BEREA ENERGY COST-SAVINGS PLAN:
A Comprehensive Community Energy Plan

Berea, Kentucky   September, 2012

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A Joint Venture of the City of Berea, the Kentucky Environmental Foundation, and Sustainable Berea

Accepted by the Berea City Council on September 18, 2012
by unanimous vote

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EXECUTIVE SUMMARY

In 2009, at the request of local environmental and civic organizations, the City of Berea became a member of ICLEI – the International Council for Local Environmental Initiatives. The purpose of this membership is to propel actions to use energy more wisely and in so doing, help the City and its residents save money, reduce emissions that harm the environment and our health, and become more energy independent.

ICLEI, which includes hundreds of cities in the U.S., prescribes a five-step process that helps cities realize their full energy savings potential: 1) conducting an energy inventory, 2) setting preliminary goals, 3) writing a plan, 4) writing an implementation program, and 5) periodic monitoring of the plan's progress over time. A unique aspect is the detailed inventory of the city as a whole in all it's energy use by types and costs, and a detailed inventory of all city buildings and fleet operations' fuel types and costs.

The Berea Energy Cost Savings Plan (BECS, or Plan) is a key step on this journey. The Plan sets forth a goal to reduce energy usage in Berea by 30% in projected growth by the year 2042, or, an average annual 1% reduction in traditional per capita energy use. It reflects a comprehensive approach, encompassing all buildings and transportation in Berea, with more than 50 recommendations for potential activities that could help achieve this goal. Recommendations are grouped by these four energy sectors:

- households (residential use);
- non-residential use, including businesses and institutions;
- transportation; and
- city government, including all city functions.

The recommendations are further divided into no-cost, low-cost, and investment grade categories, to provide city leaders with multiple strategies depending on the amount of money the City wants to, or is able to invest. Some recommendations could be enacted relatively quickly and others require longer-term planning and commitment. Most recommendations pertain to energy efficiency – well acknowledged as a least cost option – but also renewable energy from clean sources like solar power.

In any case, this Plan is designed to be a "living document" and a practical tool for city and utility leaders and other key community stakeholders for energy savings planning, for many years to come.

Creation of the BECS Plan required a comprehensive energy audit of the City in each of the four energy sectors listed above, using proprietary computer data collection and management software from ICLEI. The software helped to create estimates of dollar savings for specific energy efficiency activities. And these savings could be significant: realizing only half of the plan recommendations would result in an average annual savings of $495,000 in today's dollars, or at an assumed inflation rate, $1.6 million in the last year of the plan.[1] Estimated average household cost-savings over the life of the Plan is $639/year in FY2012 dollars.

The City government alone could save as much as 34% of its energy costs (counting both conservation and peak load management). If the City were to achieve half of the plan recommendations, it would result in an estimated average annual savings of $143,000 per year in today's dollars over the life of the plan, considerably more over time with increasing energy prices.

Some of the report's strategies include:

- Developing a coordinated approach to the city's three energy providers, the City of Berea Municipal Utility Department (BMU), Blue Grass Energy and the Delta Gas Company. Together the providers could more efficiently enact a smart energy future for Berea.

- Determining specific strategies for wise energy use by Berea's industries, which account for 55% of the City's electricity usage and which have the highest potential for energy savings.

- Engaging in a broad energy education activities, which will help all City residents and institutions.

- Reducing Berea Municipal Utility's peak power consumption.

- Creating a City government (or government/non-profit shared) staff position to help monitor energy usage, update the energy inventory using the ICLEI software, implement strategies and activities modify the Plan when necessary.

- Developing a renewable energy business model that encourages local renewable energy development including increased customer-owned net metering, optimized solar farming, and development of feed-in-tariffs.

Implementing these strategies and following specific recommendations in the Plan could result in several positive outcomes for the City government and its residents. Not only would the City realize tangible cost savings and greater independence in a volatile energy market, but it could also improve the city's economic competiveness in becoming a more efficient local economy, particularly aiding the city's self-reliant economic development strategy.

Another benefit of the Plan is reduction in greenhouse gas emissions, which are harmful to our health, the environment and food systems, together with the long-term cost savings goal. The Plan could result in 29% fewer emissions per Berea resident for the projected population by the year 2042.

The Plan offers the City an opportunity to develop a financial model in which money saved through reductions in energy consumption are reinvested in emerging energy

[1] Using an assumed average increase of 4% annually, the national average in electrical cost increases since 1997.

technologies and programs, with utilities harnessing their potential to manage energy flows.

Undoubtedly, the City will experience challenges in implementing the recommendations and strategies: educating the public on the values of energy efficiency and independence; familiarizing community leaders and the general public about new energy technologies and processes; accounting for the “externalized” health, economic and environmental benefits of energy efficiency and clean energy sources; uncertainty about fuel availability and prices at a time when world oil supplies are in a steady decline; etc. However a comprehensive, precautionary, visionary approach to energy savings can build community capacity and resilience in the face of these challenges and position the City of Berea for a bright future.

Blower door test photo courtesy of MACED

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The Berea Energy Cost-Savings Plan:
A Comprehensive Community Energy Plan

September, 2012

BACKGROUND

■ Introduction

The purpose of the Berea Energy Cost-Savings Plan (BECS) is to develop a comprehensive community approach to energy savings and independence. The Plan recommendations are divided into four energy sector categories: residential, non-residential, and transportation; the fourth category is a set of recommendations for city government energy savings. Although the government represents only 1.6% of the total energy consumption in the city, it has its own plan to serve as a local example of successful energy practices and policies, as well as to save money for reinvestment in still greater energy savings.

Energy efficiency (EE) is known to be a low-cost solution to the problem of rising fuel costs. By investing in the recommendations and strategies in this Plan, the City of Berea and its residents could experience greater stability in utility bills and many other benefits including better health, a cleaner environment, greater economic competitiveness, and higher quality of life. Utility customers could also benefit from improved system reliability and spillover effects such as increased retail sales of energy efficient products, and contractors who incorporate energy efficient services into their business models. Likewise, many Bereans derive personal satisfaction from taking action to reduce energy use and protect the environment.

This Plan lists 54 recommendations to be developed over the 30-year plan period, in order to reap the highest cost-savings and other benefits. The recommendations were developed by consensus in a community team process, involving planning teams for each of the four energy sector areas plus a public outreach team. The teams met frequently over 8 months to research and develop the plan recommendations. While a majority of the recommendations pertain to energy conservation, the Plan also considers renewable energy sources, including estimated cost savings from clean energy generation in the long-range community plan.

The Plan format follows the International Council of Local Environmental Initiatives (ICLEI) – Local Governments for Sustainability planning process. It is a five-step process that includes: 1) conducting an energy inventory, 2) setting preliminary goals, 3) writing a plan, 4) writing an implementation program, and 5) periodic monitoring of the plan's progress over time. A unique aspect is the detailed inventory of the city as a whole in all it's energy use by types and costs, and a detailed inventory of all city government buildings and fleet operations' fuel types and costs.

ICLEI's primary objective is to perform energy savings measures in order to reduce harmful greenhouse gas emissions; this Plan shows focuses on energy cost savings in a manner that also reduces greenhouse gas emissions. The value of the ICLEI approach is the way in which energy data and energy savings activities are able to be easily tracked, updated, , and adjusted when necessary.

The goal expressed in the Plan is to achieve a 30% reduction in traditional energy usage by the year 2042; and there is a potential for much larger savings. The combination of increasing price pressures on electricity and gasoline could trigger a major market response in energy conservation and thus much greater cost savings over time.

■ Plan Benefits

In addition to saving energy and reducing utility expenses, there are externalized benefits from conserving energy that contribute an additional 18 to 50 percent of the energy savings.[2] These benefits include:

- Extended Equipment Life: Longer lasting assets require less frequent replacement thereby reducing capital budget requirements.

- Reduced Maintenance Costs: When equipment runs fewer hours per year, maintenance, labor, and materials are reduced.

- Reduced Risk from Price Increases: Operations budgets are less vulnerable when energy prices spike.

- Economic Development**:** Greater investment in energy efficiency helps build jobs and improve local economies. Customers often redirect their bill savings toward other activities that increase local employment, with a higher employment impact than if the money had been spent to purchase energy (*http://www.aceee.org/pubs/u042.htm*). Many energy efficiency programs create construction and installation jobs, with multiplier impacts on employment and local economies. Lastly, energy efficiency investments usually create long-lasting infrastructure changes to building, equipment, and appliance stocks, creating long-term property improvements that deliver long-term economic value.

- Enhanced Public Image: Energy smart communities will become more attractive to economic and urban development. An autumn 2008 study by McGraw-Hill Construction in partnership with the National Association of Home Builders (NAHB) shows forty percent of builders find "building green" makes it easier to market in a down economy; 16% find it makes it much easier.[3]

- Relief for Low Income Families: Reducing energy waste can stabilize electric bills, or reduce energy spending for households (among others) that often struggle to pay

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[2] http://www.energyeducation.com/Portals/0/Secret%20Benefits%20of%20Energy%20Conservation.pdf
[3] http://www.evancarmichael.com/Going-Green/2300/Green-Building-Is-Up-While-Rest-of-Building-Market-is-Down.html

bills. This can in turn save expenses on cut-offs and reduce the reliance on charitable utility assistance programs.

- Improved Public Health. Energy savings – including electricity and transportation -- can reduce harmful air pollution, and some studies show that energy efficient homes are linked to better overall health. Clean, renewable energies do not produce toxic emissions. The Plan encourages walking and biking as a healthier alternative to motorized transportation.

- Carbon Credit Sales: In additional to parallel reductions in greenhouse gas emissions, there is an incrementally increasing ability (and detailed record) to sell carbon credits and/or offsets due to the reduced emissions.

- Enhanced Grant Funding: The community involvement component of this planning process and the specificity of the Plan goals and recommendations could make the city more attractive to foundations and government agency grants, which would translate into increased capacity for the city to enact more energy cost saving programs.

■ Explanation of Recommendations

Each of the four energy sectors – residential, non-residential, transportation and city government – has its own particular characteristics, challenges, and strategies. The chapter subheadings for each sector are generally divided into no cost, low cost, and investment grade recommendations. Each chapter also includes the respective energy & cost savings, greenhouse gas (GHG) emissions reductions, and simple paybacks as applicable and tallied in a Microsoft Excel workbook found in the Appendix B. The calculations are listed and explained in each recommendation and/or may include select Excel cell comments that further explains calculations as needed (the cell comments only open on-line at the city website). All annual averages are calculated on a 30–year basis, to 2042. A sample recommendation block with some explanation is as follows:

RAX. Sample Recommendation Data Block

Implementation year(s): 2011- 2042 *(Accrued savings may be shown a year later)*
Projected average annual energy savings: 374 MMBtu ($5,200) *(Total average annual savings in energy and dollars – except as noted otherwise)*
Projected average annual GHG reduction: 71 equiv metric tons *(Emission based on respective energy consumed, i.e., as combined electricity, natural gas, and/or gasoline, etc.)*
Simple Payback: *(Estimated time to recoup investment based on gross cost savings – shown when available)*

All estimates are rounded off and thus present slightly different totals in many cases. Additionally, the Excel tally in Appendix shows a wide variety of different start dates that are explained either in the plan text and/or in the Excel cell comment notations. Still other first-savings dates are a year later than the text date to permit first year's savings to accrue.

The organizing principle for the tally sheet savings estimates (Appendix B) is the assumption of “perfect staffing,” or, unlimited staffing to swiftly implement many recommendations, simultaneously. This scenario is highly unlikely, however the tally sheet it is a simple device to make savings estimates in the absence of an actual staffing pattern.

The city staff team recommendations are confined to their section of the plan. Its plan is an entirely separate tally of the citywide savings, but ultimately included with all of the other non-residential savings in the city (also found in Appendix B). Restated, the city government energy savings are nested within the total citywide energy savings.

The complete tallies of energy savings, cost savings, and avoided greenhouse gas emissions are included herein Appendix B for two reasons. First, to illustrate the size and span of the respective, estimated savings to compare with future results and how greater or lesser savings may affect the overall program. The second reason is to document he challenge of reaching the overall goal of an average annual 1% per capita reduction in traditional energy usage. In implementation, each set of projected savings should be recalculated for each recommendation as more detailed, better information is developed.

■ Sustainability in Berea

The Berea community demonstrated its capacity for leadership in social justice from its inception by abolitionist John Gregg Fee in 1855, with high hopes for its future and fledgling school. Berea College was created as an interracial and coeducational school in the American South, and remained as the only such institution there for 40 years after the Civil War. Not incidentally, it was a fully self-sustaining institution serving all of the needs of the college and its surrounding community well into the 20th century. More recently, the College enjoys landmark status as only one of seven work colleges in the country and as a model sustainable institution.

The City of Berea 2010 population was 13,561 and is governed under a Council/City Administrator form of government. The eight-member council is elected every two years through at-large seats and the Mayor every four years. Council members are the policymakers who establish the vision for Berea. The Council hires the City Administrator to carry out policy and oversee operations.

In 2009 the City of Berea City Council became one of the first municipalities in Kentucky to join ICLEI. Additionally, in 2010, the city became the first Transition Town designation in the state (see http://sustainableberea.org/projects/transition-town-berea/). The mindset of sustainability in Berea was further enhanced by 2011 with the decision to design a citywide economic strategy to emphasize its local economy, a key component of a successful Transition Town strategy. Also that year, Berea Municipal Utilities established a Solar Farm, through which utility customers can lease solar panels that add clean, renewable energy to the electricity grid.

Berea College addresses environmental sustainability from both an operational and an intellectual perspective; the school emphasizes an experiential education for its students, combining hands-on work with academic exploration. Berea's Ecovillage is a living/learning community comprising 50 apartments. The community houses students and student families. It includes a child development lab, an environmental studies demonstration house, wetlands, a permaculture food forest, individual gardens, and an aquaponics facility.

Berea College's sustainability initiatives earned it a "B" grade on the 2009 College Sustainability Report Card, published by the Sustainable Endowments Institute. Berea's grade placed it in the top 23% of schools nationwide, surpassed by only three schools in the Southeast. Records indicate that the college has reduced its energy usage by 53% since 1998. In 2010, the college-owned Boone Tavern became the first LEED Gold certified hotel in Kentucky.[4]

■ Berea Utilities

The Berea Municipal Utilities Department, Bluegrass Energy Cooperative, and Delta Natural Gas Company serve the city's stationary power needs. In 2010 the BMU had 5,115 customers serving roughly the southern half of the city and Blue Grass Energy had 1,885 customers serving roughly the north half of the city; or a combined 7,000 customers. BMU purchases all of its power from an outside vendor and then resells it to city customers; the current BMU residential rate is 6.05 cents per KWh. BMU's 2011 largest peak load was 30 megawatts (MW) with about 128,000 MWh in annual sales.

Blue Grass Energy is a non-profit distribution cooperative and serves a much larger area than its service area for the north end of Berea, serving nearly 55,000 member–owners in 23 counties. Blue Grass Energy obtains its power from the East Kentucky Power Cooperative, which also serves 15 other Kentucky distribution cooperatives. The current Blue Grass Energy residential rate is 8.951 cents per kWh.

Table 1 - 2010 CITY OF BEREA NET ELECTRICITY CONSUMPTION

Sector	BMU (kWh)		BLUE GRASS ENERGY (kWh)		Total (kWh)	
Residential	65,368,353	47%	24,392,118	15%	89,760,471	30%
Commercial	29,881,156	22%	14,356,528	9%	44,237,684	15%
Industrial	42,901,548	31%	121,287,600	76%	164,189,148	55%
Totals	138,151,057	100%	160,036,246	100%	298,187,303	100%

Note: Net means that "on-line" loss of electrical power is not included.

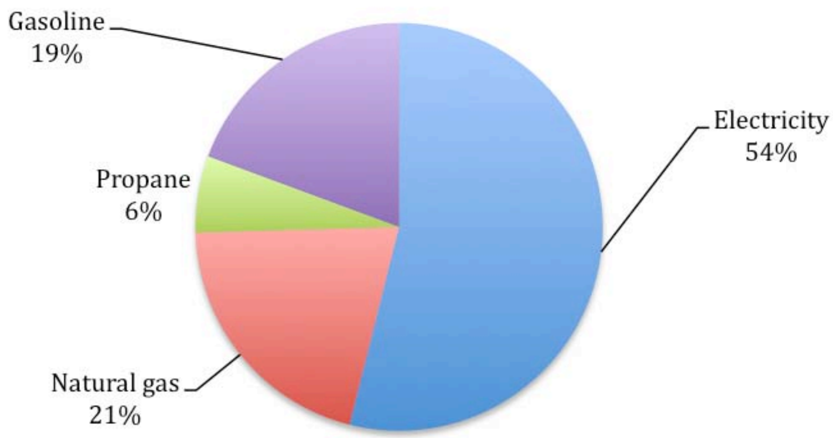
[4] LEED Gold is the highest sustainable building certification by the US Green Building Council, implementing green building design, construction, operations, and maintenance solutions.

Energy Inventories

In order to create this Plan, a detailed inventory of 2010 energy usage for both the city as a whole and the city government was conducted as a part of the study, and the data was compiled in a December, 2011 report that is posted on the city website[5].

Note that all traffic on I-75 was excluded from the usable portion of the inventory, as the BECS Community Advisory Committee felt those emissions are beyond the control of the city.[6] All data findings here are based on this "net" dataset, except where noted otherwise.

Figure 1. Berea 2010 Total Energy Consumption by Source -- 1,928,123 MMBtu



Figures 1 and 2 show Berea's energy consumption by energy source, and by major sectors. in 2010, the city consumed a total of 1.9 million MMBtu (British Thermal Units) or 142 MMBtu per capita; with 70% of all the city's electricity in non-residential use and 55% of that solely industrial use. The north side's industrial use consumed 76% of the total power provided by BLUE GRASS ENERGY there.

To put this energy consumption in perspective, the city's average monthly energy usage of 1,249 kWh per household is virtually the same as the average usage for the East

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[5] The full data inventory is on the city computer network under an "ICLEI" folder Planning Department shared server "J" drive. Also, stored there under a file name ICLEI are two Excel inventories of all city government 2010 energy uses and costs, as well as a complete, separate inventory of each city vehicle and its fuel usage and costs.

[6] This alternate or "net" count and all related inventory data is listed in the ICLEI database file as "2011" at City Hall. The actual database is flagged to avoid using the wrong baseline in the future.

South Central Region[7] during the same time period. However, average monthly commercial usage of 4,138 kWh was at about 21% below the regional average, and the city's industrial average of 198,296 kWh was roughly half the regional average. But these non-residential comparisons can be somewhat misleading due to differences in rate structures and the types of local industries involved, and that Berea is a college town with a highly effective college energy savings record.

Figure 2. Berea 2010 Total Energy Consumption by Sector -- 1,928,124 MMBtu

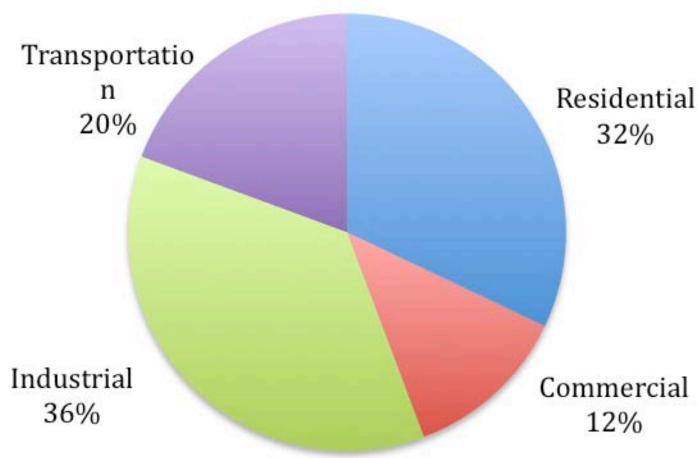

Figure 2 shows the breakdown of Berea's energy consumption by four major sectors: residential, commercial (business, institutions) industrial and transportation. Note that at 41 million miles traveled in Berea in 2010 (i.e., this is minus I-75 traffic), transportation in the city accounts for 19% of total energy used into the city. This equals 3,023 miles per capita and well the below the FWHA 1997 national average for of 5,701, However, this national figure includes all cities in the country; there is no comparable smaller city average available.

Despite their shortcomings, these national comparisons are still helpful and point out that Berea is well within regional and national averages.

At the same time, the city shows significant potential for increased pedestrian, biking, and transit usage. The local transit service show only 6,800 passengers in 2010 and contains 14 miles of designated scenic bike routes, as well as recently approved plans for nearly seven continuous miles of shared bike trails to be developed within the next two years.

[7] US Energy Information Agency Region (AL, KY, MS, & TN)

■ Population and Energy Use Growth Forecast

Based on a straight-line projection, the city's population is forecast to grow to 21,305 by 2042, a 57% increase from 2010; with the interim projections for 2020 of 15,981 and in 2030 of 18,401. In contrast, the city's total energy growth estimate increases by only 24% over the same time period. The net result is that population growth is outpacing electrical usage in Berea, even by the most conservative factor of only 1.8% average annual population growth rate (i.e., compared with the city's 2.7% rate for the past decade) and an estimated, generous 1% BMU energy use per year (i.e., compared with a nearly flat BMU growth rate during the a past 5 years, and similarly flat growth rate in peak usage for both BMU and Blue Grass Energy).

The current trend in decreasing per capita city energy use is unlikely continue to 2042; especially in light of Berea's exceptionally high average annual growth rate over the past decade. Ultimately, the energy use forecast is a starting point in the process. It will be refined as experience and performance accumulate. Likewise, any "business-as-usual" per capita decline in energy use will only aid in reaching plan goals.

Berea College Ecovillage

PLAN GOALS, OBJECTIVES AND SAVINGS

■ Target Goal

Setting energy saving goals and objectives is an iterative process. It begins with a wide range of assumptions based on known data, and serves as a starting point in measuring energy efficiency. Proposed goals will be refined again and again, based initially on community discussion, and improved over time with better data and program experience.

The Plan sets forth a goal to reduce energy usage in Berea by 30% in projected growth by the year 2042, or, an average annual 1% reduction in traditional per capita energy use. This involves reducing per capita energy consumption, with the understanding that the goal is achieved in a combination of both greater energy efficiency and expanded use of renewable energy.[8] The combined approach achieves a sustainable and affordable future by virtue of reduced dependence on finite energy sources. Based on all of the information gathered thus far, achieving this goal will require implementation of at least 90% of the energy conservation recommendations and achieving a 10% renewable energy mix by 2042. This is an ambitious goal but with the understanding that initial energy savings estimates are fairly conservative.

The plan's 1% average annual goal is comprised of two parts over the planning period to 2042. Based on the achievement of 90% of all recommended energy efficiency measures, continued growth in current city renewable energy programs (e.g., net-metering, the solar farm, and geothermal pumps), and a 10% renewable energy mix, the BECS plan recommends the following short-term and long-term energy reduction goals.

Energy Efficiency Goal: An average annual 0.75% reduction in per capita energy use. The long-term conservation goal is to reduce per capita energy use by 0.75% per year from 142 Million British Thermal Units (MMBtu) per capita now to 100 MMBtu in 2042 (projected population 21,305), for a total 30.2% reduction. The following short-term goals are recommended:

> 2020: An 18 MMBtu reduction to 124 MMBtu per capita for the projected population then (15,981).
>
> 2030: A further 16 MMBtu reduction to 108 MMBtu per capita for the projected population then (18,401).

Berea Municipal Utilities (BMU) has a record in maintaining a roughly constant electricity use since 2005. This suggests that reaching the targeted reductions is achievable.

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[8] No power source is entirely impact-free. All energy sources require energy and produce some degree of pollution starting with the manufacture of the technology, and there are a variety of definitions of renewable energy. For the purposes of this Plan, "clean renewable energy" is defined as energy from solar, wind and hydro sources because the systems, when in operation, do not generate pollution. Some governments also define renewable energy as including biofuels, wood waste, landfill gas, which do generate emissions.

However, this will depend on factors well beyond any ability for prediction, such as actual population growth, weather, energy intensity in city industrial output, and pricing factors.

Renewable Energy Goal: An average annual 0.25% reduction in traditional per capita energy consumption. In keeping with the economic objectives of the plan to develop the most efficient local economy possible, be economically competitive, and deliver Berea residents the best power at the lowest price, BMU should develop a renewable energy business plan. As explained in the plan recommendation, the business model would be designed to serve the current financial needs of the utility and in so doing, enable investment in developing clean energy generation. There are three possible approaches described in the plan. Development of the business model would be suited to the selected approach(s). This process will establish the time frame and actual development goals to implement the chosen program(s).

The 10% renewable energy mix is based on a proportional share of projected EKPC renewable energy potential prepared by Zinga & McDonald in 2008.[9] The 10% goal is based on Blue Grass Energy's proportional share from the derived 8.3% of renewable energy potential of EKPC, with an added 1.7% additional factor to reach the average annual goal of 1% reduction per year; which is seen as a modest additional factor given the 30-year time span. The same 10% factor is then also applied to BMU to match the Blue Grass Energy potential, although would be a very different renewable energy mix.

This is an ambitious goal but with the understanding that initial energy savings estimates are fairly conservative. A high degree of success in one area can balance out less successful yields in other programs. It subscribes to oldest planning tenet to make no small plans. The plan recommends strategies that support individual and business efforts to consume less energy. Implementing the plan will, for example, make one's home more energy efficient, increase public transit, and make it safer to commute by foot or bicycle; and in all cases protect the environment and save money along the way.

■ Objectives

The BECS Community Advisory Committee developed the following set of objectives that will aid in achieving the Plan goal:

1. Optimize energy efficiency and sustainability to foster economic development and job growth through energy independence and lower costs.
2. Take a comprehensive and measurable approach including an invitation to the Cooperative and Delta Gas Company to join the effort and jointly develop an overall vision of Berea's energy future.
3. Develop a flexible plan and stay alert to new techniques and opportunities.
4. Build on existing efficiency and renewable energy programs wherever possible.
5. Develop programs that make economic sense and can be self-sufficient.

[9] http://kyenvironmentalfoundation.org/ekpc_energy_portfolio.pdf. Note that this report has not been accepted or implemented by EKPC.

6. Promote government policies and programs supporting plan objectives and related community resilience.
7. Share information freely and frequently, and invite public participation in plan modifications.
8. Integrate this Plan into the city comprehensive plan update.
9. Measure and adjust plan progress on a regular basis; and to issue the city's first progress report within 2 years after plan adoption.

■ Cost Savings

All cost savings, except as noted, are based on a weighted average of BMU and Blue Grass Energy utility rates for kWh charges only and as explained further in the introductory text for each energy sector. The single most important thing about the following estimated cost savings is that these are all in *2012 dollars*. However, the middle column applies a conservative compounded average annual growth factor to reflect increasing energy prices over time. The third column reflects an average multiplier factor (see P. 14). All other factors are explained in the table notes.

The earlier that cost-savings begin, the greater the savings over time or conversely, every forgone dollar saved is an "opportunity cost", a lost benefit. The longer the delay in implementing any given program, the increasingly larger the opportunity cost becomes, as energy prices rise.

Table 2 ESTIMATED AVERAGE GROSS ANNUAL ENERGY COST-SAVINGS PER CAPITA

(Assuming 90% of all estimated plan savings are realized. [Note #1.])

Sector	**Present Value (Today's Dollars)**	**Future 4% Compounded Energy Price Increases** [#2.]	**32% Multiplier Factor Applied to Future Avg. Energy Price [**#3.]
Residential	$43	$85	$112
Non-Residential	$105 [#4]	$205	$271
Transportation	$50	$253 [#5]	$334
Select Renewable	$17	$33	$44
Total	$258	$838	$1,106

Notes:
1. Customer-owned (i.e., not leased) renewable energy generation savings not included because of incomplete information (but addressed in Rec #RC2. for improved data collection)
2. Average compounded price increases are only computed for half the time to 2042, i.e., the mid-point, 2027, and calculated for the projected city population then.

3. The multiplier factor is the mid-way point of the range estimated in the study cited under Plan Benefits. This factor allows for less replacement costs due to longer equipment life and less maintenance; such as compact fluorescent or LED light bulbs compared with incandescent. The above cost savings do not include "emerging renewable energy" customer cost savings because they are gross savings that do nor reflect any investment expenses.
4. Assumes a very conservative 20% average demand charge assessed on most non-residential tariff classes (environmental and fuel adjustment surcharges are not counted)
5. Assumes a compounded 10% average annual rate of increase in the price of gasoline, the national average rate over the past eight years.

Estimated residential cost-savings over the life of the plan is $246/year per household in today's dollars (counting only residential and transportation energy savings).
However, the average total household energy efficiency savings (subtracting out Select Renewables) are estimated as follows:

Table 3 ESTIMATED AVERAGE GROSS ANNUAL ENERGY EFFICIENCY COST-SAVINGS PER HOUSEHOLD (Same notations as Table 2. Based on the 2010 Census count of 2.65 average number of persons per occupied household)

Cost-Savings in Today's Dollars: $639 / Household

Compounded Value for Future Energy Price Increases: $2,233 / Household

32% Multiplier Applied to Future Energy Price Increases: $2,814 / Household

Estimating renewable energy cost-savings can be difficult, because there are many unknowns, but the estimate shown above is very conservative. Factors that will determine future renewable energy savings include declining prices in collection equipment, escalating fossil fuel prices, and the often longer life span and efficiency of renewable energy equipment. For example, solar panels are typically warranted for 20-30 years of performance. However, there are many cases of photovoltaic (PV) panels dating as far back as the 1960s that are still in service today; they operate less effectively than newer panels, but are still sufficient for its user's needs.[10] Once a renewable energy system's cost break-even point is reached, electricity generated from that point forward is essentially free, and likely earning continued income in net-metering or through renewable energy credits. Solar panel system may prove an amenity in the resale of the property, and that will likely increase over time with rising fossil fuel prices.[11] Therefore, while solar energy may be more expensive in up-front costs, the investment can be a very attractive in the longer term.

Overall, in terms of emerging energy technologies, feed-in tariffs, distributed energy, smart gird development, the future for affordable energy looks very bright – but very hard to predict (at this time).

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[10] http://ezinearticles.com/?Life-Expectancy-of-Solar-Photovoltaic-Panels&id=4603510
[11] http://www.renewableenergyworld.com/rea/blog/post/2011/02/do-solar-systems-increase-property-values

■ Carbon Footprint

There is significant scientific evidence that the world's atmosphere is experiencing a rapid rise in average air temperature, and that greenhouse gas emissions from human activities are the most likely cause for the increase, which is currently 1.4ºF higher since the early 20th century. If true, this unabated, rapid increase will cause immense problems in every aspect of human life around the world, from extreme weather, to major changes in world ecosystems to disruption of the world's food supply.

"Carbon footprint" is a term describing the greenhouse gas emissions associated with an individual, institution, or government; the fewer the emissions through energy efficiency and generation of clean, renewable energy, the smaller a city's carbon footprint. Achieving the energy savings goal in this Plan would result in a 29% reduction in per capita greenhouse gas emissions by the year 2042, or nearly an average 1% reduction per year. The following are the estimated, interim greenhouse gas (GHG) reductions from the current 20.2 tons per capita in Berea and all are calculated for the projected, larger city populations at each stage:

2020: 17.1 equivalent metric tons per capita projected population

2030: 15.8 equivalent metric tons per capita projected population

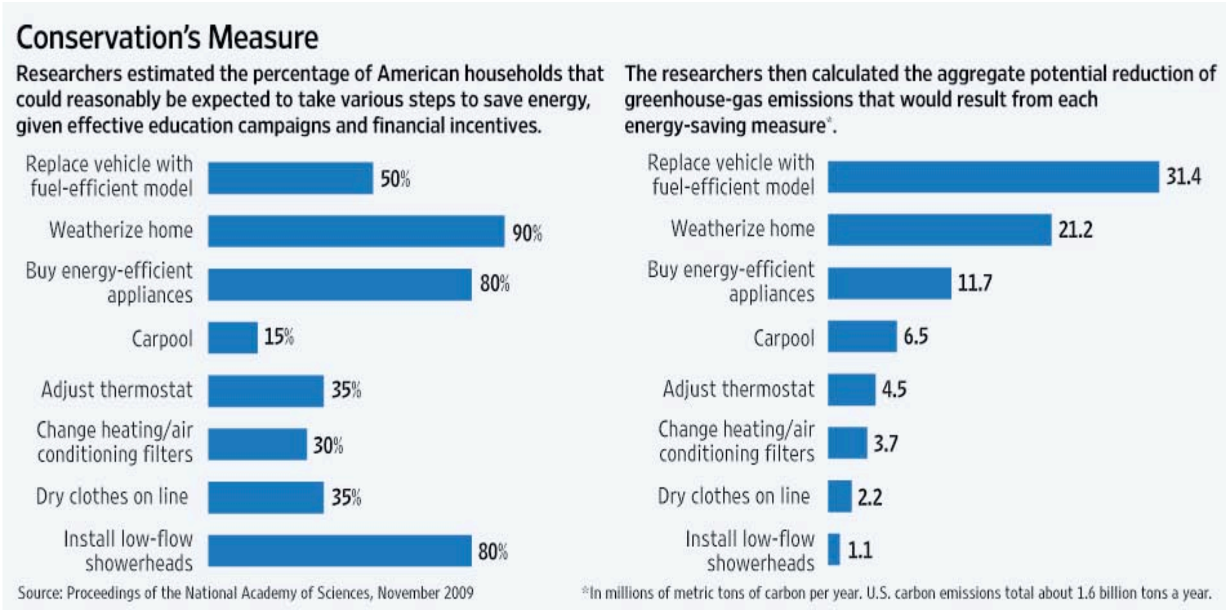
2042: 14.4 equivalent metric tons per capita projected population

The Intergovernmental Panel on Climate Change, acknowledged as the world's leading experts on the subject, has generally agreed on a greenhouse gas emission reduction of 50% below 2000 levels, by 2015, in order to limit global warming to 2.2ºC. Even this level may be insufficient to avoid extreme weather scenarios and the associated health and economic problems, but it would still be better than a "business as usual" level.

The need to fully address local impacts from GHG emissions problem will require a much more ambitious plan than what is presented here. Figure 3 (below) shows the magnitude of the challenge between energy efficiency actions and related greenhouse gas reductions, resulting in only a 5% reduction in total US emissions.[12]

[12] The most recent EPA estimates show a much higher annual US greenhouse gas emissions of 6.8 billion metric tons in 2010 and which, despite the discrepancy, only serves to magnify the magnitude of the challenge in curtailing GHG emissions. See http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

Figure 3



Some ICLEI communities have achieved significant short-term reductions below their current levels. In the final analysis, it appears that adaptation to climate change will be as important as seeking GHG emission reductions. Ultimately, both objectives need to be pursued simultaneously.

The City of Portland, OR reports an annual average per capita GHG reduction of 1.05% between the years 1990 and 2009. And Portland may be only one of three ICLEI members with documented average annual reduction rates higher than Portland (Berkeley, CA and Brattleboro, VT, but there may be others).

This Plan can provide a platform on which greater GHG reductions can be achieved, and ICLEI offers many opportunities for ongoing education and assistance for that purpose. For immediate, individual action, the EPA has a user-friendly "Power Profiler" report that analyzes air emissions generated by local electricity use and recommends individual actions to reduce emissions. See http://www.epa.gov/cleanenergy/energy-and-you/how-clean.html for complete information.

JOB GROWTH AND TRAINING

Investment in energy efficiency will create opportunities for energy auditors, insulators, and various construction trades. Renewable energy investment will create opportunities for installers, welders, sheet metal workers and machinists, truck drivers, and others. In the 40403 Zip Code there are 148 firms in a representative group of job areas that could see job growth or wage increases by putting energy efficiency and renewable energy sources to work.

Berea is counted by the US Census as a ”micropolitan” area serving the commercial needs of both Madison and Rockcastle Counties, containing a population of 99,762 residents; the idea here being that city businesses have the potential to serve a much larger market of the surrounding area.

A study by the American Council for an Energy Efficient Economy estimates that energy efficiency policies in Kentucky could produce a net gain of 10,600 jobs in 2020 and 14,300 jobs in 2030.[13] However, the Center for American Progress projects a net gain of 25,705 jobs in Kentucky from a $150 billion shift per year, in combined energy efficiency and renewable energy investments (see full report, p. 19). The same report estimates that clean energy investments create 16.7 jobs for every $1 million in spending, compared with non-renewable fuels that generate about 5.3 jobs.[14]

These projections show great promise for Berea. In order to maximize clean energy job opportunities, the city should develop a process that combines multiple purposes in developing and tracking energy efficient goods, services, and training needs. An initial process could include these four steps:

1. Formulate a series of questions to local businesses and industries about local energy efficiency goods and service trends they may need in the short- and longer-term future. Prioritize needs for local energy auditors, retrofit contractors, and building contractors a first priority, because all building sectors must comply with new energy efficiency building codes and may develop special job or training needs. This could be accomplished as part of the Business Outreach Program outlined in Recommendation NR1 in this Plan.

2. Meet with the curriculum staff of the KY Community and Technical College System (KCTCS) to discuss the BECS Plan and evolving, local workforce and training needs. The purpose of this meeting would be to understand the scope of available training resources and timing considerations for different venues. A subsequent meeting with local high school vocational curriculum staff may also be advisable. The final outcome should be a way to monitor job and training needs and, at the same time, keep the affected industries informed of available training and apprenticeship programs in support of plan implementation activities.

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[13] www.seealliance.org/se_efficiency_study/kentucky_efficiency_in_the_south.pdf

[14] www. images2.americanprogress.org/CAP/2009/06/factsheets/peri_ky.pdf

3. Review the report, ***Building Clean Energy Careers in K**entucky*, issued by the Mountain Association for Community Economic Development (MACED). It contains some excellent statewide recommendations that if adopted, could greatly assist Berea in its workforce needs, including but not limited to developing tuition assistance, particularly important for low income workers seeking additional training and certifications.

4. Scope out the online job projection and tracking methods. These include the "JEDI" model (Jobs and Economic Development Model), that forecasts job creation for different renewable energy scenarios, with an assessment of financial feasibility as described in the GC Recommendations; and the US Bureau of Labor Statistics Green Goods and Services program, to systematically identify and measure green job creation in an annual national survey (http://www.bls.gov/ggs/ggsoverview.htm).[15]

In order to gauge job creation potential of the BECS recommendations, we can look to the California climate action plan ratio of new job creation to total energy saved over their 8-year plan period. Using that ratio, it appears that the BECS plan would generate a net gain of between 440 to 885 jobs over the 30-year plan period, or 4.25% to 8.5% of the projected city employment in 2042 (using the same ratio of population to employment as the Berea 2000 Census). The California plan's jobs forecast seems analogous to Berea because of its comprehensive approach to energy efficiency, building codes, transportation, and renewable energy mix, as well as its estimated energy savings and jobs forecast. The fifty percent range in the estimate is intended to allow for the differences in the scale of the plans, plan actions, and derived variables; it is not a strict apples-to-apples comparison.[16]

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15 Also, a recent state-of-the-art study in green job development is the, *West Coast Clean Energy Economy*, May, 2012. See http://www.globeadvisors.ca/market-research/west-coast-clean-economy-study.aspx

16 The method used to derive the a proportional share estimate of the California plan was to first determine the BECS share of the CA savings rate goal, then derive the CA plan net jobs created per megawatt saved, then calculate the BECS share of the CA estimated jobs rate. This resulted in an estimated 3.675 job per BECS MW times the total estimated BECS plan savings of 241 MW resulting in a net gain of 886 jobs over the 30-year plan period, or an average annual net job creation of 29.5 jobs per year at the high end of the estimate. For the full CA plan, see http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf, and for the CA plan jobs forecast see pages 3 & 4 of http://www.cacleanenergyfuture.org/documents/CACleanEnergyFutureOverview.pdf

PLAN IMPLEMENTATION

The guiding principle for plan implementation is to build on existing programs and existing resources whenever possible, accessible, and practical, and there are already some good initiatives in Berea. Examples include the Transition Town program, and the city's recently developed Self-Reliant Community Economic Strategy. BMU's Solar Farm has been a successful way to integrate renewable energy generation into Berea's energy mix. And, the city comprehensive plan is the overarching, legal document of the planned vision of the city's development and ought to incorporate energy cost savings recommendations in its next updated version.

Setting Priorities. With so many recommendations in this Plan, it may be most practical to establish priority actions, using the following prioritization guidelines.

1. Develop a spreadsheet that organizes and quantifies the following criteria.

2. The highest prioritization should be given to the organizational recommendations; such as targeted outreach, billing records, public education, and energy audits. These are the building blocks to launch the "bricks and mortar" activities that lead to genuine savings. These tasks may only produce modest initial results in and of themselves but are essential in laying the groundwork for more productive results and likewise, may take one to two years to get in place.

3. Prioritization should reflect the staffing pattern. As an example, if a full time energy coordinator were funded ½ from the city general fund and one-half other sources, it seems only fair that the coordinator time be split 50-50 between citywide implementation and city government activities, etc.

4. Always assign the higher priority to building on or reinforcing existing programs whenever possible.

5. Prioritization should reflect the estimated cost-benefit and estimated simple payback; and include an additional filter identifying grant funding opportunities for selected projects, including funding initial staffing. The simplest way to do this is to develop a simple cost-benefit ratio such as the units of energy saved per dollar invested.

6. Prioritization should reflect the measurability of the activities and the ease/ amount of time needed to collect and post such data.

7. Prioritization should divided into duties as primary, secondary, and as-can priorities, but include at least one activity of each of the four energy sectors at any given time, if possible. However, if the implementation were a fully volunteer activity, it would be unlikely that city government activities would be included.

8. Time allocation should reflect routine administrative meetings, duties, and posting data activities. A fair starting point would 20% of staff time.

9. The selected activities should flow together in a harmonious way; taking advantage of shared resources and avoiding duplication or conflicting activities. One way to plan this is to draw a flow chart showing the selected activities over time. This is a quick, visual way to optimize the flow of concurrent activities.

It is recommended that the draft priority list be shared with someone with experience in this type of plan implementation. The best source for a similar size community that we've been able to locate is the Town of Brattleboro, VT (pop 7,400). Their ICLEI program has a 10-year record and 17% greenhouse gas emission reduction experience. Their planner has a creative funding approach for his position and is very helpful.

Utility Outreach. Given this plan as starting point, the city should set up an executive level meeting with the other power companies to share the city plan and identify the potential overlaps and areas of possible cooperation and/or coordination. A good example is the plan to reach out to all industrial customers (Recommendation #NR1) and of which Blue Grass Energy has the largest industrial energy users in Berea. They currently provides a wide range of business energy conservation services and incentives; how can the two program best coordinate/complement their activities?

Plan Staffing Choices. There are three possible choices for staffing the plan implementation: a) an all volunteer effort; b) a combination part time position and volunteer staff; and c) a full time staff position. A closely related idea is the Cannon Report recommendation to develop a shared "circuit rider" with nearby utilities to develop respective demand side management (DSM) programs,[17] However, a person in that position would not have enough time to effectively implement plan recommendations.

ICLEI program experience has shown time and again that the communities with full time coordinators enjoy the greatest implementation success. Plan activities are easily a full time job by any standard. A recent Berea example is the reluctance to convert city street lighting to LED lights, which are estimated to last 12+ years; but where ad hoc research has been unable to confirm such longevity. A full time staff person could fully search for relevant information (especially documented breakeven payback periods, etc). A full time staff position could also routinely search for grant funding for additional project implementation.

When asked, ICELI was unable to identify any such successful volunteer effort, even for the task of completing one update of the energy inventory database.

Whatever the arrangement, the implementer(s) should report to some sort of citizen advisory board. If agreeable, it seems that the Berea Utility Advisory Board would be good first choice for this role, at the beginning of the implementation process.

Plan Flexibility. The plan needs to remain flexible and in the broadest sense possible. The emerging markets in new and innovative energy conserving products and practices over the next 30 years will be dramatic if not overwhelming and will require an ability to rapidly adjust to new conditions and opportunities. As a fairly concise introduction to the

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[17] Glenn Cannon, *Berea Municipal Utilities Energy Efficiency Report*, June, 2011

topic, see the DOE "Energy Innovation Portal" -- it lists about 35 emerging energy technologies.[18] It is a dynamic and fast changing market that will require preparedness and adaptability to capture new opportunities, products, and practices.

Coordinated Public Outreach. The success of the plan depends on support and engagement of a broad cross section of the Berea community. This support could be achieved by:

- Launching a coordinated outreach and education campaign to mobilize residents, businesses, and industry around specific recommendations and activities.
- Continuing to expand the opportunities for students to learn about and take action.
- Increase awareness by providing easy-to-understand information on how to increase sustainability at home and in the workplace.

The BECS community outreach team should develop an overall brand so the program and sub-programs present a unified "look" and message. Then, as the city and energy sector stakeholders undertake recommendations, a public outreach, engagement and media components should be woven into the action planning from the first step. This develops ownership and excitement around the activities, a shared sense of accomplishment in the outcomes, and momentum for setting even greater goals. Outreach activities can be coordinated collaboratively by the city, non-profit groups and other community leaders, possibly through an ongoing BECS committee or task force (one example from ICLEI, is the Long Island Clean Energy Leadership Task Force).

College Partnerships. Berea is privileged to have Berea College as a potential partner in implementing the BECS Plan. Several recommendations in the plan have been noted as potential college student projects (PCSP) for Berea College, Eastern Kentucky University, or other nearby institutions. Berea College's Office of Internships, the Center for Excellence in Learning Through Service (CELTS) or the Entrepreneurship for the Public Good (EPG) programs are good places to begin the conversation around potential partnerships. It will be important for student projects to be assessed by the lead BECS coordinator to avoid duplication and to keep the project focused on current priorities.

Potential Grant Eligible Activities. The plan recommendations include flags for potential grant eligible activities (PGEA), including hiring staff to implement the plan, DSM financial incentives, home retrofit data loggers, and preparation of the recommended bike/pedestrian/transit master plan.

Energy Assurance Plan. As explained in Recommendation #GB1, Improved Fleet Mileage, the city should develop a fuel assurance plan to assure an adequate supply of fuel to provide minimal city services in the event of a fuel emergency or rationing. A

[18] See http://techportal.eere.energy.gov/category/emerging_technologies/browse

related plan to provide refuse collection in a fuel emergency should also be developed, i.e., as that is a city service provided by an outside vendor.

Data Issues. Given the quantitative nature of this process, it is important to identify the most useful data over time and the easiest way to collect and record it. The key Plan task is that all EE activities need to find a way to measured and converted into quantities that can be posted in the ICLEI software.

The following data collection issues require various levels of research, analysis, and recommendations that would be well suited to college and/or graduate student projects:

a. **Data Transparency:** The entire plan implementation process should make all utility cost data easily understandable and accessible through both customer billing and city website design. The Delta Gas website is a good example of both.

b. **Redefine Transportation Energy Metrics:** An inherent weakness in the ICLEI software is the community transportation metric, measured in annual vehicle miles traveled (VMT). As a practical matter, it is not a good fit with the city boundary. It would be more informative to track the rate of alternative fuel vehicle purchases in the city as an index of consumer acceptance. Likewise, there ought to be an easy was to track the number of alternative fuel vehicles owned within the city. This is project to analyze how state vehicle ownership data are collected and to identify needed modifications needed to count the ownerships. (PCSP)

c. **Non-Residential Floor Space:** It would be very helpful to know the amount of different types of non-residential floor space within the city. County PVA records are GIS indexed and should be convertible to show the amount of floor space by various assessor land use categories. The data should also prove very useful in real estate development and related investment decision-making. An exploratory discussion with the PVA Office would be a good starting point. (PCSP)

d. **Berea Energy Efficiency Information Exchange**: There ought to a blog or other web site design to collect and make available information about local energy efficiency success stories and about best practices and products. In light of the rapidly changing product lines, it's availability, and unique local climate, this would be a good source of information for local consumers. Likewise, there already exists a community Energy Empowerment listserv, managed by Berea non-profit groups. (PCSP)

e. **Waste Collection Data**: The City should explore the possibility of its waste hauler contracts to provide information about the amount of city waste is collected. This would provide a baseline for measuring how much waste is being generated and recycled. This data could then be used in a number of ways, including calculation of energy savings made over time using the ICLEI software. Currently, the city does not own nor operate any active landfills. All waste collection is made by a private vendor and disposed of outside city limits.

RESIDENTIAL TEAM RECOMMENDATIONS

Team Members: Gina Chamberlain, Chair, Steve Boyce, and Bill Blair

■ Introduction

The most effective energy cost savings in homes are in space hearing and cooling, water heating, and lighting. This section presents energy efficiency recommendations in these categories:

1. Weatherization: expenses up to $3,000, such as weather stripping, caulking, duct sealing, some insulation.

2. Comprehensive Weatherization: expenses from $3,000 - $5,000 including greater insulation, moisture barriers, under floor insulation, programmable thermostats, etc.

3. Energy Efficiency Retrofits: expenses of $5,000 or more, including HVAC improvements, comprehensive spray foam insulation, replacement windows and doors).

A better index of categories would be an average square foot cost compared with energy savings. This data should already be systematically collected in audits, but there ought to be a simple spreadsheet established to derive square-foot costs. (PSCP)

All costs are in today's dollars. The cost of electricity is a weighted average of 2012 BMU and Blue Grass Energy unit-cost rates (6.85c/kWh).

■ RA. No/Low Cost Programs

RA1. Residential Energy Audits

Implementation years: 2011 - 2042
Projected average annual energy savings: 374 MMBtu ($5,200)
Projected average annual GHG reduction: 71 equiv metric tons

Several local agencies offer residential energy audits, including Blue Grass Energy, Delta Gas, MACED House$mart, Home Energy Partners (HEP), and others; totaling roughly 50 audits per year. Auditors suggest energy efficiency actions, and the homeowner is empowered to decide what improvements will be made, and whether to contract the work or do it themselves. Follow-up monitoring of energy usage is critical in measuring progress and to publicize results for greater community awareness, if possible.

There are two levels of energy assessment. The first is a walk-through by an experienced, certified home energy auditor. For older homes and at about half the cost of a full audit, an experienced auditor can identify immediate fixes in the basic weatherization category. An additional level is a free self-assessment; see http://www.kyhomeperformance.org/SelfAssessment.aspx for complete information.

Blue Grass Energy and Delta Natural Gas provide free audit services to their customers upon request. However, they do not include blower door tests which are much more effective in pinpointing air leaks. Those companies should be asked to consider BPI-level audits and thus seek consistent information. Renters that pay their own utilities are eligible for this service.

Renters have free access to self-assessment at http://bgpride.org/documents/EnergyTipsLGL.pdf, including free software to track energy, water, and gas usage – see www.lexington.mygreenquest.com.

Specific recommendations:

1. Coordinate a residential energy audit program to identify free or subsidized audit services to eligible utility customers, continue energy audit incentive programs where its cost will be included in any follow-up financing, and publicize commercially available energy audit services. This information should be communicated in a public information program, and done in an incremental fashion so as to assure adequate contractor availability and prices.

2. Coordinate a single source website of available services, typical savings, and local savings stories and a subsidized energy audit proposal to serve BMU customers that allows the utility to recoup all of its overhead costs. A large percentage of BMU residential (and small business) customers do no have natural gas service and thus are ineligible for otherwise free Delta audits.

3. Actively encourage landlords to retrofit their properties. The challenge is that renters usually pay their own utility bills and thus keep any cost savings, however landlords may more easily rent a property that is proven to be more energy-efficient. Short of the city providing funding incentives for rental retrofits, HUD and some non-profit service agencies have developed some innovative approaches, and on-bill financing (discussed in Item #RA5) may be a good option. A search of successful landlord/renter retrofit incentives would make for an excellent college intern research project. (PCSP)

The estimated energy savings from energy audits assumes an average 125 energy audits per year, which would take about 20 years to canvass the entire city. However, depending on the rate of subsequent home improvements, this rate could be significantly less because of diverted effort in supervision of retrofits and/or the availability of contractors at peak times.

Nonetheless, assuming an average 51 MMBtu usage per dwelling per year and a 2% savings rate in behavioral changes in 15 of the completed audits (plus 10 self-assessments per year) could save in energy usage. It is assumed that the balance of 110 audits would proceed to various retrofits explained below with their full energy savings shown under those categories.

RA2. Energy Consumer Education Program

Implementation years: 2013 - 2017
Projected average annual energy savings: 1,849 MMBtu ($37,100/yr)
Projected average annual GHG reduction: 367 equiv metric tons
Simple payback: No direct cost to consumers but there would be coordination and direct costs and possibly $50,000/yr in vendor fees, 2027 -2029

Specific recommendations:

- Expand the current Home Energy Partners (HEP) energy training workshops. HEP provides short, practical energy efficiency applications and opportunities. The program information should be recorded for on-line access in addition to live sessions. It should be noted that the lowest income households have the least access to on-line resources. Another possibility is to develop a volunteer program that could go door-to-door with handouts to explain basic energy savings techniques.

- Prepare a standardized report on energy efficiency activities, such as those generated through Opower (http://opower.com), to create positive peer pressure. Studies show that households that routinely received energy efficiency reports results in a consistent, sustained reduction in energy usage of about 2% on average, compared with similar homes that don't receive the reports.[19] BMU could duplicate the Opower billing software technique and assumes a 0.5% total savings. The Opower program is generally limited to cities of at least 10,000 households, but it would valuable to investigate the program and any cheaper adaptations for smaller cities – another potential college student research project. (PCSP)

- Begin a "Lighten-up Berea" community program to invite groups of homeowners to form teams to reduce their energy usage in their respective homes. The model is based on the City of Frankfort, Ky pilot program that used a book called the *Low Carbon Diet* by David Gershon of the Empowerment Institute. The *Low Carbon Diet* technique is used in communities around the country to guide households through a series of actions to reduce their household energy use and carbon emissions. Although this is a carbon-based savings approach, it easily translates from avoided greenhouse gas emissions to saved energy. This estimate assumes 30 households per year saving roughly 11.2 MMBtu each per year. See the following link for complete information about the Frankfort program: http://frankfortclimateaction.net/lightenup.html. One modification for its application in Berea is to also track concurrent energy savings, in addition to reduced carbon emissions.

- Enhance the BMU website with more energy conservation and renewable energy information.

- Actively promote water conservation. Reduced water consumption saves both city operating money for its largest energy consumption (and, conversely, its third largest energy use, wastewater treatment, for a combined $344,000 per year or 41% of the city energy budget) and it saves consumers money as well. There's a wide range of

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[19] http://online.wsj.com/article/SB10001424052748704575304575296243891721972.html).

water conservation measures that focus on residential use. However, we have not attempted to estimate any savings here because the city usage pattern requires more research. The main issue is that the city's 2010 water usage is of 53 gallons per capita per day, approximately 20% below the national average. There are many reasons why this may be, but this needs to be better understood before designing a local water conservation program.

RA3. Public School Energy Efficiency Curriculum

Implementation years: 2024 - 2042
Projected average annual energy savings: 1,191 MMBtu ($38,000)
Projected average annual GHG reduction: 39 equiv metric tons

Madison County Schools and Berea Community Schools are already engaging in some energy efficiency measures, and energy efficiency curriculum can translate into conservation at home when children bring home the lessons they learn in school. Although hard to quantify, this calculation assumes an average of 25 Berea school alumni households saving 15% of average household energy use starting 12 years out.

The Kentucky National Energy Education Development Project (KY NEED) and numerous non-profit environmental and educational groups provide grade-appropriate curriculum materials and kits for energy activities in the classroom.

RA4. Energy Star Purchasing and the US Energy and Security Act of 2007

Implementation years: 2012 -2024
Projected average annual energy savings: 2,385 MMBtu ($22,000)
Projected average annual GHG reduction: 488 equiv metric tons

Energy Star label products can save, on average, 20% to 30% of energy compared with standard products, although, the standard is not based solely on power savings. Overall efficiency, the length of product life, and in some cases water usage are carefully measured and compared with models of similar type or design. (www.greenbuildingenergysavings.com/). Energy Star models are a little more expensive initially, but savings in utility bills will more than make up the difference over time; price rebates may also apply. See complete Energy Star information including available rebates at http://www.energystar.gov/index.cfm?fuseaction=find_a_product. Also see the following site to learn more about the ES Change the World Campaign: https://www.energystar.gov/index.cfm?fuseaction=globalwarming.showPledgeHome

This savings calculation also includes the much larger conversion to the new energy efficiency standards of the 2007 US Energy Independence and Security Act (EISA). It assumes a full lifecycle residential conversion by the year 2024 of 37% of total city residential power consumption, which is average amount of power consumed by refrigerators and home appliances. The basic calculation assumes a modest 3% total average appliance savings spread out over 10 years for 75% of the city's housing stock (i.e., a net rate to factor for completed change-outs to date and student housing); and within that larger transition, a complete phase-out of all general household lighting by

2022, prorating an average of 30 and 20 such bulbs per homeowner and rental household respectively.

The estimated savings of the lighting is especially conservative because it calculates only CFL savings and not LED bulbs, which are much more cost effective and do not contain mercury nor phosphorous. Although LED bulbs are more expensive initially, they are more cost effective with a much longer life.

EISA has an additional provision for selected appliances to develop test standards to turn off “standby power” automatically, i.e., the constant 2 to 5-watt current that many appliances draw when plugged into an outlet . Although there is no implementation schedule as yet, this will mean significant, additional energy savings starting within the next 5 to 10 years. This will amount to between 1% and 4% savings over the lifecycle replacement of those appliances. Although this is not reflected in the savings calculation, it will ultimately contribute to it.

The energy savings shown is a composite of estimated Energy Star promotion and EISA implementation; EISA does not have a complete implementation schedule at this time. There are several variables affecting full program implementation, including when selected products coming on line, life-cycling out of old equipment, and the inevitable time lag in implementing so many different things over different timelines. Local promoting of Energy Star will still be invaluable in helping achieve the city’s conservation goals over the next 10 years.

RA5. On-Bill Financing Program

Implementation years: 2013 - 2030
Projected energy savings: (Not applicable - finance measure only, see related Item Nos. RB1, RB2. & RB1.)
Projected GHG reduction:

On-bill financing allows homeowners to install new appliances or systems and pay for the upgrade through their utility bill. Payments are made using the energy cost-savings, and at a payment rate less than the average monthly power bill. The principal owed is linked to the electricity meter, not to the customer. If the “borrower” leaves the property, the next occupant pays the balance owed; but in so doing, also enjoys the reduced energy costs due to the energy efficiency improvements. Savings increase still further once the loan is repaid and the loan amount drops off the bill. Still additional savings accrue through avoided, future cost increases in electricity and potentially for natural gas.

The program should be developed using a standard business model to assure that all overhead costs are covered. The city could develop an on-bill program where both BMU and Blue Grass Energy could offer this to their customers.[20] MACED provides an established and successful program that can help develop a proposed business model making economic sense to both power providers in the city.

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[20] The US Rural Utility Service is currently proposing rule-making to provide up-front money for electrical cooperatives to implement on-bill financing. Search the Federal Register for “Energy Efficiency and Conservation Loan Program “ for complete information.

An important measure of program success would be how well retrofit improvements reduce peak demand. This requires periodic readings of a special data logger on the customer side of the meter. It would measure demand intervals on a rotating, sample-size basis, involving as many as 10 meters at any one time. Program administrators should search for a grant to fund this effort. Pending a cost estimate, $10,000 should pay for the equipment and software. (PGEA)

An additional on-bill financing measure would involve replacement of major, older home appliances such as refrigerators, room air conditioners, and water heaters. The replacement of old appliances with newer, more efficient Energy Star products can effect a huge reduction in home energy use; replacing an old refrigerator alone can save nearly 900 kWh per year or about $60 and more as electricity prices rise. See the Zinga & McDonald Energy Efficiency Report for a complete explanation of the possibilities at http://kyenvironmentalfoundation.org/ekpc_energy_portfolio.pdf. The report also explains a stand-alone approach for such appliance financing.

RA6. New Energy Efficient Building & Rehabilitation Code

Implementation years: 2013 -2042
Projected average annual energy savings: 14,989 MMBtu ($19,400)
Projected average annual GHG reduction: 195 equiv metric tons
Simple pay back: Not applicable – cost absorbed into the price of each new house

The state's new International Energy Conservation Code (IECC) for residential construction takes effect this summer. It is estimated that the new code will be approximately 18% more energy efficient than the previous state code (DOE Report, *Impacts fort the 2009 IECC for Residential Buildings in Ky*). Using this finding, the above calculation assumes an average of 105 new homes per year and an average electrical bill of $1,025 (kWh only), thus representing an average savings of about 2,700 kWh/yr or $185/new home/year.

There is a second energy efficiency-rating program for Energy Star (ES) certified homes. It is a voluntary and rigid step-by-step construction inspection process. The ES website states that ES rated homes are 15% more energy efficient than the 2004 IRC code (very similar to the IECC) and 20% - 30% more efficient than a standard home. Although ES homes are clearly more energy efficient than the ICEE code, it is difficult to quantify the increased performance given the different base codes and timelines. But with the launch of the ES Version 3.0 this summer, it is sure to stay in the 15%+ range over the new state code. Better, future cost-savings information and publicity may well lead to increased builder interest. The number of ES houses can be tracked and its additional energy savings in future energy savings updates.

One Berea Energy Star Home Builder says that she has never calculated the extra cost of ES construction because it is not an issue. In fact, the same builder is so pleased with the program that she currently offers to pay the first year's power with each new home purchase; and which for the past 6 months has ranged between $50 and $75 per month. The other ES cost factor is that a properly insulated building envelope means the builder can save money on installing a smaller HVAC system because the house is properly insulated (as well as saving the new owner money on larger power bills).

There is also an Energy Star program for multi-family housing and eligible for additional financial incentives. See
http://www.energystar.gov/index.cfm?c=bldrs_lenders_raters.nh_multifamily_units

RA7. Holiday LED Lighting

Implementation years: 2012 -2021
Projected average annual energy savings: 41 MMBtu ($726)
Projected average annual GHG reduction: 7 equiv metric tons
Simple payback: 8.3 years

LED lights use up to 95% less energy than incandescent lights. Each bulb in a light string is small, but together, with several strings per home, they can draw a lot of energy. One string can use 150 watts or 16 kWh over the holiday season, while an LED string will use less than 1 kWh.

This calculation assumes 100 households per year's switchover at an average 8 strings per household (combining indoor and outdoor displays on average). The calculation assumes a cumulative total to 2021 in the further assumption that most older holiday lights will have been replaced by then. This is a conservative estimate as it represents only about 1/5 of all homes in the city, in the further assumption that many city homes have already made the switch.

■ RB. Low Cost Programs

RB1. Basic Weatherization

Implementation years: 2012 -2032
Projected average annual energy savings: 1,310 MMBtu ($52,500)
Projected average annual GHG reduction: 255 equiv metric tons
Simple payback: 8.8 years (Less than one year for do-it-yourselfers)

These recommendations will help accommodate low income households, with the most basic and least expensive building envelope improvements such as weather stripping, duct sealing, caulking, some insulation, and the like. With roughly 1,300 city households below the poverty level, this is an important community to assist in coping with rising energy costs.

Based on MACED historical data, an average household expenditure for basic weatherization averaged $1,811. This figure is close in range to the Blue Grass Energy Button-up/Tune-up pilot program of 2008-09; their average adjusted home improvement cost was $2,022 per home. The MACED average energy saved was 10 MMBtu per dwelling annually and additional savings in those homes with natural gas service. Many of these basic weatherization improvements are comparatively simple to do, if not time consuming, and can be done by the homeowner for direct cost of materials only (about $200), a very significant savings.

The energy savings associated with this recommendation assumes 110 projects per year. The calculation above is based on the composite services yielding 13 such basic weatherizations annually; or 12% of the total retrofit jobs per year on average. The energy savings estimate also assumes an average annual of 5 self-made basic retrofits resulting from self-assessments starting in the year 2014.

RB2. Comprehensive Weatherization

Implementation years: 2012 -2032
Projected average annual energy savings: 3,022 MMBtu ($99,200)
Projected average annual GHG reduction: 538 equiv metric tons
Simple Payback: 11.4 Years

The principal focus in this moderately-priced second category is to accommodate mid-range efficiency retrofits including such items as insulation, moisture barriers, under floor insulation, programmable thermostats, and all basic weatherization. Based on MACED historical data, this level of energy improvements averaged $4,318 with average energy saved was 13.2 MMBtu per dwelling annually and additional savings in those instances with natural gas service. The savings calculation is based on the composite services yielding 19 comprehensive weatherizations annually, or 17% of an estimated 110 total retrofit jobs per year on average, and again based on MACED historical data. The combined residential retrofit program is shown as a cumulative savings to 2032; the last year of this major program as it is assumed that roughly half of all eligible older homes in the city will have made retrofits by then.

■ RC. Investment Opportunities

RC1. Energy Efficiency Retrofits

Implementation years: 2013 -2032
Projected average annual energy savings: 25,200 MMBtu ($515,200)
Projected average annual GHG reduction: 429 equiv metric tons
Simple payback: 13.1 years

The principal focus in this category is to accommodate full energy efficiency retrofits including HVAC improvements, comprehensive spray foam, and/or replacement windows, and all weatherization. Based on MACED historical data, this level of energy improvements averaged $7,935 and average energy saved was 18.2 MMBtu per dwelling annually with additional savings in those houses that have natural gas service. The calculation above is based on the composite services yielding 78 such major retrofits annually; or 71% of the projected 110 total retrofit jobs per year on average, and again based on MACED historical data.

RC2. Customer-Owned Residential Solar Generation

Implementation years: 2011 - 2042
Projected average annual energy savings: 3,623 MMBtu ($33,000)
Projected average annual GHG reduction: 806 equiv metric tons
Simple payback: 20+ years, but the 30% federal tax rebate remains in effect to 2016 and the state certified installation $500 tax rebate remains in effect through 2015

At time of printing, there are seven net-metered residential solar power installations in Berea. These provide an estimated total of 31-kW installed capacity. Net metering allows customers to feed unused power back to BMU and to receive full credit for the power produced by offsetting total usage. The projected energy savings is a straight-line projection of the average annual solar development of the last three years in the city.

Our calculation assumes a doubling of the city growth rate in residential solar power every 10 years. This is a reasonable assumption given the declining cost of solar panels and the rising cost of electricity. By one General Electric forecast, the cost of solar power may be cheaper than electricity generated by fossil fuels or nuclear reactors within three to five years, compared with average US retail prices. The development of thin-film solar panels is a large part of the declining cost. Further out, there's another study that estimates the underlying costs of solar manufacturing may drop as much 10% per year to the year 2020[21].

One especially promising area is the installation of solar hot water heaters. Installing a residential solar water heater in Kentucky typically costs about $4,000 to $6,000 and will save a family about $150 to $400 per year on their utility bills. Systems typically operate for over 25 years. There are several variables in determining the price range including amount of hot water used each day, water storage capacity, professional installation, and other factors[22].

Perhaps one of the best things the city can do in the short term to promote net metering is to develop a well-designed local solar information website as a part of its overall BECS outreach campaign. The website should focus on the emerging economics and local case studies as well as a link to the Kentucky Solar Partnership website and which includes an online copy of, ***The Kentucky Solar Energy Guide*** (http://kysolar.org/ky_solar_energy_guide); it includes statewide case studies.

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[21] See article at http://www.bloomberg.com/news/2011-05-26/solar-may-be- cheaper-than-fossil-power-in-five-years-ge-says.html . However, the reality is that BMU's current kWh price is even lower than the quoted lowest 2009 price in the article, 6.1c/residential kWh in Wyoming. But it's not quite as discouraging as may seem at first given the rising cost of traditional electrical prices compared with the continuing decline in solar prices. Regarding the sharp decline in solar manufacturing costs, see http://www.businessgreen.com/bg/news/2168375/mckinsey-solar-cost-competitive-decade .

[22] See the Kentucky Solar Partnership, *Solar Water Heating Fact Sheet*, at www.kysea.org/clean-energy-resources/solar/SWH%20Fact%20Sheet%20Sept%2009.pdf for complete information and current state and federal tax credit eligibility.

However, over the long term, the achievement of significant energy independence may require “feed-in tariffs”. This is a pricing mechanism to accelerate individual investment in renewable energy technologies by offering long-term contracts with a guaranteed price to renewable energy producers. Individual homeowners can benefit from this arrangement by having a long-term contract and price to reliably repay the renewable energy investment. This program is the key to energy independence and discussed further under City Government Programs. The ability of a utility to commit to a long-term purchase price is one of several considerations that need to be carefully evaluated.

The city could also systematically measure solar power generated in the city; to collect this data from all of the net meter customers. Although the city’s net metering records shows power credited back to the grid, it does not track total power generated. This would be a very simple system inviting net metered customers to annually send their current system capacity and total power generated. It would be a relatively simple way to measure total solar generation and could ultimately also include stand-alone and other clean energy generators. It would also provide useful data in future system design and in optimizing system pricing. (PCSP)

RC3. Geothermal Heat Pumps

Implementation years: 2011 -2042
Projected average annual energy savings: 1,289 MMBtu ($44,600)
Projected average annual GHG reduction: 93 equiv metric tons
Simple payback: 12 to 20 years

There are a number of existing geothermal heat pump (GHP) installations in Berea. A GHP is a central heating and/or cooling subsystem that pumps heat to or from the ground. It uses the earth as a heat source (in the winter) or a heat sink (in the summer). This design takes advantage of the moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems, and may be combined with solar heating to form a geo-solar system with even greater efficiency.

GHPs are characterized by high capital costs and low operational costs compared with traditional HVAC systems. In general, a homeowner may save anywhere from 20% to 60% annually on utilities by switching from an ordinary system to a ground source system. Payback period’s range from 12 to 20 years depending on the system replaced, electric heating being the quickest cost recovery. Here we’ve estimated annual average of five new installations per year.

Information and local case studies about this technology should be shared in a similar format and access as suggested in the solar power recommendation above.

NON-RESIDENTIAL TEAM RECOMMENDATIONS

Team Members: Steve Karcher, Chair, Cheyenne Olson, Josh Bills, and Steve McNeill

■ Introduction

Non-residential energy makes up 70% of all electricity used in the city; industrial development alone comprising 55% of energy used. Blue Grass Energy, serving the northern portion of Berea, provides 74% of all industrial power in the city, and represents 76% of all of the power they provide in Berea. Thus, 76% of all the power in Berea is used by 17 industrial customers; customers using in excess of 1-megawatt power each year.

Unlike other sections of the BECS Plan, the non-residential recommendations are presented as a single section, offering a holistic approach. The usual increments of no cost, low cost, and capital cost are nested within the program design.

All estimated savings use weighted average utility rates for per-unit charges of electricity for BMU and Blue Grass Energy. The weighted average rates are 6.93c/kWh for commercial and 4.67c /kWh for industrial. The combined weighted average rate for both all commercial and industrial in the city is 5.15c/kWh. The savings do not include natural gas usage and are somewhat high on that account but at the same time do not reflect demand, fuel adjustment nor unit other charges.

NR1. Business Outreach Program

Implementation years: 2013 -2033
Projected average annual energy savings: Not applicable
Projected average annual GHG reduction:

Recommendations are as follows:

- Develop an outreach program to introduce energy cost-savings to city business and industry. The program would be in two parts. The first and highest priority would be to contact local manufacturers offering initial one-on-one meetings with plant decision makers. The next is to develop a 2-part outreach for local non-manufacturing concerns conducting group meetings of businesses grouped by customer base or service area (e.g. restaurants only, etc). The group meetings would give a general introduction to energy efficiency cost-savings and extend a general invitation to meet one-on-one to discuss individual situations. The second phase would be to systematically invite individual businesses to meet one-on-one that either did not sign up originally or did not attend in the first place. This gives businesses a scope of possible savings, encouraging a billing baseline; a view of their billing rates; a site assessment or energy audit; and potential financing sources for improvements, including applicable incentives, rebates, and training opportunities. The program should have information handouts of simple, no cost, and low cost efficiency measures.

  This process should provide on-going information as needed, answering questions and giving direction. The program should provide for monitoring of reduced energy use by program participants, i.e., in an aggregated and otherwise blind database. MACED has some excellent commercial handout materials available on their website (http://www.maced.org) to begin the process.

- Link city businesses with available resources to achieve the most efficient results and highest cost savings. such as from Blue Grass Energy, MACED, Delta Natural Gas, the state KPPC, and/or Kentucky Save Energy Now program whose goal is to reduce energy use in business facilities by 2.5% per year for 10 years. (see https://louisville.edu/kppc/es/ky-sen). Other businesses may choose to pursue an incremental program tackling individual projects of their own time and choosing; such as lighting changes, space-cooling improvements, high efficiency, or variable speed motors, compressed air improvements, etc. The aforementioned Zinga & McDonald EKPC study has some specific suggestions in this regard. (see http://kyenvironmentalfoundation.org/ekpc_energy_portfolio.pdf)

- Develop simple outreach tools, such as an energy efficiency information brochure attached to new city business licenses.

This outreach and engagement process could be staged over a long period of time and in coordination with other (designated) staff duties. As an example, once the program format and materials are developed, staff might begin meeting with one manufacturing concern per month and conduct one business group meeting per quarter. Then, depending on the level of interest, the timing of such meetings might become more frequent. Given the current 900 businesses, NGOs, and houses of worship in the city, and assuming a 50% response rate, it would take approximately 10 to 15 years to complete the canvass. There are about 70 large industrial concerns in the city. That would take about four years but included within the longer time frame.

NR2. Billing Baselines

Implementation years: 2015 -2024
Projected average annual energy savings: 6,700 MMBtu ($89,800)
Projected average annual GHG reduction: 1,410 equiv metric tons
Simple payback: Less than one year as these are entirely behavioral changes

An essential starting point in the energy efficiency process is the assembly of one or two years of utility billing history. For non-manufacturing businesses, an excellent software to do this is Portfolio Manager (PM). It is energy management software that tracks and assesses energy and water consumption. It provides a benchmark for building performance compared with the same building types; based on a national energy survey conducted every four years and adjusted for different climates. The software is free and can be downloaded with full instructions at energystar.gov.

In the case of large manufacturing facilities, PM benchmarks are of limited use. The benchmarking does not track specialized manufacturing (forklift makers, aluminum producers, etc). Likewise, industrial needs are not a square-foot metric but instead, looking for energy efficient production measures such as the amount of energy used per widget produced. Although there are a wide range of billing software solutions commercially available, an industry baseline needs to be carefully constructed to suit an individual industry's needs and particular equipment; and where most often a custom Excel sheet is designed for that purpose, that is, yielding "key performance indicators".

A quick look at a billing history can often reveal potential energy inefficiencies in areas such as seasonal shutdowns (usually July & December), unexpected patterns of seasonal variation, unexplained high weekend usages, etc. Another frequent use of billing records is to help determine if the business is taking advantage of the lowest possible tariff category. It doesn't necessarily save energy, but can save significant money for the business.

The analysis of billing patterns often leads to energy behavior programs in the workplace, which aim to reduce energy use through change in employees' attitudes and behaviors. A recent ACEEE study of energy behavior projects shows the savings from 4% (a stand-alone behavior program) to nearly 75% (savings from a comprehensive project in which a behavior program is a component). (see http://aceee.org/research-report/b121 -- Its free access but you'll need to log in.)

Behavioral changes in energy use can include things like making sure unused lights/equipment are turned off when not in use, use of natural day-lighting, dressing comfortably, improved maintenance practices, dimming hallway lighting, use of "smart power strips", eliminating excessive break-room energy usage, incentivizing employee suggestions, and more. The total behavioral savings rate shown here is 4% annually spread over 10 years, assuming 200,000 sq ft /yr of commercial billing baselines established annually and at a $1.50 sq ft average annual energy cost for a total $300,000 annual energy budget.

NR3. Site Assessments and Energy Audits

Implementation years: 2013 -2033
Projected average annual energy savings: (Not Applicable – information gathering)
Projected average annual GHG reduction:

Blue Grass Energy provides their business customers with a wide range of no-cost site assessment, energy audit, and related services. Likewise Delta Gas, KPPC, and MACED offer a variety of commercial site assessment through energy audit services; with KPPC specializing in manufacturing industry energy studies and training.

There are two levels of commercial energy assessment. The first is the preliminary audit (alternatively called a simple audit, screening audit or walk-through). It is the simplest and quickest type of audit. It involves minimal interviews with site-operating personnel, a brief review of facility utility bills and other operating data, and a walk-through of the facility to become familiar with the building operations and to identify any glaring areas of energy waste or inefficiency.

Typically, only major problem areas will be uncovered during this type of audit. Corrective measures are briefly described, and quick estimates of implementation costs, potential operating cost savings, and simple payback periods are provided. A list of energy conservation measures or opportunities requiring further consideration is also provided. This level of detail, while not sufficient for reaching a final decision on implementing proposed measures, is adequate to prioritize energy-efficiency projects and to determine the need for a more detailed audit.

A higher-level assessment is an energy audit, a formal inspection, survey, and analysis of energy flows in a building, process, or system. Its purpose is to reduce the amount of energy input without negatively affecting the output(s). The general audit expands on the preliminary audit described above by collecting more detailed information about facility operations and by performing a more detailed evaluation of energy conservation measures. Roughly one-third to half of MACED commercial site assessments mature into an energy audit.

There is an even higher level of investment grade audit, focusing on comparatively more expensive retrofits and their return on investment.

Industrial energy audits require a different skill set than smaller, residential audits. For industrial applications, weatherproofing and insulating are often minor concerns. In industrial energy audits, it is the HVAC systems, compressed air, lighting, and production equipment that use the most energy.

There's a special opportunity in Berea to improving the compressed air processes. Although compressed air is critical to manufacturing, these systems are some of the most inefficient in terms of energy usage. Roughly 80 to 90% of the electricity used to operate compressed air systems is converted to low-temperature waste heat. This lost energy can quickly add up, costing individual manufacturers as much as double the purchase and installation cost (first-cost) of an entire system.

Compressed air energy efficiency measures can achieve significant savings, as high as 50 percent in some cases. Improvements often pay back investment in short time. Despite this high return on investment, manufacturers have been slow to address energy efficiency related to compressed air. Nationally, only about 20 percent have undertaken energy efficiency improvements. Based on information from a local energy company, the Berea area is consistent with this national trend.

In the case of large scale manufacturing especially, there are variety of specialized studies that may be indicated and corrective action taken such as infrared surveys, i.e., the use of predictive maintenance technologies that can significantly reduce maintenance costs. There are power factor correction studies that identify excess current difficulties that can lead to increased operating and capital expenses. There are enhanced energy control studies to monitor/track wasteful practices, automatic meter reading technologies for continuous monitoring, and/or development of energy control systems. It is sophisticated stuff, but for megawatt users can help save an average $1.4 million year for large manufacturing plants. For small to medium size plants, an average of $55,000 in annual savings.[23]

[23] Source: www1.eere.energy.gov/manufacturing/tech_deployment/ energy_assessment.html

NR4. Energy Star Purchasing Policy & EISA Transition

Implementation years: 2014 – 2026
Projected average annual energy savings: 26,338 MMBtu ($328,000)
Projected average annual GHG reduction: 5,334 equiv metric tons
Simple payback: Generalized data not available but, generally, very little time as the initially more expensive price makes up the difference in energy cost savings.

Energy Star products are impartially tested to achieve the highest energy efficiency available and/or comply with minimum federal standards. Energy Star label products save on average 20% to 30% energy use compared with standard products. And the standard is not based solely on power savings; overall efficiency, length of product life, and in some cases water usage are carefully measured and compared with models of similar type or design. (www.greenbuildingenergysavings.com/) Although Energy Star models are a little more expensive initially, the savings in utility bills will more than make up the difference over time. The policy should also reflect available product rebates for additional city savings.

However, this calculation also includes the much larger conversion to the new energy efficiency standards of the 2007 US Energy Independence and Security Act (EISA). The calculation assumes a full lifecycle conversion by the year 2026. Assuming 37% of the city's non-residential facilities electrical budget as equipment and lighting (the national average) and then assuming a total 7% improved efficiency in most all appliances, common area lighting, and full lighting, there would be a cumulative, average energy savings of 1,440 MMBtu/yr spread out over 13 years.

NR5. Moderate Cost Energy Retrofits

Implementation years: 2015 -2034
Projected average annual energy savings: 21,740 MMBtu ($310,800)
Projected average annual GHG reduction: 3,392 equiv metric tons
Simple payback: 2.7 years

Moderate cost energy efficiency recommendations include:

- Lighting: a major business expense and can often pay for itself within a couple of years due to much lower operating costs and the longer life of new lighting products.
- Insulation and duct sealing;
- Water leakage repairs
- LED exit sign lighting
- Programmable thermostats
- Light sensors for security

This calculation assumes one large user moderate-cost retrofit at $50,000 each and 2 commercial retrofits at $6,000 each. Based on MACED retrofit historical data, the average industrial energy saved is 1,052 MMBtu and average GHG emissions avoided is 213 tons per retrofit; and for commercial retrofits, the average energy saved is 222 MMBtu and average GHG emissions avoided is 39 tons per retrofit.

The estimated time range is based on a rough assumption of the total time needed to locate and implement all such-sized retrofit opportunities but is lacking the floor area data needed for a true projection. Possible, future County PVA Office data may help ascertain land use floor areas in the city and thus better estimation of the scope and opportunities for non-residential retrofits.

NR6. New Non-Residential Building Code

Implementation years: 2012 -2042
Projected average annual energy savings: 19,110 MMBtu ($278,500)
Projected average annual GHG reduction: 3,729 equiv metric tons

New building codes are now in effect. Based on a review of the last 2 years of city permit records, the estimated savings assumes an average 75,000 SF of non-residential development per year and an old code average of $1.50 /yr/SF energy use with a 15% cost savings translating into 1,120 MMBtu savings per year.

Although Energy Star certification can potentially improve building performance, it begins with an energy savings target and focuses on prescriptive requirements – see www.energystar.gov/index.cfm?c=cbd_guidebook.cbd_guidebook_learn_more_2 for complete information. As a practical matter, ES commercial certification is a private sector decision, but should certainly be encouraged should comparative cost-savings results with the new IECC code become available.

NR7. Capital Cost Retrofits

Implementation years: 2015 -2032 (End year pending)
Projected average annual energy savings: 42,276 MMBtu ($713,600)
Projected average annual GHG reduction: 9,553 equiv metric tons
Simple payback: 2.7 years

This is an area of comparatively more expensive of energy efficiency improvements. For non-manufacturing business, the scale and scope can vary widely due to the type of business and its size. Typically, large national retailers have energy plans and managers. But for smaller, locally owned business, the threshold decision to consider improvements is often a function of whether the own their property or rent. Comparatively more expensive capital improvements vary tremendously but include such items as HVAC improvements, replacement windows, refrigeration placement, etc.

Again, in industrial energy efficiency improvements, it's the HVAC, compressed air, lighting, and production equipment that use the most energy. Our calculation here assumes one major retrofit every two years to 2032 (nine total) and/or a combination of smaller ones averaging 200,000 sq ft/year with a $1.85 sq ft electrical cost and saving 30% of energy costs on average.; with a $1.50/SF retrofit cost for a total construction cost of $300,000.

NR8. Non-Residential Renewable Energy

Implementation years: Starting 2022
Projected average annual energy savings: 2,988 MMBtu ($48,400)
Projected average annual GHG reduction: 624 equiv metric tons

Although this is certainly a separate category unto itself and there are some attractive economies of scale, it's difficult to project possible business and industrial renewable energy applications in Berea. There are several reasons, but mainly that the extent of business energy conservation needs need to first be assessed through Item #NR1 outreach activities, as well #NR3, as the most effective way to utilize renewable energy is to first make sure that the buildings are properly insulated and climate controlled.

That said, the calculations show a 100 kW non-residential solar installation every two years starting in 2021, when the price of solar installations could be half of what they are today (see Recommendation # RC2.); and after a period of local assessments experience described above. The increased price of power at that time will also influence the decision process.

Commercial scale solar water heating systems offer a more rapid payback, especially for such uses as hotels, laundries car washes, apartment complexes, restaurants, food processing facilities, and factories. For a sample payback, See p.28 the Zinga & McDonald report , *A Portfolio of Energy Efficiency and Renewable Energy Option for East Ky Power Cooperative*, 2008.[24] Also see the Kentucky Solar Partnership, *Solar Water Heating Fact Sheet*[25] for complete information and current state and federal tax credit eligibility.

However, there are two immediate no-cost actions that could be pursued in the interim. The first to seek a college intern project to identify Kentucky clean energy business success stories, resources, and incentives. (PCSP) The end product of the research paper could be a one-page handout for local businesses. The second initiative is through the #NR1. and related activities, to include the handout in the standard packet and to have it readily accessible whenever the question come up. Additionally, and after some NR1 program experience, there will be opportunities from time to time to raise the possibility of renewable energy generation depending on the situation and individual interest.

As is true with all energy development, renewable energy technology is a rapidly evolving field; and where a key component is the increasing affordability of solar equipment and other applications. Knowing emerging thresholds for affordable applications is critical and at the same time a challenge to stay abreast of over the 30–year time period of the plan.

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24 On-line link: http://kyenvironmentalfoundation.org/ekpc_energy_portfolio.pdf

25 www.kysea.org/clean-energy-resources/solar/SWH%20Fact%20Sheet%20Sept%2009.pdf

NR9. Berea College and School District Energy Savings

Implementation years: 2012 - 2020
Projected average annual energy savings: 6,489 MMBtu ($131,000)
Projected average annual GHG reduction: 1,744 equiv metric tons
Simple payback: Not available, due to different cost and implementation timelines.

Berea College has achieved a 39.4% reduction in energy consumption since 2002 to June, 2010. The College has a remaining goal of 5.6% savings needed to achieve their total 45% savings goal by the year 2014, for an average annual energy savings goal of 1.4% until then. This translates into 1,900 MMBtu and 422 tons of avoided GHG emissions annually.

Berea Independent School District: In the 2011/12 school year the district exceeded its goal of 10% savings from the previous year, saving more than $30,000 in utility costs. In 2012/13 plans to replace its roof and add roof insulation, install a new energy efficient HVAC system and update its elementary school lighting system. The energy cost savings associated with these activities have not been updated as yet but the school expects to achieve or exceed another 10% reduction. Due to the old electric and HVAC systems and unique school blueprint, BCS is one of the highest Btu/sq ft schools in the state, but has a goal to make the largest efficiency gains in the state. and transition from a school The school is also leasing three solar panels from BMU's Solar Farm.

Madison County Schools has completed its energy savings goals for its schools located in Berea and has no further plans here at this time. The District's Berea schools have saved about 1.7 million kWh or $117,000/yr in energy costs compared with three years ago. The District's Berea schools were part of the original plan to save 10% in energy costs and they will have completed that district-wide goal this year. The District will next prepare a plan for other schools in the district outside of Berea; but has no additional plans within the city at this time.

Berea College Ecovillage aquaponics facility

TRANSPORTATION TEAM RECOMMENDATIONS

Team Members: Jan Pearce, Chair, Cecile Schubert, Bill Stolte, Howard Carlburg, and Paul Schrader

Introduction

The independent International Energy Agency (IEA) has reported that the earth has reached peak oil production in 2006 at 70 million barrels per day and will probably level out in that range for about the next 20 years. In the most recent US Energy Information Agency (EIA) "reference case", projected consumption of petroleum and other liquid fuels increases from 86 MBD today to 112 MBD in 2035. Although not a strict apples-to-apples comparison, this means that with growing international demand and forecast growth of 17 MBD of unconventional liquid fuel sources (oil shale, biofuels, etc), the world is still short by about 25 MBD or about 21% of demand by 2035.

Despite rapidly improving alternative fuel technology, rising fuel prices, fuel shortages, declining car travel due to economic downturns, it will take a very long period of time to replace the country's 240 million internal combustion engine vehicles. Although the EIA predicts a possible 50% market share of alternative fuel vehicles by 2035, it's a predominantly flex-fuel change, internal combustion engine. Likewise, the hybrid and electric car market share consistently remains under 3% of total sales.

That said, implementation of a comprehensive transportation energy strategy will improve the city's ability to deal with such events, and result in less harmful pollution.

Alternative Transportation Infrastructure Capital Improvement Programming (CIP) Policy. Many, if not most, of the proposed programs here entail a recommended change in approach in CIP funding and maintenance. The recommended change is to view non-motorized transportation development on the same priority level as paved roadway maintenance for cars., facilities, and maintenance. Likewise, the city would find that the expense of alternative travel facilities is only a fraction of that for its traditional roadway budget. Additionally, alternate modes help lessen traffic congestion and related expenses, such as Chestnut Street through the middle of town.

The city could develop an inventory and analysis of smaller city alternative transportation CIP budgets compared with traditional roadway budgets. Most of the needed data is on-line and the findings would be a major contribution to the field, as well as inform the city government of the successful experiences elsewhere. (PCSP)

Methodology. Most of the data calculations are generated by ICLEI's CAPPA Excel-based tool to make various estimates. Gasoline costs are estimated at $3.38/gal in today's dollars; actual savings will vary significantly over time with rising gas prices.

■ TA. No/Low Cost Improvements

TA1. Individualized Transportation Options Outreach Program

Implementation years: 2014 -2024
Projected average annual energy savings: 517 MMBtu ($14,000)
Projected average annual GHG reduction: 325 equiv metric tons
Simple payback: Less than one year saves for direct costs such as a bicycle, walking shoes, etc.

This program would entail direct contact with households to provide individualized information they request on transit services, ridesharing, biking, and walking options in Berea. This effort would also teach “eco-driving” skills that can significantly improve gas mileage, saving up to 33% depending on the type of driving and vehicles involved. Based on a test program in the first year or two, eventually ramp up in contacting 100 households per year with an eventual goal of an 8% reduction in car use in participating households; increasing 10% each year to 2025, when the full CAFÉ fuel efficiency standards go into effect. This is also a good way to share fuel-efficient car information as described in Item #TB3, especially federal and state alternative fuel incentives and rebates (see http://www.afdc.energy.gov/laws/).

The calculation reflects an average annual trip reduction of 4% in the number of participating households due to the need to ramp up the program as many of the recommended alternative transportation programs here are developed over time, additional bus service, etc.

TA2. Safe Routes-to-Schools (SRTS)

Implementation years: 2012 - 2042
Projected average annual energy savings: 24 MMBtu ($5,900)
Projected average annual GHG reduction: 12 equiv metric tons
Simple payback: Grant funded improvements, family car fuel cost savings

Safe Routes to School is a national program being implemented at Berea Community Schools that encourages children to walk or bike to school. The program includes a variety of pedestrian and bike safety improvements connecting with the school and to be completed this year as well as the recent, additional $140,000 SRTS grant for additional pedestrian and bike safety improvements. Participation in the annual Walk and Bike to School Day has increased each year, and the school could create specific goals for year-round walkers and bikers. Schools are also encouraged by state and federal governments to enact anti-idling policies for buses and parked cars, to reduce fuel waste and air emissions.

Assuming future participation of the three Madison County elementary schools of 1,700 students, a nominal 20 additional students are assumed to participate each year over the life of the plan.

TA3. Compact Land Use

Implementation years: 2017 - 2042
Projected average annual energy savings: 13,149 MMBtu ($83,200, not including avoided public infrastructure and longer service delivery costs)
Projected average annual GHG reduction: 999 equiv metric tons
Simple payback: Less than one year save for direct costs such as specialized studies, cost take-offs, and or public meeting expenses

Berea's well-developed town core and close-in neighborhoods have the potential to encourage more compact development, thus promoting more walking, biking, mixed-used development and easy access to local transit. This savings calculation has been factored for the projected city population, capturing one–third of new residential development or about 30 households annually to be located in compact development, with households traveling 2,000 fewer annual vehicle miles on average.

The rate of deferred trips in the estimated savings may seem high at first until one also factors in significant transportation cost savings in delivering city services shorter distances to serve compact development. There are additional savings in otherwise building and maintaining increasingly more expensive streets, utilities, and city facilities.

Other benefits of compact land development include economic gains, higher property values, and lower vacancy rates, as well as the health benefits of higher rates of walking, biking, and outdoor activities.

Perhaps the single most important prerequisite, is to first conduct the pedestrian, bike, and transit master plan study described in Item #TB1. Understanding the interrelationships of the three systems, the related distribution of existing residential density, and major city destinations is the threshold to understanding where compact development would work best. The timing of these two initiatives, the bike, pedestrian, & transit plan and a subsequent compact development proposal need to be coordinated with the current update of the city comprehensive plan.

The need for a well-designed community participation process cannot be overemphasized. Infill studies always draw significant community interest. An excellent example of a compact development study can be found on-line for the Town of Falmouth, Maine, pop 11,000.

TA4. Consolidated Transit and Student Shuttle Information

Implementation years: 2014 - 2042
Projected average annual energy savings: 4,843 MMBtu ($96,200)
Projected average annual GHG reduction: 92 equiv metric tons
Simple payback: Less than one year, not including promotional printing costs, etc.

There are a wide variety of transit and shuttle services available for Berea residents and Berea College students. These include a variety of services ranging from daily Foothills Express bus service including service to Lexington and Richmond and area airports and bus stations, as well as school pick-ups and other services. Additionally, the college has a variety of periodic free student shuttles to local destinations and cities. There should be a combined information source for all residents and students,. A single website and some choice public announcements would be a good beginning. The combined annual ridership for both systems is 8,789 passengers. The growth forecast shows a nominal 1/4% average annual growth rate in the (equivalent) number of additional daily passengers, about 25 additional passengers per year.

TA5. Car-Pooling / Ridesharing

Implementation years: 2013 - 2033
Projected average annual energy savings: 5,159 MMBtu ($151,000 and annual avoided cost of car ownership: $144,000)
Projected average annual GHG reduction: 390 equiv metric tons
Simple payback: Less than one year, not including promotional printing costs, etc.

Establish a local car-pooling website and local information program; tracking participants and success stories for publicity. This could be a college student project, but with on-going site administration and updating needed. (PCSP) There are about 6,500 employed city residents in 2010 plus a larger commuter group from outside the city. There should be an assessment of potential employee interest. A nominal 25 additional cars-share participants each year is shown in the forecast – but only intended as a "placeholder" until better information is obtained.

■ TB. Low Cost Energy Efficient Improvements

TB1. Bike/Pedestrian/Bus Master Plan

Implementation years: 2013 - 2014
Projected average annual energy savings: Not applicable
Projected average annual GHG reduction:
Simple payback: Less than one year in optimized cost efficiency and utilization of alternative travel modes.

The city should develop an integrated bicycle, pedestrian, and fixed-route bus master plan to identify the interrelationships of the three systems and optimize their use, safety, and convenience. The plan should 1) address specific measures to estimate future energy savings using the ICLEI/CAPPA workbook, and 2) prepare preliminary unit-cost estimates for at least the top priority projects. Although such estimates are very rough, they're critical in helping establish a program budget and in knowing how much money is needed to implement the plan. Likewise, our $20,000 estimated plan cost is a placeholder only -- a unit-cost estimate of the study scope-of-work needs to be developed to solicit the best vendor response and best price.

The implications of a "complete streets" interconnected trail system serving city pedestrians, bicyclists, and transit riders could buoy a significant shift in how people travel in the city, including possibilities like it becoming a tourist attraction and related special events, a greatly enhanced Berea Independent Schools District Safe Routes-to-School Program, bicycle police patrols and related fleet savings, and as a city asset attracting new economic development. The Madison County School District should be invited participate with the ultimate hope of their participation in the City/Health Department's Safe Route-to-Schools Program. A continuing increase in future gas prices will likely enhance interest in all of the above.

TB2. Increased Bus Ridership

Implementation years: 2014 - 2030
Projected average annual energy savings: 2,038 MMBtu ($55,100 – passenger gas savings only)
Projected average annual GHG reduction: 51 equiv metric tons
Simple payback: Suggested first source is to seek a demonstration grant

Foothills Express provides a number of different types of ride services and would like to increase ridership. Their main objective is to increase ridership for its fixed-route service that completes an hourly 10-mile route through the city each weekday between the hours of 9 AM and ending 5 PM. The city should explore the possibility of proposing expanded service to start 7 AM and ending 7 PM to capture rush-hour commuter patronage.

This above savings estimate is based on an average annual goal of capturing 20% of all city commuters projected to the year 2030, or an average annual increase of 65 passengers. This would initially require approximately $55,000 a year in additional operating costs. Foothills Express is constrained by their grants funds to limit its fare structure. It's a 50-50 matching grant arrangement and hence, an approximate $27,500 match would be required annually. Other potential funding approaches/fare structures should be explored with Foothills. This "fixed-route" transit served 6,846 passengers in 2010. (PGEP)

Foothills provides a $20 round-trip fare to area airports and other transportation connections. They provide daily commuter service to Lexington from Richmond and would consider departing from Berea if there were enough interest. They also provide other connection services, school pick-up, and medical transport. LexTran also provides a daily commuter service from Richmond to Lexington. Optimizing these existing resources would be an important part of the master plan process described in the Item #TB1.

TB3. Increased Fuel-Efficient Car Ownership

Implementation years: 2013 - 2024
Projected average annual energy savings: 8,214 MMBtu ($236,900 – straight gas savings)
Projected average annual GHG reduction: 671 equiv metric tons
Simple payback: Varies enormously due to model choice and applicable rebates

The auto market has been changing in recent years to include more fuel-efficient options, and this presents both a challenge and an opportunity to for Berea residents on the choices and advantages of fuel-efficient vehicles (flex-fuel, hybrids, plug-ins, fuel cell, and combinations thereof). The city should develop an objective buyer's information service to help the public understand the choices and available incentives and rebates; with the goal of significantly increasing local ownership of high efficiency vehicles and that a potential buyer may be best able to afford.

The BECS goal is to improve five percent of buyer fuel efficiency in their purchase of used or new cars. It is estimated that there are approximately 2,800 passenger cars owned by Berea residents. At an average rate of ownership of 9.2 years per passenger car, the city's entire resident passenger fleet would be replaced within that time, or about 300 new/newer cars per year. The calculated saving estimate is based on the goal of 10% more efficient vehicles than might otherwise be purchased, or 30 cars per year. A vehicle that gets 30 MPG will cost the consumer $845 less for fuel each year than one that gets 20 MPG (assuming 15,000 miles driven annually and a fuel cost of $3.38/gal) or, over a 5-year period save $4,225; or potentially much more in the event of proportionally, ever higher fuel costs.

The full effect of the new federal fuel efficiency standards (known as CAFE standards) will take effect by 2025, nearly doubling the previous fuel efficiency standards (basically up to 54.5 MPG for cars and trucks – but in reality a much more complex set of milestones and numbers). The estimated savings shown above works through the city vehicle life cycle to 2033 when most of the city fleet will then comply with new fuel standards.

The U.S. Department of Energy has an outstanding website to assist buyers in this effort as well as a guide to current buyer incentives and rebates, including their annual, *Fuel Economy Guide for the Model Year 2011*,[26]. The website also includes a fuel calculator. Previous model year's guides are also available to evaluate used car purchases. It also has a comprehensive section on available tax incentives, credits, and rebates. Another excellent resource devoted solely to plug-in cars is Plug In America at http://www.pluginamerica.org/.

The higher cost of fuel-efficient and hybrid vehicles is a barrier for some residents. However, it is expected that with increasing sales volume and improving battery technology that prices will come down over time. The U.S. EIA sees "alternative vehicles" (which includes flex fuel, hybrids and diesel) making up 49 percent of new vehicle sales by 2035. In 2008, this category only made up 13 percent. Higher CAFE standards and climbing fuel prices may well force an increase in those numbers.

Likewise, the same is true for the school bus fleet serving the city. Currently, the state has grant funds to purchase 60 additional diesel-hybrid busses, depending on when districts may retire older busses. Madison County Schools currently has at least 3 hybrids in service.

Another valuable source of significantly improved fuel economy is the area of motor scooters, mopeds, trikes, and electric variations with current mileages ranging from 52 to 102 miles per gallon, starting from around 30 MPG for all-electric powered two-wheelers. Our reticence to formally recommend it is due to the lack of a helmet law in the state. But in the new paradigm of ever-rising gas prices and the need for affordable transportation, it's a niche market that's likely to happen; but for the moment, has not been factored into the estimated energy savings here.

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[26] http://www.fueleconomy.gov/feg/FEG2011.pdf

TB4. *(Reserved)*

■ TC. Energy Efficient Investments

TC1. Electric Vehicle Charging Stations

Implementation year: 2015 - 2042
Projected average annual energy savings: 8,657 MMBtu (net $174,000)
Projected average annual GHG reduction: 667 equiv metric tons
Simple payback: To be determined as explained below.

As plug-in hybrid electric and all-electric vehicles (EV) ownership expands, there is a growing need for widely distributed, publicly accessible charging stations, some of which support faster charging times and currents than are available from domestic sources. It presents a special opportunity to encourage local EV ownership, a possible revenue stream in charging a fee for the power, and/or shared utilization of future city government EVs for use in its fleet and thus significant savings over traditional fuel costs. Although, the state does not yet have an EV charging network plan, there is no reason that a local station could not serve local trip needs.

The city should either 1) meet/consult with an EV charging station expert to discuss the possibilities and costs of developing EV charging capacity in Berea, preferably solar powered charging equipment only; or 2) could develop an initial, in-house college student project to compare electrical and gasoline mileage costs (roughly a 4:1 ratio at current prices), i.e., compared with varying development costs and potential revenue streams and returns-on-investment. (PCSP) A good, introductory article on EVs can be found at http://www.edmunds.com/car-technology/electric-car-battery-basics-capacity-charging-and-range.html.

It should also consider shared charging capacity in the incremental conversion of the city fleet to electric vehicles. And in all cases, also consider savings where all-electric vehicles require far less maintenance and are also showing far longer battery life than originally projected [sic]. The student project would only be intended as a first look at project feasibility prior to consulting with an expert, or preparing a solicitation to consult with one.

The savings calculation shown is a placeholder pending consultation with an expert. The calculation assumes the installation of 20 charging stations over the 10-year period shown; solar powered stations recommended. The assumed net output is the equivalent of 10 gallons of gas per station per day. The solar powered units use conventional power for car charging and feed collected solar power back to the grid.

TC2. Improved Safe R-T-S infrastructure
TC3. Pedestrian Improvements
TC4. Bikeway Infrastructure
TC5. Improved Transit infrastructure

Implementation years: 2011 - 2042
Projected average annual energy savings: 6,671 MMBtu ($155,100)
Projected average annual GHG reduction: 472 equiv metric tons
Simple payback:

Except as explained above, the following options depend almost entirely on the master plan called for in Option #B1 above. Once the plan is completed, the following items can be estimated for energy savings and reduced GHG emissions.

The estimated savings assumes a 20% shift in weekly trip made by private vehicle or 440 weekly trips switching from car to alternate modes starting in 2015 and assuming an average two-mile trip avoided at a current 19.7 average MPG. The calculation assumes an additional 440 weekly trips each year to 2042, then totaling 13,000 weekly trips avoided by then. This could be considered a moderate assumption when one considers increasingly more expensive gas prices, incrementally higher patronage on alternative modes, and potential bicycle police patrol savings, and related avoided costs of car ownership. The college town of Boulder, CO is shooting for a 25% modal shift by 2025.[27]

Berea College Campus

[27] see http://s3.amazonaws.com/zanran_storage/www.bouldercolorado.gov/ContentPages/620122368pdf

CITY GOVERNMENT TEAM RECOMMENDATIONS

Team Members: Selected staff, chaired by Randy Stone

■ Introduction

Summary of Plan Yields: The following yields are the maximum possible if all recommended programs are successfully pursued. A complete tally of all savings by each recommendation can be found in Appendix B.

- Total Estimated Energy Savings Potential: 8,312 MMBtu average annually or 9% of 2010 energy consumed.

- Total Estimated Cost Savings Potential: $286,000 average annually or 34% of FY 2009-10 energy expenditures. (The reason for the much larger percentage is the combined effect of recommended peak load management where, basically, little or no energy is saved as that energy is essentially shifted out of the peak time but still consumed in the off-peak.)

- Total Estimated Greenhouse Gas Emission Reduction: Average annual 1,337 equiv metric tons by 2042 or 26% below 2010 emissions.

Cost Savings: Most of the savings calculations are based on percentage calculations of the 2010 energy bills and all costs are in today's dollars. However, where units cost are calculated it is a weighted average cost of BMU Class 3 and Blue Grass Energy A-2 rates from $0.0611/kWh, now other demand or other charges calculated. Of the city total stationary energy bill in 2010, 42% was Blue Grass Energy power and the balanced provided by BMU.

This is a conservative estimation since it does not include an increasing rate of energy use due to city growth.

An important aspect of energy efficiency improvements is that once the cost of any improvements is finished, the energy savings continues through time. Additionally, the value of the savings increases further due to rising energy prices and especially whenever the increase exceeds inflation. Restated, an annual 100 megawatts/hour savings in 2013 worth $7,000 would increase at, say, a compounded annual average rate of 4% due to electrical rate increases, would be $10,300 in 2023. Restated, most all investments in energy efficiency achieve payback at a point in time and yield increased savings into the future.

And while clean energy equipment replacement costs more tend to be higher, banking energy savings for future replacement costs can plan this for. Although, as with all new product types, the cost of equipment will decline over time as demand increases and new technology develops.

Future Technological Solutions. These recommendations are made with the understanding that future technology may solve many current energy inefficiencies. The further out in time each recommendation is, the greater the likelihood that unanticipated technological changes may improve the situation in unforeseen ways. The challenge is for the city to stay informed about new technology and products as they develop.

Program Starting Dates. Each starting date shown is the earliest possible date that any chosen program savings could begin. As an example, a start date of 2014 means that the preparation for that particular program would require 2 years before initial savings could be realized.

■ GA. Low/No Cost Energy Efficiency Improvements

GA1. Portfolio Manager: Tracking energy and water use

Implementation years: 2013 -2018
Projected average annual energy savings: 658 MMBtu ($13,900 in gas and electric)
Projected average annual GHG reduction: 133 equiv metric tons
Simple payback: Not applicable

Portfolio Manager is an energy management software that tracks and assesses energy and water consumption across the entire ownership of all city buildings. It does two things: 1) identifies underperforming buildings; and 2) identifies investment priorities and verifies efficiency improvements. After the initial database is established, the software compares the city's energy performance with national benchmarks for similar types of buildings. The ongoing energy use record then becomes a management tool to verify future energy savings. The software is free and can be downloaded with full instructions at http://www.energystar.gov. An additional benefit of the PM database is after two years of collected data, it can easily be sorted for the city fiscal year, July 1st to June 30th.

The systematic tracking of energy use and costs is the key to developing a successful energy efficiency and cost-savings program. It measures progress over time. Another valuable feature is that PM also benchmarks energy performance compared with a quadrennial survey of all similar buildings in the country and respective climates, such as office buildings and fire stations.

Behavioral changes in energy use involve changing the culture of the organization. This can include things like making sure unused lights/equipment are turned off when not in use, use of natural day-lighting, dressing comfortably according to the weather, improved maintenance practices, dimming hallway lighting, use of "smart power strips", giving incentives for employee suggestions, and more. The total estimated savings rate shown here of 2% ($14,400) is spread over three years is and based on a national study (cited in Item #NR2.). However, water savings are not included because there is no demonstrated savings rate, but would be an additional source of cost savings.

Another source of energy savings ideas is to begin an employee suggestion program. No one knows the untapped sources of energy efficiency better than the employee that does the job every day. Ac college student could investigate the state-of-the-art employee incentives and results. (PCSP)

GA2. Energy Star Purchasing Policy

Implementation years: 2013 – 2023
Projected average annual energy savings: 82 MMBtu ($14,400)
Projected average annual GHG reduction: 693 equiv metric tons
Simple payback: Varies, but generally less than one year

The city should create a policy to purchase Energy Star approved equipment as needed and for replacements. Energy Star products are impartially tested to achieve the highest energy efficiency available and/or comply with minimum federal standards. Energy Star label products save on average 20% to 30% in energy use compared with standard products. And the standard is not based solely on power savings. Overall efficiency, lengths of product life, and water usage are carefully measured and compared with models of similar type or design. (www.greenbuildingenergysavings.com/) Although Energy Star models are a little more expensive initially, the savings in utility bills will more than make up the difference over time. The policy should also seek any available product rebates for additional city savings.

This calculation assumes 37% of the city's facilities electrical budget as equipment and lighting (national average) and then assumes a three-quarters of one percent energy savings per year or $1,700, a cumulative savings that stabilizes after 10 years, (but worth significantly more then due to increasing energy prices).

GA3. Performance Contracting (P-C)

Implementation years: 2014 - 2016 (presumed savings years 2017 – 2042)
Projected average annual energy savings: 3,618 MMBtu ($72,900 in gas & electric in today's dollars, minus the debt service which would equal or be less than the savings)
Projected average annual GHG reduction: 619 equiv metric tons
Simple payback: 5 to 10 years (This is a zero-sum project using energy cost-savings to pay back all expenses)

Following state law, pursue the feasibility of conducting a performance contract for a select group of city facilities. Performance contracting (P-C) is a way of financing energy efficient improvements to be paid for with energy cost-savings and where the estimated energy savings are guaranteed to pay the projected debt for the upgrades. In this arrangement, the selected vendor or Energy Services Company (ESCO) would amortize all costs involved including analysis, design, and all construction costs in the repayment plan. There are many different ways to finance the upgrades. It is vitally important that an independent expert help guide the vendor selection process to assure that the terms of the agreement accomplish the objectives with no major surprises down the road. The types and range of ESCO services vary tremendously.

Expected average energy savings are in the range of 20% for near term (average 9 years out). However, projected savings vary widely based on local conditions and the scope of effort. In the case of further-out time periods, significantly higher savings are targeted.[28]

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[28] This estimated average savings estimate is based on a derived finding from Table 1 in a 2008 study of 12 performance-contracting state government markets. http://eetd.lbl.gov/EA/EMP/reports/lbnl-1202e.pdf. But again, actual savings vary widely.

The estimated hypothetical savings represents an 18% savings of only half of the city's 2010 building energy costs. This is a net savings subtracting out the 2% Portfolio Manager savings shown earlier. If street lighting were included in the package, the potential savings would be significantly higher. However, this is a hypothetical illustration only for our plan recommendation. An actual solicitation would yield the most feasible debt service plan.

Two additional things to remember: first, the expected life of the retrofit equipment is in the 10 to 20-year range. The projected savings plan should include an equipment replacement plan as the savings accrue and that can be expected to go well beyond the term of the debt service. Second, any solicitation for proposals should also include a required cost-benefit analysis for the replacement of HVAC and other expensive equipment. As an example, an 80% efficient furnace near the end of its usable life is a good bet to replace with a new 95% efficient furnace. However, a 2-year old 80% efficient furnace may not justify the replacement, etc. and would be part of staged replacement plan.

The P-C contract could include an assessment and potential costs and savings for renewable energy applications at various city facilities whether solar, geothermal, etc. This should be specified in the vendor solicitation scope-of-work. Even if initially found not cost-effective, the city should periodically revisit the original cost estimate to track falling installation prices and thus improved returns on investment.

A reported, good case study of a nearby, small town P-C program is Mount Vernon, Indiana (pop 6,687).

GA4. Anti-idling Policy

Implementation years: 2013 -2042
Projected average annual energy savings: 186 MMBtu ($5,100 at $3.38/gal)
Projected average annual GHG reduction: 3 equiv metric tons
Simple payback: variable fuel costs

EPA calculations state that an average car burns nearly a gallon of gas for each hour spent idling. Calculations from the Hinkle Charitable Foundation conclude that depending on the engine size, a car that reduces five minutes of unnecessary idling daily will save 10-20 gallons of fuel annually. This is something that the city could develop immediately and include various exceptions as needed. The Town of Tolland, CN (pop 15,000) has an excellent sample anti-idling policy to review.

The City in any event would see all of the estimated savings long before entering an agreement to proceed.

The estimated savings is shown here is an illustration for our planning purposes here. Based on an average 15 gals of saved fuel annually for each 5 minutes of eliminated idling per day, the following scenario of 5-year increments is possible:

Participating % of fleet	**Average daily time of reduced idling**	**Program years**
25%	5 minutes	2014 – 2019
30%	10 min	2020 - 2023
40%	10 min	2024 – 2031
50%	10 min	2032 – 2042

This is a "placeholder" estimate only given a wide variety of variables, not the least of which is that improved fuel efficiency over time will likely reduce saved fuel, but which may be far out-weighed by dramatic price increases over the plan period.

An additional fleet maintenance savings could be the use of synthetic motor fuel oil. Although synthetic oil goes much longer between oil changes, it costs about twice as much as regular motor oil. Its principal advantage is that synthetic oil is more slippery than regular and makes for less engine wear and thus greater engine longevity. Should the city decide to try this, it should start using the synthetic oil in its new cars first. Older cars with greater engine wear tend to not do as well with the extra slippery synthetic oil.

GA5. Landfill Methane Gas Harvesting

Implementation years: pending additional information
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

The city's old landfill may be eligible to economically harvest methane and develop one or both of 2 potential revenue streams: 1) utilizing the methane; and/or 2) selling related carbon offsets. If the there is sufficient methane gas flow and acceptable gas quality, there are companies that develop gas collection and utilization systems on qualified landfills at no cost to the landowner and would pay a royalty to the city. The initial threshold to determine the potential flow is to find the total number of tons in place and the year the landfill was closed. That then would allow utilization of the EPA/LMOP website to determine initial feasibility, then usually followed by a gas analysis (the quality of the emission). Staff is searching for a previous technical study that probably contains much of the initial information needed.

If implemented, this would develop an energy source and a revenue stream to help finance other efficiency improvements. The current market for both revenue streams is weak. But these weakness in the current market should not stop a preliminarily evaluation for potential development at a more profitable time. Additionally, this research should also consider potential of selling carbon offsets or credits for the entire BECS program, as it too will be tracking reduced GHG emissions. (PCSP)

GA6. Programmable Thermostats

Implementation years: 2013 - 2042
Projected average annual energy savings: 286 MMBtu ($6,500 per year including gas and electric)
Projected average annual GHG reduction: 58 equiv metric tons
Simple payback: Less than one year

According to the U.S. DOE, a building can save about 10% per year in heating and cooling bills by turning down the thermostat back 10 to 15 degrees for eight hours a day. In this calculation, we take 1/2 of the city's total buildings energy budget in 2010 (a nominal estimate of eligible buildings and minus the city's pump stations, water tower, and aeration facilities), $162,303 (electricity and natural gas), and conservatively assume 40% heating and cooling costs (a national average), or $64,921 annually and then assumes a 10% savings annually or about $6,500 savings per year, in today's dollars. There is of course a wide range of variables affecting savings, but for our planning purposes here, this illustrates the degree of possible savings.

Both City Hall and the Municipal Building have programmable thermostats already installed but are not currently programmed. Due to its 24/7 ventilation, City Hall should show immediate results. There are practical challenges of keeping thermostats correctly set and only changed by authorized staff; as well as the reported widespread use of personal space heaters. These issues should be addressed over time with both new policies and efficiency retrofits to realize the full benefit of temperature setbacks.

GA7. Facilities Lighting Retrofit

Implementation years: 2012 - 2015
Projected average annual energy savings: 1,358 MMBtu ($30,800)
Projected average annual GHG reduction: 274 equiv metric tons
Simple payback: under one year

The current city plan is to change out most all of the existing city hall lighting to more efficient T-8 fluorescent lamps and ballasts. However, overall lighting typically accounts for 17% of office electrical costs. The city should conduct a systematic assessment of the cost of lighting upgrades for all city properties and develop an overall retrofit program. If not part of a performance contract per #GA3 above, there are lighting companies that will propose a performance contract for this type of project alone, design a payment plan out of energy cost-savings, and with no out-of-pocket cost to the city.

The future of lighting is in LED bulbs. LED lighting is roughly 40% more efficient than comparable CFLs and roughly 75% more efficient than incandescent bulbs. Additionally, LEDs last about 5 times longer than CFLs and therefore have more dramatic savings. The estimated savings in this section assumes a complete switch-out to optimized lighting by 2018, assuming a modest 40% savings rate or roughly $33,000 per year and which easily absorbs the initial extra cost of more efficient bulbs and ballasts. The estimate assumes an incremental five-year transition.

Optimized lighting retrofits are in practice a highly technical field based on existing conditions. Pending a decision on an overall performance contract described in Item

#GA3. above, a separate solicitation for a lighting retrofit proposal could be prepared and again, in consultation with an independent expert.

GA8. Customer Water Conservation

Implementation years: pending
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

Another potential area of significant energy savings is water conservation. Reduced water consumption saves both city operating money for its largest energy consumption, water treatment (and, conversely, its third largest energy use, wastewater treatment, costing BMU a combined $344,000 per year or 41% of the city energy budget) and it saves consumers money as well. There's a wide range of water conservation measures that focus on residential use. However, we have not attempted to estimate any savings here because the city usage pattern requires more research. The main issue is that the city's 2010 water usage is 53 gallons per capita per day, approximately 20% below the national average. There are many reasons why this may be, but this needs to be better understood before designing a local water conservation program.

■ GB. Low Cost EE Improvements

GB1. Improved Fleet Mileage

Implementation year: 2015 -2024
Projected average annual energy savings: 1,370 MMBtu ($37,400)
Projected average annual GHG reduction: 31 equiv metric tons
Simple payback: varies on a case-by case basis

The city's development of systematic fleet mileage records will provide the basis to understand the city's fuel utilization and thus identify potential areas for improvement. After two years of fuel records and its analysis, the city should study the possible ways to improve fuel efficiencies including acquisition of alternative fuel vehicles and/or modified vehicle usage, and/or an improved anti-idling policy (see Item #GA4.).

Berea would be well served to consider all recommendations here as well as support the citywide transportation recommendations to adapt to the evolving situation. The key to optimizing fuel efficiency is a review of city fleet fuel mileage records of individual car models and to conduct a standard statistical analysis of their comparative fuel efficiency. This will help understand usage patterns and develop fuel efficiency targets, potential savings in future car purchases (given higher initial purchase prices in many cases), and factor significantly reduced vehicle maintenance. Likewise, the State Purchasing Contract office will consider car models not currently available. Given the city mileage database this would make for an excellent college math-major project. (PCSP)

Of special note is the Transportation Team recommendation to develop electric vehicle charging stations and how to best test city EV utilization. In addition to significant fuel savings, they last much longer than gas powered cars (because of fewer moving parts) and require much less maintenance.

In a larger sense, the city should systematically monitor the rapidly changing field of ever improving fuel-efficient cars (e.g. flex-fuel, hybrids, plug-ins, fuel cell, and combinations thereof). The City should also develop a fuel emergency assurance plan to assure that the city can deliver vital services in the event of a fuel emergency or rationing.

A staff committee should be formed at the earliest possible time to study the entire fleet efficiency situation and make recommendations, writing an anti-idling policy. The staff committee should develop a cost benefit model based on current government fuel mileage to consider the extra price of more efficient vehicles and related financial advantages. (See http://www.fueleconomy.gov/feg/savemoney.shtml for a sample cost-benefit formula.) Its expected that significant increases in fuel prices will incrementally improve the cost-benefit over time, as well as technology improvements and as fuel efficient cars become more affordable. This could be a part of the earlier college student project above or done separately depending on the timing. (PCSP)

In the anticipation of fleet fuel mileage records, the estimated savings show a modest, average 10% fuel improvement over the life of the plan for the fleet's on-road vehicles; starting in 2015 with an incremental and additional 1% improvement each year to 2025.

GB2. Comprehensive Energy Audit

Implementation years: To be determined pending determination of Item #GA3
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple pay back:

As an alternative to the recommended performance contracting described above in Item #GA3, the city could hire a commercial energy auditor to conduct a full energy audit for its own use. The city could then develop a plan of their own accord and make incremental EE improvements over time. However, there are two disadvantages in this approach: Without implementing a coordinated package of improvements, it will take the city considerably longer to achieve the available energy savings. Secondly, there is a significant cost in the delay of energy efficiency projects. Restated, there's a loss in the delay and an additional compounded, second loss in paying ever-higher energy prices.

A middle alternative between full pursuit of a performance contract and an independent audit is to solicit an ESCO contractor where the City evaluates each next step in the performance contracting (P-C) process. This would be the usual P-C process but with the caveat that its incremental and alerting interested vendors in advance of the fair likelihood that the city could stop the process at any time. Ideally, this should involve some pre-agreed compensation or modest honoraria in the event the audit is completed but the larger process of moving to a P-C is stopped.

GB3. Street Lighting Upgrades

Implementation years: 2021 – 2042
Projected average annual energy savings: 703 MMBtu ($12,200 - using weighted average BMU and Blue Grass Energy non-residential kWh rate – not the fixed pole rate)
Projected average annual GHG reduction: 153 equiv metric tons
Simple payback: 1 – 3 years

The current city policy is to replace its mercury vapor streetlights as the bulbs wear out with equivalent high-pressure sodium bulbs, about 10 bulbs per year.

However, the city is currently testing LED bulbs for possible use in the future, but concerned about the viability of their bulb life, estimated 12+ years. Research is underway to improve LED street lighting. One company reports an LED street light that is up to 60% more efficient than previous models and allows cost recovery through energy savings in only three years. The city should compute its own payback rate using its local utility rates compared with the fixed pole rate it charges. The city's 2010 street lighting expense was $76,459. The payback rate should also include the cost savings of fewer replacement bulbs.

See the following DOE website for detailed LED street lighting case histories (with the oldest case histories dating back to 2008):
www1.eere.energy.gov/buildings/ssl/gatewaydemos_results.html

Assuming the LED bulbs prove satisfactory, it is recommended converting the entire 899 street lights to 50 LED bulbs/yr for the next 17 years, reflecting an overall 26% savings using LED bulbs compared with the current fixed pole rate and current city mix of mercury vapor and high pressure sodium lights and at their respective wattages; lit an average of 11 hours per day. Although the current fixed-pole utility rate needs to be periodically adjusted to compensate the reduced electrical consumption (the current utility tariff is charged on a set per pole rate, which would need to be adjusted to reflect reduced energy use and cost savings to the city) .

Hopefully the city can decide to begin the switch much sooner than 2021. This is another good example of where a college student could do a thorough review of the state-of the-art to examine the documented longevity of LED street lights and break-even points. (PCSP)

A second potential type is retrofit is solar street lighting. These typically take much longer to capture its return on investment, 10 to 15 years. But once paid off, the solar equipment can be guaranteed for up to a total of 30 years and cost significantly less to operate. The city should consider solicitation of vendors to try a small area of about 10 to 20 streetlights to test the possible economies. A key part of the RFP process is to have an expert in the field write a precise scope-of work, to make sure that proposals received compare apples to apples. Berea College has solar powered street furniture and may have the sought longevity experience. As above, a college student could combine her LED research and also report on this state-of-the-art on this topic as well. (PCSP)

As described in Item #GA7, there are performance contracting lighting companies that will assess and recommend energy efficient street lighting alternatives and install improvements at no out-of-pocket expense if the cost savings are sufficient.

GB4. Firehouse #2 Upgrades

Implementation years: 2013 - 2014
Projected average annual energy savings: 110 MMBtu ($2,500/yr)
Projected average annual GHG reduction: 28 equiv metric tons
Simple payback: To be determined

In the process of deciding how to proceed with the energy audits of all buildings, the city should proceed as soon as possible with an energy audit of Firehouse #2. At our estimated $3.00 per sq ft energy costs per year, it is clearly far above average cost. An immediate audit and review of possible EE improvements could save the city significant money.

GB5. Energy Efficient Construction Policy

Implementation years: 2015 – 2042 (very approximate time period)
Projected average annual energy savings: 145 MMBtu ($5,100 gas & electric)
Projected average annual GHG reduction: 28 equiv metric tons
Simple payback: 4.9 years (assuming a $1/sq ft extra construction cost)

The City should pursue the highest and most cost-effective energy efficient design for all capital projects. All new construction exceeding 5,000 sq ft and major renovations exceeding 1,000 sq ft of municipally owned facilities should seek Energy Star certification. On average, Energy Star buildings use 35% less energy than their peers. To achieve the label, buildings must be independently verified to perform among the top 25% of similar buildings nationwide[29]. The savings estimate here is based on an approximate 6,000 additional square feet that may occur of the adjacent Municipal Building site and/or a possible building addition nearby.

For our purposes here, the net energy advantage of Energy Star is assumed to be 15% more efficient then the new code. Although, there is no direct correlation between Energy Star commercial certification and the new IECC code. ES certification can potentially improve building performance. It begins with an energy savings target and then focuses on prescriptive requirements – see www.energystar.gov/index.cfm?c=cbd_guidebook.cbd_guidebook_learn_more_2 for complete information. The final cost–benefit decision should research the best information at the time of the decision.

This calculation assumes an additional 20,000 SF of city facilities in a straight-line projection to serve the projected 21,305 population in 2042 and uses the BMU Class 2 Commercial rate (6.23c/kWh) for this case of future city.

[29] see www.energystar.gov/ia/partners/publications/pubdocs/C+I_brochure.pdf?2230-5030

GB6. LED Holiday Lighting

Implementation year(s):
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback: 4 years

(Pending a count of existing holiday lights to complete this recommendation.)

■ GC. Energy Efficient Investments

GC1. Incremental EE Building Upgrades

Implementation years: (Pending decision on #GB2 above)
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

Corresponding to Recommendation #GB2 this activity represents an incremental approach to comparatively major efficiency upgrades over a 20-year period achieving an additional 19% in total energy savings (the same calculation as explained in the alternative program #A3. above). This calculation is simply prorated over that period of time.

GC2. Enhanced Building Automation

Implementation years: To start in 2021
Projected average annual energy savings: 553 ($9,900)
Projected average annual GHG reduction: 112 equiv metric tons
Simple payback: To be determined

This is a future activity once all or most of the city buildings have been retrofitted for EE improvements. Enhanced Building Automation is an electronic monitoring system that permits the city to better manage both energy in all its buildings and the comfort of building occupants. It is sophisticated software that monitors and adjusts all HVAC, lighting, and security including optimized air exchange rates balancing indoor climate with outside temperature and humidity. Systems can also be designed to automatically respond to utility price changes. Berea College uses this system as a part of their overall 39% energy savings since 2002.

The savings shown here assumes that 25% of the city portfolio would be eligible for such automation and a 10% average annual savings rate starting in the year 2021. This is a conservative assumption. Savings could be significantly higher if more city buildings are included in the program and the actual savings rate could be higher as well; a 20% savings rate is not uncommon -- but the lower 10% rate is used here because the city's pre-retrofit program and energy costs will be significantly lower thereafter (i.e., in today's dollars).

GC3. Solar Farm Leasing Program

Implementation years: 2011 -- 2042
Projected average annual energy savings: 1,035 MMBtu[30] ($20,700 – weighted-average residential rate only)
Projected average annual GHG reduction: 223 equiv metric tons

BMU leases out 235-watt solar panels for $750 each for generated-power cost-credits on owners' electricity bills. The program cost is partially grant funded and each lease is for 25 years. There are currently two arrays totaling 120 panels for a total 28.2 kW of collection capacity.

With the grant funding spent, the city should develop a new business model with the goal of continuing and monitoring the program for its cost savings and particularly its impact on peak loads. Based on Kentucky Utility discussions, they have no objections in the development of up to 1% of total power purchased as renewable sources or about 300 kW (including the current net metering program) or about 20 additional solar arrays. This calculation assumes the implementation of one additional array annually for 20 years, or until a more significant renewable energy mix is developed.

The city's renewable energy business model should also be reviewed to assure that the city's overhead costs, maintenance expenses, and even a modest return on investment are developed; to create a sustainable business approach and capital for future equipment replacement and renewable investments. That developed, the city should devise an overall program design, measurable goals, and marketing program to expand its renewable activities. In the short term, the city should promote both its solar leasing and net metering programs through the city website, bill stuffers, periodic press releases, GTV, and other publicity.

On a larger scale, a policy decision is needed whether to pursue and at what pace a significant source of local renewable energy development. The city should undertake a fiscal analysis to determine the range of activities to save both peak load power and reduced power purchases in general. At the same time, this needs to bear in mind the City's need to make its required bond payments for its recent purchase of the electric utility. These bond payments end January 2025 and are currently paid out of BMU revenues. The fiscal analysis also needs to consider possible future revenue declines such as due to this past, record warm winter. The development and pace of significant renewable power in Berea needs to be carefully timed and priced, to adequately fund the dual purposes of required bond payments and renewable development.

Concurrent with the development of the city's renewable energy policy, the city should invite Bluegrass Energy and Delta Gas to help develop the city's renewable program with an eye toward their own renewable energy programs in Berea.

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[30] assuming average of 4 hrs sun/day

GC4. Utility Peak Load Reduction

Implementation years: To start 2017
Projected average annual energy savings: $114,800 in BMU payments to KU
Projected average annual GHG reduction: Not applicable
Simple payback: To be determined

Energy efficiency and utility peak load management share certain benefits. Reducing peak demands may also yield energy savings, and most energy efficient technologies yield some peak demand savings. While energy efficiency programs can, and often do, produce reductions in peak demand, such results have not historically been a priority of these programs. Instead, the primary focus has been the estimation of the program's energy (kWh) savings.

When coordinated with energy efficiency and demand response programs, peak load management programs yield reduced peak-coincident electric load, improve electric system reliability and system load factors, manage risk, and improve system efficiency. These programs also provide cost-effective energy and capacity by reducing summer and/or winter coincident peak demand.

Peak period demand charges paid by BMU to its power provider in 2011 represented 39% of total charges paid, at a rate of $10.674/kW (and an additional $1.17562/kW for OATT). By reducing peak period consumption, BMU saves the peak period charges. A 1% peak reduction in 2010 would save BMU approximately $31,000, a 5% reduction would have saved $156,000, and a 10% reduction would have saved $313,000. Reducing utility peak period use helps save peak charges and aids in keeping rates lower than might otherwise be the case. Likewise, these savings gives BMU greater ability to invest in sustainable energy options and thus greater degrees of energy independence.

There are several approaches in reducing peak load including such techniques as the analysis of load shape factors, targeted efficient appliance incentives, and consumer education in avoiding peak times, such as Blue Grass Energy's "Beat-the-Peak" Program. The Berea Utility Advisory Board is examining these techniques recommended in a 2011 report by Demand Side Management expert Glenn Cannon.

There is an additional, longer-term peak reduction technique in developing customer-owned renewable energy sources discussed in Recommendation #GC5.

For our estimated savings here, we have assumed a conservative, net savings in an increment of 1% bi-annually to 5% over a 10-year period starting in 2017. However, there will be various implementation costs depending on the strategies chosen and when they are chosen.

Additionally, in a conversation with Mr. Cannon, he said that the city can also expect additional energy savings because as customers observe peak load reduction practices, they ultimately also use their energy more wisely and save on their own energy charges and "non-coincident" peak use as well.

GC5. Distributed Energy Feasibility

Implementation years: To be determined
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

The concept of Distributed Energy is that a significant percentage of the population produce their own renewable energy and then share it with each other over the electricity grid, like an "energy internet".

This vision has already gained traction in the international community. The European Parliament has issued a formal declaration calling for its implementation to involve millions of people and other nations in Asia, Africa, and the Americas are preparing their own initiatives for transitioning to this new power paradigm.[31]

A robust distributed energy plan will require improved flexibility of the smart grid, even without the addition of energy storage. The current infrastructure is not built to allow for many distributed energy feed-in points, and typically even if the some feed-in is allowed at the local (distribution) level, the transmission–level infrastructure cannot accommodate it. Rapid fluctuations in distributed generation, such as a cloudy day of gusty weather, present significant challenges to ensure stable power levels through varying the output of more controllable generators such as gas turbines and hydroelectric generators. Smart grid technology is necessary for very large amounts of renewable electricity on the grid. The question then, is how much renewable energy can the current grid accommodate?

If this opportunity were to materialize, there are two things for Berea to bear in mind: 1) investments would create hundreds of new businesses and jobs; and 2) the fundamental nature of local utilities would remain largely as is, managing the flow of electricity and maintaining infrastructure; only instead of using only one wholesaler, there would be many other, smaller wholesalers. Even at full build-out, this system would still need a traditional back-up power source from a wholesale provider.

Utilizing this new approach would permit BMU to purchase significant, renewable local power. However, there is one important caveat, and that is the starting point for this new system is to develop a "feed-in" tariff, which initially agrees to a guaranteed price from the utility for a 10+ year period of time. The reason for this is to thus allow individual energy generators to have an assured income to pay off their investment debt, i.e., used to develop their power generation and equipment. The decision of whether a utility would want to enter a long term price commitment requires careful study of it's ability to carry such a long term commitment.

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[31] A full explanation of the vision and its implementation can begin with a one hour presentation at http://www.booktv.org/Program/12890/The+Third+Industrial+Revolution+How+Lateral+Power+is+Transforming+Energy+the+Economy+and+the+World.aspx and Mr. Rifkin's recent book on the subject, *The Third Industrial Revolution: How Lateral Power is Transforming Energy, the Economy, and the World*.

An excellent introduction to the feed-in tariff situation in Ky is a whitepaper, *Feed-in Tariffs: Building a Renewable Energy Industry in Ky*, by the Ky Conservation Committee, on line at http://www.kyconservation.org/production-incentives12.pdf

The good news is that once such long-term agreements are completed, the individual vendor would enter a normal market situation; and where the utility could find a short-term price in a normal market situation – and then enjoy concurrent savings in purchasing power from multiple vendors as opposed to only a few.

Although not an immediate issue, this would be an excellent project for joint electrical engineering and economics major students to do a research paper scoping out the long-term possibilities for Berea. This sort of long range planning might be a student project 3 to 5 years down the road. However, the earlier the possible implications are understood, the better position for the city to lobby for the best rules possible.[32] (PCSP)

GC6. Emerging Energy Generation Technologies

Implementation years: 2021- 2042
Projected average annual energy savings: 51,672 MMBtu ($305,200)
Projected average annual GHG reduction: 10,753 equiv metric tons

The utility industry is undergoing a fundamental change. The future utility will almost certainly become a hybrid of centralized power plants and massive distributed generation, combined with a much more efficient system of both generation and consumption. But the business model of the utility and its relationship with its customers will be radically different. It will require utilities to invent a replacement of the spinning meter revenue model. [33]

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[32] This section belies a revolutionary trend in the power industry worldwide. As reported by Mr Rifkin, the emerging situation in Europe is that it is moving toward millions of people, small businesses, and producer's coops producing their own energy. His premise is that renewable energy collection technologies over the next 20 years are going to get cheaper and cheaper. It will follow the same trend as computers and cell phones where the hardware will become so cheap, it will reach a give-away price and energy producers will pay for a service to manage their energy flows. In this new economy, business survival will revolve around energy costs, not labor costs. Because renewable energy is intermittent, business clients in this new system will need to hire expertise to manage the energy flows in their supply chains, products and processes, and distribution. To the extent that utilities can help companies keep energy costs low, keep thermodynamic efficiency high, and increase productivity, these companies can share their productivity and savings with the utilities, in a new paradigm called shared savings. This will also mean a wave of start-up companies selling this expertise as energy aggregators managing flows over the energy Internet. These will be the start-up companies of the 21st century. This is an alternative future that is starting to take shape. Part of reason that Europe is moving so fast is their concern over the global warming crisis. Paradoxically, if this in fact happens, the demand for traditional brown fuels will drop as the utilization of green fuels takes off. There's no guarantee this will happen, but something worth investigating in its potential applications for Berea.

[33] See http://www.pecanstreet.org/2010/05/renewable-energy-and-the-utility-the-next-20-years/

Locating successful renewable energy generation for smaller cities with purchased power utilities is very hard to find -- the possibility of distributed power described above is a potential if not promising avenue. However, the city should also be prepared to assess other renewable energy sources as well. The city should begin a formal review process of other possibilities about five years before the last utilities acquisition bond payment is made on January 1, 2025 (this anticipating the 7-year KU contract cycle coinciding with the end of a contract in 2024). The city should evaluate its options in whatever the current technologies are and be prepared to act when the bond payments are completed.

Using the Zinga & McDonald 2008 report, *A Portfolio of Energy Efficiency and Renewable Energy Option for East Ky Power Cooperative*, 2008, the Bluegrass Energy Coop share for it's service area in Berea was stepped down to estimate a total of 8.3% renewable energy capacity. Given the 30-year time span, it seems reasonable to add an additional 1.7% to reach a 10% renewable energy component by 2042. Likewise, the same factor was applied to BMU. Although BMU's renewable energy mix would be very different as the vast majority of Blue Grass Energy's ultimate source (via its parent energy provider, East Ky Power Cooperative) would be hydropower.

A particularly promising, large-scale renewable energy source maybe the American Municipal Power association. Based in Ohio, it is a nonprofit corporation of 129 member utilities in seven states (including three in Kentucky: Paducah, Princeton, and Williamstown). AMP develops and distributes renewable energy to its member utilities. This would be worth exploring further – see http://www.amppartners.org for complete information.

Given the importance of this assumption as a 30% share of the total one percent per capita BECS plan goal, the complete proportional share calculation is shown in Appendix C.

A recent assessment of current renewable energy technologies in the Kentucky region is the 2010 SEEA study, *Renewable Energy in the South*. In addition to review of the utility-scaled renewable sources (wind, biopower, hydro, and solar), it also assesses customer-owned renewables (combined heat and power, distributed biofuels, geothermal heat pumps, solar hot water, and distributed solar PV). A systematic review of this report and its applicability to Berea would make for an excellent independent study college project to begin monitoring this rapidly changing field in the short and long-range. (PCSP)

DEFINITIONS & ACRONYMS

ACEEE – American Council for an Energy Efficient Economy

Aquaponics is a sustainable food production system that combines a traditional aquaculture (raising animals in water tanks) with hydroponics (cultivating plants in water) in a symbiotic environment.

BECS – Berea Energy Cost-Savings Plan

BMU – Berea Municipal Utilities

British Thermal Units (Btu) -- The amount of heat energy needed to raise the temperature of one pound of water by one degree for roughly the energy in a lit match. This is the standard measurement used to state the amount of energy that a fuel has as well as the amount of output of any heat-generating device. MMBtu is the common symbol for one million Btus.

Carbon Footprint -- The term carbon footprint is actually the total set of greenhouse gas emissions caused by a given activity. Greenhouse gas emissions are comprised of several gases; but for our purposes the inventory software computes carbon dioxide, methane, and nitrous oxide. The footprint is frequently stated as a total number of (equivalent) tons of greenhouse gases or as a per capita number.

Carbon Offset -- A carbon offset is a reduction of carbon dioxide or greenhouse gases made in order to compensate for or to offset an emission made elsewhere.

Comp Plan – Short for the City-adopted 2005 Comprehensive Plan, a document intended to guide all aspects of the city's growth and development, especially land use. Updated and formally adopted approximately every 5 years.

DSM -- Demand Side Management, the modification of consumer demand for energy through various means such as financial incentives and education.

EE – energy efficiency

EISA – US Energy Independence and Security Act of 2007

EKPC – East Kentucky Power Cooperative

Energy Budget -- A balance sheet of energy supply and energy needs More simply, a designated amount of energy to accomplish a given task.

ES – Energy Star program

EV – electric vehicle

Equivalent Metric Ton -- A unit of mass equal to 1,000 kg (2,204.62 lbs). This is the commonly used measure of greenhouse gas emissions. Although its weight is approximately 10% more than a US, 2,000-lbs ton (ie, a short ton).

Feed-in Tariff (FIT) -- A policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long term contracts to renewable energy producers, typically based on the cost of generation of each technology. The goal of FITs is to offer cost-based compensation to renewable energy producers, providing a price-certain in a long-term contract that help finance the renewable energy investment.

GHG -- Greenhouse gases

ICLEI (pronounced "ick-lee") -- The International Council of Local Environmental Initiatives (see icleiusa.org for complete information.)

Kilowatt Hour (kWh) -- A unit of energy equal to 1,000-watt hours or 3.6 mega joules. A heater rated at 1,000 watts (1 kilowatt), operating for one hour uses one-kilowatt hour (equivalent to 3.6 mega joules) of energy. Using a 60-wat bulb for one hour consumes 0.06 kilowatt hours of electricity. Using a 60-watt light bulb for one thousand hours consumes 60 kilowatt hours of electricity.

Megawatt Hour (MWh) -- A megawatt hour is a unit for measuring power that is equivalent to one million watts. One megawatt is equivalent to the energy produced by 10 automobile engines. A MWh is equal to 1,000 kilowatt hour (kWh). It is equal to 1,000 kilowatts of electricity used continuously for one hour. It is about equivalent to the amount of electricity used by about 330 homes during one hour.

MTCE – Metric Tons of Carbon Emissions

Net metering is an electrical policy for consumers who own and generate (general small) amounts of renewable energy (solar power, etc). Under net metering, a system owner receives a retail credit for at least a portion of the electricity they generate.

NGO – non-governmental organization

OATT – Open Access Transmission Tariff – a fee to provide access for wholesale power providers to transmit power on the grid.

Peak Load -- The maximum instantaneous load or the maximum average load over a designated interval of time. Also known as peak demand.

PV Panels -- photovoltaic panels – used to collected solar energy to produce electricity.

Reference Case -- A baseline forecast used by the EIA assuming the most likely forecast conditions, versus other forecasts assuming less likely conditions, usually a higher and lower forecast.

Sector – Type of land use such as residential, commercial, or industrial categories.

Smart Grid generally refers to a class of technology to bring electricity into the 21st century using computer-based remote control and automation. These systems are made possible by two-way communication technology and computer processing that has been used for decades in other industries. They offer a wide range of utility management tools not previously available.

Stationary Uses – Buildings and other permanent facilities, as opposed to mobile equipment such as cars, etc.

Total Per Capita Energy Consumption – Total energy consumed annually plus imports minus exports, expressed in kilowatt hours. The discrepancy between the amount of electricity generated and/or imported and the amount consumed and/or exported is accounted for as a loss in transmission and distribution. Per capita figures expressed per one (1) population.

Vehicle Miles Traveled (VMT) -- A measure of the extent of motor vehicle operation; the total number of vehicle miles traveled within a specific geographic area over a given period of time.

APPENDIX

<u>Appendix A</u> - Berea Energy and Greenhouse Gas Emissions Projections

<u>Appendix B</u> - (The actual Excel workbook should be posted on the city government website for easier use and access to cell comments – at bereaky.gov)

Appendix B.1 -- Citywide Energy Savings (MMBtu)
Appendix B.2 -- Citywide Gross Cost-Savings (Dollars)
Appendix B.3 -- Citywide Avoided Greenhouse Gas Emissions (MTCE)
Appendix B.4 -- City Govn't Energy Savings (MMBtu)
Appendix B.5 -- City Govn't Gross Cost-Savings (Dollars)
Appendix B.6 -- City Govn't Avoided Greenhouse Gas Emissions (MTCE)

<u>Appendix C</u>- Calculation: Berea Share of Southface Institute Estimated EKPC Renewable Energy Potential

APPENDIX A

Berea
Community Greenhouse Gas Emissions
Time Series Report

Scope 1 + Scope 2

Year	2015	2020	2030	2040	2042
Residential					
eCO2 (tonnes)	85,399.4	90,536.1	101,775.8	114,439.5	117,158.6
Energy (MMBtu)	647,336.5	685,317.8	768,426.5	862,064.5	882,170.1
Commercial					
eCO2 (tonnes)	38,122.2	40,438.2	45,506.1	51,216.1	52,442.1
Energy (MMBtu)	246,774.6	261,508.3	293,747.7	330,071.5	337,870.9
Industrial					
eCO2 (tonnes)	130,393.4	138,099.3	154,960.9	173,958.8	178,038.0
Energy (MMBtu)	730,829.0	770,769.8	858,166.2	956,635.1	977,778.0
Transportation					
eCO2 (tonnes)	26,823.0	26,874.0'	26,976.3	27,079.0	27,099.6
Energy (MMBtu)	373,998.2	374,709.4 '	376,135.7	377,567.5	377,854.5
Waste					
eCO2 (tonnes)	4,893.6	4,893.6	4,893.6	4,893.6	4,893.6
Total					
eCO2 (tonnes)	285,631.7	300,841.3	334,112.8	371,587.0	379,631.9
Energy (MMBtu)	1,998,938.4	2,092,305.2	2,296,476.1	2,526,338.5	2,575,673.4
Cost ($)	0.0	0.0	0.0	0.0	0.0

This report has been generated for Berea, Ky using ICLEI's Clean Air and Climate Protection 2009 Software.

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APPENDIX C

Berea Share of Southface Institute Estimated EKPC Renewable Energy Potential

Given that the approximate 30% share of the 1 percent per capita energy goal is long-range renewable energy development, we thought it important to share the calculation of that energy savings:

Solve for x to find Berea's BLUE GRASS ENERGY share of estimated renewable potential:

(BLUE GRASS ENERGY Berea 2010 power:) 160,036 MWh "x" = 13,351 MWh
(BLUE GRASS ENERGY renwbls share)

_______________ = ____________________

(EKPC 2008 power) 12,948,091 MWh 1,0076,761 MWh (EKPC renwbls est)

Therefore, 13,351 MWh / 160,036 MWh = 8.3% renewables of 2010 BLUE GRASS ENERGY power sold in Berea

Thus, estimating a total 10% renewable energy mix for the combined BMU and BLUE GRASS ENERGY power in 2010:

2 98,187,303 kWh (combined 2010 BMU & BLUE GRASS ENERGY power sold in Berea)
x 10% (renewable energy mix goal)
____
29,818, 730 kWh (total renewable energy potential) = 101,745 MMBtu

101,745 MMBtu
/ 22 years (time span of the implementation, 2021 – 2042)
____
4,625 MMBtu per year (or 1,355,397 kWh or about .045% of the combined 2010 city electrical power consumption)