Centre County Long Term Energy Efficiency Plan

(Adaptable to the Georgetown University $5 million Energy Prize Competition: April 2014 – June 2017)

presented by the Mid-State Community Advisory Group on Sustainable Energy

(CITY-GREEN)

April 2014

Draft version 1.5

Contents.

Contents, continued.

Introduction.

At least $640 million in savings over thirty years - $20,000 per household – could possibly be recovered in the Centre Region if all its 32,000 residences were converted to renewable energy. This region's market saturation is estimated to be between one-quarter and one-half per cent. A long term goal would be 90%.

The financial aspect, along with the accompanying environmental benefits, can well serve as incentives for a transition from non-renewable to renewable and sustainable uses of energy.

Preamble.

> "Communities will be asked to develop
> a long-term energy efficiency Plan"[1]

This plan is a comprehensive approach to energy conservation in the Pennsylvania mid state area geographically defined by Centre County and its contiguous counties. The ideas and information are presented into the public forum for comment and review. It is intended that material from this paper would be adapted by the Centre Region Council of Governments for its participation in the Georgetown University's $5 million Energy Prize Competition (the Competition) and for this reason, the subjects covered will closely match the format of the Competition. Necessary material can be formatted for use in its advancement through the Application, Quarterfinals, Semifinalist, Finalist, and winners circle stages of the Competition.

Background.

Why a competition?

> "Throughout history, highly visible prize
> competitions have demonstrated their capacity
> to spur innovative approaches to some of the
> most difficult challenges faced by mankind."[1]

The Competition's "difficult challenge" is energy inefficiency. Its solution will be quantified with: ~~basis is:~~ measurable consumption decreases in utility-supplied gas and electric directly to residential and municipal customers.

The Competition allows for a community's businesses, foundations, institutions, local colleges and universities, relevant organizations, and interested leaders to partner with the residential and municipality customers in a supporting role.

Although finalists will be selected primarily on their energy saving performance, the Judging Panel, however, will also score effectiveness in specific weighted categories concerning *how* the decreases in consumption are accomplished. The Competition Outline emphasizes sustainability and development of long-term plans. Accordingly, after being filtered through the sustainability and long term framework, competitors will be judged on their ability to:

> Spur innovative approaches to decrease per-capita energy usage
>
> Highlight best practices for collaboration between utilities, businesses, and their local governments to implement inventive plans for sustained energy efficiency
>
> Educate public and engage students in energy efficiency including environmental costs of the full fuel cycle
>
> Increase Georgetown University and its sponsor's visibility, who are facilitating creative approaches to energy efficiency.

The Plan.

The Competition Guidelines seem to indicate that the primary movers, in order to achieve long term reductions in per capita energy through processes that are innovative, replicable, scalable, and spur growth in renewable energy production markets where customer, community, and utilities are all rewarded, are through policy and education. (The underscored terms, all listed on the Competition website, will be addressed in order of appearance.)

Long term.

"a . . . community's energy-saving program . . .
should be long-term* Plans."[1]

The Competition rules say that in order for divisive issues to be avoided, one method of energy reduction (such as renewables) will not be valued over another (such as energy efficiency with non-renewables) in its respective weighted category. (For the purposes of clarification, energy efficiency measures with renewables will also be referred to as active conservation and with non-renewables, passive conservation.)

However, because long term sustained energy efficiency, which implies the use of renewables, is the basis of an additional weighted category, and for practical reasons, it is recommended that Centre Region explore renewables rather than efficiency increases with non-renewables, as its primary focus.

Practical Reasons. The wall of separation between non-renewable energy system efficiency limits – its fatal flaw - and 100% energy efficiency, that is, a sustainable energy system with renewable, can be avoided. Although energy efficiency in a non-renewable energy system can display a considerable short-term jump in conservation, all money spent in energy efficiency measures which entrench non-renewable energy systems will have to be re-spent after the efficiency wall of separation is hit, in order to change direction into a system that *does* lead to 100% energy efficiency. Supporting justification is as follows:

- Energy generation. Passive means do not generate energy, they only conserve it. Active conservation, by contrast, provides a long term energy supply in place of energy provided by utilities.

* In the same context, the Competition Outline prefaces the term "long-term" with the term "sustainable." The competition FAQ section states: "When it comes to energy efficiency . . . an entire community becomes more energy independent and environmentally sustainable."**

** This paper is careful not to confuse "sustainability" with "sustainable" and construes the following: sustainability means the ability to sustain while not necessarily having the characteristic of being sustainable. In other words, something can possess sustainability, a noun, as an attribute in moving towards being sustainable, an adverb, yet not itself *be* sustainable. Sustainable is defined as follows: replenishing.

- Energy reduction vs. energy elimination. There is a theoretical limit (50 – 80%?) to energy reduction through passive means when coupled with non-renewable systems. And they can never be long term solutions because they push the problem of depletable energy use, along with emissions issues, to the future where dollars are spent a second time when the aged conventional systems, even though they may have become more efficient, would be replaced anyway, by renewable energy sources, due to inherently higher operational costs, depleting supplies of resources, increasing environmental risks, and public policy. Renewables, by contrast, replace and therefore eliminate, for the long term, use of non-renewable fuels, achieving up to 100% reductions in utility-supplied energy ~~reductions~~, manageable operational costs, negligible depletion, a vastly decreased environmental risk, and public support.

- Sustainable nature. Non-renewables can never become sustainable energy providers because their costs cannot be predictably contained, their energy is from finite depletable, non-restorable resources, and their sources usually only exist outside of the local community. Renewables, whose installation investment is finite and predictable, use energy sources – sun, earth, and wind - that are free, replenishable, restorable, always available, and present in every locality.

- Ease of funding. Up front passive conservation installation costs cannot always be 100% financed or recouped with grants or other incentives. Contrast this to active conservation measures, where there is a growing market for up-front, cost-free solar PV and geothermal installations,* that can provide long-term supplies of energy, especially for the residential market - a perfect match for the Competition, since its guidelines focus on energy conservation at the residential level.

* There is a growing market where installer-owned solar PV and geothermal customer-leased systems are offered on a rent-to-own basis. At no up front investment to the customer, and with lease payments frozen at a level roughly equal to non-renewable fuel payments at the time of the install, possibly all of the 32,000 residential dwellings and municipal buildings in the Centre Region area can be at least partially equipped with renewable energy systems. This idea's promotion and implementation would seamlessly match the Competition Guidelines since it looks at net reduction in utility-metered energy usage: system ownership is a non-issue.

Innovations.

> "This multi-year, $5 million prize was born of a mission to tap the imagination, creativity, and spirit of competition between communities across the country to develop sustainable energy-saving innovations."[1]

All the energy saving innovations outlined in this section fall into three categories: 1) those that are already being done locally (Local) but can be scaled up, 2) those that are being done outside (Outside) of this community but can be adopted, 3) those unique ideas which can be implemented within three years during a research & deployment* (R&Dep.) phase. In order to remain vibrant and healthy and to strengthen a community's move towards 100% energy efficiency, it seems essential for any culture to embrace and to spur creativity in bringing fresh ideas forth, along with the means to put them into service. For this reason, it is recommended that $500,000 (10%) of the $5 million Energy Prize be earmarked for research and deployment.

Innovation #1 (Local): Plastic Window Inserts: ~~Window Dressers.~~

Statewide Interfaith Power & Light, through the efforts of its locally based Weatherization First initiative headed by ~~chapter head,~~ Ms. Cricket Hunter, began, at State College's House of Care, to implement a system to help local residents stay warm while saving energy. From its makeshift workshop in the basement of UCC College Avenue, they began to build plastic window inserts based on an idea put into place by ~~the~~ Window Dressers, Inc. at the First Universalist Church in Rockland, Maine.

I recently put in a little volunteer time as I learned how to make a Window Dresser. First, 1 1/2" x 3/4" furring strips were screwed together to form a frame, then double-sided tape applied, then plastic window wrap attached. Then, after both sides were fitted, white duct tape was folded over the edges to seal and hold the plastic, after make-shift handles - made out of the same tape - were affixed to the 2-sided edges. After shrinking the window wrap with a blow dryer, one of the lead carpenters, John, said that varying amounts of

* The term "deployment" is used in place of the word "development" to denote the difference between research for research's sake (leading to development which does not necessarily mean a meaningful end use) versus deployment which is geared towards practical implementation, say, within one week's worth of years (less than 7 years).

weatherstripping will be applied to the edges to snug the fit to each window since the frame is purposely cut a bit smaller than each window frame. Ms. Hunter said this unique system increases the utility of the system since the plastic window inserts can be repeatedly popped in or out in seconds, without damaging existing window structures – a comfort to both home owners and landlords.

Right now, these windows are mainly being built for the financially disadvantaged who approach a participating congregation for assistance. The workshop volunteers shared that the recipients are very pleased with the results of this system. The installers said that from an initially drafty residence, they can actually feel the heat increasing by the time they finish installing the treatments. A typical 14-window, 3-bedroom apartment job would require an initial visit to measure, then 1/2-day workshop time, and a final visit to install.

Stats: $90 per home (14 windows), $27,000 for 300 homes (100 homes per year). Estimated savings = 25% total heat bill, or $250/yr. Estimated 3-year Competition savings: 1,899 MWh. Dollars spent to save 1 kWh: $0.0156. Volunteer construction labor + 1/2 hour @ $18.00/hr staff per home = $2,700. Recommended GU Energy Prize contribution: **$29,700**.

Idea by: Cricket Hunter

Innovation #2 (Local): Hot Water Tank and Pipe Insulation ~~heater~~.

Interfaith Power and Light has also installed water pipe insulation to reduce energy load. If they are willing, water heater thermal jackets installations can also be added as an option. ~~Expected payback on both is 1 1/2 years~~. Assume 20% increase in hot water efficiency, or $50 per year.

Stats: $~~125~~ 35 per home, 300 homes (100 homes per year). Tank blanket $11; $10 for 60' pipe insulation; $10 for (5) @ "T"'s and elbows; $4 for 50-yards foil tape. Estimated 3-year Competition savings: 379.8 MWh. Dollars spent to save 1 kWh: $0.0276. Volunteer construction labor. ~~700MWh saved during 3-year Competition. 300 homes, 100@/yr.~~
Recommended GU Energy Prize contribution: **~~$37,500~~ 10,500**

Idea by: Cricket Hunter

Innovation #3 (Local): Faucet Aerators:

Replacing faucets with low flow aerators reduces water flow saving well pump electricity and hot water tank energy.

Stats: $4.25 per home for two aerators (1 x 1.5 gpm kitchen faucet; 1 x 1.0 gpm for main bathroom faucet). Estimated savings = $8/yr. Estimated 3-year Competition savings: 61 MWh. Dollars spent to save 1 kWh: $0.021. Volunteer construction labor.
Recommended GU Energy Prize contribution: **$1,275.**

Innovation #4: Energizing Community Housing:

A healthy, sustainable community is one who takes care of her own.

The State College community has three operating shelters: Housing Transition (serving the homeless); Woman's Resource Center (haven for abused women); and Youth Haven (foster and orphaned children). Both passive and active conservation retrofits would be implemented:

Stats: $50,000 per shelter for PV/Geo retrofits, $8,333 @ for passive conservation. One building year1, two buildings year 2. Estimated 3-year Competition savings = 166 MWh active; savings = 34 Mwh passive. Dollars spent to save 1 kWh active: $0.906; passive: $0.7248.
Recommended GU Energy Prize contribution: **$175,000.**

Idea by: Matthew Dahlhausen and Katherine Watt

Innovation #5 (Local): LED Lighting – 32,000 Home ~~program~~ Campaign:

Interfaith Power and Light has also given out packs of LED's to households, subject to funding. After speaking to some of the volunteers, three obstacles were identified with this program: 1) LED's would only be installed by a customer after a currently-in-use bulb burnt out meaning packs of LED's would be kept in storage, unused, in the meantime. 2) dissatisfaction with quality of light emitted with the LED, so, resident not likely to replace all light fixtures with LED's. 3) Education: residents not always familiar with the cost benefit. For these reasons, it is recommended that no more than one LED, unless specifically requested, be offered to each resident.

Scott Patterson from the campus-based Organizing For Action (OFA) expressed interest in putting this project into action.

Stats: 60 people, by 2's, 1 LED per home, 15 homes every other weekend = 9,000 homes/yr x 3-years = 27,000 homes = 80% saturation. Estimated 3-year Competition savings: ~~330~~ 1,518MWh ~~saved during 3-year Competition~~. Dollars spent to save 1 kWh: $0.142. Volunteer construction labor.
Recommended GU energy Prize contribution: **$0.** Possible West Penn Power Grant. ($216,000 otherwise - $8/LED x 27,000 homes).

Idea by: Mike Rybacki

Innovation #6 (Local): Operation White Roofs.

OFA student contact Chris Heinemann would like to expand Penn State Campus' efforts in the installation of white roofs in order to deflect heat form the sun and use less energy due to air conditioning reductions.

Covering roofs with white roof coating can save 20% on cooling costs, or $50 per year for 1,750 sf home. Roofs last for 7 years before needing re-coat. ~~an upgrade.~~

However, the Competition only judges energy efficiency for residents and municipalities directly served by utilities??

Option: initiate residential and municipality white roof campaign within the surrounding community.

Stats: Coat 30 x 700sf roofs (10 roofs per year). $163 materials per roof. Estimated 3-year Competition savings: 38MWh. Dollars spent to save 1 kWh: $0.129. Volunteer construction labor.
Recommended GU energy Prize contribution: **$4,890** ~~**30,000**~~**.**

Idea by: Chris Heinemann – undergrad student OFA

Innovation #7 (Local): Renewable Energy for ~~Solarization of~~ Local Farms.

OFA student contact Scott Patterson would like to organize fund-raising in order to expand this area's local farm efforts to use sustainable energy sources

such as solar photoelectric power. Using 30-year savings for renewable energy conversion projection data, a geothermal/PV mix averages 8% lower investment than a 100% solar energy retrofit.

Participating farms: TBD.

However, the Competition only judges energy efficiency for residents and municipalities directly served by utilities??

Option: target the residences of farmers.

Stats: Assume $3,250/kW installed and $6,710/1 Ton capacity geothermal (refer to Appendix A for 30-year projection calculations. Estimated 3-year Competition savings: 71 MWh. Dollars spent to save 1 kWh: $0.705. Recommended GU energy Prize contribution: **$50,000.**

Idea by: Scott Patterson – undergrad student OFA

Innovation #8 (Local): Renewable Energy for ~~Solarizing~~ Local Community Supported Agriculture (CSA).

Greenmoore Gardens CSA, located in Patton Township recently won a $50,000 grant (towards a total estimated project cost of $200,000) from the U.S. Department of Agriculture towards installation of a PV array. 50KW of capacity is needed to offset their present electrical consumption.

This marks a significant step towards having Pennsylvania's first National Green Building Design's pre-certified village become 100% renewable energy powered since the 1,625 home village, still in its planning stages, is anchored by its CSA, operational since 2009.

However, the Competition only judges energy efficiency for residents and municipalities directly served by utilities??

Option: target the residences of the CSA workers and the residences that would be preserved that currently dot the 500+ acre parcel. (Using 30-year savings for renewable energy conversion projection data, a geothermal/PV mix averages 8% lower investment than a 100% solar energy retrofit.)

Recommend: 15 kW @ $50,000.

Stats: Same assumptions as Innovation #6 above, but dollars spent by Competition money is halved. Estimated 3-year Competition savings: 71 MWh. Dollars spent to save 1 kWh: $0.353.

Recommended GU energy Prize contribution to match OFA fund raising: **$25,000.**

Idea by: Scott Patterson – undergrad student - OFA

Innovation #9 (Outside): Community Bulk Buying: The idea would be to purchase large quantities of solar modules and ground source heat pumps at wholesale prices to reduce installations costs: $500,000 bulk modules; $500,000 bulk ground source heat pumps.

Stats: Assume $3,250/kW install price PV reduced to $2,000/kW, which would be paid by the consumer. 800KW would be the offset, enough for 50 homes – 1,750 sf - (17 installs per year, 3-years), each with 8kW PV + 3 Tons geothermal capacity. Estimated 3-year Competition savings: 2,278 MWh. Dollars spent to save 1 kWh: $0.439.
Recommended GU energy Prize contribution: **$1,000,000.**

Idea by: Johan Zwart

Innovation #10 (Outside): City Hall Green: The plan would be to have the energy usage of all six "City Halls" offset by a minimum of 30%. By lot, one of the six would be selected to have a 100% offset (municipal auxiliary buildings can be addressed as well, pending available funds).* In all cases, firms which offer Power Purchase Agreements and Loop Tariffs, that is, ***no*** upfront investments on a lease-to-own basis, can be solicited to make up the difference. The systems can be paid off early as grants and/or prize money is awarded.

* Penn State's Old Main can be included in this idea as well. A couple of solar trackers on Old Main's lawn would surely be a positive image booster, a tourist destination, and a rallying point for renewable energy. Of the geothermal portion, for those leery of vertical boreholes, two alternatives exist: Direct Exchange which consists of 45 foot long copper tubes placed at 45 degree angles from each drilling platform, or Horizontal Ground Loops which are buried to only a 6 to 7 foot depth.)

This idea holds the most promise in increasing visibility/publicity for renewables and shows that we are serious. Independent of any other commitments, it can be started immediately and would exhibit long-term efficiency reductions which would begin immediately.

First step: gathering energy usage, building square footage, and lot size data from all seven "City Halls."

Stats:
Recommended GU energy Prize contribution: **$451,750**.

Idea by: Mike Rybacki

Innovation #11 (Outside): Residential Green 30 & 30 for 60: How greatly would offering subsidization for renewables affect the increase in its use? This idea would offer to have upfront funding of 30% for renewables (up to $7,500 each for the PV and geothermal portions), for 60 homes. Each year, by lot, one system would be awarded as a give-away ($50,000 max.). When the following are added: 30% federal tax credit; the $50 per SREC; the ~$20,000 increase in home equity; and a balance that can be fully funded by the installation firm,* one ends up with a powerful incentive package where more than 50% of the renewable energy installation investment is funded.

Stats: Estimate (10) residences signing up year 1, (20) year 2, and (30) year 3. Estimated 3-year Competition savings: 2,460 MWh. Dollars spent to save 1 kWh: $0.408
Recommended GU energy Prize contribution: **$1,005,000.**

* Installers must offer PV: no greater than 25% above national average ($2.59/W – 2013), or $3,250/kW for basic install (1-story ranch); Geo.: no greater than $5,500 + 22% (domestic hot water), or $6,710/Ton capacity for 3-Tons or national average,whichever is lower.

Innovation #12 (Outside): Right-of-Way Power Generation: The idea of solarizing public and transportation rights of way, along roads, railways, bus stops, sidewalks, and parking lots is not new. Canopies, pole mounts, and other fixtures can be dressed with PV and grid fed so that the municipality's electric usage can be offset.

This idea can piggy-back onto the porposed State College Borough water main project where empty conduit can be set under the road surface and elctrical inlet ports and micrometers can be placed at regular intervals to accept grid feeds from future rights-of-way-solarization projects.

One prototype bus stop size canopy can be planned along the new water main route, along with a stretch of associated conduit and grid tie-in ports.

Stats: (1) bus stop size canopy ~ 12' x 6' surface area.. Estimate (10) residences signing up year 1, (20) year 2, and (30) year 3. Estimated 3-year Competition savings: 1.4 MWh. Dollars spent to save 1 kWh: $1.752
Recommended GU energy Prize contribution: **$75,000.**

Idea by: Jon Eich and Wesley Glebe

Innovation #13 (Outside): Municipal Waste Water Heat Recovery: This district level reclamation project would be for the University Area Joint Authority. Research, planning, and projection, to determine "Dollars spent to save 1 kWh of energy" would be the goal.

Recommended GU energy Prize contribution: **$50,000.**

Idea by: Idea by Nari and Cory

Innovation #14 (Outside): Energy Audits: Energy audits, as well as available funds for their implementation, would provide a low up front investment avenue to increase energy efficiency.

Stats: 8 homes per year for 3-years, 24-home total. $8,000 per home (includes audit + implementation. Half for owner occupied and half for tenant occupied residences. Choose only implementation techniques that are no more than 80% of the cost of renewables to save 1 kWh of energy.

energy tchoose hhalf, (1) bus stop size canopy ~ 12' x 6' surface area.. Estimate (10) residences signing up year 1, (20) year 2, and (30) year 3. Estimated 3-year Competition savings: 1.4 MWh. Dollars spent to save 1 kWh: $1.752
Recommended GU energy Prize contribution: **$75,000.**

Innovation #15 (R&Dep.): Feed-back E-coupling. I talked to some of Penn State's hydrogen research program engineers who examined the shell of one of General Motors' EV-1 automobiles in the mid-2000's. An idea they had was to create a car-to-home module that could transfer excess energy stored in a car's battery system into the home. For instance, if, by way of the car's built-in solar modules and help from a solar canopy installed at work or in town, if it is known that the car will be driven only 50 miles the next day but the battery bank has a 300-mile charge, then the 250-mile excess can be dumped back through the house, thus reducing the home's energy profile.

On a larger scale, a fleet of parked vehicles that are exposed to sunlight during the day can convert sunlight, via roof-top stick-on thin film solar cells, into battery power whose excess can be e-corded back into the building, day or night.

An idea would be to create a working model of such a module. It could involve having a universal e-cord with a micro inverter built into the cord's wand which could also sense voltage and frequency. The inlet could be both indoor and outdoor and be a flat plate sheathed in plastic. A toggle switch both at the inlet and cord's outlet can be tripped which would allow the cord to be magnetically plugged into place. The business end of the cord can have a metallic adapter in the shape of the letter "e". It can be plugged not just into a car, but also a mobile set of solar modules or into a bicycle generator which could be located in any room of the home or on the 50th floor of a high rise apartment building. It could also be adapted to any battery or electrical storage device, draining its remaining energy back through the home's metering system.

This plug and play item could vastly increase the interdependency and reciprocity of a community-shared energy system, or for an off grid home, increase the available options for garnering usable energy and recharging its storage system.

Even though the Georgetown Energy Prize Competition does not encompass energy efficiency issues with the transportation sector, a parked car in the driveway is not transportation. The E-coupling would have merit whether or not the manufacturing industry decides to incorporate an energy transfer outlet in every vehicle. But if the carrot is offered, the rabbit may come.

Stats: Possible project for The Make Space or Johan Zwart
Recommended GU Energy Prize contribution: **$8,000**

Idea by: Mike Rybacki and Johan Zwart

Innovation #16 (R&Dep.): NiMH-Geothermal electricity generation. The idea to couple a geothermal (ground source heat pump) system to a bank of thermally chargeable nickel metal hydride batteries (currently installed in many hybrid automobiles, laptops, cell phones, cordless drills, and commonly available by retailers as small rechargeable batteries) was put forth as a concept in the *West Campus Renewable Energy Plan,* where the earth, and not the batteries, would be used as storage – any stored power in the batteries would be incidental to the system. The idea would be to actually build a working model to determine the relationship between geothermal capacity input and electrical power output.

(As an aside, an expanded use of such a system would be to generate electricity and recharge the batteries of an electric car, at night.)

Recommended GU energy Prize contribution: **$25,000.**

Idea by: Mike Rybacki

Innovation #17 (R&Dep.): Farm-to-Module Concept (Silicon Happy Valley): Local farmers to grow silicon-rich plants processed locally into high-grade silicon wafers to see if module efficiency can be boosted and overall production costs decreased.

Recommended GU energy Prize contribution: **$25,000.**

Idea by: Mike Rybacki

Replicable, Scalable.

> "communities will . . . develop . . . replicable, scalable . . . reduction in energy."[1]

Can energy conservation measures be reproduced on their own without the need for outside monetary stimulus? What long term good can be achieved if money spent towards energy reductions can not be reproduced by the residents and their municipality, scalable to every capacity, nor shared with other communities? The Competition gives weight to innovations that can be sustained, which also implies resilience.

In order to avoid redundancy, it shall be assumed that all the ideas and innovations presented in this Plan have the characteristics of being replicable and scalable and thus readily shared by most every community throughout the United States.

Growth in renewable energy production markets.

> "The Georgetown University Energy Prize will: Help to grow markets for products and services that facilitate energy efficiency and renewable, clean energy production."[1]

Who can forget the landmark that was achieved when, in 2012, Ball State University installed the largest ground source heat pump system in the United States? Predictably, this heavily promoted renewable energy implementation event spurred the growth of an industry to manufacture equipment and accessories for the geothermal industry.

In the same manner, promotional events coupled with actual renewable energy installations scan spur tremendous growth of a renewable energy industry, here, in Centre Region. Expected areas of growth: manufacturing; suppliers; installers; designers; consultants; training facilities including increased associated University course offerings; research. Listed below are **promotional** ideas that can spur market growth in all these areas:

Growth Idea #1: Free Website Calculator – Renewables vs. Non-renewables Comparison, 30-year Projection. A freely accessible ~~community~~ regionally-specific website would be created to provide a plug-n-play 30-year side by side projection for a home or small apartment building's non-renewable fuel costs verses the return investment for renewables. It would also serve as a tool to provide cost-free assistance in maintaining fairness between renewables and nonrenewables at the settlement table (refer to Policy Issue #1).

It would: 1) provide an educational tool for the financial and environmental impact differences between renewables and non-renewables, 2) promote energy efficiency, 3) compare financial savings over the long term (30-years).

The average 30-year savings of an investment in renewables for a ~2,000 square foot home are $30,000 along with an immediate increase of home equity by ~$20,000. The data show that the greatest savings were when a combination of geothermal and photovoltaics is used.

If renewable energy market saturation is currently 0.5%, the goal would be to spur its growth to 1% after year one of the Competition, 2% year two, and 4-6% after year three. It is thought that mainstream knowledge occurs after 6%.

Sample projections performed in the community are ~~attached~~ shown in Appendix A.

Stats: Development by Dr. David Lemmon, Research and Development Engineer, Innovation Park, Penn State University

Recommended GU Energy Prize contribution: **$5,000.**

Idea by: Mike Rybacki

Growth Idea #2: Save Energy: Straw Bale & Modular.

Straw bale: Invite the Out-On-Bale Society to host a one-day demonstration project where members of the community would build a straw bale home in one day, using locally sourced straw, an fit it with solar power, accompanying composting toilet, and its own well and battery back-up. Invite a student or two to live in it for one year while keeping it open to the public on select days.

Strawboard panels: Outside and inside partitioning can be outfitted with strawboard panels, rigid building panels made from natural fibrous raw materials, which are designed to replace 2x4 stud walls. It takes 18 acres of wheat straw to build a 1,760 sf house (compare to one acre of clear cut forest (replaceable every thirty years). Cost benefits are an 18 – 22% savings.[3] These types of panels have been used in over 20 countries for more than 50 years.

This idea can spur the construction of energy efficient homes, modular homes, help solve the affordable housing crises, and the growth of a local industry.

Hosting Out-On-Bale: **$10,000**
Materials, including local farmers' price for straw products: **$30,000**

Idea by: Mike Rybacki and Joe Cusumano

Growth Idea #3: Seed Money for Community Renewable Energy Cooperative Start-up. Behind the local food cooperative movement, the idea of for-profit community owned and operated energy cooperatives is gaining traction. The seed money would match the first 13-members' $1,000 lifetime membership for a total of $52,000. Most of which would be used to subcontract and build

its first renewable energy system implemented on a Purchase Power Agreement basis.

Objectives: 1) provide an avenue for local-vesting: where local community members can financially benefit from locally implemented projects 2) provide a way for home and building owners to reduce their initial investment for renewable energy conversions.

Recommended GU energy Prize contribution: **$25,000.**

Idea by: Mike Rybacki

Growth Idea #4: State College Borough Net Zero Initiative: offer financial assistance to help kick-off this Fall's Net Zero Initiative, a State college borough and Penn State Sustainability Institute collaborative.

Recommended GU energy Prize contribution: **$10,000**.

Idea by: State College Borough and The Sustainability Institute

Growth Idea #5: Radio and Television Advertising:

Recommended GU Energy Prize contribution: **$500,000.**

Growth Idea #6: West Penn Power Sustainable Energy Fund:

This fund's website advertises funding for a myriad of renewable energy projects including, solar, fuel cells, wind, and bioenergy.

Recommended GU Energy Prize contribution: **WPP funding.**

Growth Idea #7: Energy Progress Dashboard: Creation of a website and other forms of promotion, to display our cost savings due to efficiency increases. It would include increases from current installed PV and geothermal capacity, and the estimated savings due to efficiency increases such as outlined in this Plan. There would also be a side-by-side comparison of energy provided by renewables compared to non-renewables. Update progress thermometer monthly. Goal would be 90% saturation for renewables.

Recommended GU Energy Prize contribution: **$0 (CITY-GREEN volunteers).**

Growth Idea #8: RE Entrepreneurial Fund: The fund would provide up to 30% of the funding for start-up expenses for the ideas, or similar, put forward in this Energy Efficiency Plan.

Recommended GU Energy Prize contribution: **$50,000.**

Idea by: Joe Cusumano

Customer, community, and utilities are all rewarded.

> "The prize money must be spent on energy efficiency programs that reward the community as a whole and not just specific individuals, and provide for the long-term implementation of those plans."[1]

Environmental benefits: Estimated emissions reductions are listed in Table 1. More energy efficiency equals less emissions and therefore a greater positive impact on our environment and health.

Financial benefits - $200 per Household: The Competition Guidelines link the idea of being sustainable to financial stability. They say that up-front costs will be met with far greater rewards in the end, with one of the most tangible benefits being a more sustainable and financially sound community.* With a suggested achievable goal of $200/household per year due to increased energy efficiency, the Guidelines state that this gives residents more disposable income, and allowing local governments [due to *their* reduced energy bills] to provide more money for direct services to residents.

Reward Idea #1: Renewable Energy Local-Vesting Event: utilities, private companies, venture capital organizations to promote local investing of renewable energy systems on buildings at no up front cost to customers – lease-to-own option.

Recommended GU Energy Prize contribution: **$5,000**

Reward Idea #2: Utility Company Energy Efficiency Challenge: with a chosen power plant, when its customer base offsets the plant's capacity with energy conservation, close and dismantle the plant.

Recommended GU Energy Prize contribution: **N/A**

* This looks like it is the closest the Competition comes to admitting that, by nature, a centralized system based upon the use of nonrenewable energy is inherently debt-riddled, and that renewable energy actually serves to *reverse* this trend.

Policy.

> "a . . . community's energy-saving program . . . should be long-term Plans, with commitments by residential associations, governments, institutions, or businesses . . . to policies and projects that will yield continual improvement."[1]

Unless policies are in place for encouragement, it is an uphill battle for energy efficiency and use of renewable energy to be adopted into a community. Whether it is development of an energy guide for city leaders who want to develop a strategic plan using policies, or the town of Marburg, Germany whose City Council actually passed an ordinance requiring all building to have solar power, policies can be some of the most effective drivers of change.

Policy Issue #1: Fairness in Energy Act. Deregulation of the non-renewable energy bias at the building-owner level would be addressed. Similar titles to stress the idea could be: "Deconstruction of Energy Bias Resolution"; "Energy Anti-Prejudice Ordinance"; "Equal Energy Representation Law"; "Deregulation of Energy Choice Restriction".

The precedent would be similar to the issue – fairness - that was addressed when the use of the utility grid was deregulated in the late 1990's, allowing for utilities and non-utilities to both have fair and equal access to the electrical grid.

If policy that pro-actively favors one form of energy over another can be seen as an injustice, a Fairness in Energy Act, rather than being proactive in nature, would simply allow for such a bias to no longer continue. By way of analogy, if two people are running for office but it is discovered that only one is represented at the voting booth then unfairness would reign. If the voting booth is the settlement table* (or the blueprints for new construction) then what a deregulation of the non-renewable energy bias would look like is a long-term comparison of the cost of **each** (non-renewables and renewables) projected through one generation, that is, 30 years.

* The same standard would apply at the settlement table of a 100% renewable energy home – there would need to be a comparison of a 30-year projection for the case in which a home were to be de-converted to non-renewables . . . less we forget.

It is assumed that both energy systems would offer the same level of basic tangibles: 1) reliable, proven methods of energy supply using off-the-shelf, readily available materials; 2) be able to function on a stand-alone basis, without any human interaction prior to standard maintenance, for at least six consecutive months, every six months throughout its lifespan; 3) major parts would have a lifespan of at least 30 years; 4) would either be similar in initial investment or have readily available standardized means to obtain installation.

A website is currently being developed that would offer a free calculator service to the community (see Growth #1) which would generate a 30 year projection of a side-by-side cost and environmental impact comparison for renewable and non-renewable energy systems.

Choices in energy brought to light through this policy can spur the growth of renewables. Assuming that their present share of ¼ - ½% (~160 households) can be increased to 4 – 6% (1,120 households) within the three years of the Competition, much energy, at little expense, can be conserved:

Stats: 160 homes converted the first year, 320 the second, and 640 the third year, each having 50% of their energy needs supplemented. Assume 1,750 sf average size home, each with 8kW PV + 3 Tons geothermal capacity. Estimated 3-year Competition energy savings: 20,0443 MWh. Dollars spent to save 1 kWh: < 1¢. Assume 1 hour of administrative time per household: $22,400.
Recommended GU energy Prize contribution: **$22,400.**

Policy Issue #2: Residential Micro-Wind: It appears that power from wind is vastly underutilized in this region. The residential micro-wind market can be recognized by municipal policy, thus opening the door for its promotion in the open market.

Generally, the greatest inhibiting factor would be its need for a 500 linear foot unobstructed wind path. This would necessitate a minimum 250' property setback. Anything less than the 250' setback would infringe on an adjoining neighbor's wind rights. See article addressed to Ferguson Township (via Supervisor Elliott Killian) in Appendix B.

Stats: 3 homes converted the first year, one each year. Assume capacity equivalent to a 16 kW PV system, which would require a rotor windswept area

= 750 - 800 sf. Estimated 3-year Competition energy savings: 137 MWh.
Dollars spent to save 1 kWh: $0.329.
Recommended GU energy Prize contribution: **$45,000.**

Idea by: Joana Santamaria

Policy Issue #3: RE Land Trust/Housing Transitions: A tax payer whose ongoing expenses are reduced would be better able to pay taxes. With this idea, State College Borough would be required (Housing Transitions (HT) may adopt a similar policy) to choose the less costly form of energy, as projected over 30-years, when rehabilitating, and re-presenting homes under the State College Land Trust (SCLT) program. Except when prize or grant money is available, up to 100% of the funding for the renewable energy conversions can be handled by the installation firm under a special agreement to assign the Power Purchase Agreements to the first home buyers.

Stats: 6 total conversions, 2 per year, 1 each for SCLT and HT. Allow $50,000 per conversion, 16 kW PV equivalent per 1,750 sf home, and 40 hours per home, $20/hr, for admin.
Estimated 3-year Competition energy savings: 295 MWh. Dollars spent to save 1 kWh: $1.033.
Recommended GU energy Prize contribution: **$304,800.**

Idea by: Jon Eich

Education.

> "Educate the public and engage students in energy efficiency issues including methods, benefits, and the environmental costs of the full fuel cycle . . . and encourage lasting behavior change."[1]

Education and policy complement each other: what is policy if not educating the people about the will of the municipality which is in turn, a mirror of the will of the people? What is education but an attempt to bring about a unity of mind concerning social policy? Even so, because of a greater level of unity, the more weight thrown into the education arena, as a result, less policy would be required.

Education Idea #1: LED Lighting – 32,000 home program. This idea, first mentioned in the Innovations section, is re-visited due to its extraordinary impact potential. When every home is visited, information about the free website calculator can be handed out, and a word of knowledge about energy efficiency can be spread.

Stats: 64,000 copies at 5¢ @ = $3,200 + gift cards, water, etc., for volunteers: $3,300.
Recommended GU Energy Prize contribution: **$6,500**.

Education Idea #2: Energy Efficiency Educational Video's to Affordable Housing Candidates: This would be part of the package that Interfaith Power and Light offers its clients. $3.33 per DVD?? X 300 = $1,000.

Stats: 300 homes for the 3-year period.
Recommended GU Energy Prize contribution: **$1,000.**

Idea by: Cricket Hunter – Paipl

Education Idea #3: Student Projects to Produce Customized Comparison.
Students to produce a customized financial and environmental 30-year comparison of their current home energy use with a 100% conversion to renewables. The environmental aspect would include "the environmental costs of the full fuel cycle"[1], that is, emissions and health impacts. Combines sound financial management with environmental awareness.

Associated materials: $1,000??

Recommended GU Energy Prize contribution: **$1,000.**

Idea by: Mike Rybacki

Education #4: Student Demonstration: NiMH: A kit is available, strictly for educational purposes, which demonstrates the fundamentals of nickel metal hydrides. The double chambered enclosed kit demonstrates the endothermic/exothermic principles of the charge/discharge cycle of the NiMH battery system, similar to the systems in use in automobile hybrids and in the proposed geothermal/NiMH electric generation idea. The kit also brings to light the system's classification as a solid state miniature hydrogen system, and hydrogen's natural affinity for metals with hydrogen itself exhibiting metallic properties.

$600 per kit.

Recommended GU Energy Prize contribution: **$600.**

Education Idea #5: State College Area School District Projects: contact Ms. Eggebeen, District Coordinator for K-12 Health, Physical Education, Driver's Safety Education, & Family and consumer Sciences for project ideas.

Administrative Funding.

COG admin: 4 hours per week x $20/hr x 52 weeks/year x 3 years:
Recommended GU Energy Prize contribution: **$12,480.**

Contingency: 5%, or $250,000 of the $5 million overall energy prize. Used to supplement other programs or to underwrite, over the process of time, those that demonstrate top performance.

Recommended GU Energy Prize contribution: **$250,000.**

References:

1 Georgetown University $5 million Energy Prize Competition website: GUEP.org.

2 Centre Region Council of Governments Public Services & Environmental committee AGENDA Wed. April 02, 2014.

3 Strawboard panels: http://www.toolbase.org/Technology-Inventory/Whole-House-Systems/strawboard-panels.

Table 1: $5 million Spending Plan; Projected Energy Savings

	Energy Saved 3 yrs (MWh equiv)	Dollars Spent to save 1 kWh	Investment
Innovation #1: Plastic Window Inserts	1,899	$0.0156	$29,700
Innovation #2: Water Tank & Pipe Insulation	380	$0.0624	$13,200
Innovation #3: Faucet Aerators	61	$0.0644	$2,625
Innovation #4: Energizing Community Housing	200	$0.875	$175,000
Innovation #5: LED – 32,000 Homes	1,518	$0.142*	$0
Innovation #6: White Roofs Campaign	38	$0.228	$4,890
Innovation #7: Solarization of Local Farms	71	$0.705	$50,000
Innovation #8: Solarization of Local CSA	71	$0.352	$25,000
Innovation #9: Community Bulk Buying	2,460	$0.406	$1,000,000
Innovation #10: City Hall Green	707	$0.639	$451,750
Innovation #11: Residential Green: 30&30for60	2,460	$0.408	$1,005,000
Innovation #12: Right-of-Way Power Generation	1.4	$1.752	$75,000
Innovation #13: Munic. WWater Heat Recovery	-	-	$50,000
Innovation #14: Energy Audits	158	$1.22	$192,000
Innovation #15: Feed Back E-Coupling	-	-	$8,000
Innovation #16: NiMH/Geo. Electric Production	-	-	$25,000
Innovation #17: Farm-To-Module Concept	-	-	$25,000
Growth #1: Website RE Calculator	-	-	$5,000
Growth #2: Save Energy: Straw Bale & Modular	-	-	$40,000
Growth #3: RE Cooperative Start-up	-	-	$25,000
Growth #4: Net Zero Initiative Shot-In-Arm	-	-	$10,000
Growth #5: Radio, TV Advertising	-	-	$500,000
Growth #6: West Penn Power RE Grants	-	-	$0
* Assumes wholesale prices			

Table 1: $5 million Spending Plan; Projected Energy Savings

	Energy Saved 3 yrs (MWh equiv)	Dollars Spent to save 1 kWh	Investment
Growth #7: Progress Thermometer	-	-	$0
Growth #8: RE Entrepreneurial Fund	-	-	$50,000
Reward #1: RE Local-vesting Event	-	-	$5,000
Reward #2: Utility Co. Energy Efficiency Chall.	-	-	N/A
Policy #1: Fairness in Energy Act	20,043	< 1¢	$22,400
Policy #2: Residential Micro-Wind	137	$0.329	$45,000
Policy #3: RE Land Trust/Housing Transitions	295	$1.033	$304,800
Education #1: LED Flyers	10,021	< 1¢	$6,500
Education #2: Videos: Energy Efficiency	152	< 1¢	$1,000
Education #3: Student 30-year Projection Proj.	1,254	< 1¢	$1,000
Education #4: Student Demo. NiMH	N/A	N/A	$600
Education #5: SCASDistrict Projects		< 1¢	$5,000
Administrative Funding			$12,480
Contingency - 5%			$250,000
Total so far:			$4,415,945
Remaining bal; looking for spending ideas			**$584,055**
Emissions avoided: S0x; N0x; CO; PM			

Calculations.

Innovation #1: Plastic Window Inserts:

Assume $250/yr saved on heating: 20% savings on $1,250/yr heating bill, 1,750 sf residence.

Assume: $90/home materials (lasts 4-years) x 300 homes + labor [paipl](1/2 hour admin./home x $18/hr) = $27,000 + $2,700 = **$29,700**.

Assume: other than admin., all construction labor is volunteer.

electric heat: $250/yr x kWh/$0.079 = 3,165 kWh/yr

gas heat: $250/yr x mcf/$5.25 = 47.6 mcf/yr

Year1: elec: (50) homes x 3,165 kWh/yr = 158,250 kWh

gas: (50) x 47.6 mcf/yr = 2,380 mcf

Year 2: elec: year 1 (158,250 kWh) + additional 50 homes (158,250) = 316,500 kWh

gas: year 1 (2,380 mcf) + additional 50 homes (2,380) = 4,760 mcf

Year 3: elec: year 2 (316,500 kWh) + additional 50 homes (158,250) = 474,750 kWh =

gas: year 2 (4,760 mcf) + additional 50 homes (2,380 mcf) = 7,140 mcf mcf

Energy Saved (Factor = 6x for 3-years):

elec: year 1 (158,250 kWh) + year 2 (316,500 kWh) + year 3 (474,750 kWh) = 949,500 kWh = 949.5 MWh

gas: year 1 (2,380 mcf) + year 2 (4,760 mcf) + year 3 (7,140 mcf) = 14,280 mcf.

Energy Saved 3-years (MWh equivalent): 949.5 MWh x 2 = **1,899 MWh**

Dollars spent to save 1 kWh: $29,700/1,899,000 kWh = **$0.0156**.

Innovation #2: Hot Water Tank and Pipe Insulation:

Tank insulation: 2" x 48" x 75" =	$22
6' pipe insulation = $2 x (10) =	$20
elbow or "T" = $2 x (5)@ =	$20
Foil Tape = $8 for 50 yards =	$8
Total:	$70

Assume materials last 15 years)

$70/home x 300 homes + labor [paipl](1/2 hour admin./home x $18/hr.) = $21,000 + $2,700 = **$23,700**

Assume: other than admin., all construction labor is volunteer.

If average bill for hot water use per year for 1,750 sf household = $250, assume insulation increases efficiency by 20%, or, $50 per year.

Elec.: $50/yr x kWh/$0.079 = 633 kWh/yr

Gas: $50/yr x mcf/$5.25 = 9.52 mcf/yr

Year 1: elec.: (50) homes x 633 kWh = 31,650 kWh

Gas: (50) homes x 9.52 mcf = 476 mcf

Energy Saved (Factor = 6x for 3 years):

Elec.: 31,650 kWh x 6 = 189,000 kWh = 190 MWh

Gas: 476 mcf x 6 = 2,856 mcf

Energy Saved 3-years (MWh equivalent): 189.9 MWh x 2 = **380 MWh**

Dollars spent to save 1 kWh: $23,700/379,800 kWh = **$0.0624**.

Innovation #3:

Aerators: kitchen faucet = $3.00 (1.5 gpm)
bathroom faucet = $5.50 (1.0 gpm)

Total: $8.50

$8.50 per household x 300 households + [paipl](1/4 hour admin./home x $18/hr.) = $2,550 + $1,350 = $3,900.

Assume: other than admin., all construction labor is volunteer.

Assume: $8/yr saved (Michael Blasnik data shows $25/yr saved for low flow shower head, assume 1/3 of this for faucet savings.

Year 1: $8/$0.079 = 101 kWh/yr x 100 households = 10,100 kWh/yr = 10.1 MWh/yr

Energy Saved (Factor = 6x for 3 years):

10.1 MWh x 6 = 60.6 MWh.

Energy Saved 3-years (MWh equivalent): 61 MWh

Dollars spent to save 1 kWh: $3,900/60,600 kWh = **$0.0644**.

Innovation #4: Energizing Community Housing:

3 shelters: active = $50,000 ($25,000PV, $25,000Geo.) x 3 = $150,000
passive = $8,333 x 3 = $25,000

Assume: shelter one retrofitted year 1; two shelters year 2.

Active: Geo/PV mix,

Year 1: PV equivalent: $50,000/$3,250 per kW installed = 15,385 kW x 2.9 sunhours/day x 365 days/yr = 21,900 kWh/yr

geo/PV mix has 8% greater power production than PV alone: 21,900 kWh x 1.08 = 23,652 kWh/yr = 23.6 MWh.

Energy Saved (Factor = 7x for 3 years):

Active: 7 x 23.6 Mwh = 165,564 kWh = 166 MWh

Passive: $25,000/kWh saved = $0.7248*, savings = $25,000/$0.7248 = 34,492 kWh = 34 MWh.

Energy Saved 3-years (MWh equivalent): 166 Mwh + 34 Mwh = **200MWh**.

Dollars spent to save 1 kWh: $175,000/(165,564 kWh + 34,492 kWh) = **$0.875.**

* choose only passive measures that cost no more than 80% of active measures (refer to the paper: *Active and Passive Conservation and Their Shared Influence on a Comprehensive Renewable Energy Plan*, attached to *The West Campus Renewable Energy Plan 2013 – 2043*.

Innovation #5: LED Lighting – 32,000 Home Campaign:

75W equivalent LED = 12W = $16 @, wholesale = $8,

32,000 homes x $8/bulb = $256,000 x 80% saturation = $216,000.

Assume LED replaces: half compact fluorescents (21W@) = 9W savings
Half incandescents (60W @) = 48W savings

Average savings: 9W + 48W = 57W/2 = 38.5 W x 2hours use/day x 365 days/yr = 28,105 Wh/yr = 28.1 kWh/yr.

Year 1: 9,000 households x 28.105 W saved = 252,945 kWh/yr = 253 MWh/yr .

Energy Saved (Factor = 6x for 3 years):

253 MWh x 6 = 1,518 MWh.

Energy Saved 3-years (MWh equivalent): 1,518 MWh

Dollars spent to save 1 kWh: $216,000/1,518,000 kWh = **$0.142.**

Innovation #6: White Roofs Campaign:

5-gal white roof coating (covers 250-375 sf, two coats) x 1.5	$111
1 gal white roof patch	$20
caulk (white roof sealant) x 2	$8
6' x 50' roof patching fabric	$9
18" nap x 2	$18
extension stick x 2	$30
white plastic sheets (siding protection)	$20
trays x 2	$6
extension cages x 2	$42
blue tape (50 yards)	$25

[pressure washer rental?]

Total price: $289

Roofs coated: May – July = 2@; April, Aug.-Oct. = 1@ = (10)/year x 3-years = 30 roofs total, 30 x 289 = $8,670.

Assume 15 roofs <400sf; 15 roofs <750 sf.

Assume $250/yr average cooling bill for 1,750 sf home.

Assume 20% savings = $50/yr per home.

$50/yr x kWh/$0.079 = 633 kWh/year per home

Year 1: (10) homes x 633 kWh/yr = 6,333 kWh

Energy Saved (Factor = 6x for 3 years): 6,333 x 6 = 37,998 kWh = 38 MWh

Energy Saved 3-years (MWh equivalent): 38 MWh

Dollars spent to save 1 kWh: $8,670/37,998 kWh = **$0.228.**

Innovation #7: Solarization of Local Farms:

Choose $50,000 investment.

If 100% PV: $50,000/$3,250 per kW installed =
15.385 kW x 3.9 sunhours/day x 365 days/yr = 21,900 kWh/yr

Geo/PV mix: 8% greater power output than 100% PV: 21,900 kWh/yr x 1.08 = 23,652 kWh/yr = 24 Mwh/yr.

Energy Saved 3-years (MWh equivalent): 23,653kWh x 3 = 70,956 kWh = **71 MWh.**

Dollars spent to save 1 kWh: $50,000/70,956 kWh = **$0.705.**

Innovation #8: Solarization of Local CSA:

Choose $25,000 investment. $25,000 matched donations.

<< same as Innovation #7 >>

Energy Saved 3-years (MWh equivalent): 23,653kWh x 3 = 70,956 kWh = **71 MWh.**

Dollars spent to save 1 kWh: $25,000/70,956 kWh = **$0.352.**

Innovation #9: Community Bulk Buying:

Bulk buy: $500,000 ground source heat pumps
$500,000 PV solar modules

Assume 50 homes equipped with a Geothermal/PV mix over 3-years, 1/3 installations each year.

Assume customer install costs reduced from $3.25/W to $2.00/W: savings per W = $1.25.

$1,000,000/$1,250 per kW offset = 800 kW leveraged installed PV capacity, enough for 50 homes each with 8kW PV + 3 Tons geothermal capacity.

[New install prices: 800 kW x $2,000/kW = $1,600,000 total net community investment for 800kW]*

Year 1: 100% PV Power output = 800 kW x 3.9 sunhours/day x 365 days/yr = 1,138,800 kWh/yr x 1/3 = 379,600 kWh/yr for 17 homes.

Energy Saved (Factor = 6x for 3 years): 6 x 379,600 kWh = 2,277,600 kWh = 2,278 MWh.

Geo/PV mix: 2,277,600 kWh x 1.08 = 2,459,808 kWh = 2,460 MWh.

Energy Saved 3-years (MWh equivalent): 2,460 MWh.

Dollars spent to save 1 kWh: $1,000,000/2,459,808 kWh = **$0.406.**

* Assume $2.00/W is the install price to the customer.

Innovation #10: City Hall Green:

All six main municipal buildings would have 30% minimum offset, with one of the six having 100% offset, determined by lot.

Assume highest dollar amount in the case of State College Borough hall being selected by lot for the 100% offset.

Assume $3,250/kW installed. Assume Patterson, Patton, and College Township buildings 1/3 that of S.C.B. Assume Harris is 1/6, and Halfmoon is 1/10.

Old Main, PSU, would assume to have 100% assistance by the installation firm, who would offer Penn State a lease-to-own agreement.

Assume 1/3 installations per year.

S.C.B	50 kW??PV	50 kW ?? equiv. Geo.	100%	$325,000
College	17 kW	17 kW	30%	$33,150
Patterson	17 kW	17 kW	30%	$33,150
Patton	17 kW	17 kW	30%	$33,150
Harris	9 kW	9 kW	30%	$17,550
Halfmoon	5 kW	5kW	10%	$9,750
Total:				$451,750

Leveraged installed capacity for the six municipal buildings = 230 kW at 100% PV equivalent. Geo/PV mix = 230 x 1.08 = 248.4 kW.

Year 1: 248.4 kW x 3.9 sunhours/day x 365 days/yr = 353,597 kWh/yr x 1/3 117,866 kWh.

Energy Saved (Factor = 6x for 3 years): 6 x 117,866 kWh = 707,195 kWh.

Energy Saved 3-years (MWh equivalent): 707 MWh
Dollars spent to save 1 kWh: $451,750/707,195 kWh **= $0.639.**
Innovation #11: Residential Green 30 &30 for 60:

Estimate (10) residences year 1; (20) year 2; (30) year 3.

Assume $50,000 system price (1/2 PV, 1/2 geothermal), that achieves 8kW PV and 8 kW equivalent geothermal.

One system, full price, to be awarded each year. The remaining (57) systems receive 30% subsidization.

Overall funding amount: 57 homes x (($25,000 PV + $25,000 geo.) x 30%) + 3 homes @ $50,000@ = $855,000 + $150,000 = $1,005,000.

Year 1: (9 leveraged homes + 1 home at 100%) x 16 kW equivalent x 1.08 (Geo/PV mix efficiency factor) = 172.8 kW x 3.9 sunhours/day x 365 days/year = 245,981 kWh/yr x 3 years = 737,942 kWh.

Year 2: (19 leveraged homes + 1 home at 100%) x 16 kW equivalent x 1.08 = 345.6 kW x 3.9 sunhours/day x 365 days/year = 491,962 x 2 years = 983,923 kWh.

Year 3: (29 leveraged homes + 1 homes at 100%) x 16 kW equivalent x 1.08 = 518.4 kW x 3.9 sunhours/day x 365 days/year = 737,942 kWh/year.

Year 1 – 3 = 2,459,808 kWh

Energy Saved 3-years (MWh equivalent): 2,460 MWh

Dollars spent to save 1 kWh: $1,005,000/2,459,808 kWh = **$0.408.**

Innovation #12: Right-of-Way Power Generation:

Assume one bus stop solar canopy – 1 kW - can be built along the new water main route, State College Borough.

Assume one-quarter payback* for this project, compared to the base example: 1 kW = $3,250 installed, 1 kW x 3.9 sunhours/day x 365 days/yr = 1,424 kWh/yr. Dollars spent to save 1 kWh = 1,424 kWh/$3,250 = $0.428.

Assume canopy built during third year of competition: 1 x 1,424 kWh.

Estimated cost: $75,000.

Energy Saved 3-years (MWh equivalent): 1.4 MWh

Dollars spent to save 1 kWh: ¼ base example = 4 x $0.428 = **$1.752.**

* higher expenses due to initial municipal level planning and infrastructure level construction.

Innovation #14 (Outside): Energy Audits:

24 homes total, 8 per year. $8,000 per audit. Assume $6,000 goes to actual passive implementation. Assume 80% of cost of PV equivalent:

Year 1: 8 homes x $6,000/$3,250 per installed kW PV equivalent = 1.846 kW x 3.9 sunhours/day x 365 days/yr x 1.25 (80% factor) = 26,280 kWh.

Energy Saved (Factor = 6x for 3 years): 6 x 26,280 kWh = 157,680 kWh.

Energy Saved 3-years (MWh equivalent): 158 MWh

Dollars spent to save 1 kWh: $192,000/157,680 = **$1.22.**

Policy #1: Fairness in Energy Act:

Assume the following increases in renewable energy implementation:

Year 1: increased to 1%, = 160 additional homes
Year 2: increased to 2%, = 320 additional homes
Year 3: increased to 4%, = 640 additional homes
Total: 1,120 homes.

Assume 1 hour of administrative time per home: 1,120 x $20/hr = $22,400.

Assume each home has 50%, on average, of its energy needs supplemented by renewable energy.

Year 1: 160 homes x 16 kW avg. equiv. capacity x 3.9 sunhours/day x 365 days x 50% = 1,822,080 kWh x 3 years = 5,466,240 kWh.

Year 2: 320 homes x 16 kW avg. equiv. capacity x 3.9 sunhours/day x 365 days x 50% = 3,644.160 kWh x 2 years = 7,288,320 kWh.

Year 3: 640 homes x 16 kW avg. equiv. capacity x 3.9 sunhours/day x 365 days x 50% = 7,288,320 kWh

3-year total: 5,466,240kWh + 7,288,320 kWh + 7,288,320 kWh = 20,042,880 kWh

Energy Saved 3-years (MWh equivalent): 20,043 MWh

Dollars spent to save 1 kWh: $22,400/20,042,880 kWh = **$0.00112.**

Policy #2: Residential Micro-Wind:

Assume 3 residential wind installs, one per year. Assume 30% subsidy to spur installs. Assume price installed per energy generated on par with PV.

Year 1: PV equivalent: 1 home x 16 kW average home capacity x 3.9 sunhours/day x 365 days/year = 22,776 kWh. Wind would need to generate this amount of power per year to satisfy an average 1,750 sf home's needs.

Energy Saved (Factor = 6x for 3 years): 6 x 22,776 kWh = 136,656 kWh.

Energy Saved 3-years (MWh equivalent): 137 MWh

Dollars spent to save 1 kWh: $45,000/136,656 kWh = **$0.329.**

Policy #3: RE Land Trust/Housing Transitions:

Assume six total conversions, 2 conversions per year, 1 each for SCLT and HT.

Assume administrative time = 40 hours per home x $20/hr = $800/home x 6 homes = $4,800.

Assume $50,000 per conversion for a Geo./PV mix for a 1,750 sf home requiring 16 kW PV equivalent capacity.

Year 1: 2 homes x 16 kW x 3.9 sunhours/day x 365 days/year x 1.08 (geo/PV efficiency factor) = 49,196 kWh.

Energy Saved (Factor = 6x for 3 years): 6 x 49,196 kWh = 295,177.

Energy Saved 3-years (MWh equivalent): 295 MWh

Dollars spent to save 1 kWh: ($300,000 (RE conversions) + $4,800 (admin.) / 295,177 kWh = **$1.033.**

Education Idea #1: LED Flyers: It is believed that this door-to-door initiative can be at least half as effective as the Policy #1 idea:

Energy Saved 3-years (MWh equivalent): 20,043 MWh x 50% = **10,021 MWh.**

Dollars spent to save 1 kWh: $6,500/10,021,440 kWh = **$0.000649.**

Education Idea #2: Video's on Energy Efficiency Available to Affordable Housing Candidates:

300 video's: 300 x $3.33 = $1,000.

Assume 300 energy efficiency educational video's distributed to 300 residences, 100 per year.

Assume average total energy usage per residence amounts to $2,000 per year.

Assume each home implements a 1% energy reduction, or, $20 per home.

Year 1: 100 homes x $20 x 1 kWh/$0.079 = 25,316 kWh yr.

Energy Saved (Factor = 6x for 3 years): 6 x 25,316 kWh = 151,899 kWh

Energy Saved 3-years (MWh equivalent): 152 MWh

Dollars spent to save 1 kWh: $1,000/151,899 = **$0.00658**

Education Idea #3: Student Projects to Produce Customized Comparison:

Assume class size = 500. If one in sixteen projects results in a 50% renewable energy, then this would amount to 17 full conversions per year.

Assume full conversion = $50,000, 8 kW PV; 8 kW equivalent geothermal.

Assume $1,000 for educational materials.

Year 1: 17 homes x 8 kW x 1.08 geo/PV mix efficiency factor = 146.9 kW.

147 kW x 3.9 sunhours/day x 365 days/year = 209,084 kWh/yr

Energy Saved (Factor = 6x for 3 years): 6 x 209,084 kWh/yr = 1,254,502 kWh

Energy Saved 3-years (MWh equivalent): 1,254 MWh

Dollars spent to save 1 kWh: $1,000/1,254,502 = **$0.000797**

Education Idea #5: State College Area School District Projects:

Assume $5,000 spent on project-related student supplemental materials.

Following the trend of the other educational ideas, assume less than a penny for dollars spent to save 1 kWh.

Energy Saved 3-years (MWh equivalent): ?? Mwh

Dollars spent to save 1 kWh: <$0.01.

Appendix A.

Present: Electric = $2,096/yr; Fuel Oil = $227/yr.	Conventional (currently in place)	100% Solar PV 18.64kW	Geothermal/PV Mix 3.05 tons GSHP 8.0kW PV
Year 1. Conven. Elec+Oil	$2,323	-	-
PV	-	$39,377	$16,883
Geothermal	-	-	$16,775
Year 2. SRECS ($50/SREC x 2-years)	-	-$2,050	-$880
Year 15. Conventional	$2,512	-	-
PV (inverter replacement)	-	$12,600	$6,500
Geo. (circ/compr. pumps)	-	-	$2,000
Year 23. Furnace Replacement	$6,000	-	-
Year 30. Cumulative Investment	($75,690)	($49,927)	($41,278)
Net Savings	-	**+$25,763**	**+$34,412**
Real Feel Difference (x 1.42 – savings not taxed)	-	+$36,583	+$48,865
Real Feel R.O.R. (x 1.42 - savings not taxed)	-	4.8%	5.8%
Home Equity Increase ($10 for $1 saved)	-	+$23,230	+$23,230
Fuel costs (+1.5% inflation)	($87,202)	-	-
Net Savings (after inflation)	-	+$37,275	+$45,924
Real Feel R.O.R. (with Inflation Factor)	-	6.0%	7.3%

Appendix B: Residential Micro Winid Open letter to Ferguson Township.

Application.

"Highlights of the energy savings

program that would be implemented
to compete for the prize."[2]

The implanted ideas from the savings program (the Energy Efficiency Plan) would save **41,926.4 Megawatt hours** (over 41.9 Gigawatt hours!) of power for Centre Region over the first three years of the Competition. And only $4.4 million of the $5 million prize has been "spent" so far.

We believe this energy projection idea will be seen as a powerful predicting modeling approach, especially since it is offered so early in the Competition. It is hoped that it would give us a measure of weight in competing through the various stages.

We are currently in the Application Stage of the Competition. This Plan's tentative options would need to be boiled down to its highlights for the purpose of submitting the Application which is due by the end of June.

The overall spending Plan is what is required for the Quarterfinalist round after the Application is accepted. The reason a Plan was developed now is to help answer the question of what the Application's highlights would be taken from if there was nothing yet to take them from.

The main thrust behind creating a Plan and a community sustainable energy group to review them would be to use these tools, in a community open forum format, in deciding what to include in our Highlights section of the Application that COG is working on.

Highlights.

The highlights ideas would follow the categories identified in the competition Guidelines: long term reductions in per capita energy through processes that are innovative, replicable, scalable, and spur growth in renewable energy production markets where customer, community, and utilities are all rewarded, are through policy and education.

Energy Efficiency Plan – Overview

Long-term planning in replicable, scalable, innovations:

Plastic Window Inserts – 1,899 MWh saved
Water tank & Pike Insulation – 380 MWh saved

Faucet Aerators – 61 MWh saved

Energizing Community Housing – 200 MWh saved

LED lighting – 32,000 homes – 1,518 MWh saved

White roofs campaign – 38 MWh saved

Solarizing Local Ffarms – 71 MWh saved

Solarization of Local CSA – 71 MWh saved

Community Bulk Buying – 2,460 MWh saved

City Hall Green – 707 MWh saved

Residential Green – 2.460 MWh saved

Right-of-Way Power Generation – 1.4 MWh saved

Municipal Waste Water Heat Recovery

Energy Audits – 158 MWh saved

Research and Deployment Innovations:

Feed-back E-coupling

NiMH/Geothermal Electric Production

Farm-To-Module Concept

<u>Promotional Ideas to spur growth:</u>

Free Renewable Energy Website Calculator

Save Energy: Straw Bale & Modular Construction Event

Community Renewable Energy Cooperative Seed Money
Net Zero Initiative Assistance

Radio, TV Advertising

West Penn Power RE Grants

Energy Progress Dashboard

Renewable Energy Entrepreneurial Fund

Community Rewards:

Renewable Energy local-vesting event;

Utility Company Energy Efficiency Challenge

Policy Initiatives

Fairness in Energy Act – 20,043 MWh saved

Residential Micro-Wind – 137 MWh saved

Renewable Energy Land Trust/Housing Transitions – 295 MWh saved

Education Initiatives:

Door to Door LED's – 10,021 MWh saved

Video's: Energy Efficiency – 1525 MWh saved

Student 30-year Projection Projects – 1,254 MWh saved

Student Demonstration Materials – NiMH

State College Area School District Projects

Administrative Funding

Projected 3-year energy savings