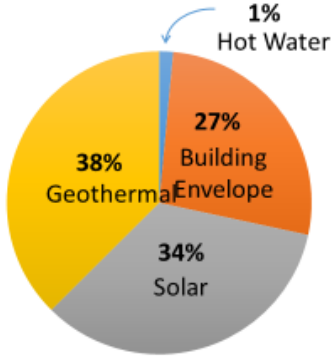

Net Zero Carbon Sustainable Energy System
An extraordinary commitment to our 7th Principle supported by extraordinary contributions by church members
• Provides substantial long-term cost savings, but…
• Requires up-front investment with extended pay-back period
Critical questions to be addressed
• What 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?
FIRST UNIVERSALIST

Solar Power Generation

What is it and what does it do?

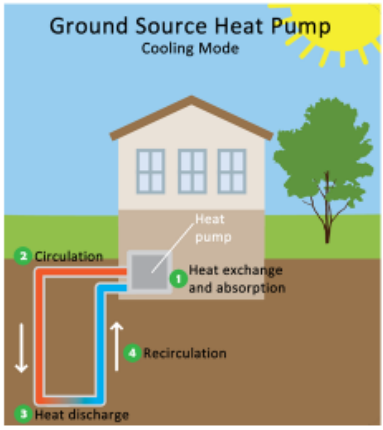


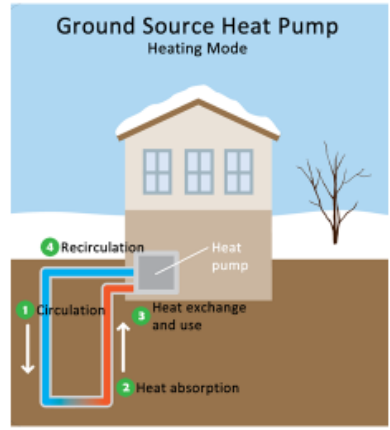
Carbon Savings

Total: 88 metric tonnes/year
(1 tonne = 1,000 kg = 2,200 lbs

- **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)

Geothermal System





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!

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

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

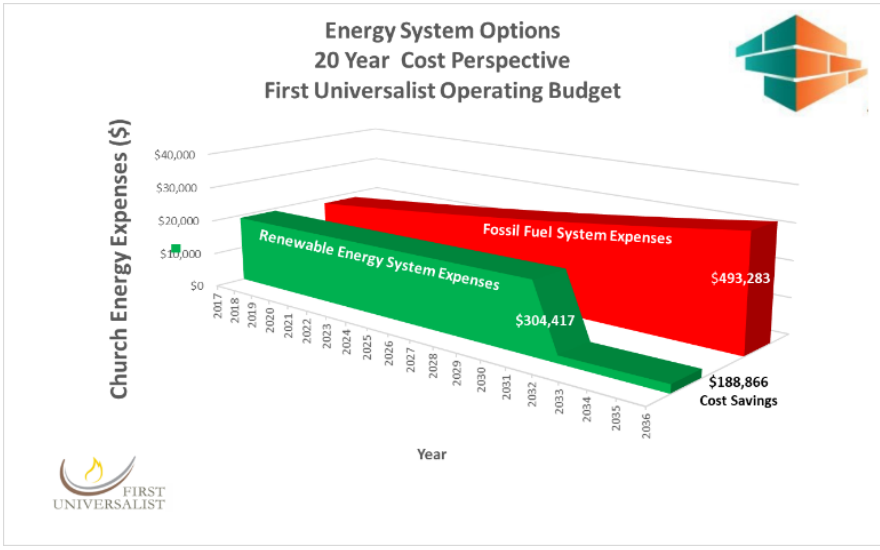
Notes

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

Part II: Energy System Capital Campaign

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 CO_2 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.



After this presentation, the Board of Trustees discussed the proposal internally. There was an effort to reduce the number of member loans even further – to $200,000 (a new requirement) that would reduce the monthly/annual utility payments the church would have to pay.

The Board Chair conducted an "Auction" starting at $200,000 and slowly raised the loan limit but was not getting any response from the other Board members. 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 hopefully approval.

Limiting the loan amount to $240,000 meant that the Green First team had to rescind about $25,000 in loans and replace that amount with $25,000 in donations for a financial plan that would meet the new Board criteria. The new limitation on loans meant going back to the congregation, yet again for more contributions. That was just about impossible at this point in the campaign.

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. They discussed an "integrated" fundraising plan. All groups involved would participate in an integrated fundraising campaign to raise $65,000. ($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 – a month away.

This was a bittersweet moment for the Green First Task Force because the rules had changed again. This time, however, there was the reason for optimism, because the Board, the BFF Building Committee and the Green First Team were working together to raise the remaining shortfall. This final fundraising campaign was referred to as "Finish Strong."

After Board Approval - Town Hall Meetings (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 in November to explain the plan and provide an opportunity for members to ask questions about the new energy system.

The Senior Minister suggested that the Sundays on October 16, 23, 30 were probably the best for Town Hall meetings after the church service.

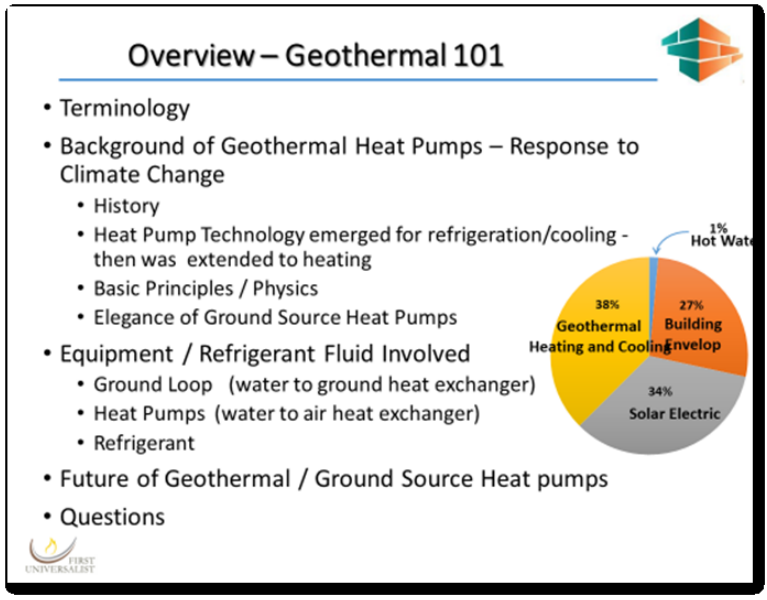
The Independent Reviewers, appointed by the Board, facilitated these Town Hall presentations. The discussion used the same charts presented to the Board. Members were encouraged to ask questions and express any concerns about the proposed energy system. The three Town Hall meetings were attended by 20-30 members on each of the three Sundays.

‘Geothermal 101’ Community Forum (23 Oct 2016)

In addition to the three Town Hall events, a Green First Task Force member suggested a short informative session entitled ‘Geothermal 101.’ 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 educational program to familiarize church members with geothermal heating & cooling basics, the Green First Team provided a 45 minute “Community Forum” style presentation followed by a Question and Answer sessions. A Green First Team member was the presenter.

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 better thermal conductivity between the pipe and the Earth. The “show and tell” samples were provided by the certified geothermal drilling contractor selected for the project.



A few of "Geothermal 101" charts are provided below for illustration; however, the complete presentation is available online.

Geothermal 101, October 23, 2016		
http://coloradointerfaithgreenbuilding.org/Geothermal101Book.pdf		17 pgs

The presentation was divided into four parts, followed by an opportunity for Questions & Answers. After identifying basic terminology, the historical background of geothermal heating and cooling systems was provided. This history illustrated the fundamental physics had been known for over 250 years. The third segment describes the actual equipment involved. The last section summarizes the benefits of this sustainable energy technology for the future.

Terminology. The term, 'geothermal' refers to thermal energy or heat that is present in the Earth. It was quickly pointed out that the church application refers to "Low-Temperature Geothermal energy." Thirty (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 50-55 degrees Fahrenheit year round.

The church application was not considered "High-Temperature Geothermal Energy" that boils water and makes steam for geysers like Old Faithful in Yellowstone.

So what is a heat pump? Most everyone already has one in their home or apartment. A geothermal heat pump is just a refrigerator with a "reversing valve" so it can cool and heat. For the geothermal heat pump envisioned for the church, the heat transfer coils would be embedded in the ground (probably under the north parking lot.)

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 the exchange of thermal energy between a building and the Earth. In the winter, heat is extracted from the ground to heat the building; in the summer excess heat is removed from the building and stored in the ground.

In the application at church, the air conditioning units & natural gas furnaces would be replaced with geothermal heat pump furnaces for heating and cooling. (The heat pump provides both heating and cooling.)

Part II: Energy System Capital Campaign

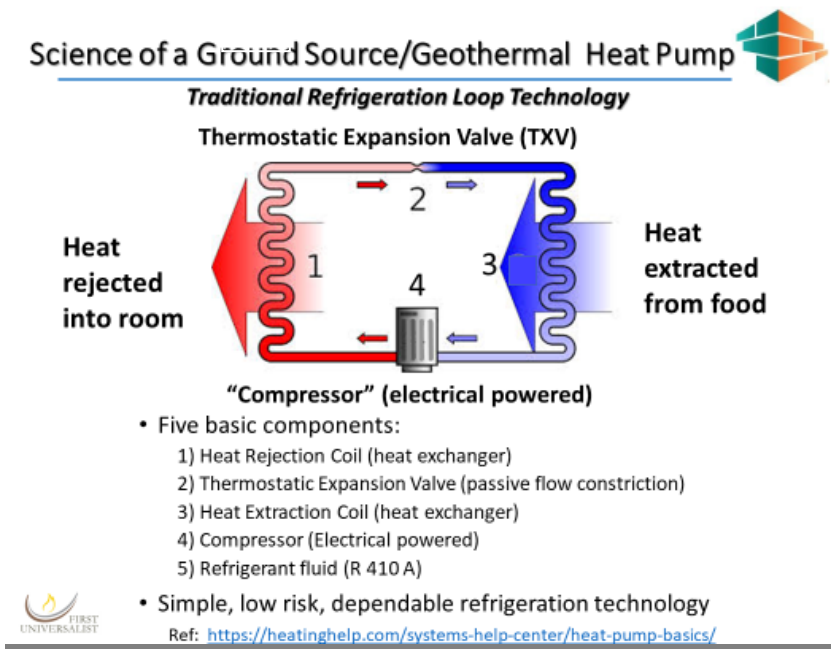
The proposed geothermal heating and cooling system would include a ground loop with black plastic pipe buried in the ground. Twelve holes 300 feet deep will be drilled in the ground. Black plastic pipe will be inserted and interconnected to allow water to circulate in a closed loop through these pipes for heat exchange purposes.

History. 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 of 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**.**

Basic Principles / Physics. Thermal energy (heat) naturally flows from hot (high energy level) to cold (lower energy level). A heat pump 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 offers 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.



The figure above depicts the simple heat pump used in refrigerators. As indicated, there are 5 basic elements:

The compressor (#4) compresses/pumps the refrigerant 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 fridge 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 came from inside the refrigerator, but it is now outside in the room warming up the kitchen up a bit.

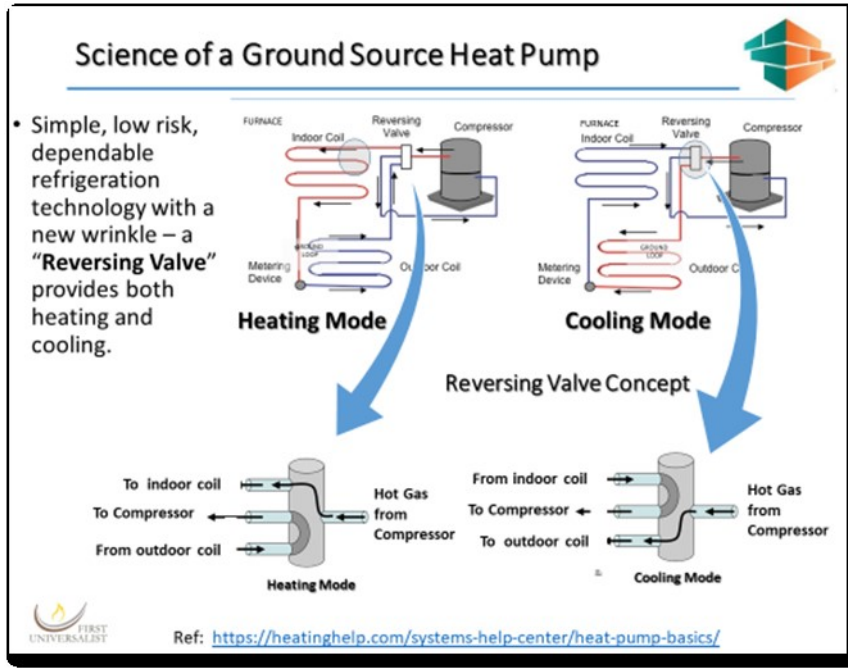
#2- is the expansion valve. It is a small restriction in the tube. The high-pressure warm fluid now passes through the small orifice/expansion valve. As it expands into a lower pressure region of the loop, it cools again – actually to a temperature lower than it was inside the refrigerator (because it 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.

#5 is the refrigerant fluid (typically R-410A) that is pumped/circulated around a closed loop when the refrigerator is operating. 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 their effect on our Earth's heat balance with the Sun – i.e., global warming. Sure enough, the new refrigerants created to mitigate the ozone problem are unfortunately extremely potent greenhouse gases.

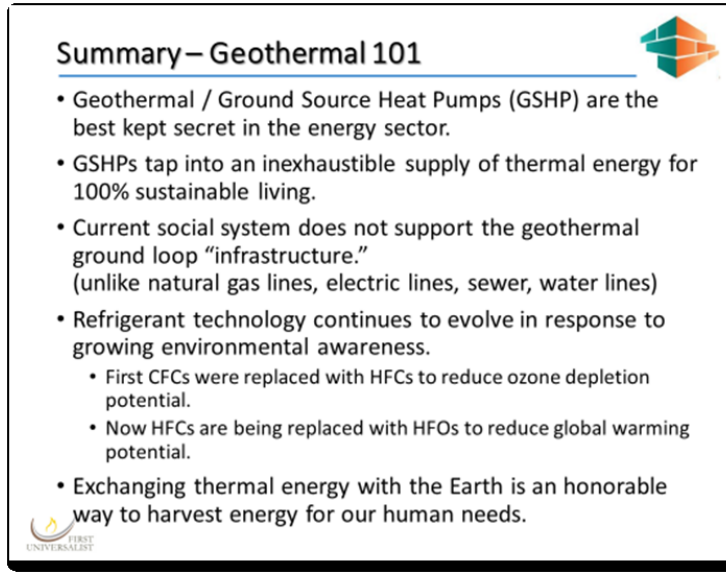
Within the last several years, a new refrigerant (e.g., HFO-1234yf) has been developed that does not harm the ozone layer and does not act as a GHG and contribute to global warming. Although HFO-1234yf is now being used in European automobile air conditioners, it has not yet been introduced into U.S. heat pump furnaces. Do ask for HFO-1234yf, nevertheless.

The Carrier brand heat pumps used at First Universalist use R-410a that is good for the ozone layer but bad for global warming. This refrigerant should not be allowed to escape into the atmosphere by properly recycling the heat pumps at their end of life 20 years from now.

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.



Typically the same people who manufacture HVAC systems now sell air-source and ground-source heat pumps for heating and cooling – and there are nearly a dozen to choose from in the US market.



The primary benefits of using a ground-source geothermal heat pump for heating and cooling are numerous. There is only one mechanical unit

involved in heating and cooling. The heat pumps are located inside the facility where they are protected from the weather and vandalism.

Preparation for the Congregational Meeting

Before presenting the renewable energy system proposal to the congregation for approval, it was necessary to finalize the "revenue-neutral funding approach.

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 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 purchasing gas and electric from the local utility company, Xcel Energy. The church utility bills using 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, but it could not be quantified.

The adjusted utility cost going forward with the renovated building was estimated to be $17,430. This utility expense is a significant 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: 1) no upfront down payment, 2) no change in the church operating budget, and 3) no future balloon payments.

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		1 pg
http://coloradointerfaithgreenbuilding.org/Solar-GeoFundingModelA.xlsx		1 pg

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 yearly operation and maintenance cost; input estimated 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.

4) Assume an escalation rate for the cost of fossil fuel derived energy. Colorado data has shown a 4-5% 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 combination 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" — **$ 208,400 GREEN GRANTS (DONATIONS)**

FIRST UNIVERSALIST

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		2,913	Average				
Total		17,505		Organization's Total Budget	$828,870 (Optional)		

"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*
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 Total 20 yr Fossil Fuel Costs	36,243	$262,574 Total Loan Payments		$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.

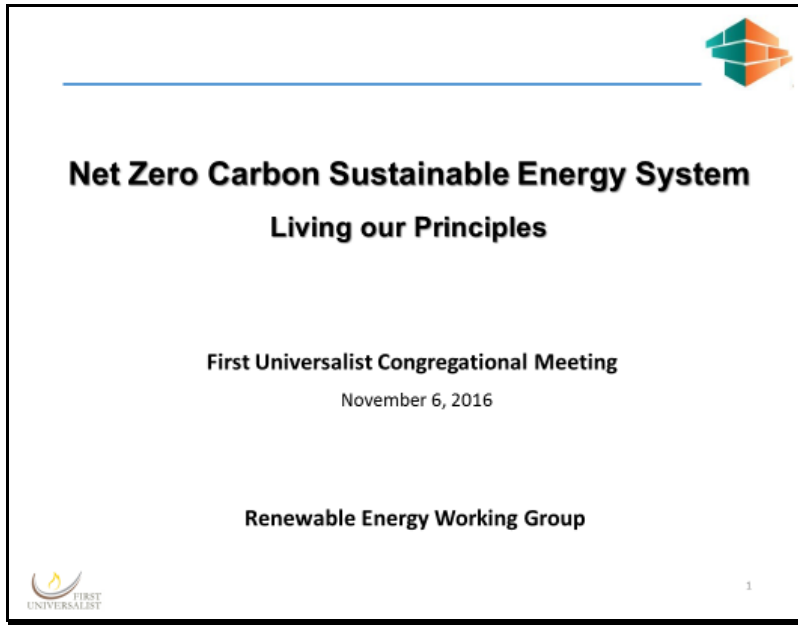
3) Green Cell below the Yellow Cell indicates the calculated amount of member loans that are consistent with a revenue neutral financing model

4) Gold Cell in the bottom row highlights the financial gain in switching to renewable energy

Congregation Approval of the Sustainable Energy System (6 Nov 2016)

After three "Town Hall" meetings following the Sunday morning services, and one Geothermal 101 session, the time to inform the congregation ran out and it was time to vote.

At a Special Congregational Meeting held by the Board of Trustees on November 6, one of the Independent Reviewers repeated the same PowerPoint presentation (except for the title chart shown below) made to the Board a month earlier on October 4, 2016 (entire presentation provided previously). This time, the invited audience was the whole congregation.



Again the proposed sustainable energy system was described as:

An extraordinary commitment to our 7th Principle supported by extraordinary contributions by church members, that will:

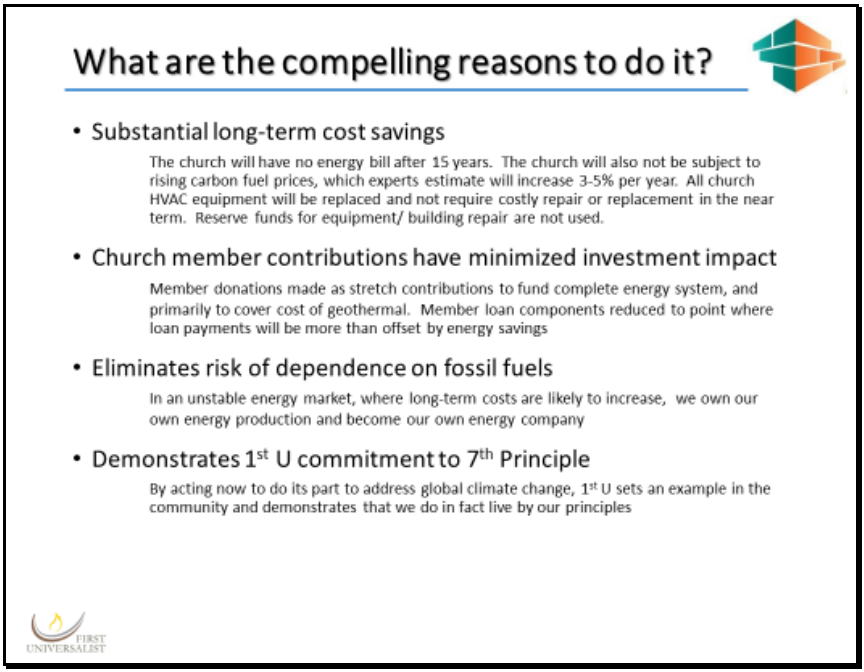
- Provide substantial long-term cost savings, but
- Require up-front investment with an extended payback period.

Critical questions to be addressed

- What is it?

Part II: Energy System Capital Campaign

- Can we make it work?
- How do we pay for it?
- What are the compelling reasons to do it?



After the presentation, congregants had time to ask questions. A motion was presented by one member 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, to complete 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 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 take 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 the combined human energy, resolve and shared-purpose of many more members.

By reflecting on their shared values, by managing and resolving their internal differences, by respecting each other's diverse perspectives, by sharing knowledge and experience, by applying their sacred principles, this small group of people enacted a change that now benefits their broader community. In a sense, reason, logic, spirituality, scientific evidence, and empathy for all prevailed over the opposing forces of a broken 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 harming their children's future. They can hope their example will make it easier for others to follow. They know their worship facility is now in compliance with the 2015 COP21 Paris Agreement, the 2018 IPCC 1.5°C Report and even the 2019 emerging Green New Deal to reduce GHG emissions to zero. They have stopped dumping 100 tons of GHG into the atmosphere annually.

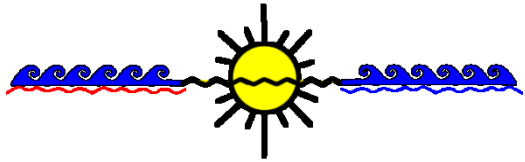
They are willing to provide tours and give seminars on the lessons

learned and potholes to avoid as others choose a transition from burning hydrocarbons.

In retrospect, having the congregation vote democratically for or against this project was a wise strategy. The vote allowed everyone to ask questions and then be part of the decision to transition to a new energy system.

Some Green Advocates After the Vote

Figure 25 Green Advocates Celebrating after the Unanimous Approval of the Congregation, 6 Nov 2016 to pursue the goal of becoming a "Carbon Free Church."



Part III Final Design, Construction (Nov 2016 – April 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, 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 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.

Unexpected Good Financial News (Xcel Energy Rebates) (11 Jan 2017)

One Green First member, 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 and the rebate application.[37]

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.)

Unexpectedly, the total of these energy-related rebates was approximately $91,000 over the next 20 years. The first component was $20,000 for energy conservation/efficiency elements that were incorporated into the renovated building. 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 is 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 second component was $71,000 for the REC Purchase Agreement that was entirely linked to the solar PV system. The REC rebate payments are around $3600 per year for 20 years.

To receive an $81,000 rebate for the energy system is equivalent to a significant (and 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 this time is the new utility rate structure that will be 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 the

church is not expected to need to buy any electrical 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. It will either be a new "Demand Charge" based on the peak demand during a billing period or a "Time of Use Charge."

Typically, that means that only about 50% of a commercial utility bill is offset by the net metering policy while nearly 100% of a typical residential bill is offset by the same policy. This is a cleverly contrived rate structure by a regulated monopoly, sanctioned by the PUC, allowed by the state legislation and a primary reason that commercial buildings (including places of worship) are slow to adopt rooftop solar all over the country.

Finalizing the Solar PV System Design

One member of the Green First Task Force, 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

Geothermal System Design

Earlier in the project, when the Green First Team introduced a ground-source heat pump heating and cooling system to the Building Committee, the Team also insisted that the design and installation of the geothermal system be performed by certified contractors. The Green First Team recommended a minimum certification by The International Ground Source Heat Pump Association (IGSHPA). The IGSHPA has published standards that help assure that certified personnel are part of the design and installation team. The mechanical designer was certified but not overly experienced and probably underestimated the amount of effort involved in this

remodeling project. The geothermal driller and installer were also IGSHPA certified and well experienced.

A member of the Green First Task Force and one of the Board's Independent Review Team reviewed the geothermal system design developed by the architect team. The reviewers wanted to understand how the new geothermal heating and cooling system was being designed to operate. As might be expected, they did find a few areas of concern that had to be worked out; the review process was worth the effort.

Monitoring System Design

The 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. The Green First Team was a novice at installing and operating 21st-century renewable energy systems. They had not thought about operation and maintenance and did not request any means of monitoring the performance of the system from the installers. The First Universalist energy system was a bit complicated because it involved not just solar PV equipment but also ground-source heating and cooling equipment (ten heat pumps) as well as five ERVs (Energy Recovery Ventilation Units). The Green First Team decided it was appropriate to monitor the operation of the entire complex energy system.

The Green First Team learned later from St. John's Episcopal, Boulder, CO that an eGauge monitoring system that displays the solar system performance on a web site could be beneficial. So plans were made to add an eGauge system that records the solar production and the specific energy usage of the building after the system was up and operating.

They discovered from the geothermal drilling contractor there was 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)

The monitoring equipment comprised of eGauage and WEL equipment was estimated to cost around $3500-$4000. The Green First Task Force found the funds to finance a complete combined monitoring system and volunteers installed it after the energy system was commissioned and the building had been certified for occupancy.

All Member Tour of the Church (August 12, 2017)

Early on, one of the renovation project completion dates was August 2017. However, as August rolled around, there were still 4-5 months of work to be completed. To illustrate to the congregation that progress was being made, 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.

The posters used to describe the new energy system during the tour are provided below.

- Poster #1 provides an overview of the complete "100% Sustainable Energy System." It points out the new system avoids dumping 100 tons of CO_2 into the atmosphere annually and could save over $150,000 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 energy 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 shows some of the steps for installing the ground loop heat exchanger
- Poster #5 illustrates internal geothermal equipment
- Poster #6 demonstrates the use of five ERVs intended to conserve energy

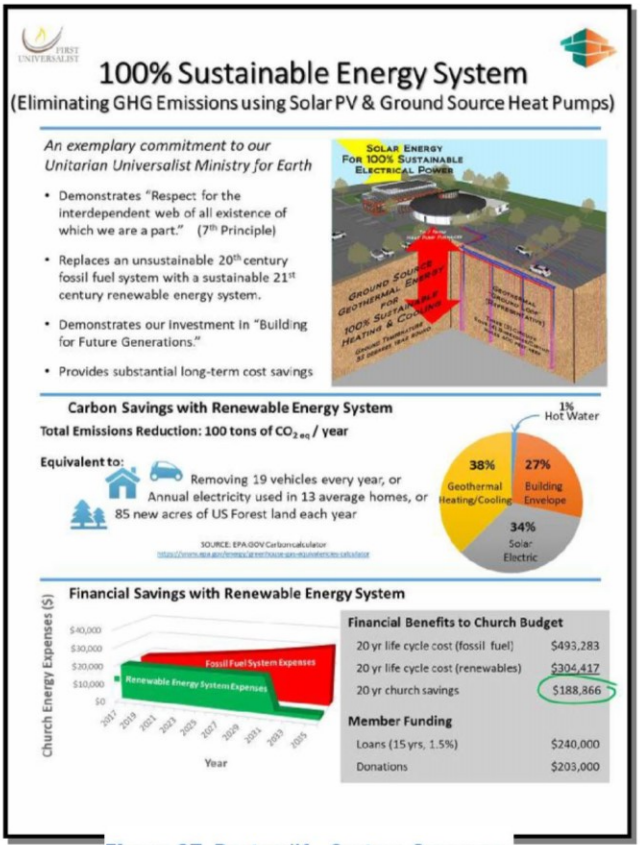


Figure 27 Poster #1 System Summary

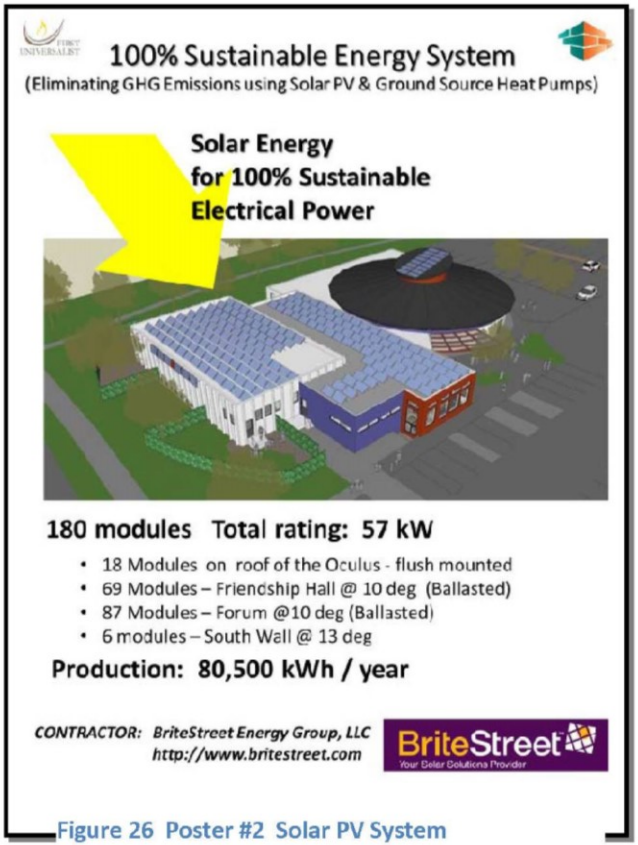


Figure 26 Poster #2 Solar PV System

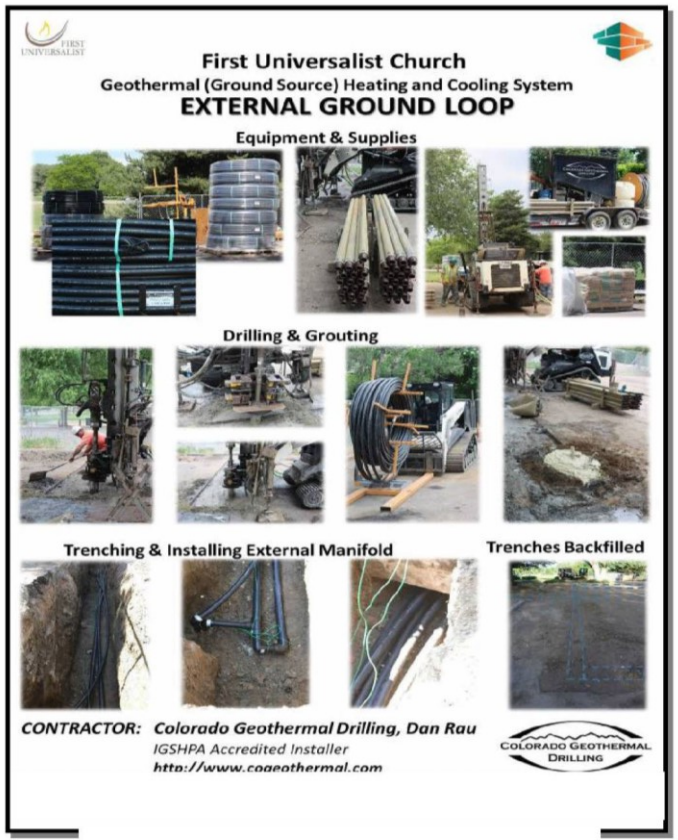


Figure 29 Poster 3 Geothermal Heating & Cooling

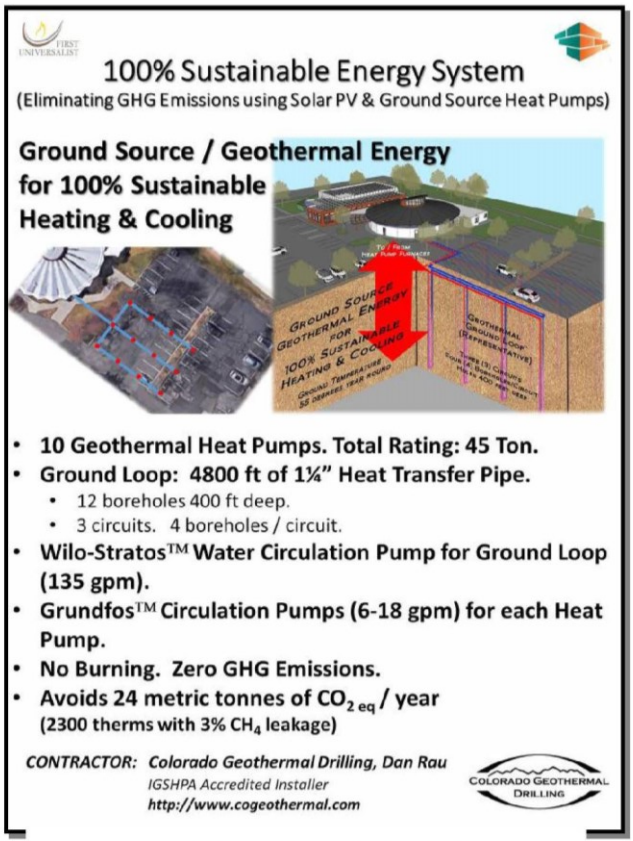


Figure 28 Poster 4 Installation of the Ground

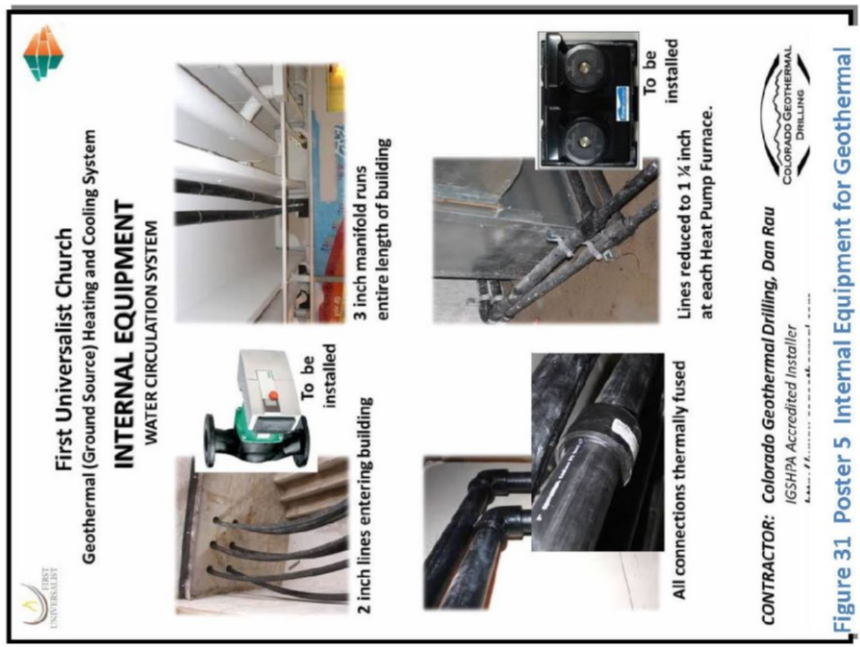


Figure 31 Poster 5 Internal Equipment for Geothermal

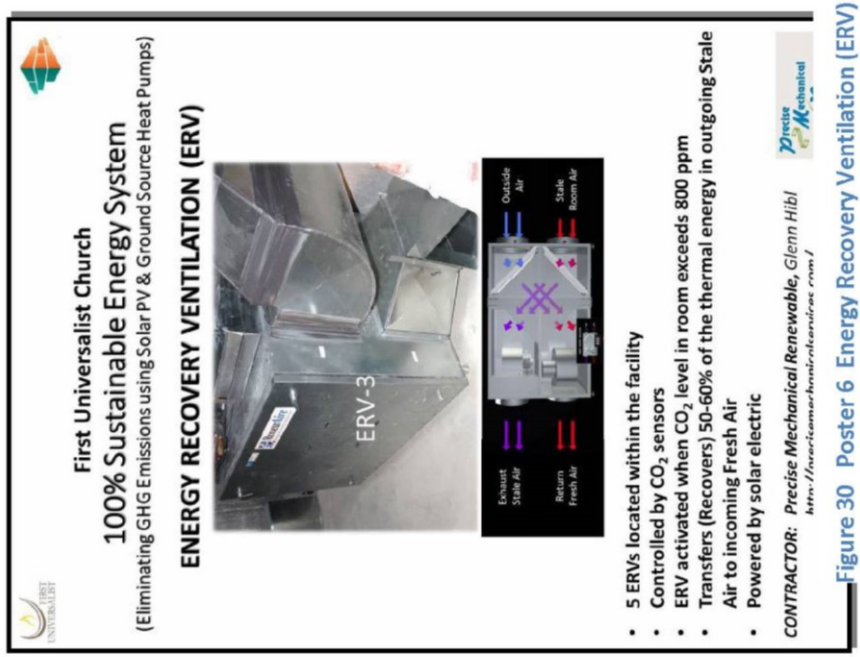


Figure 30 Poster 6 Energy Recovery Ventilation (ERV)

Energy System Installation Progress (7 Nov 2017)

The geothermal ground loop heat exchanger was installed during one week in June 2017. The remaining internal geothermal work was delayed until the HVAC contractor finished installation of the furnaces, positioned them, connected the forced-air ductwork, installed the ERVs, and the electrical contractor provided power to the water circulation pumps and heat pump furnaces. The geothermal work then resumed. Within several weeks, the heating & cooling system was completed in November 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.

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 a typical cold December evening, and the new geothermal heating 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 must have 78 degrees in there."

> **Note: An adult human gives off the same amount of heat as an old fashion 100 Watt incandescent light bulb. Three hundred fifty light bulbs will warm up a room.**

Typically 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. The thermostat settings were corrected immediately after the Service.

Monitoring Performance of the Energy System

After the building was thoroughly 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 dry walling was completed in anticipation of the monitoring systems.

During 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.

The electrical contractor, City Electric, activated the solar system on 6 June 2018, and the new solar energy system began producing electrical power. A typical summer 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 represents the power consumed by the church facility (usage spikes peak at around 18 kW).

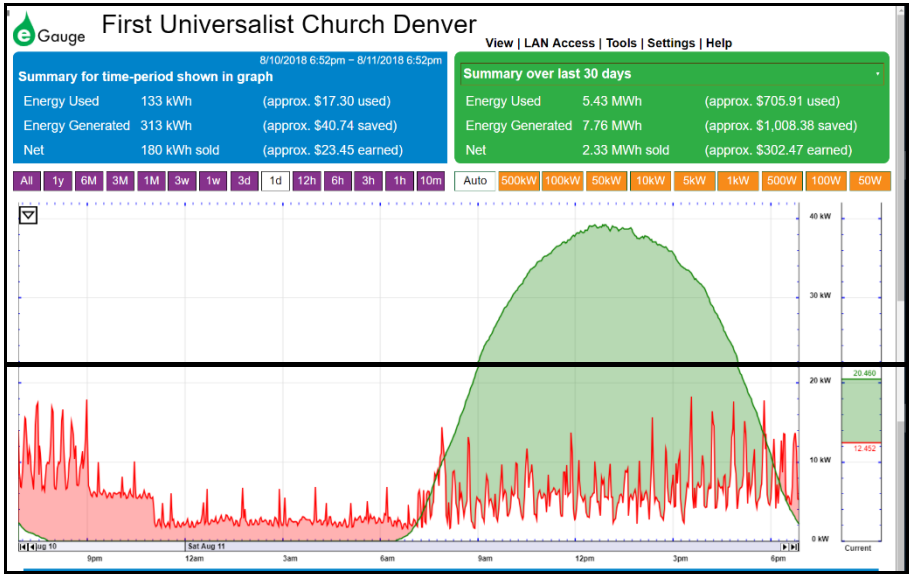
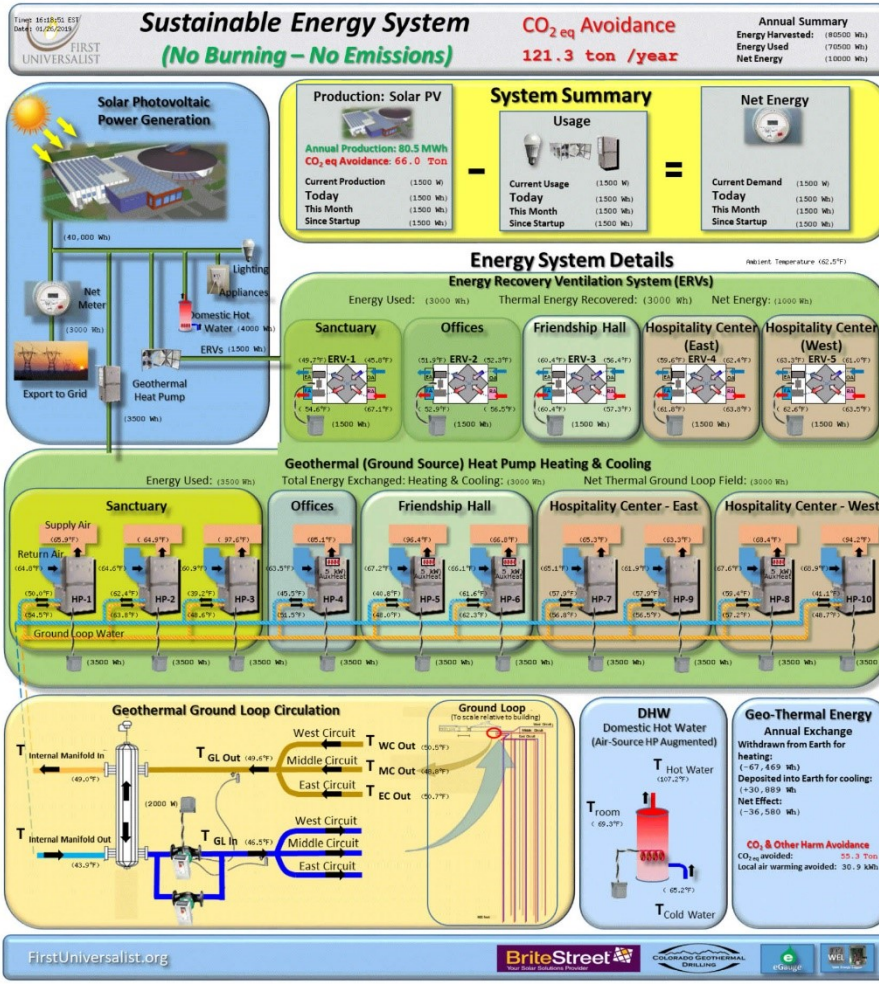
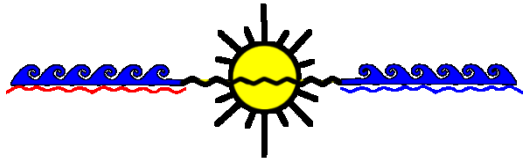


Figure 32 eGauge Monitoring System

The WEL monitoring system records the energy system temperatures throughout the facility. The performance information can then be displayed real-time on the graphic below via the internet.



Part III: “GreenNotes” Version



Part IV Post Project Reflections / Lessons Learned A "GreenNotes" [38] Version of the Project

"Communities of Faith need to lead the climate response…."
-- Colorado Interfaith Power & Light

NOTE: The information in this section (Part IV) is also available as a stand-alone summary document with a similar title referred to as the "GreenNotes Version."

The "GreenNotes" version provides an overview or summary of the First Universalist Case Study where the church transitioned from a fossil fuel-based energy system to a sustainable renewable energy system.

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. 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 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 charted this specific Path to Zero GHG Emissions.

Urgency.

This is a creation-care story about a bottom-up (grassroots) initiative started by a small group of concerned church members who were committed to preserving a habitable planet for future generations of life. They were committed to the 2015 Paris Agreement to limit global warming to less than 2°C. The subsequent 2018 IPCC Special Report clarifies that to

limit warming to 1.5°C, every individual and organization must be on a path that reduces GHG emissions by 50% by 2030. From there, the path must achieve net-zero GHG emissions before 2050 to avoid the need for implementing extreme, large-scale carbon capture/sequestration measures.

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 actually to implement change from the bottom–up. Real changes that can be measured as 'tonnes of GHG that have been eliminated/avoided' must begin now, regardless of the current social system.

It appears that too many people are expecting and waiting for system-level programs to solve the problem. These top-down programs have yet to be legislated. 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 measure reductions in GHG emissions. Climate science indicates we cannot wait 4-8 years to start changing our ecocidal behavior.

Contrast this with a bottom-up approach, where organizations use the freedom and power they already have and just do it. It took one year from the time the project was approved to begin operating the First Universalist Zero GHG Emission Energy System – to implement a 100-ton reduction in GHG emissions. (The actual installation work time was less than one month, but the installers were delayed because of schedule conflicts caused by the other trades working on the primary renovation project.)

Currently, no plans are being considered, even with the Green New Deal, to directly assist non-profit, faith-based organizations in financing new equipment necessary to reduce their carbon emissions to zero. So even after waiting 4-8 years for the Green New Deal Programs to be enacted, there still may be no financial assistance from the Federal government that applies directly to non-profit organizations.

Brief History of the First Universalist Church Denver 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. Over a year, they crafted a financing approach to purchase and install a new 100% Sustainable Energy System (using solar electric plus ground-source heat pump heating and cooling system.)

Using the new 21st-century equipment they proposed to install, the church could harvest inexhaustible emission-free energy that is already on-site to operate the renovated facility. (i.e., they could use the daily sunlight to generate all their electrical power and the thermal energy in the ground beneath them and in the air surrounding them for heating and cooling purposes. No net energy needs to be imported.)

The small group of advocates/supporters of a 100% Sustainable Energy System slowly grew in number as well as resolve during the project. Collectively, they 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.

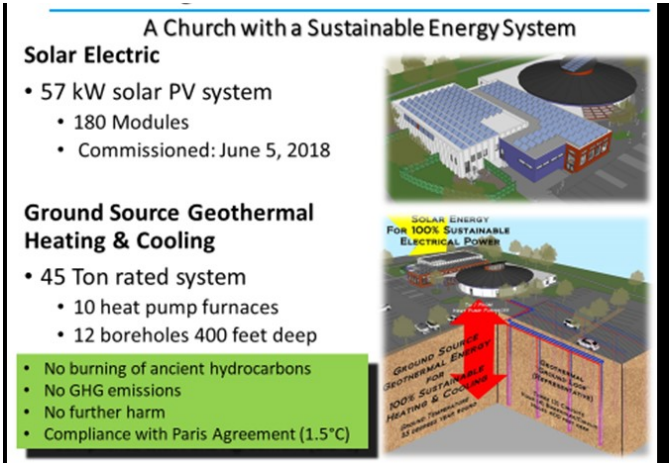
A sustainable energy system design, cost estimate, and financing plan evolved and was presented to the Board of Trustees for approval. After several iterations, the Board approved the funding approach in Oct 2016. The proposed revenue-neutral funding approach backed by member donations of over $200,000 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. This added scope to install a new energy system represented 10% of the renovation project budget.

Deconstruction / Construction of the BFF remodeling effort had begun in August 2016. The ten natural gas-fired furnaces and domestic water heaters were removed and recycled as part of the Deconstruction phase to Reuse/Recycle. Installation of the geothermal ground loop was delayed until city water was available at the worksite 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 Sanctuary for the Christmas Eve service on 24 Dec 2017. The lower level of the facility was still under construction during December and completed in February.

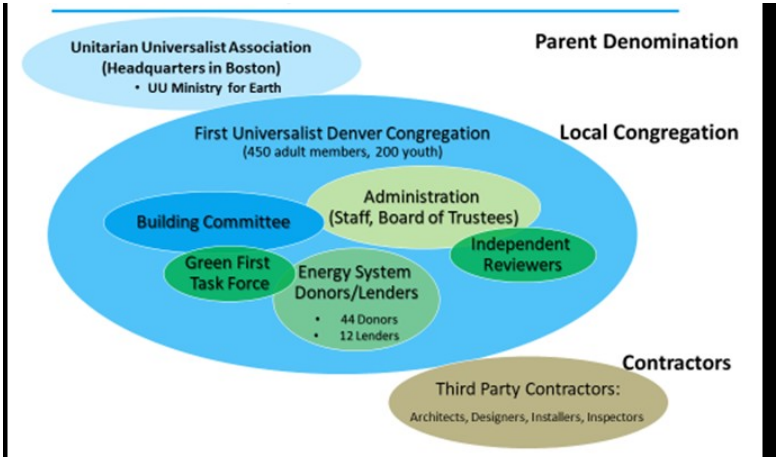
Part III: "GreenNotes" Version

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.

What Emerged?



Who were the People Involved?



What was the Motivation to Change?

Before describing "How the Church Transitioned to a 100% Sustainable Energy System" to comply with the Paris Agreement, it is essential to ask, **"What was their Motivation?"**

Upon reflection, it was evident that a "motivation to change" was probably the key element of the project. Motivation can be reframed as "human energy." It appeared that a critical amount of human energy first had to be amassed and then focused on bringing 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 several 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."

Motivation, or lack thereof, seemed to be one of the first significant challenges confronting the Green First Team. The Team found it was prudent to tap into every source of motivation available because a substantial 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 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 several areas where religious organizations (and other non-profits) have distinct disadvantages (e.g., particularly in the financial sector) 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.)

Part III: "GreenNotes" Version

- 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 apply to other faith-based organizations.

Religious, Spiritual, and Ethical Values.

The Green First Team helped identify and align their congregation with intrinsic 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 universal 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 about 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 more significant number of their fellow congregants.

Science-based motivations.

They found 'reason and logic' was an authoritative 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 know how infrared energy is absorbed by specific 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 would 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 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.[39] This latest publication provided a new awareness of the urgency of changing human behavior and reducing GHG emissions to net-zero. 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 CO_2 (adjusted 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 CO_2 emissions of 50% by 2030 (as illustrated in Figure 33.**)**

At the current rate of burning, humans are adding around 43 gigatonnes of CO_2 per year. So if nothing is done to change behavior, the quota for a 1.5°C warmer planet will be used up within 12 years - by around 2030.

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 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**. Denver's 80x50 plan must become 100x50 with a companion plan of 50x30 to be meaningful.

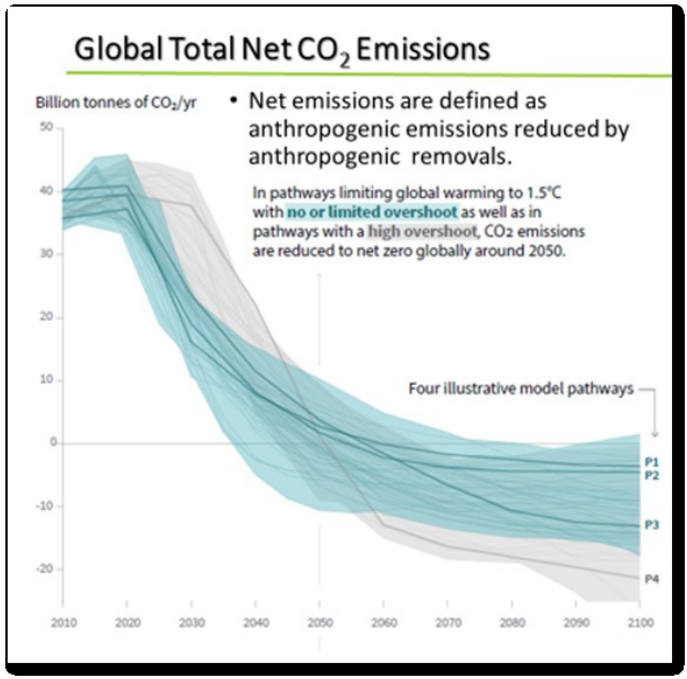


Figure 33 Paths to Zero GHG Emissions for a 1.5°C World (Ref: 2018 IPCC 1.5°C Special Report)

It appears that too many people are expecting system-level programs to solve the problem. These top-down programs have yet to be legislated. 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 and expect to 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 one year (from the time the project was approved) to install and operate the First Universalist Zero GHG Emission Energy System. There was an immediate reduction in GHG emissions equivalent to 100 tons annually. (The actual work time was less than one month, but the installers were delayed because of delays caused by the other trades working on the main renovation project.)

Currently, no Federal plans are being considered, even with the Green New Deal, to directly assist non-profit, faith-based organizations in financing new equipment necessary to reduce their carbon emissions to zero.

Part III: "GreenNotes" Version

Using several workshops, the Green First Team encouraged the use of personal freedom and power to reduce GHG emissions in the member's private lives. Members were invited to join groups where they could magnify their power to bring about a more significant change in organizations.

The good news is that faith-based organizations can empower themselves to reduce GHG emissions right now. As members of a group, individuals can magnify their power to bring about measurable change from the bottom-up.

Economics and Financial gain

The Green First Team observed that becoming a fiscally responsible investor was essential 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 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 disconcerting 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 five times more CO_2 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 several people to support a clean energy transition project now. They understood because members of the team were themselves parents and grandparents.

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.

Possibility and Hope.

The Green First Team also observed a less defined source of motivation that can only be described as optimism. Some church members, who are not scientists, not financial experts, may not be considered as environmentalists or naturalists, still 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.

Biomimicry.

It was observed that several members had strong attachments to the natural world. In their case, the concept 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).

Situational Awareness

It can also be observed that 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.[40]

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 continuingly. 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 highest priority step 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 are **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 CO_2 and other GHG to our shared 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 endless energy sources are 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 a 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 ten steps listed in Figure 34.

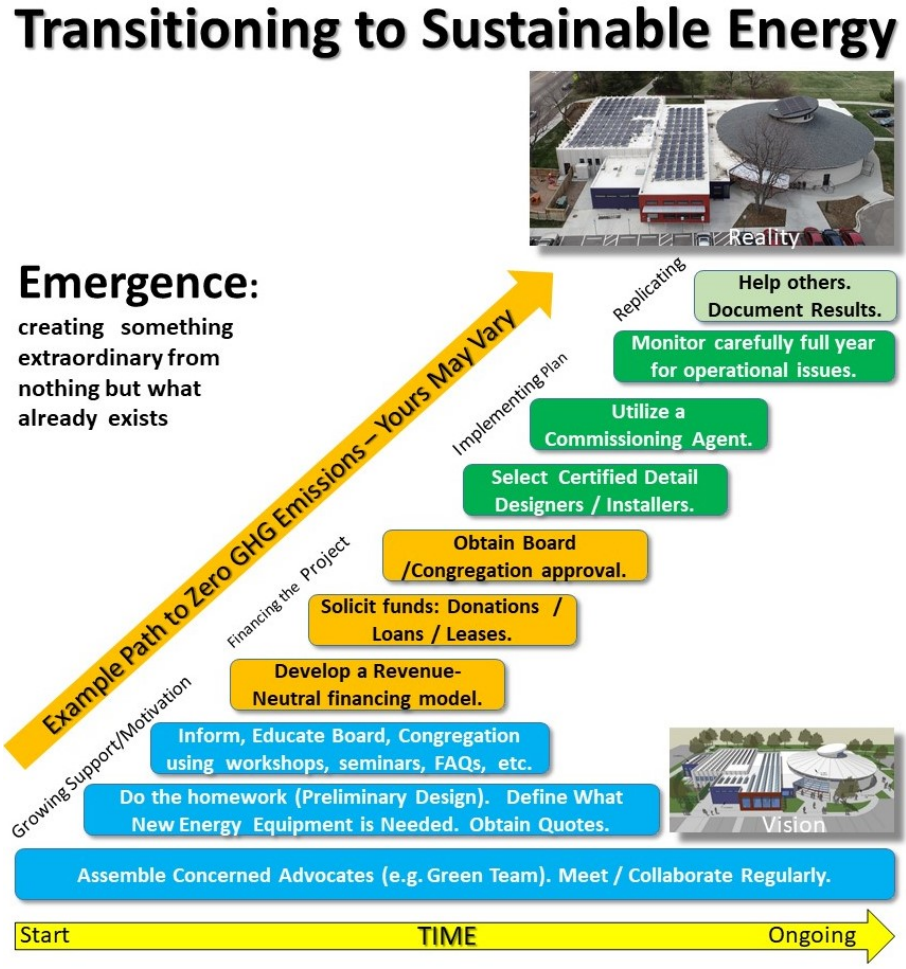


Figure 34 Steps Along the Path to Zero GHG Emissions

1. Assemble a Group of Advocates – a 'Green Team'

First, they formed a group of advocates – a Green Team. First Universalist called its team 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.[41] So this small group not only shared religious values, but they already had built working relationships.

The Green First Team started advocating for a rooftop solar photovoltaic

(PV) system to generate electrical power 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 broader 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 ground-source 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 and committed people. They became the engine of change.

Based on the experience of the Green First Team, several suggestions are offered:

a) Do invite a few STEM[42] 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) Encourage anyone concerned about the climate crisis and living sustainably to be a part of a "Green Team." Other helpful skill sets to have on the Green Team include legal, graphic design, media & communication, 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, engineers, installers, and

other professionals who would eventually be contracted to perform the work.

Some of the early homework was intended to envision the range of technology options available for their application. They quickly learned there was already sufficient energy onsite (in the form of sunlight) to generate all the electrical power they needed. They learned there was enough thermal energy (in the air or 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 the 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 significant externally imposed obstacles (e.g., historical preservation constraints) preventing the project from proceeding. Nor did they find any noteworthy 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 expenses because they 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 ten 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 yearly fossil fuel cost (to be approved by the Board)

Identify and quantify the amount of harm the current fossil fuel system

is doing in terms of greenhouse gas (GHG) emissions. The Green Team quantified the amount of damage the church was causing in terms of the amount of greenhouse gas being dumped into the atmosphere each year. Using the techniques described in the detailed Case Study, they quantified the harm.

- **The church was responsible for dumping about 124 tons (112 metric tonnes) of $CO_{2\ eq}$/year into the atmosphere.**

Create a graphical image that depicts the GHG emissions.

As shown in Figure 35, 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 generating plant.

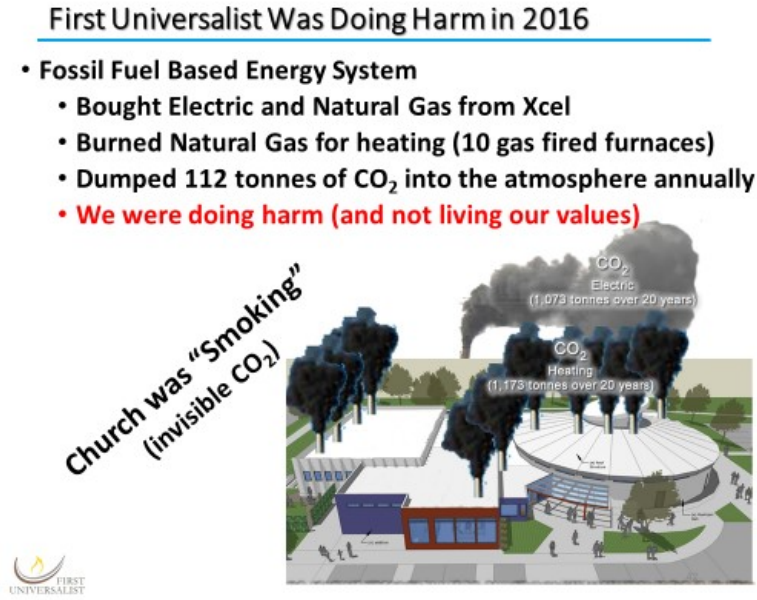


Figure 35 illustration of the GHG emissions from First Universalist Church in 2016

Include externalities (Ignored social costs)

[A detailed discussion of Externalities is provided in 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.[43] of the Harvard Medical Center analyzed 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 shortlist of ignored social costs and concluded the actual 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 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 leading good people to make some bad (ecocidal) decisions.

If ignored costs are included in the "cost analysis" (i.e., externalities are internalized), it is overwhelmingly evident that the true cost of fossil fuel is much more expensive than renewable energy. If the actual cost of burning fossil fuel were used in the free market, everyone would be transitioning to solar, etc. in a heartbeat.

When the Green First Team presented this perspective of externalities to the Building Committee and Board, they were told not to discuss this 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 (broken) economic frame of reference in all "cost" discussions.

Envision a New Energy System with Zero GHG Emissions

Using open-source tools described in the 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 ten natural gas furnaces with ten 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 main remodeling project would be sufficient to 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.
- Make the Board an airtight offer they cannot refuse.
- 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 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.

Part III: "GreenNotes" Version

The Green First Team found it is prudent to establish a baseline Life-cycle Cost analysis assuming they could 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 several other possibilities 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 of the detailed Case Study. 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 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 light-weight materials – particularly for transportation, etc. The carbon materials can be recycled.) But humans must stop **burning** these limited supplies of ancient hydrocarbons.

3. Inform, Educate the Board/Congregation about the Climate Crisis

One of the more critical 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 the detailed Case Study, the process of increasing awareness of this threat to the well-being of all life on our Planet can occur in several 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 essential 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 draw down 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 five 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 CO_2 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 of the Detailed Case Study for more details.

- Ideas about different approaches to investing. For example, Woody Tasch was invited to talk church members about his book ***"Slow Money"*** and socially responsible investing.

- Ideas from Lynne Twist's ***"The Soul of Money"*** were used, such as *"We've made money more important than God or spirit."* or *We've given money more power than … love, or our relationship with one another."*[44]

- Ideas from Naomi Klein's "***This Changes Everything-Capitalism v The Climate,"*** were paraphrased including, *"Climate Change pits what the planet needs to maintain stability against what our current economic model needs to sustain itself." Also, "The Climate Justice fight … 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."*[45]

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 most critical 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 expense 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?

There will be a financial gain because the Green First Team can develop a financing approach that creates the gain.

The detailed Case Study describes the technique First Universalist used to construct a funding approach that assembles the needed capital for the new energy equipment AND:

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 became 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 ingenious funding approaches involving third parties (Power Purchase Agreements, Leases, PACE, Commercial Loans, etc.). The baseline also identifies the amount of sacrifice required by the congregation (if any).

1.5% Interest Loan Background.

After searching for several months without success for a third-party investor to fund their new 'energy system' that included both solar and geothermal equipment, the Green First Team finally gave up. It was then the self-funding models developed locally by Christ the Servant Lutheran, Louisville, CO, and St. John's Episcopal Church, Boulder, CO were discovered.

An informal poll by the Green First Team indicated that church members were "tapped out" as far as making further donations to the church. However, that same poll found some members would be willing to "loan" money to the church if they at least got back their principle.

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. 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.

The Green First team also considered using an LLC made up of church members. It turned out that the LLC approach did not work as well at First Universalist Church Denver because the congregational demographics did not involve enough members with 'passive income' for the amount of capital needed to be raise.

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%]

Nevertheless, the idea of self-funding was still a good idea, and the LLC morphed into a Partnership, as explained in the detailed Case Study. It is fair to say First Universalist Church would not have found their path without the new ways of thinking opened up by Christ, the Servant Lutheran and St. John's Episcopal Churches.

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 discovered 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 result was a monthly repayment plan comparable to the current monthly budget for gas & electric.[46] 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."

The use of a combination of donations and low-interest (i.e., 1.5% interest) member loans seemed to emerge as a viable financing approach for First Universalist Church. (The commercial financing sector refers to this type of financing as "Impact Investing" or "Impact Lending."[47])

Unitarian Universalists were being encouraged to divest from enterprises that operated unsustainably (e.g., coal, oil, and gas-related enterprises) by

the 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 suggesting Total Divestment. Total divestment means you stop feeding the monster financially - completely. Full Divestment means you stop buying their stocks, bonds, AND unsustainable products – a choice consistent with transitioning to zero GHG emission renewable energy sources.

For First Universalist Church, 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) At the church level, stop buying fossil-fuel generated electrical power (the local utility company still generated 80% of its electricity by burning coal and natural gas), and
c) Stop buying/burning natural gas for heating the facility.

Members of the Green First team had also been influenced by the "Occupy Wall Street" movement in 2011. The "Occupy" movement identified several economic injustices and introduced 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 had just been initiated? Their voices were heard, and the renovation project soon included a renewable energy system.

The low-interest member loan approach was aligned with several ideas advocated by the members of the congregation. For example:

- Avoid feeding Wall Street where possible. Income inequality & wealth inequality are already crippling this country.
- 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 "want to promote a good cause that represents their values" instead of being focused on "making money."
- Keep wealth within the local community, where it provides local jobs. Better yet, retain the entire financial gain within the church community. If you have to pay any usury fees, pay it to yourself – to your church members.

Spreadsheet Analysis of the Funding Model.

A relatively simple financial spreadsheet model similar to that shown in Figure 4 was used to construct a "Revenue Neutral" funding plan. Essential steps in designing a "Revenue Neutral" funding plan include the following:

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.
   The analysis defines the baseline annual cost required to operate the existing hydrocarbon-based energy system.

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 differently. 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 36 will perform all these calculations when you input the necessary costs.

Figure 36 A 20 Year Life-cycle Cost Assessment Used for the First Universalist Sustainable Energy System Project.

RENEWABLE ENERGY SYSTEM PROPOSAL - REVENUE NEUTRAL

MEMBER LENDER FINANCING "TRADITIONAL LOAN REPAYMENT" — $ 208,400 GREEN GRANTS (DONATIONS)

FIRST UNIVERSALIST

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	2,913	Average				
Total	17,505		Organization's Total Budget	$828,870 (Optional)		

"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
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 Total 20 yr Fossil Fuel Costs	36,243	$262,574 Total Loan Payments		$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

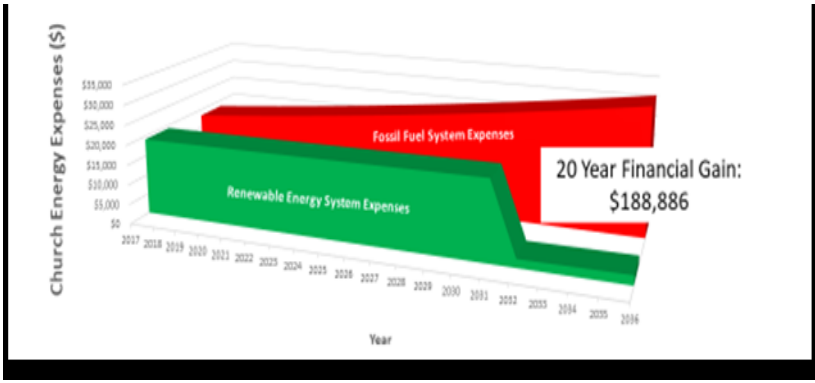


Figure 37 Comparison of Annual Expenses for operating a Fossil Fuel Energy System (RED) vs. a Renewable Energy System (GREEN) using a 20-Year Perspective.

Final Spreadsheet Analysis of the Funding Model.

The final financial assessment available for the November 2016 Congregational Meeting is provided in Figure 36. 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 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 annual bills based on a fossil fuel energy system was around $13,146 for electric and $3,372 for natural gas plus $2912 for annualized equipment replacement costs for a total of $19,430.

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 $1,900 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 $17,500. 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.

7) 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.

8) If the new energy system is being installed along with some energy conservation/ energy efficiency improvement, estimate the annual savings,

9) 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)

10) Assume an escalation rate for the cost of fossil fuel-derived energy.

Colorado data has shown a 4-5% annual increase over the past 20 years – it is reasonable it can increase that much over the next 20 years.

11) 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 combination of the yellow cell and the green cell should be the total cost of the new energy system.

12) 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.

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.

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.

The following situation occurred at First Universalist Church Denver. The congregation had just finished a significant capital campaign to raise funds for a $4.5 M renovation project that included a new energy system with zero GHG emissions. That capital campaign ended with a shortfall of nearly $1M. In response to that shortfall, the new sustainable energy system was deleted from the remodeling project, but the Green First Team was authorized to seek "third party" funding for the new energy system subject to approval by the Board.

After failing to identify any third-party financing, the Green First Team turned to re-soliciting the congregation for funds to install a new energy system.

The Green First 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.

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. 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 donate.

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.

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.[48]

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 essential for all faith-based and mission-oriented non-profit organizations in the early stages and throughout.

At First Universalist Church, the process of obtaining approval from the Board of Trustees to transition from fossil fuel to renewable energy was difficult. Though 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 complicated than necessary because the Green Team did not initially discuss an approach or strategy for gaining Board approval. They 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 proclaim proudly, "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.[49] 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 the 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.[50] 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.[51]

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.[52]

- 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.

Based on the Green First Team's experiences, it appears crucial to understand the perspective of the Board / Vestry /Council for effective communication. Based on observation, it seems 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.

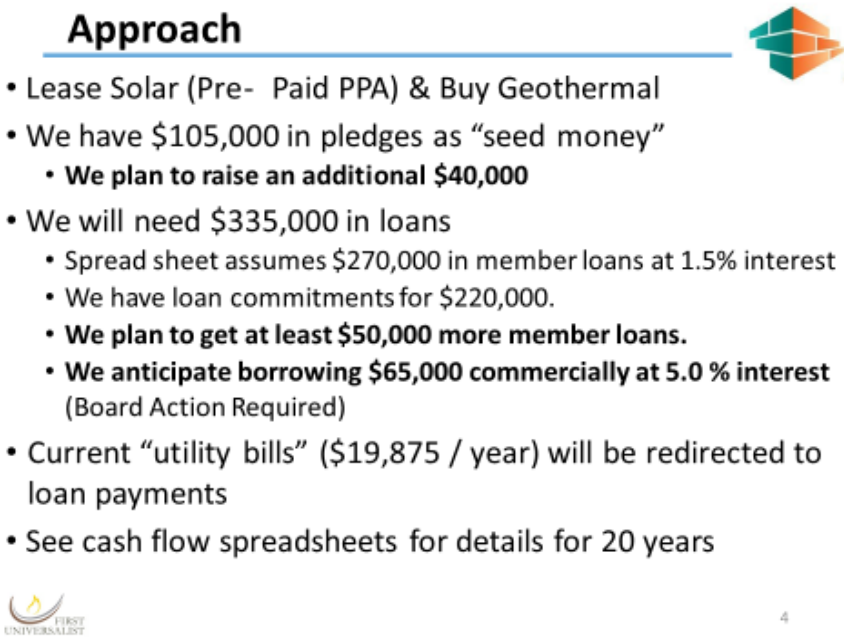
The Green First Team did not appear to acknowledge that some members of the Board were not financial experts. As a result, the Team did not provide an adequate explanation of a Life-cycle Cost analysis.[53] So part of the challenge for a Green Team is to introduce to the Board the importance of a life-cycle cost assessment.

Presentation to the Board of Trustees (5 Jul 2016)

Before 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 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. The first time the Green First Team presented their proposal to the Board, **Two-thirds (2/3) of the capital required for a new energy system had already been pledged.** So the presentation was a status report and not a final report.



The spreadsheet model in Table 4 illustrates the 20-year cash flow with this funding model.

Figure 23 summarizes the 20-year annual payment profile (shown in green) that was designed to be the same as the projected utility bills (shown in red). A 4% / year escalation in expenses was assumed (sum of inflation and rising energy prices.) The escalation rate became a very contentious assumption as discussed later.

Table 4 Baseline Proposal to Board 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	$660
Annualized Equipment Replacement Cost	$3,250	ear (Ref: ASHRAE)				Equip servicing	$650
Total	$19,269					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	$40,000			1%	Additional Cash Contributions from BFF		
	$440,000						
Dedicated Pledges for Energy System	$105,000	(22%)		2%	Inflation rate		
	$335,000			2%	Fuel cost escalation		
Financed by Member Energy Loan	$270,000	81%	for 15 years @	1.5%	Interest Rate	$301,681	$31,681 (Member Lender Gain)
Financed by Commercial Energy Loan	$65,000	19%	for 15 years @	5.0%	Interest Rate	$92,523	$27,523 (Wall Street Gain)
20 Year Life Cycle Cost (Renewable)	$426,670				Total Loans	$394,204	
20 Year Life Cycle Cost (Fossil Fuel)	$620,615						
20 Year Savings with Solar/Geothermal	$193,945						

Year	Fossil Fuel Utility Bill plus Replacement	New Operat Cost			ment bers	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	$1,33			7	$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	$36,083	$8,040	$2,956	$417,311	$301,681	$104
2032	$37,534	$1,798			$0	$1,798	$0		$419,110	$301,681	$0
2033	$39,035	$1,834			$0	$1,834	$0		$420,944	$301,681	$0
2034	$40,597	$1,871			$0	$1,871	$0		$422,815	$301,681	$0
2035	$42,221	$1,908			$0	$1,908	$0		$424,724	$301,681	$0
2036	$43,910	$1,947			$0	$1,947	N/A loans paic		$426,670	$301,681	$0
	$620,615	$32,466	$92,523	$301,681	$301,681	$426,670	$0	$31,681			
		Total Loan Payments	$394,204		Savings	$193,945					

STATUS REPORT

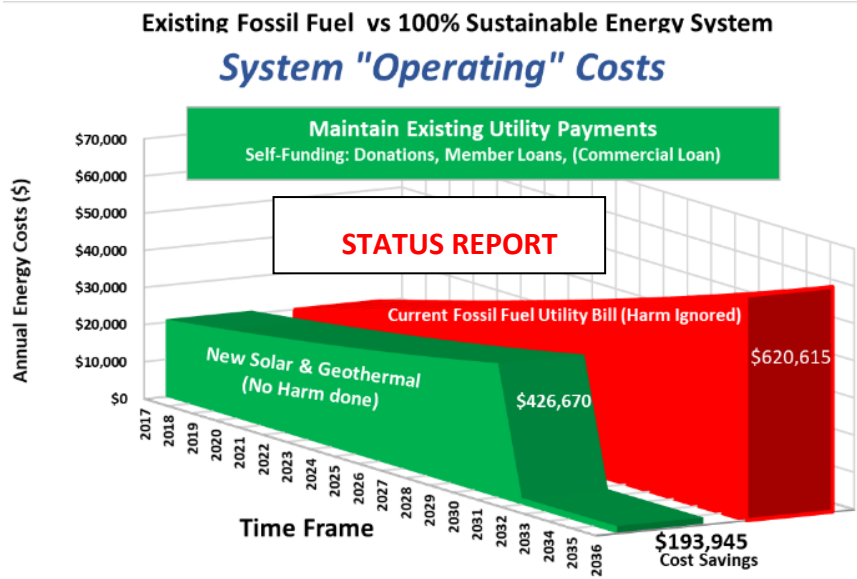


Figure 38 Summary of the proposed energy system 20-year cost profile compared to fossil fuel system cost.

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.

FIRST UNIVERSALIST

13

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 ten-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, but there was still work to do to raise the remaining 1/3 – including several new Board requirements yet to be identified.

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 attended who were curious or concerned about the proposed new energy system. 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.

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 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 typical construction permitting process does not include quality 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 sophisticated technologies. Validation of quality 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 correctly. 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/conserve 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 thoroughly inspected and certified for occupancy, several members of the Green First Team installed the 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 critical items.
  See egauge41397.egaug.es
- **Web Energy Logger (WEL)** for measuring/recording geothermal system temperatures. See www.welserver.com/WEL1022/

Over 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 significant energy users.

City Electric activated the solar system on 6 June 2018, and the new energy system began producing electrical power.

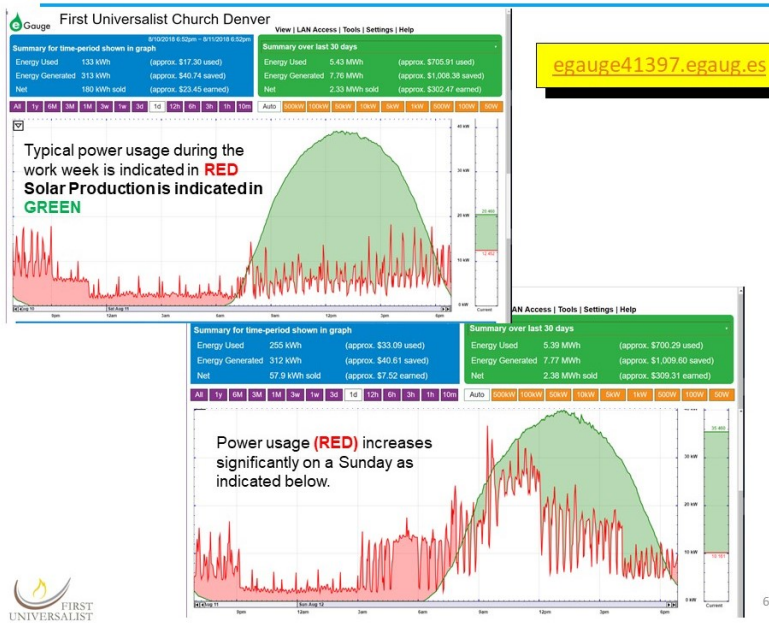


Figure 39 eGauge display showing Energy Usage midweek and on Sunday in RED. Solar PV power generation is shown in GREEN

The eGauge monitoring system records and displays the power generation and usage of the church. The green profile in Figure 39 illustrates the power (**green**) generated by the rooftop solar PV system over 24 hours. 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 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 are 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 below.

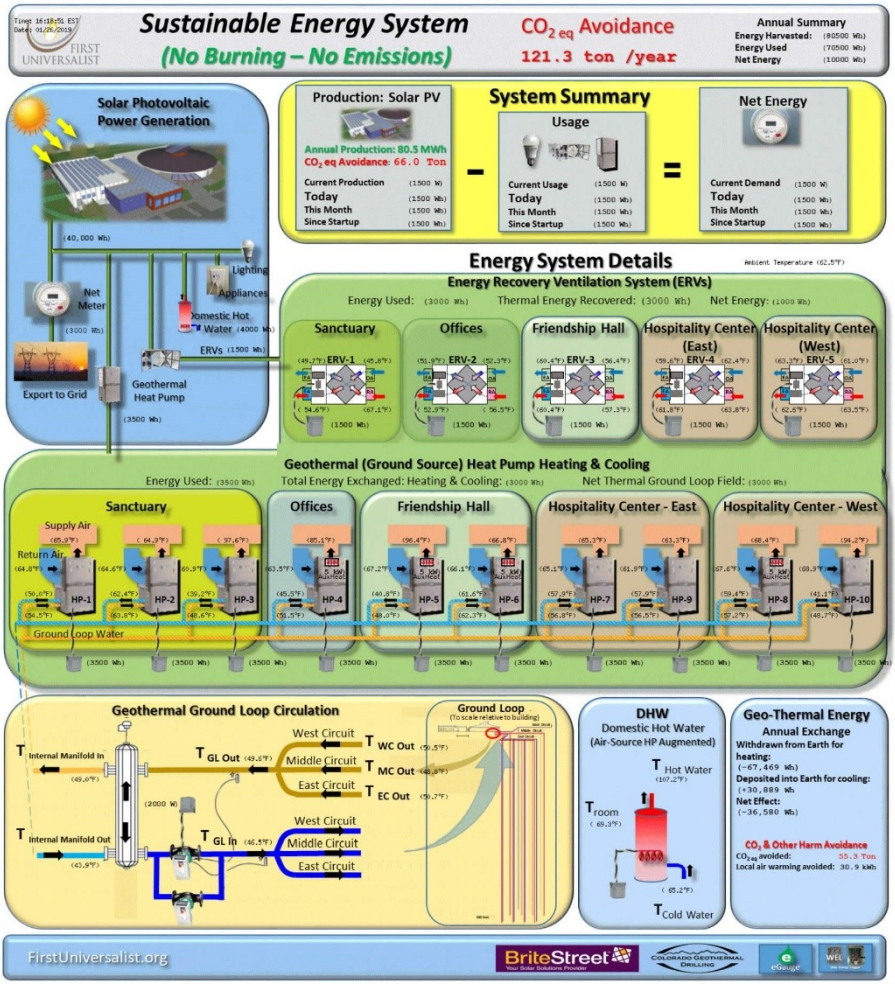


Figure 40 WEL Temperature Monitoring System

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 account 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.

Conclusions

- Transitioning to a 100% sustainable (renewable) energy system results in financially 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.

Conclusions / Summary

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.

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.

Construction of the new energy system began June 21, 2017, with the drilling of the first borehole for 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 $CO_{2\ eq}$ into the atmosphere annually and complies with the 2015 Paris Agreement and the 2018 IPCC 1.5C Report.

Things Left to Do. To reach the goal of Net-zero GHG Emissions, First Universalist still has work to do. The kitchen uses a natural gas burning stove. The exhaust hood includes a make-up air heater that burns natural gas to warm incoming cold air. Zero waste is still a challenge. Recycling / composting food waste is still in-work. There are no electric vehicle charging stations for the Staff or congregants – transportation has yet to be addressed. Most of the staff and members drive gasoline powered vehicles to church. Utilizing the “grounds” in a sustainable manner (so it harvests sunlight and serves as a regenerative system) has yet to be addressed.

Summary of Key Events in this Story

[Concerning Climate Change]

"winning slowly is the same as losing" [54]
…. 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 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.

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 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 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.

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 Reay." 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.[55]

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 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) Giving up on Tax subsidies lead to member financing.

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. Not finding any viable participants, the Green First Team eventually abandoned for-profit third parties as a funding source for the total system and began exploring alternative funding approaches.

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 funding mechanism that would be acceptable to the Board of Trustees.

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 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) Failure to consider externalities

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.

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.

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) 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.

8) 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 equipment was identified to be around $4,000. 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 this new energy system 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.

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-to-go-around or hurdles-to-jump-over.

A few hurdles that were encountered during the First Universalist project are identified:

National Hurdles.

There were several 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.

  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 principal 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 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, there 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 $0.37 / kWh. (See Harvard Medical Center study.)

There are few, if any, hidden or ignored costs associated with solar, wind, and geothermal energy. Yet we continued 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, 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. [56]In particular, they say that Fred Seitz, Fred Singer, and a few other contrarian pseudo 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.[57]

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.

Local Hurdles / Obstacles / Delays

Motivation /Lack of Awareness /Lack of Concern

Aside from the Green First team, initially the congregation did not appear to be that concerned about climate change issues. Workshop, Seminars, and Science Discussion groups might be 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 circle-of-advocacy grew to include several of Building Committee members who leaned in and supported the idea. Then several Board Members joined the circle. Eventually, there were 44 of the 450 adult members of the church who made financial contributions to this specific project – either in the form of a donation, a low-interest loan or other services rendered; that was 10% of the congregation.

The goal of convincing the whole congregation that climate change is an existential issue, and the number one priority is not required; that's an obstacle that you can go around. Not everyone in the congregation has to become a climate activist to have a successful transition from fossil fuel to renewable energy.

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. But to the 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 to include a new sustainable energy system in the renovation project.

The final Board-approved funding plan was designed actually to lower the church operating budget for energy-related utilities. As a result, the congregation voted unanimously to go forward with the project.

Construction 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.

Also, 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 whole project of which the new sustainable energy system was a small (10%) part.

The sustainable energy project was an independently funded effort embedded within a larger church renovation project. How much this arrangement was a hurdle or help is not known. 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.[58] The forced air supply and return ducting were essentially 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 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 installation.

During the project, there were some significant design issues and installation issues that managed to navigate this communication arrangement between the Green First Team and the folks doing the work.

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
- 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."
- 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 GF Team to find a "revenue neutral" solution
    - A Board representative chaired the ad hoc Renewable Energy Working Group

Part IV: Post Project Reflections

- Was assisted by 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 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.

Change the System

- This project was a grassroots effort that was able to take place despite the hurdles in place by today's social system.
- There is still enough freedom to do what is right – to do what is consistent with our 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.

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 have 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., CO_2 is now up to 410 ppm and rising rapidly.)
  - Only a fraction of the members are 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 our planet for all future generations is an existential repudiation of our 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 $CO_{2\ eq}$. 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 several concerns with their "Governance Policy," i.e., how the Staff / Board of Trustees relates to the general church membership.

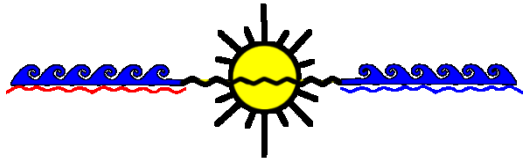
Things that didn't work

- We did not get any traction with the concept of "externalities."
  - The true cost of burning coal was not used in decision making. Monetizing harm was popular
- Talking about the harm caused by the operating our church by burning ancient hydrocarbons. Dumping GHG emissions into the atmosphere was not a popular topic.
- The urgency identified by the 2015 Paris Agreement and the 2018 IPCC 1.5 C Report never got any traction.

Part IV: Post Project Reflections

- Slowly transitioning to renewable energy in 20 years seems to be adequate for most of the congregation. Why hurry and change now?

- We did not get traction with a carbon tax
  - Board of Trustees would not consider it as an argument for transitioning to the inexhaustible energy
- Reframing (e.g. 'fossil fuel' becomes 'ancient hydrocarbons')
  - Example: You don't think about making a black plastic pipe out of fuel.
  - But you can think of using ancient hydrocarbons as a feedstock for recyclable black plastic.
- There was no interest in adding charging stations.
  - Adding a free charging station for the church staff could incentivize them to consider a plug-in vehicle.
  - Adding in the GHG emissions by members driving to church was never seen as a consideration/responsibility of the church.



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 significant 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 significant remodeling project for the existing facility. The congregation voted to launch a building renovation effort in May 2014.

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 deleted. 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 funding, 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 began meeting at Hamilton Elementary School in South Denver. De-construction 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.

Construction of the new energy system began June 21, 2017, with the drilling of the first borehole for the external ground loop for the geothermal system. The ground-loop heat exchanger system was completed 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 Energy 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 $CO_{2\ eq}$ into the atmosphere annually and complies with the 2015 Paris Agreement and the 2018 IPCC 1.5C Report.

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.

The newly renovated church building, the renewed spirit of congregants, ministers and staff and their reconnection to the interdependent natural and spiritual world, could evolve a higher-order living system.

The new 'brick and mortar' portion of this emergence may be 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.

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 transition 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, Iowa, is another example of what faith-based organizations can do NOW. They dedicated their new Zero Energy facility in November 2017.[59]

"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 41 Unitarian Universalist Society in Coralville, Iowa, Zero Energy facility, November 2017.[60]

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 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 human energy for this project to install a sustainable energy system in a religious facility came from those who donated their time and energy, who sought to form right relationships, and who supported this project in any way.

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.

The First Universalist Church of Denver staff 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.

This endeavor was possible because of a team effort involving several dozen key people with shared values working together on a common cause. Over 40 members contributed their time, talents, and financial resources to make this Energy System project possible. An equal number of dedicated professional craft people applied their design and construction skills to make the goal of zero GHG emissions a reality.

Upon reviewing the list of people involved, the reporter of this case study can confidently say that everyone involved contributed something significant to this effort – be it specific expertise, a source of human energy, life experience, financial resource, coordination, leadership, affirmation, skepticism, and constructive criticism.

.

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."

Figure 42 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 43 Architects Drawing vs Drone photo

Afterword: 1/2 Year of Operation (Jun 21, 2018 – Dec 21, 2018)

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 six months, the halfway point in the annual cycle, it is possible to look at the period from the 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 44, during the first six 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.**

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.

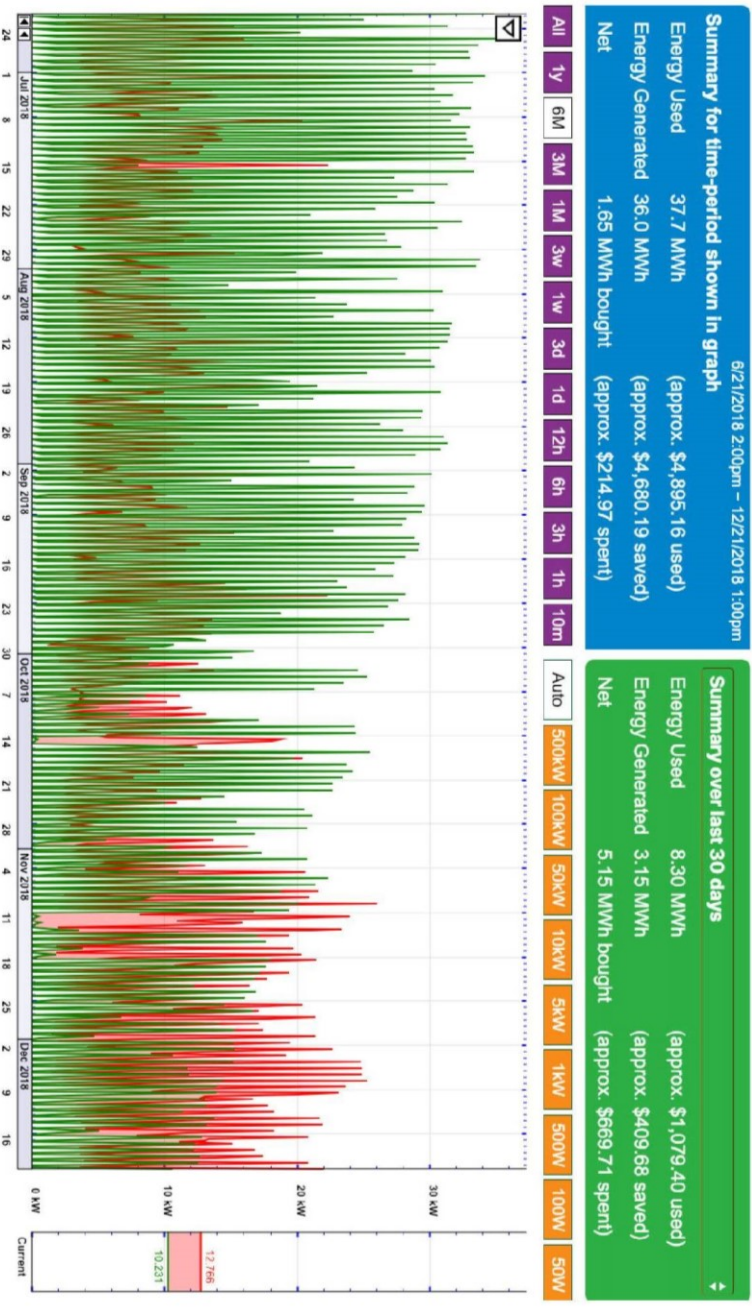


Figure 44 First Universalist Church Sustainable Energy System Performance

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 / m2 / 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

Print Results

1,349 kWh/Year*

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 Solar Energy Incident on Church Lot

Lot Size

1.7 acres

74,052 ft^2

6,880 m^2

Solar Radiation (PVWATTS)

1790 kWh / m^2 /year

12,311,156 kWh /year

Solar Electric Production

1349 kWh/year @ 0 deg tilt

1485 kWh/year @ 10 deg tilt

1580 kWh/year @ 20 deg tilt

1635 kWh/year @ 30 deg tilt

1648 kWh/year @ 40 deg tilt

Factoid A.4 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 45. The yellow curve illustrates a 4% annual increase as a reference for comparison.

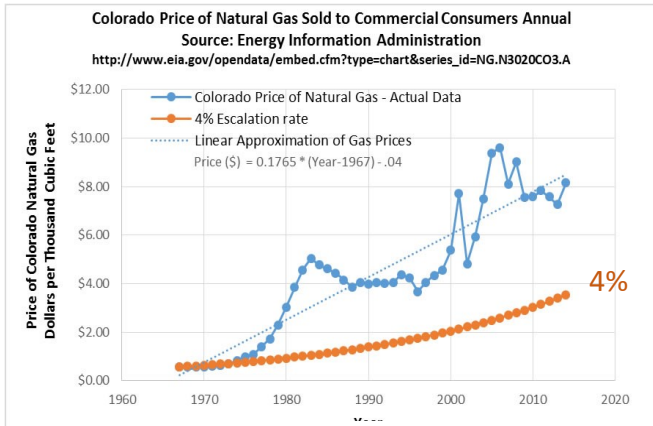


Figure 45 Historical Natural Gas Prices in Colorado

The current natural gas price in Colorado is now around $8/1000 cubic feet. Twenty years ago, the price was $4. Forty 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.5 How Big is a Ton of CO_2?

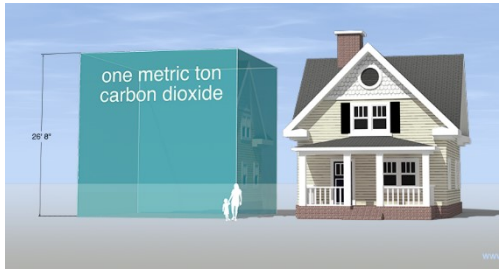


Figure 46 How Big is a Ton of CO_2?

At standard pressure and 15 °C (59 °F) the density of carbon dioxide gas is 1.87 kg/m3 (0.1167 lb/ft^3). One metric ton (2,205 lb) of carbon dioxide gas occupies 534.8 m^3 (18,885 ft^3; 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' or 40' adjusted for 5,280' altitude)

Ref: http://www.carbonvisuals.com/projects/usa-specific-image-set

Other interesting Carbon Visuals available at this source include: How Much CO_2 is Created by Burning 1 gallon of gasoline? How Much CO_2 is Created by Burning 1 gallon of Gasoline? How Big is a Pound of CO_2? What is the Annual Per Capita Emissions of U.S. and China?

Factoid A.6 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 throughout 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
- **Aug 21, 2015 – Energy System (solar& geothermal) Presented to Barrett**
- Sep 13, 2015 – Congregation unanimously supports plan
- Nov 2015 – Faurot Construction hired as a contractor
- **Dec 2015 – Sustainability Framework Approved by Board (Solar-Geo)**
- Mar 2016 – Capital Campaign concludes; $3.5 million raised
- **Apr 3, 2016 – Congregation approves $4.0 million budget; deletes energy system from the budget but 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). Geothermal Operational**
- 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 (Actual)**

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 CO_2. 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.**

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LIVING OUR VALUES SERIES

First Universalist

Solar-Geothermal Energy System:

Electrical Power, Heating & Cooling without burning fossil fuel

FIRST UNIVERSALIST
GREEN FIRST TASK FORCE

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 inconsistence with our UU principles and moral values. So the Green First Task Force coordinated a find 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 the 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 resentment 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 was also around in those earlier years and remembered the situation (and its root cause) a bit differently.

The commercial interest rates were quite high at the time – let's say around 6-7%. The project was funded by a combination of commercial loans and member loans and completed successfully. The loans were being paid back regularly 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) 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 principal would be deferred. The member lenders agreed – after all, their near 7% return on the church loan was better than the current commercial rates. 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."

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.

Relevance / Lessons Learned

The root cause of this previous problem rested at the feet of the Senior Minister and/or the Board of Trustees who creatively requested the loan payment deferrals on the member loans. The member lenders simply entered into an agreement to provide a subprime source of capital for the church – a better deal for the church than a commercial loan. Nevertheless, the member lenders are remembered as 'taking advantage' of the members who were not lenders.

Nothing was put in place to prevent the current/future Board of Trustees or Senior Minister from asking member lenders to extend the term of their loan 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 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 is no motivation to pay off a $235,000 @ 1.5% interest before paying off a $400,000 commercial loan @ 5%. 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

The Green First Task Force spent months exploring different funding scenarios. 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 homeowners has a significant impact on the financial viability. Also, 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 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.)

The Green First Team was able to overcome the burden imposed by a typical commercial interest rate by raising capital from low-interest member loans. They had raised $300,000 in member loans but were limited to using only $240,000 by the Board (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. Investing in Wall Street is one way to "make money." Investing in the local community is one way to invest that doesn't contribute to further inequality of income and wealth.

Appendix E Reframing – a New Glossary

"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. George Lakoff, noted linguist, has published several helpful books that illustrate how to reframe political issues.[61]

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.

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 concentrated forms of carbon. 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 in 1876 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*

True Cost (aka ~~Externalities~~/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.

One hundred 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 – social costs of extracting/transporting/processing/burning this product are ignored.

For further discussion, see **Appendix F Externalities.**

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 harming 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 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 just the 'retail market costs' or 'initial costs' – not the 'life cycle cost.'

'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 high initial/ upfront cost.

Continuing to burn ancient hydrocarbons requires little to no new equipment. There is no initial/upfront cost.

Using this frame, the choice is simple. Go with the zero (initial) cost option even though it has a higher life-cycle cost.

Frame: (Life Cycle) Cost.

The Life-Cycle Cost Analysis (LCCA) and Assessment (LCA) create a broader / more comprehensive frame.

Life-cycle cost analysis (LCCA)[62] 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**,[63] 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]

Epstein et.al. from the Harvard Medical Center conducted a life-cycle cost analysis to determine the true cost of electrical power generated by a coal-fired generating plant.

"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.”[33]

Others Reframing Assignments e.g. "We Can't Afford It."

Figure 47 Reframing Example

Reframing everyday concepts using faith-based values and today's awareness of the Universe can be an exciting endeavor for an emerging Green Team. Obviously, the laws of physics and chemistry are not influenced by someone claiming, "We can't afford it." A church, synagogue, mosque, or temple that dumps a ton of CO_2 into the atmosphere is no different from a fossil fuel generating plant that dumps a ton of CO_2 into the atmosphere.

Sandboxes and Frames of Reference (Ref: George Lakoff)

It is likely that the Board members will be in what might be called the Oil & Gas (O&G) frame of reference. That will be the sandbox (and the rules) the Board will expect the Green Team to play in. Playing in the O&G sandbox with its rules will make it difficult to get approval for your project, but not impossible.

For a moment, picture a Green Team arriving on the scene in a clean sandbox, no oil spills, no GHG emissions, no mercury spewing out of smokestacks, no smokestacks, no global warming, no ocean acidification, etc. The Green Team will be carrying their faith-based values with them and where necessary challenging the O&G sandbox rules.

In the Green sandbox, a place of worship is sacred and it uses the gifts of energy (e.g. sunlight, thermal energy) that are already onsite to operate. Using the latest 21st-century technology, the Green Team will propose to honorably harvest these gifts of energy to operate the facility. By operating in this fashion, the updated facility will stop doing harm to future generations; their facility will operate sustainably using inexhaustible sources of energy that are actually "clean."

This clean sandbox is real. In fact, a few organizations are already in one and there is a growing number under construction every day.

From a sustainable sandbox, it is possible to look back at the O&G frame and identify where their human-made rules are influencing good people to make bad decisions.

Today's imperfect human-made social system includes an economic sector that places a fictitious low cost on goods and services created by burning ancient hydrocarbons as an energy source. This same economic system places a low value on good health, well being and sustainable living. From the sustainable living frame of reference, it becomes obvious that the O&G social system has evolved in a way that influences well-intentioned people to make choices that are degrading the habitability of our planet. In a sustainable living sandbox, people are not influenced to make ecocidal choices. Instead, they can live their faith-based values.

Appendix F 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 even to identify and list them.

In the detailed study by Epstein et.al.[33] 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 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 CO_2 and N_2O
- 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 **R**eal. The "laws"

developed by humans are **r**eal. There made be a conflict between "**R**eal World" (Nature) and the human-created "**r**eal 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 choice, 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 adequately 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 - 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*:

- 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 can find the most efficient option.

Background / Economic Principles

An economic system that tolerates externalities is broken because it distorts the market.

In 1920, economist Arthur C. Pigou[64] 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 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 CO_2 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 ?"*[65]

Mankiw suggests there are three approaches:

1) "One approach is to appeal to individuals' sense of social responsibility …..Unrealistic."

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.*"

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 has over 50 members. **Citizens Climate Lobby (CCL)**[66], 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. There 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 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 CO_2.[67] To sequester the CO_2 from a coal-fired electrical generating plant requires between \$50 / ton of CO_2 for a gas-fired plant to \$168 / ton of CO_2 for a coal-fired plant.[68] We will use \$100 / ton of CO_2 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.**

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)[69]
- Assume that the cost of harvesting sunlight using solar PV modules to make electrical power is $0.11 / kWh.[70]

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.

Appendix G 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 unique 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" about 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 20 illustrates what the church would look like after spending $4M to remodel (including new windows and additional insulation) without changing the old energy system.

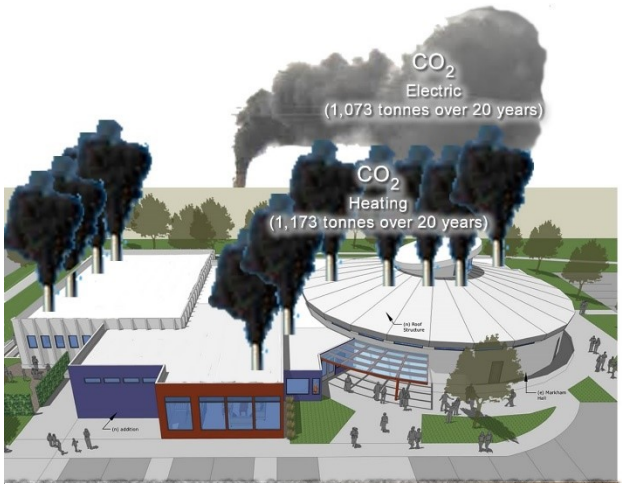


Figure 48 First Universalist's 2016 Contribution to Climate Change

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.

In 2015 Xcel generated nearly 80% of its electrical power by burning ancient hydrocarbons (Coal & Natural Gas).

Nearly two (2) pounds of CO_2 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 CO_2 into the atmosphere each year.

Also, in past years the church purchased 5196 therms (equivalent to

152,243 kWh) of natural gas that was burned in the ten gas furnaces to heat the church. The ten gas furnaces dumped an additional 58 metric tonnes of CO_2 into the atmosphere each year as depicted in the foreground of Figure 20. Total emissions were over 100 metric tonnes of CO_2 per year.

As a result, the church would dump a total of 2,243 tonnes of CO_2 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, Green$_2$, Chair
Science Discussion Group – Green$_6$
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, Green$_1$, 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?

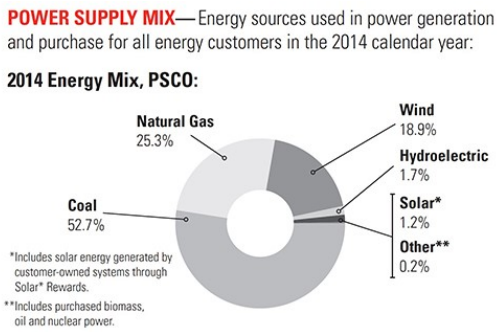
The energy usage was in the form of electrical energy and thermal energy derived by burning natural gas, all purchased from the Xcel Energy Corporation.

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 = 10^5 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, 78 % of the electrical power bought from Xcel Energy was generated unsustainably by burning ancient hydrocarbons. Only 22 % was generated by wind, hydroelectric, and solar. Of course, none of the natural gas purchased from Xcel is sustainable.

As a result, less than 7% of the energy First Universalist used to operate was derived from sustainable sources.

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 Clean 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.

The focus in this document is on the Energy Generation System – sustainable sources of energy for operating the facility. A sustainable "Energy Generation System" for First Universalist is envisioned as two major elements:

1) Solar Photovoltaic Modules (panels) that honorably harvest onsite solar energy from the Sun and transform sunlight into electrical power. This will replace the current power purchased from Xcel Energy that is generated by burning coal and natural gas.
2) Ground-source geothermal Heat Pumps that honorably harvest/exchange (free) thermal energy with the Earth to provide heating and cooling to replace the natural gas currently burnt to heat the building.

Harvesting Solar Energy to Generate Electrical Power.

By adding solar PV to the flat portion of the church roof, they can sustainably generate all their electrical power. With a Solar PV system, 32% of the church's energy needs will be generated sustainably as illustrated in Figure 49.

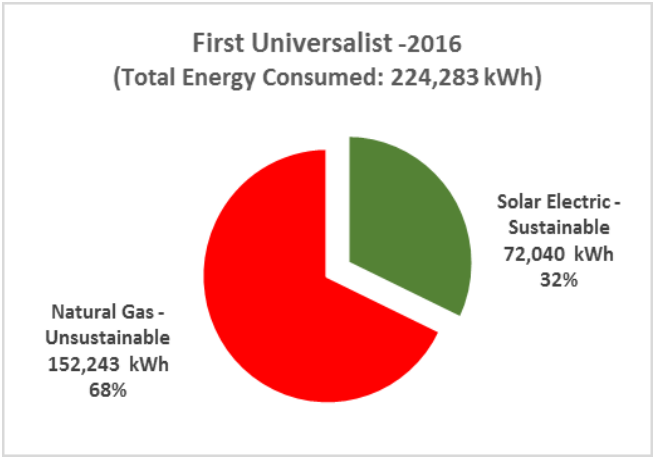


Figure 49 Solar PV Provides 32% of the Church's Energy Needs Sustainably

As a result of adding a solar PV system, they will eliminate the 1,073 tonnes of CO_2 emissions shown in Figure 50. 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 50, the church will still be emitting 1,173 tonnes of CO_2 from its gas furnace exhaust flues as a result of continuing to burn natural gas for heating purposes over the next 20 years.

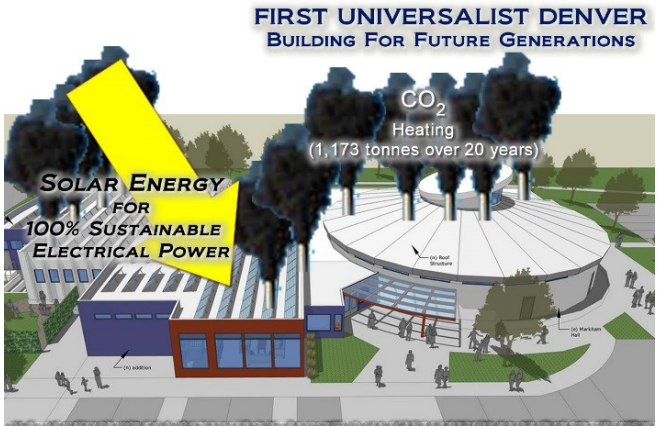


Figure 50 First Universalist's Contribution to Climate Change after Adding Solar PV

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) that is already onsite is our preferred sustainable approach for heating and cooling the church.

Although it is possible to add more solar modules and heat the church with electric furnaces, a more efficient and cost-effective approach is to transition to a ground-source geothermal heating and cooling system.

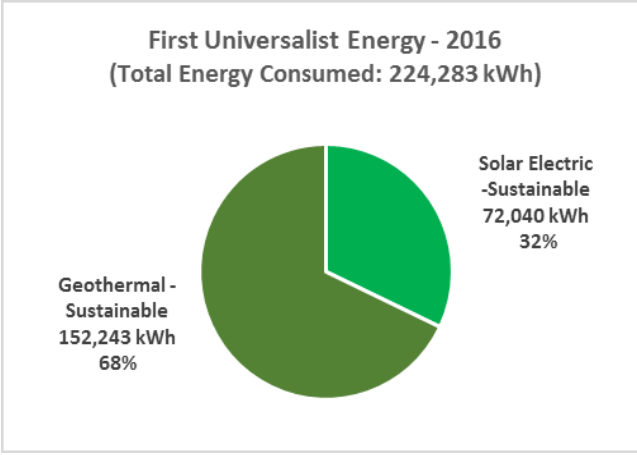


Figure 51 Solar PV and Geothermal Provide a 100% Sustainable Energy System

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 – 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.

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 6, a ground source / geo-exchange heating and cooling system require a ground loop heat exchange system.

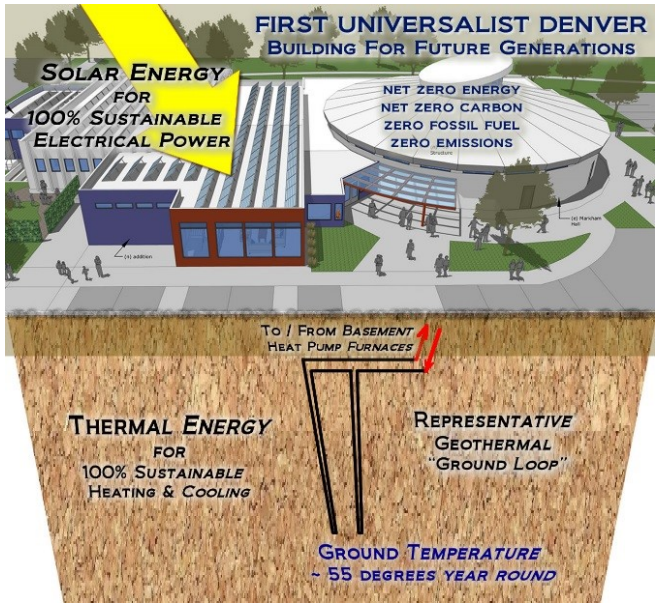


Figure 52 Using Solar and Geothermal Energy, Our Church Can Transition to Zero Carbon Emissions.

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 on site (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.

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1. BFF Flyer (Available from the BFF Committee)
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://uusj.net/wp/wp-content/uploads/2009/07/AIW_2015-global-April-V4.pdf

Operating a Sustainable Energy System

The solar PV system is sized to harvest enough solar energy to generate excess power during the day and 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.

We have already incorporated enough "green" features into the BFF plans. We don't need a new energy system.

Consuming less fossil fuel is a good thing, but the 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 – and be less expensive over 20 years than continuing to burn fossil fuel.

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. '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; the investment in geothermal & solar 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 (estimated service life of 200 years).

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 the roof area is limited, it is not cost-effective to harvest sunlight just to convert it into low-grade thermal energy. We can harvest thermal energy from the Earth that is already onsite instead using ground source heat pumps power by solar-generated electricity. Air-source heat pumps are not able to provide efficient heating in the winter when the air temperature drops below 30 degrees. So for the Colorado region, ground-source geothermal is a preferred approach and provides both heating and cooling.

No fossil fuel is required. There are zero emissions. Water is used as

a heat transfer fluid, but constantly recycled in a closed loop and not consumed.

Indigenous People would describe a Heat Pump system powered by solar electric as a method that can **Honorably Harvest**[2] energy from the Earth or the Air using solar electric (energy provided by the Sun.)

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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.

How Does a Geothermal Heat Pump Work

A geothermal/geo-exchange heat pump uses the same technology and thermodynamic principles as your refrigerator; the 'technology' has been around for over 100 years. (See Geothermal 101 presentation in this document.)

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.[71]

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.[72]

The Unitarian Universalist 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.[73]

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.

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.[7475] 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.

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 or boiler**— regardless of its age, efficiency, Energy Star rating, price, or prior usage.

The phrase 'good gas-furnace' has become an oxymoron.

Even the three-year-old furnaces in the basement of Markham Hall are not "perfectly good furnaces" – even though there are relatively new. All current furnaces in the church burn natural gas and dump CO_2 into the atmosphere. Regardless of their age, none of our current furnaces is a "good" furnace – especially for our children or for their children.

But 'good' furnaces do exist; First Universalist just don't have any 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. A good furnace does not spew out tons of CO_2 that alters the planet's heat balance and contributes to anthropogenic climate change.

One class of a "good furnace" uses heat pump technology instead of burning. There are air-source and ground-source heat pumps. Ground-source heat pumps are well suited for the Denver area because they utilize the fact our ground temperature remains between 50-55 degrees year-round.

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 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 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 evaluation
- 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/

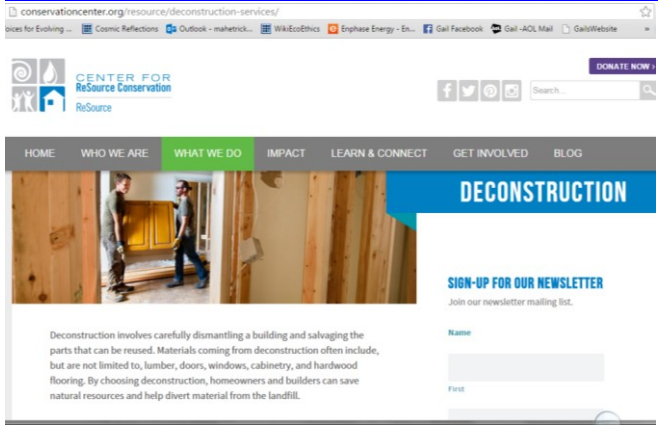

Figure 53 Deconstruction Example #1

http://www.ecocycle.org/a-zguide/construction-materials-and-deconstruction-services

Figure 54 Deconstruction Example 2

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.

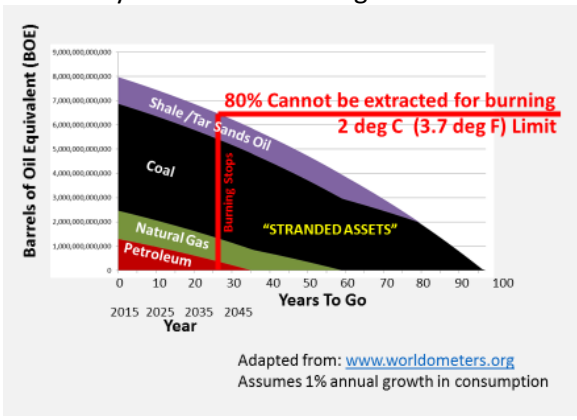

Figure 55 Fossil Fuel Resource Drawdown (Math Results)

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 after that) 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 6 First Universalist Energy Usage for 2015 for a total of **$16,625.**

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.[76] As indicated in Table 7, 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**.[77] The total outlay of direct costs after 20 years will be $556,000 to $659,000.

Table 7 First Universalist Energy Costs - 20 Year Forecast

First Universalist Energy Costs – 20 Year Forecast[78]	
	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**

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 even to identify and list them. In the detailed study by Epstein et.al.[33] there are a dozen ignored cost that is 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 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 CO_2 and N_2O

Reparation Costs

For illustration purposes, only one of the many fossil fuel-related externalities will be singled out and examined in more detail - CO_2 emissions - the last item in Epstein's list.

If we insist on continuing to do harm by dumping CO_2 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 CO_2, a greenhouse gas (GHG). The CO_2, 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 CO_2 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 EPA[79], this will dump 27.4 tonnes of CO_2 into the air each year. Over the 20 years of operation, First Universalist gas furnaces will add 551 metric tonnes of CO_2 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 CO_2. 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 CO_2 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 CO_2 but unburned methane is 86 times worse than CO_2, so the CO_2 equivalence = 0.83 tonnes x 86 = 71.3 tonnes of CO_2. So the total harm would be 27.4 + 71.3 = 98.7 tonnes of $CO_{2\,eq}$ each year. Over 20 years that is 1973 tonnes of $CO_{2\,eq}$.

Carbon dioxide capturing and sequestering (CCS) processes are available, and according to an IPCC study could cost between $33 - $57 / metric ton of CO_2.[80] So if we internalize this specific externality, we can add another **$65,109 to $112,461** to the stack of paid bills 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,[81] Xcel Energy will have dumped 1310 metric tonnes of CO_2 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. *t*he true cost of coal-produced electrical power must be increased by $0.094 to $0.27 / kWh with the best estimate of $0.18 / kWh to account for some of the major externalities.[82] 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. Also, 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.[83] 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 **Un**sustainable 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 CO_2 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 closer to $1.8 M. That's what we cannot afford.

Q&A for the solar, geothermal Green First proposal by Green$_6$ (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: 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. 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 CO_2) 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 20 years. 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 temporarily.

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.

About The Reporter

The reporter, Milt Hetrick, a retired engineer/physicist, 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 a 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 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 documented 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" 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. This new way of thinking will be based on sustainable living in the Real World with finite resources and limits to further physical growth - not political ideology based in human-created 'real world,' Our human-created 'real world' systems must be updated to be consistent with Real-World evidence we have just learned to see within the last half-century. 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 our collective consciousness, and express unlimited sustainable creativity in concert with the Cosmos.

What an exciting foreseeable future,
should we as a species choose to take a sustainable path.

"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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Endnotes

[1] 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

[2] 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.

[3] The four forces of nature are the strong and weak nuclear forces, gravity, and the electromagnetic force.

[4] 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

[5] Duke University. "'***Tree of life' for 2.3 million species released: Large, open-access resource aims to be 'Wikipedia' for evolutionary history***." ScienceDaily. ScienceDaily, 18 Sept 2015. https://www.sciencedaily.com/releases/2015/09/150918180310.htm

[6] Astonishingly, species living today are a mere 1% of all the species that once lived and ae now extinct.

[7] 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/

[8] 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 simplier versions of ours.”

[9] Religious Naturalism. https://en.wikipedia.org/wiki/Religious_naturalism

[10] Emergence. https://en.wikipedia.org/wiki/Emergence

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[11] Scientists have observed that the preferred source of energy for complex eukaryotes can be traced back through an interdependent network to sunlight – electromagnetic energy that emerges from continuous nuclear fusion of hydrogen at a relatively safe distance of 93 million miles (150 million kilometers)[11] away.

[12] ***The Sixth Extinction: An Unnatural History*** by Elizabeth Kolbert, 2015. https://www.amazon.com/dp/1250062187/

[13] The observatory is under the Earth System Research Laboratory that is part of the National Oceanic and Atmospheric Administration (NOAA).

[14] Edwards, Paul N. (2010) ***A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*** MIT Press ISBN 9780262290715 pp. 366–71

[15] Forrester, Jay Wright (1971). ***World Dynamics***. Wright-Allen Press. ISBN 0262560186.

[16] Peter A. Victor (2008). ***Managing Without Growth*****,** Edward Elgar Publishing, pp. 92–93, ISBN 978-1-84720-078-5

[17] https://www.uua.org/environment/sanctuary/old/steps/justice/293262.shtml

[18] https://www.uua.org/environment/sanctuary/steps/plan/290993.shtml

[19] https://www.uua.org/environment/sanctuary/steps/plan/292488.shtml

[20] https://www.uua.org/environment/sanctuary/steps/plan/292494.shtml

[21] Consider Divestment in Fossil Fuel. https://www.uua.org/action/statements/consider-divestment-fossil-fuel-industry

[22] 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

[23] 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.

[24] "***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. A plug-in vehicle recharges using solar electric. Hence, no burning is required in this home.

[25] Paris Agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[26] For more information see: http://climate-l.iisd.org/news/indc-analyses-show-improvement-need-for-radical-action/

[27] ***IPCC Fifth Assessment Report***. https://www.ipcc.ch/assessment-report/ar5/

[28] Sources Of Our Living Tradition, https://www.uua.org/beliefs/what-we-believe/sources

[29] See Factoid A.3

[30] https://www.fujielectric.com/company/research_development/theme/heatpump.ht

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ml, Fuji Electric.

[31] 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 specfic design effort by a different skill set than traditional HVAC.

[32] 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.

[33] ***"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.

[34] One (1) metric tonne = 1000 kg = 2204.6 lbs. A U.S. ton is 2000 lbs. So a metric tonne = 1.1 tons.

[35] Credit to David Takahashi (GreenFaith) for suggesting this graphic.

[36] The Xcel Investors web site can be found at http://investors.xcelenergy.com/

[37] 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.

[38] The "GreensNotes" is patterned after the idea of SparkNotes or CliffsNotes in that it represents a condensed version of the parent document.

[39] IPCC Global Warming of 1.5°C, https://www.ipcc/ch/report/sr15/

[40] Billion-Dollar Weather and Climate Disasters: Overview, https://www.ncdc.noaa.gov/billions/

[41] 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.

[42] STEM. Denotes people involved in Science, Technology, Engineering and/or Mathematics.

[43] ***"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.

[44] Lynne Twist, ***"The Soul of Money,"*** 2017

[45] Naomi Klein, "***This Changes Everything-Capitalism v The Climate*,"** 2014

[46] 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.

[47] What is Impact Investing? … investing that aims to generate specific beneficial social or environmental effects in addition to financial gain. Impact investing is a subset of socially responsible investing (SRI). 'Socially responsible' investing encompasses avoidance of harm; 'impact' investing actively seeks to make a positive impact. For example, by investing in non-profits that benefit the community or in clean technology enterprises. The basic goal of impact investing is to help reduce the negative effects of business activity on the social environment, and it can be considered an extension of philanthropy. [Ref: https://www.investopedia.com/terms/i/impact-investing.asp , James Chen, 2018]

What is an Impact Loan? A financial tool for businesses who measure and are committed to improving their social and environmental impact. Established small business owners who focus on the Triple Bottom Line (People, Planet, Profit) and are committed to becoming B Corp Certified are eligible to access Impact Loans. The Impact Loan is meant to incentivize and reward for-profit businesses who focus on their social and environmental impact. Through Impact Loans, entrepreneurs will be rewarded with flexible terms, and lower interest rates. Entrepreneurs who receive the Impact Loan are committed to submitting for B Corp certification within 12 months of funds being disbursed. Ref: https://assetspa.org/programs/social-impact-loan/

[48] 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.

[49] M. Scott Peck's definition of love "…extending one's self for the purpose of nurturing …another's spiritual growth."

[50] 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.

[51] 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.

[52] 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

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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.

[53] 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.

[54] https://www.rollingstone.com/politics/politics-news/bill-mckibben-winning-slowly-is-the-same-as-losing-198205/

[55] 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.

[56] Steketee, Mike (November 20, 2010). ***"Some sceptics make it a habit to be wrong"***. *The Australian*.

[57] 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

[58] According to "Reserve Study" by a consultant, Miller & Dodson, the average age of the existing 10 natural gas furnaces was 15 years.

[59] **UU World**, Spring 2019. https://www.uuworld.org/articles/spiritual-landmark-spring-2019

[60] **UU World**, Spring 2019. https://www.uuworld.org/articles/spiritual-landmark-spring-2019

[61] 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 A**LL 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.

c) Moral Politics: How Liberals and Conservatives Think

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].

[62] See: https://en.wikipedia.org/wiki/Life-cycle_cost_analysis, https://www.nist.gov/customcf/get_pdf.cfm?pub_id=907459

[63] See: https://en.wikipedia.org/wiki/Life-cycle_assessment or ***"Defining Life Cycle Assessment (LCA)."*** US Environmental Protection Agency. 17 October 2010. [http://www.gdrc.org/uem/lca/lca-define.html]

[64] ***The Economics of Welfare*** Arthur C. Pigou, . London: Macmillan. 1920. http://en.wikipedia.org/wiki/Pigovian_tax

[65] ***"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&

[66] see www.CitizensClimateLobby.org

[67] EPA http://www.epa.gov/cleanenergy/energy-resources/refs.html

[68] ***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

[69] http://en.wikipedia.org/wiki/Oil_sands

[70] 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).

[71] ***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

[72] Personal Conversation with Ron Larson, Jefferson Unitarian Church (JUC),

[73] ***Solar Energy and Geothermal Heating and Cooling Systems at MVUC*.** **"**MVUC's sustainable energy project incorporates solar panels 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-solargeothermal-energy-program/

[74] Refrigeration. https://en.wikipedia.org/wiki/Refrigeration

[75] 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**.

[76] 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

[77] 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.

[78] [**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 CO_2 they produce when burned. The plan is to start slowly with a fee of $10 / metric tonne of CO_2 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 .]

[79] 1 therm = 0.0053 metric tons CO_2 Ref: http://www.epa.gov/cleanenergy/energy-

resources/refs.html; 1 kWh = 2 lbs CO_2

[80] Manuela Loos, Leo Meyer, Prepared by Working Group III of the Intergovernmental Panel. See also MIT study on removing CO_2 from the atmosphere. For this assessment we will use a sequestration cost of $57 / tonne of CO_2. Ref: http://sequestration.mit.edu/pdf/economics_in_technology.pdf

[81] ***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 CO_2 from the atmosphere. For this assessment we will use a sequestration cost of $57 / tonne of CO_2. Ref: http://sequestration.mit.edu/pdf/economics_in_technology.pdf

[82] According to an 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

[83] 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 year**s." 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:

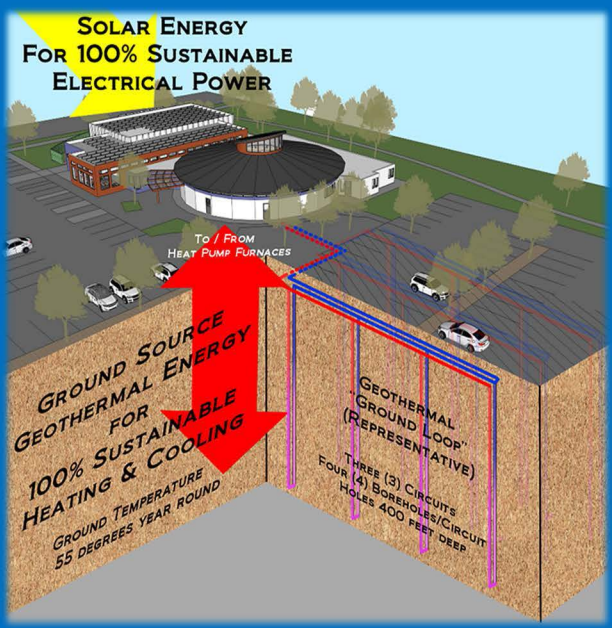
- Fix a leaky roof,
- Accommodate more people in a larger Sanctuary,
- Provide more classroom space,
- Replace aging equipment, and
- Use less energy - install new windows, add insulation, new lighting.

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 required new 21st century equipment. The new energy equipment required even more financial resources. 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 Abridged Version of the Case Study documents some of the unavoidable conflicts that occurred among the diverse parties involved and how these differences were generally resolved or at least managed. There is also a post-project summary of the key steps taken along the path to zero GHG emissions.