M E M O R A N D U M

TO BECS Community Advisory Committee

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RE TRANSMITTAL

Attached for your review and comment is a copy of the BECS teams' preliminary recommendations. This is one of two review periods over the next 5 weeks. ***This first round of comments is due Friday, April 27, 2012.*** I will send everyone attending today's meeting an electric copy for your use, or if you prefer to mail me any comments, please mail to 310 Cochran Road, Lexington, KY 40502.

The purpose of today's CAC meeting is to give a personal presentation and overview of the draft recommendations and also have some discussion. But the nature and depth of the plan could entertain far more discussion than most folks would be able to accommodate and that's the reason for this particular format.

There are three things that I would like to share in reviewing the plan. The first is that the general public is the primary audience. But at the same time, the plan is designed to be a guide and resource for those implementing the plan over time.

The second point is that the main feature of this particular planning process is that implemented programs be measurable. This is important to evaluate what's working best and where to best devote time and resources in the future. Likewise , the first part of this plan process includes a computerized data inventory of all aspects of citywide energy use as well as all city government operations . Annual update of this database will be the overall measure of the effectiveness of the program.

Lastly, initial goals are always the softest part in the process. Better goals will be developed over time as program experience and better data feed the program. The initial goals are a starting point in what should be a flexible and adaptive plan implementation.

On behalf of the City of Berea staff, the Kentucky Environmental Foundation, and Sustainable Berea Inc., thank you for your time, efforts, and interest in crafting the plan. It's community participation that makes all the difference!

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PRELIMINARY BECS RESIDENTIAL TEAM RECOMMENDATIONS

Revised April 15, 2012

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

Introduction

Three are three categories of energy efficiency home improvements discussed in these recommendations:

1) Weatherization: actual improvement cost under $3,000 (ie, weather stripping, caulking, duct sealing, some insulation)

2) Comprehensive Weatherization: $3,000 - $5,000 (ie, #1 above + insulation, moisture barriers, under floor insulation, programmable thermostats)

3) EE Retrofits: $5,000+ (#1 & #2 above plus HVAC improvements, comprehensive spray foam, and/or replacement windows)

All costs are in today's dollars and the cost of electricity is a weighted average of BMU and BGE unit-cost tariffs. The next plan iteration will develop weighted averages also calculating applicable base fee and demand charges. Bottom line: the cost savings shown in this draft are conservatively low.

RA. NO COST (OR VERY LITTLE) PROGRAMS

RA1. Residential Energy Audits

Implementation year(s): 2013 - 2030
Projected average annual energy savings: 41 MMBtu ($820)
Projected average annual GHG reduction: 8.3 equiv metric tons

A combination of several local agencies offer residential energy audits, BGE, Delta Gas, MACED, HEP and others; currently totaling about 130 [sic] audits per year. The outcome of an audit determines and type and level of retrofit needed for a home. The occupant is then empowered to decide what suggested improvements will be made and whether to be contracted out or done by the homeowner. Follow-up monitoring of energy usage is critical in measuring progress and in publicizing results for greater community awareness (ie, on a data-blind basis).

The proposal here is to develop a coordinated city residential energy audit program that uses a three-prong approach: (1) to identify free or subsidized audit services to eligible utility customers, (2) continuing an energy audit incentive program where the cost will be included in any follow-up financing, and (3) to publicize commercially available energy audit services, ie, for a price. This information should be communicated in a public information program, to be done in an incremental fashion to not overwhelm available resources.

All of the city's audit agencies should meet to develop a program to achieve the above objectives and develop recommended proposals including but not limited to: (1) a meeting with rental property owners, (2) creating a single source website of available services, typical savings, and local savings stories, and (3) develop a subsidized energy audit proposal to serve BMU customers within a business model for the city to recoup at least all of its overhead costs.

BGE 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 is pinpointing air leaks. Those companies should be asked to consider BPI level audits and thus seek consistent information.

The calculation above assumes an average 150 energy audits per year, which would take about 30 years [sic] to canvass (ie, existing buildings targeted only as all new construction will be to new EE codes). However, depending on the rate of subsequent home EE improvements, this rate could be significantly less because of both diverted effort in supervision of retrofits and/or the availability of contractors at peak times. Nonetheless, assuming an average 51 MMBtu usages per year (ie, not including natural gas use for which this number is not available) and a 4% rate of behavioral changes in 20 of the completed audits, could save in energy usage as shown above. The balance of 130 audits targeted for various retrofits explained below.

RA2. Energy Consumer Education Program
Implementation year(s): 2013 - 2042
Projected energy savings: (Pending)
Projected GHG reduction: 68 equiv metric tons

There is a separate recommendation for public education covering the entire BECS program. However, the residential component should include the following two recommendations in its outreach and be scheduled at times that best coincide with timing of selected priorities.,

The first is the expansions of the current HEP energy training workshops that are provide 1-1/2 hour practical energy efficiency applications and opportunities. The program information should be recorded for immediate public access in addition to live sessions.

The second recommendation is to begin a "Lighten-up Berea" community program to invite groups of about 6 homeowners each to form teams to reduce their energy usage in their respective homes. The model is based on the City of Frankfort, Ky pilot programming 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. The book is inviting and easy to use. Participating households are encouraged to form teams which meet four times over the course of one to three months to work through the book together.

Although this is a carbon-based savings approach, it easily translates from avoided greenhouse gas emissions to saved energy. Based on the initial Frankfort experience, this assumption assumes 30 households per year saving 5,000 lbs of CO2 emissions or (pending) MMBtu 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, ie, in addition to reduced carbon emissions.

RA3. Public School Energy Efficiency Curriculum
Implementation year(s): 2023 - 2042
Projected energy savings: 191 MMBtu ($3,800)
Projected GHG reduction: 38.6 equiv metric tons

This program is to integrate energy conservation in the two public school districts' curriculums. The Madison County school district has a pilot program underway and Berea Community Schools has expressed similar interest. This represents an excellent opportunity to teach future Berea citizens the advantages of saving energy and money; particularly for future residents that stay in Berea and become efficient energy consumers, thus contributing to overall city energy savings. 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.

RA4. Energy Star Purchasing and the US Energy and Security Act of 2007
Implementation year(s): 2012 -2022
Projected energy savings: 1,601 MMBtu ($32,000)
Projected GHG reduction: 324 equiv metric tons

Promote the purchase of Energy Star label products to save on average 20% to 30% energy use compared with standard products. Although, 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/). 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.

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). This calculation assumes a full lifecycle residential conversion by the year 2026. The basic calculation assumes a modest 3% total average appliance savings spread out over 10 years for 75% of the city's housing stock (ie, minus completed change-outs and student housing); and a complete phase out of all "common lighting" by 2022, prorating an average of 30 and 20 such bulbs per homeowner and rental household respectively. And all of these calculations only apply to the 37% regional residential average of power consumption devoted to refrigerators and home appliances.

EISA has an additional provision for selected appliances to develop test standards to turn off "standby power" automatically, ie, 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, but is not reflected in the calculation above.

RA5. On-Bill Financing Program
Implementation year(s): 2013 - 2030
Projected energy savings: (Not applicable - finance measure only)
Projected GHG reduction:

To help property owners and renters afford EE improvements, develop an on-bill financing program to serve all city customers. On-bill financing is, effectively, a loan to an occupant to make EE improvements to their property at a low interest rate. However, unlike a traditional loan, this type of loan is paid back through the utility bill using prorated energy cost-savings to pay back the loan and at less than the average monthly power bill. Additionally, the cost of improvements is linked to the power meter, not the customer. If the "borrower" leaves the property, the next occupant pays the remaining portion of the improvement; but in so doing, also enjoys the reduced energy costs due to the EE improvements. Savings increase still further once the loan is repaid and the loan amount drops off the bill, as well as avoided, future cost increases in electricity and, conceivably, natural gas.

To clarify, the funds that pay for the improvements is not actually a loan, but for all intents and purposes serves as one and is the easiest way to understand the consumer's role in the transaction. There is no value here in going into the reasons why, except to say that this is a "tariff-based on-bill financing system" and the reader can look it up if so inclined.

Using a standard business model to assure that, at the very least, all overhead costs are covered, develop a proposed on-bill financing program. Using MACED's current, on-bill financing support services, currently serving four other local utilities in the region, develop a proposed program where both BMU and BGE could offer this to their customers.

Program design, financing, and operations are complex. Suffice it say, MACED provides an established and successful program that can help develop a proposed business model that should make economic sense to both electric power providers in the city.

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

RA6. Holiday LED Lighting
Implementation year(s): 2011 -2022
Projected energy savings: 41 MMBtu
Projected GHG reduction: 9 equiv metric tons
Simple payback: 4.6 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 us 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 swithchover at and average 8 strings per household (combining indoor and outdor displays on average). This information should be included in the RA2. Consumer Education Program.

RB. LOW COST PROGRAMS

RB1. Basic Weatherization
Implementation year(s): 2013 -2030
Projected energy savings: 104 MMBtu ($2,100)
Projected GHG reduction: 20.8 equiv metric tons

The principal focus in this first category (please see above) is to 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 households below the poverty level, this is an important community to help adapt to rising energy costs. Although these types of improvements are certainly eligible for all residents and renters to save money. Based on MACED historical data, the first level of energy improvements averaged $1,811 and which compares with the BGE 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 6.4 MMBtu per dwelling annually and additional savings in those instances with natural gas service.

Its important to note that 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 retrofit objective for all such categories is 130 projects per year. This is a high number but can be adjusted over time. The calculation above is based on the composite services yielding 16 such basic weatherization annually; or 12% of the total retrofit jobs per year on average, and again based on MACED historical data.

RB2. Comprehensive Weatherization
Implementation year(s): 2013 -2030
Projected energy savings: 227 MMBtu ($4,600)
Projected GHG reduction: 42.6 equiv metric tons

The principal focus in this moderately- priced second category (see introduction) is to accommodate mid-range EE 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 $4,416 with average energy saved was 10.3 MMBtu per dwelling annually and additional savings in those instances with natural gas service.

The calculation above is based on the composite services yielding 22 such comprehensive weatherizations annually; or 17% of an estimated 130 total retrofit jobs per year on average, and again based on MACED historical data.

And again, a great deal of these basic weatherization actions described above can be made by the homeowner for material costs only and save a substantial amount of the estimated cost.

RB3. Energy Star Residential Construction and Building Rehabilitation
Implementation year(s):
Projected energy savings:
Projected GHG reduction:

(Pending)

RB4. IECC New Construction and Building Rehabilitation Building Code
Implementation year(s): 2012
Projected energy savings:
Projected GHG reduction:

(Pending)

RC. INVESTMENT OPPORTUNITIES

RC1. Energy Efficiency Retrofits
Implementation year(s): 2011 -2023
Projected energy savings: 2,121 MMBtu ($42,500)
Projected GHG reduction: 429 equiv metric tons

The principal focus in this category (see introduction) is to accommodate full EE 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 $8,520 and average energy saved was 23.1 MMBtu per dwelling annually and additional savings in those instances with natural gas service.

The calculation above is based on the composite services yielding 92 such major retrofits annually; or 71% of the projected 130 total retrofit jobs per year on average, and again based on MACED historical data.

RC2. Customer-Owned Residential Solar Generation
Implementation year(s): 2011 - 2042
Projected energy savings: 120 MMBtu (actually energy produced)
Projected GHG reduction: 26 equiv metric tons

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

However, the achievement of significant energy independence will require "feed-in tariffing". This will require state legislation for BGE to consider but probably BMU too as a purchased-power utility. 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 profitably finance renewable energy investments. This programs is the key to stationary energy independence and is discussed further under City Government Programs. The ability of a utility to enter into a long-term purchase price contract is one of several considerations that need to be carefully evaluated.

Our calculation here assumes an annual average 24 kW of customer-owned solar installation per year and includes some solar hot water heating, which has a much faster payback. However, there are many factors that impact this emerging market and ultimate build-out. The main factor at this time is price and the long cost-recovery period. However, solar panel prices are projected to become significantly lower over the life of this plan and which then directly effects the feasibility of feed-in tariffing.

Perhaps one of the best things the city can do presently is to develop 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 Ky Solar Partnership website and which includes an online copy of, *The Ky Solar Energy Guide* (http://kysolar.org/ky_solar_energy_guide), which also includes statewide case studies.

Another recommendation is to 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 the seven 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 prove useful data in future system design and therein yield the most cost-efficient system pricing.

Affordable residential solar power is also available through the city's solar farm leasing program. Please see Program #GC3. for complete information.

RC3. Geothermal Heat Pumps
Implementation year(s): 2011 -2042
Projected energy savings: 27 MMBtu ($2,700)
Projected GHG reduction: 6 equiv metric tons

At present there are ?? geothermal heat pump 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 geolsolar system with even great 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.

This technology should be shared in a similar location and format as suggested in the solar power recommendation above.

PRELIMINARY BECS NON-RESIDENTIAL TEAM RECOMMENDATIONS

April 18, 2012

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

Introduction

Non-residential energy use in Berea is a special creature. It is the lion's share of energy used in the city. Its uses are diverse and specialized, and in the case of the large manufacturing uses, highly specialized. Non-residential energy makes up 70% of all energy used in the city; industrial development alone comprising 55% of all energy used (ie, figuring blended BGE & BMU tariff categories). The Blue Grass Energy Coop alone, serving the north side, 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 they provide in Berea is used by 17 industrial customers, ie, customers using in excess of 1-megawatt power.

Unlike other parts of this plan broken into three cost categories, this part is presented as a single section. Taken together, these recommendations offer as a holistic approach where the proposed outreach program targets a specific audience. 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 BGE. The weighted average rates are 6.93c/kWh for commercial and 4.67c /kWh for industrial. The savings do not include natural gas usage and are somewhat high on that account but at the same time do not reflect base fees and demand charges. Bottom line: the cost savings shown are somewhere near the mark.

NR1. Business Outreach Program

Implementation year(s): 2013 -2033 (End date pending)
Projected average annual energy savings: (Not applicable)
Projected average annual GHG reduction:

Develop an outreach program to introduce energy cost-savings to city business and industry. The program would be in two parts: (a) The first and highest priority would be to contact local manufacturers offering initial one-on-one meetings with plant decision makers, and (b) develop a 2-part outreach for local non-manufacturing concerns conducting group meetings of like businesses (eg, restaurants only, etc.). The group meetings would give a general introduction to EE cost-savings and make a general invitation to meet one-on-one to discuss individual situations. Those meetings and follow-ups completed, 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.

Restated, this process is a systematic canvass of all businesses in the city, starting with those showing the most interest and gradually progressing through the list to contact those with the least interest.

These contacts would be staged over a long period of time and in coordination with other 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 4 years but would be included within the longer time frame.

Depending on the location and type of business, the program's main function would be to share information about how to identify EE opportunities and available, least cost resources to do so. Businesses in the area have access to several site assessment and related technical services such as BGE's program (ie, for BGE customers only), MACED, Delta Natural Gas, the state KPPC, and others. Outreach activities within the BGE service area needs to be closely coordinated with their staff.

Given the size and scale of large energy users, their ultimate goal would be for three key elements of a fundamental, continuous improvement energy management approach:

- Establish a baseline of key performance indicators,
- Develop an energy management plan to meet the facility's energy reduction goals, and
- Support the development and achievement of in-house energy teams.

The main purpose of this outreach is to give businesses an idea of the scope of possible savings, developing a billing baseline; a review of their billing rates; to conduct a site assessment or energy audit as indicated; and identify potential financing sources including applicable incentives, product rebates, and training opportunities. And then to also have ready, information handouts of simple, no cost, and low cost EE measures. The 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, ie, in an aggregated and otherwise blind database.

The program should also makes it's resources available to the public-at-large as a part of the overall energy efficiency campaign in the city. In this case, a simple outreach information brochure attached to new city business licenses could elicit some response. Two excellent non-res energy saving programs are Georgia Power's Earth Cents and Wisconsin's Focus on Energy, excellent case studies for source materials and methods.

The program should be designed in consultation with KPPC, local utilities, and germane NGOs; to develop a coordinated approach and explore possible joint ventures. Like any program design, its level of success will ultimately dictate the level of service provided. However, with 55% of all electrical power in the city used by industry, they should be the first priority in the program.

NR2. Billing Baselines
Implementation year(s): 2013 -2028
Projected average annual energy savings: 710 MMBtu ($13,200)
Projected average annual GHG reduction: 143 equiv metric tons

An essential starting point in the EE process is the assembly of one, preferably the last two years of utility billing. For non-manufacturing businesses, an excellent software to do this is Portfolio Manager. It is an 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 4 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 is of limited use. The benchmarking does not track specialized manufacturing (eg, forklift makers, aluminum producers, etc). Likewise, industrial needs are not a square-foot metric but instead, looking for production measures such as the amount of energy used per widget, etc. Although there are a wide range of billing softwares 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, ie, yielding "key performance indicators."

The systematic tracking of energy use and costs is the key to developing a successful energy efficiency and cost savings program.

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

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 15 years, assuming 220,000 sq ft /yr of commercial billing baselines established annually and at a $1.50 sq ft average annual energy cost for a total $330,000 annual energy budget. Please note that this is an assumption of stand-alone behavioral changes only, ie, no retrofitting involved.

NR3. Site Assessments and Energy Audits
Implementation year(s): 2013 -2033
Projected average annual energy savings: (Not Applicable – information gathering)
Projected average annual GHG reduction:

BGE 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 2 levels of 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 cost, 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 1/3 to ½ 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 yet a different skill set. 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.

Although compressed air is critical to manufacturing, these systems are some of the most inefficient in terms of energy usage. Roughly 80 to 90 percent 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, ie, the use of predicative 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. Its 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. (source: www1.eere.energy.gov/manufacturing/tech_deployment/energy_assessment.html)

BGE provides a wide range of these services at little or no cost to their customers and which happen to be some of the largest electricity consumers in the city.

NR4. Energy Star Purchasing Policy
Implementation year(s): 2013 – 2026
Projected average annual energy savings: 1,440 MMBtu ($19,700)
Projected average annual GHG reduction: 291 equiv metric tons

Purchase ENERGY STAR approved equipment as needed and for replacement equipment. 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 lighting, and full lighting, there would be an average energy savings of 1,440 MMBtu/yr spread out over 13 years.

NR5. Moderate Cost Energy Retrofits
Implementation year(s): 2013 -2033
Projected average annual energy savings: 4,417 MMBtu ($69,000)
Projected average annual GHG reduction: 893 equiv metric tons

In practice, energy conservation is an incremental process that begins and ends with affordability of the simple payback. Having picked the low hanging fruit described earlier, a common strategy is to undertake one of two moderately priced improvements at a time. A frequent choice is improved lighting because its a major business expense and can often pay for itself when a couple of years due to much lower operating costs and the longer life of new lighting products. Other examples in the low to moderate cost range includes insulation costs, leakage repairs, lighting switch-outs, LED exit lighting, programmable thermostats, light sensors, and much more.

This calculation assumes 3 large users' moderate-cost retrofits at $50,0000 each and 5 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. Although a very limited sample size, local data is always more representative than national rates.

NR6. New Non-Residential Construction
Implementation year(s): 2014 -2032
Projected average annual energy savings:
Projected average annual GHG reduction:

(Reserved)

NR7. Capital Cost Retrofits
Implementation year(s): 2014 -2033 (End year pending)
Projected average annual energy savings: 9,470 MMBtu ($68,800)
Projected average annual GHG reduction: 1.916 equiv metric tons

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 plan and managers. But for smaller, locally owned business, the threshold decision to consider improvements is 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 per year and/or combination of smaller ones averaging 200,000 sq ft/year with a $1.85 sq ft electrical cost and saving 35% of energy costs on average.

NR8. Non-Residential Renewable Energy
Implementation year(s):
Projected average annual energy savings:
Projected average annual GHG reduction:

(Reserved)

NR9. Berea College and School District Energy Savings
Implementation year(s): 2011 - 2020
Projected average annual energy savings: 755 MMBtu
Projected average annual GHG reduction: 203 equiv metric tons

(A) 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 energy savings goal of 1.4% per year til then. This translates into 1,900 MMBtu and 422 tons of avoided GHG emissions annually.

(B) Berea Independent School District: According to the previous School Energy Manager, BISD has a nominal goal of saving 1% per year in energy consumption for each of the next 10 years. This translates into an average annual savings of 151 MMBtu and 34 tons of avoided GHG emissions annually.

(C) 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.

The estimated energy savings shown above is the sum of the Berea College and BISD different savings rates over the same 10-year time line.

PRELIMINARY BECS TRANSPORATION TEAM RECOMMENDATIONS

Revised April 8, 2012

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

Comments:

1. Introduction - The following options are based on the internal-combustion engine being around for a long time, cognizant of the national decline in driving and the advent of significantly more fuel efficient vehicles transitioning to comply with new "CAFÉ" standards, fully implemented by 2025.

The national 6-year, average cost increase in gasoline is 7% per year (2006 – 2011). With increasing demand worldwide and declining sources, implementation of a comprehensive transportation energy strategy will improve the city's ability to deal with such events if not fuel emergencies, albeit on an incremental basis as the plan is implemented over time.

2. Setting Energy-Savings Goals - Goal setting is an iterative process. It begins with a wide range of assumptions and serves as a starting point in measuring energy efficiency. Proposed goals will be refined again and again, based initially on community discussion and by better data collection and program experience with each iteration.

3. 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. All calculations are saved in the CAPPA Workbook and will be stored in the City GIS computer at the end of the project.

TA. NO COST EE IMPROVEMENTS (OR VERY LITTLE)

TA1. Individualized Transportation Options Outreach Program
Implementation year(s): 2013 -2033
Projected average annual energy savings: 517 MMBtu ($14,000)
Projected average annual GHG reduction: 40 equiv metric tons

This program would contact households directly and 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 contacting 100 households per year with an eventual goal of an 8% reduction in car use in participating households; increasing 10% each year after 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 #B3. below.

The calculation shows an average annual trip reduction of 4% due to the need to ramp up the program as many of the alternative transportation programs here are developed over time.

TA2. Safe Routes-to-School
Implementation year(s): 2012-2042
Projected average annual energy savings: 1.8 MMBtu ($485)
Projected average annual GHG reduction: 1 equiv metric tons

This is an existing Berea Community Schools program that encourages children to walk or bike to school, emphasizing slowing traffic, improved crossing signals, adult crossing guards, etc. There are about 550 elementary school students at the Berea school. The program includes a variety of pedestrian improvements connecting with the school and to be completed this year as well as the recent, additional $140,000 SRTS grant for pedestrian and bike safety improvements. Assuming future participation of the 3 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 year(s): 2017 - 2042
Projected average annual energy savings: 491 MMBtu ($13,200, not including avoided public infrastructure andlonger service delivery costs)
Projected average annual GHG reduction: 37 equiv metric tons

Berea's well-developed town core and close-in neighborhoods has the potential to encourage more compact development, thus promoting more walking, biking, and mixed-used development. Especially important is the opportunity to encourage compact development with easy transit access and in outlying areas as well. This calculation has been factored for the projected city population, capturing, on average, one–third of new residential development to the year 2033 or about 30 households annually to be located in compact development, ie, essentially designated area(s) with a minimum density similar to the existing, surrounding neighborhood.

There are many considerations leading up to development of a compact development program; especially for adequate infrastructure and traffic capacity. But in addition to the benefits above, compact development can also lead to economic gains, higher property values, and lower vacancy rates, as well as the health benefits of higher rates of walking, biking, and outdoor activities.

Another savings factor in compact urban development is the savings in building and maintaining increasingly more expensive streets, utilities, and city facilities. Additionally, there's a significant transportation cost savings in delivering city services shorter distances to serve compact development.

Perhaps the single most important prerequisite, is to first conduct the pedestrian, bike, and transit master plan study described in Item #B1. below. Understanding the interrelationships of the 3 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 2 initiatives, the bike, ped, & 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. Any and all 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 year(s): 2013 - 2042
Projected average annual energy savings: 323 MMBtu ($6,200)
Projected average annual GHG reduction: 6 equiv metric tons

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 school pick-ups and other services. Additionally, the college has a variety of periodic free 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 per year.

A longer-term goal should be to also investigate the possibility of a commercial car-sharing program such as Zipcar, as an example.

TA5. Car-Pooling/Ridesharing
Implementation year(s): 2013 - 2042
Projected average annual energy savings: 387 MMBtu ($10,500 and annual avoided cost of car ownership: $144,000)
Projected average annual GHG reduction: 29 equiv metric tons

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. 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/Ped/Bus Master Plan
Implementation year(s): 2013 - 2014

Projected average annual energy savings: (Not applicable)
Projected average annual GHG reduction:

Develop an integrated bicycle, pedestrian, and fixed-route bus master plan for the city. The plan would identify the interrelationships of the 3 systems and optimize their use, safety, and convenience. The plan should address, (1) 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 are critical in helping establish a program budget and in knowing how much money is needed to implement the plan. Without preliminary cost estimates, the plan will fail because it will not know how much funding to pursue. Likewise, our $20,000 estimated study 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 an 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 Safe Routes-to-School Program, bicycle police patrols and related fleet savings, and as being a city amenity 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 steep increase in future gas prices would likely enhance the impact of all of the above.

TB2. Increased Bus Ridership
Implementation year(s): 2014 - 2030
Projected average annual energy savings: 174 MMBtu ($4,700)
Projected average annual GHG reduction: 4 equiv metric tons

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. Based on a well-designed commuter peak hours route plan and publicity, 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 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 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 transit served 6,846 passengers in 2010.

Foothills provide a $20 round-trip fee to area airports and other transportation connections. They also 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.

TB3. Increased Fuel-Efficient Car Ownership
Implementation year(s): 2013 -2024
Projected average annual energy savings: 1,311 MMBtu ($34,000 @ $3.38/gal)
Projected average annual GHG reduction: 99 equiv metric tons

The advent of new minimum fuel efficiency standards (CAFE) are now in effect and accompanied by an expanding range of new fuel-efficient models and alternative fuel types. This radically changing market presents both a challenge and an opportunity to inform the Berea buying public of the choices and advantages of fuel-efficient vehicles. 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 outreach program described in Item #A1. above is a good outlet to share this type of information. Maintaining this program over time is also a good way to monitor a rapidly changing market and improving models .

This BECS goal here is to improve 10 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 savings 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 CAFÉ fuel efficiency standards will take effect by 2025, nearly doubling the previous fuel efficiency standards. Therefore, the calculation works through a life cycle of an additional 10% efficiency for the next eight years past 2025, as the entire city fleet is (in theory) replaced and most used cars will then comply with the new standard, in 2033.

The US Dept of Energy has a 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*, see http://www.fueleconomy.gov/feg/FEG2011.pdf . 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.

A key factor in the increased buyer acceptance of more fuel-efficient cars is the cost of the new technologies such a plug-in electric cars (prohibitive at the current time, ie, the fuel savings do not justify the extra vehicle expense, save current federal tax rebates and/or possibly long-term ownerships such as city fleet vehicles, etc). However, it is expected that with increasing sales volume and improving battery technology that prices will come down over time.

Likewise, the same is true for the school bus fleet serving the city. Currently, the state currently has grant funds to purchase 63 additional diesel hybrid busses, depending on when districts may retire older busses. Madison County Schools currently has at least 3 such 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 electric powered. 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, its a niche market that going to happen in any event.

TB4. Waste Oil Collection Depot
Implementation year(s):
Projected average annual energy savings:
Projected average annual GHG reduction:

(Prof Mark Mahoney contact pending.)

TC. ENERGY EFFICIENT INVESTMENTS

TC1. Electric Vehicle Charging Stations
Implementation year(s): 2014 - 2024
Projected average annual energy savings: 597 MMBtu (gross $16,000 in gas only, ie, electricity not counted)
Projected average annual GHG reduction: 45 equiv metric tons

As plug-in hybrid electric vehicles and battery electric vehicles ownership is expanding, 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, develop 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 hub 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) compared with varying development costs and potential revenue streams to determine alternative returns-on-investment, also considering 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 calculation shown is a placeholder pending consultation with an expert. The calculation shown assumes the installation of 20 charging stations (recommended as all solar) over the 10-year period shown; solar powered stations recommended.

TC2. Improved Safe R-T-S infrastructure
TC3. Pedestrian Improvements
TC4. Bikeway Infrastructure
TC5. Improved Transit infrastructure
Implementation year(s): 2011 - 2022
Projected average annual energy savings: 350 MMBtu ($9,400)
Projected average annual GHG reduction: 26 equiv metric tons

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.

Nonetheless, shown above is a conservative, placeholder calculation of 100 weekly trips switching from car to alternate modes and assuming an average one-mile trip avoided at a current 19.7 average MPG. The calculation assumes 100 additional weekly trips each year to 2034, then totaling 2,000 such weekly trips avoided by then. Restated, this assumes a compounded rate of an additional 100 such trip per year. This is a very modest assumption not considering increasingly more expensive gas prices, incrementally higher patronage on alternative modes, and potential bicycle police patrol savings and related avoided costs of car ownership.

TD. SPECIAL TRANSPORTATION RECOMMENDATIONS:

TD1. Energy Assurance Plan - The City should develop a fuel emergency assurance plan to assure that the city can deliver vital services in the event of a fuel emergency or rationing.

TD2. Redefine Transportation Energy Measures - An inherent weakness in the ICLEI software is the community transportation measure, measured in annual vehicles miles traveled (VMT). However, the goal ought not be so much fewer miles traveled as less gasoline used. There ought to be a way to track the amount of gasoline sold within the city; particularly in light of the fact that the state collects tax on every gallon of gas sold. This would be an ideal college or graduate student project to figure out the mechanics of doing this and to then lobby to make the information available. The city government side of the ICLEI ledger is in gallons.

Likewise, there ought to be an easy way to track the number of alternative fuel vehicles bought and located in Berea. It would be very informative to know the rate of purchase of alternative vehicles as an index of consumer acceptance in the city. Likewise, all vehicle transfers track buyer residence and it should be very possible to do.

Both of these suggestions could also track commercial vehicle type acquisitions as well.

Introductory Comments:

1) Work-in-Progress -- This revised draft is a work-in-progress. The purpose of these improving drafts is to facilitate a starting point for staff discussion and to best adapt current energy efficiency practices to Berea's needs. The savings estimates shown are our best estimates at this time; intended as a starting point in the process. Periodic review of steps taken over time will dramatically improve estimated future savings. All city budget data is for the base year 2010 and all estimated future savings are in today's dollars.

2) Increased Savings Over Time -- 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%, would be $10,300 in 2023. Restated, most all investments in energy efficiency end 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.

3) Future Technological Solutions -- These recommendations are made with the understanding that future technology may solve many current energy inefficiencies. As an example, there is the (hoped for) launch this summer in India of an affordable, hybrid car that runs on compressed air -- this could change the world oil situation dramatically. 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 alert to new technology and products as they develop.

4) 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.

5) Program Savings, Greenhouse Gas Reductions, and Simple Paybacks shown are the result of ICLEI/"CAPPA "software or calculations as explained. Many of the following recommendations are not covered in the 2008 CAPPA software and that 's the reason for the separate calculations.

GA. NO COST EE IMPROVEMENTS (OR VERY LITTLE)

GA1. Portfolio Manager: Tracking energy and water use

Implementation year(s): 2013 -2018
Projected average annual energy savings: : 21,700 kWh & 220 ccf ($1,600)
Projected average annual GHG reduction:
Simple payback: 0

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 2 things: (1) It identifies underperforming buildings and (2) it 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. This BECS category assumes an initial, average ½ percent improvement over each of the 3 years crediting improved knowledge of energy used and consequential adjustments in building use and practices. 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 energystar.gov.

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 very valuable feature is that PM also benchmarks our energy performance compared with a quadrennial survey of all similar building sin the country and (climate?)

Behavioral changes in energy use involve changing the culture of the organization. That said, this 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", and incentivizing employee suggestions. The total savings rate shown here of 1% spread over 3 years is a conservative one based on the corresponding average residential savings rate of 1% to 3% percent. There is no such documented non-residential rate.

An additional benefit of Portfolio Manager database is after two years of collected data, it can easily be sorted for the city fiscal year, July 1st to June 30th.

GA2. Energy Star Purchasing Policy
Implementation year(s): 2013 – 2050
Projected average annual energy savings: 16,600 kWh ($1,050)
Projected average annual GHG reduction: (pending)
Simple payback: Varies, but generally less than one year

Purchase ENERGY STAR approved equipment as needed and for replacement equipment. 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.

This calculation assumes 37% of the city's facilities electrical budget as equipment and lighting (national average) and then assumes a one-half of one percent energy savings per year or $1,046, a cumulative savings, ie, that would result in a $10,460 total energy savings in 10 years, etc. (in today's dollars and probably worth significantly more then due to increasing energy prices).

GA3. Performance Contracting
Implementation year(s): up to 15 years
Projected average annual energy savings: 1,200,000 kWh and 11,500 ccf ($105,000)
Projected average annual GHG reduction:
Simple payback: 5 to 15 years

Following state law, pursue the feasibility of conducting a performance contract for a select group of city facilities. Performance contracting 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 "ESCO" company (Energy Service Company) would amortize all costs involved including analysis, design, and all construction costs. There are many different ways to finance the upgrades. It is vitally important that an independent expert guide the vendor selection

process to assure that the terms of the agreement accomplish the its objectives and assure 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. (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. Source: http://eetd.lbl.gov/EA/EMP/reports/lbnl-1202e.pdf. But again, actual savings vary widely, but the City would see all of the estimated savings long before entering any sort of contract.)

The estimated savings rate shown is 19%. This is a net savings subtracting out the Portfolio Manager savings shown earlier.

An additional P-C component should be to include an assessment and potential costs for renewable energy applications at various city facilities whether solar, geothermal, etc . This should be specified in the vendor the solicitation scope-of-work.

GA4. Anti-idling Policy
Implementation year(s): 2013 -2050
Projected average annual energy savings: 223 gallons ($725 at $3.25/gal)
Projected average annual GHG reduction: 2 equiv metric tons
Simple payback: 0

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.

This calculation assumes that only 25% of the total fleet avoids 5 minutes daily idling. The actual savings could be significantly higher.

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. An additional advantage it that synthetic oil is more slippery than regular and makes for less engine wear and thus greater engine longevity. However, should the city decide to try this, it should start using the synthetic oil in its new cars. Older cars with greater engine wear tend to not do as well with the extra slippery synthetic oil.

GA5. Landfill Methane Gas Harvesting
Implementation year(s): (To be determined)
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 credits. 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 (ie, 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 a clean energy source and a revenue stream to help finance other EE improvements. However, 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. It's worth a quick look.

GA6. Programmable Thermostats
Implementation year(s): 2013 - 2050
Projected average annual energy savings: $6,500 per year
Projected average annual GHG reduction:
Simple payback: less than one year

According to the US 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 (ie, 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 assume 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. However, they are not programmed and should be. Due to its 24/7 ventilation, City Hall should show immediate results. There are however, the practical challenges of keeping the thermostats correctly set and only changed by authorized staff; as well as the reported widespread use of personal space heaters. These issues should be adequately addressed over time with both new policies and EE retrofits to realize the full benefit of such temperature setbacks.

GA7. (City Hall) Relighting
Implementation year(s): 2012
Projected average annual energy savings: $9 per year
Projected average annual GHG reduction:
Simple payback: under 5 years

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 account for 17% of office lighting costs. The city should conduct a systematic assessment of the cost of lighting changes for all city properties and develop a program. There are some programs where lighting companies will provide a performance contract of this type of project alone, pay for the improvements out of energy cost savings, and with no out-of-pocket cost to the city.

GB. LOW COST EE IMPROVEMENTS

GB1. Improved Fleet Mileage
Implementation year(s): (To be determined)
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

The city's development of systematic fleet mileage records will provide the basis to understand the city's fleet fuel utilization and thus identify potential areas for improvement. After 2 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.

The independent IEA has reported that the earth has reached peak oil production in 2006 at 70 million barrels per day and will probably level out at that amount for about the next 20 years. In the most recent 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 even with the EIA forecast growth of 17 MBD of unconventional liquid fuel sources by 2035 (oil shale, biofuels, etc), the world is still short by about 25 MBD or about 23% of demand.

In addition to the upward pressure on prices due to demand, traditional petroleum reserves will become increasingly more expensive to extract in reaching ever harder to reach sources. Mindful of a vast array of technological improvements in the next 25 years that could drastically change the scenario, the world supply of oil is going to drop significantly and possibly much sooner than later; not to mention the ever-present political instability in many parts of the world threatening the oil supply. (This is an extreme summary of a great deal of information on this subject. The best and most reliable [and free] assessment of the situation can be found at http://www.eia.gov/forecasts/ieo/liquid_fuels.cfm).

Berea would be well served to do everything described here as well as support the citywide transportation recommendations to adapt to the evolving situation. 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. At staff committee should be formed at the earliest possible time to study the situation and make recommendations.

The staff committee should also study the Transportation Team recommendations for their applicability to the city and especially the recommendation to develop electric vehicle charging stations and how to best transition to a predominantly EV city fleet. In addition to fuel cost savings, their much longer life than gas powered cars (fewer moving parts) , they also require much less maintenance.

GB2. Comprehensive Energy Audit
Implementation year(s): (To be determined)
Projected average annual energy savings: (Not Applicable)
Projected average annual GHG reduction:
Simple pay back:

As an alternative to the recommended performance contracting described above, 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 2 disadvantages in this approach: Without the expertise of an ESCO company implementing a coordinated package of improvements, it will take the city considerably longer to

achieve the desired energy savings. Secondly, there is a significant cost in the delay of energy efficiency projects.

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 P-C process. Although this essentially the usual process, this variation would let interested vendors know in advance of the fair likelihood that the city would stop the process at any time. Ideally, this should involve some pre-agreed compensation or most modest honoraria in the event the process is stopped.

GB3. Street Lighting Upgrades
Implementation year(s): 2011 – 2050 (about 75% of change-outs needed)
Projected average annual energy savings: 3,400 KWh ($619 - using 2010 fixed-pole utility rate)
Projected average annual GHG reduction: 2 equiv metric tons
Simple payback: 1.4 years

The current city policy is to replace its mercury vapor streetlights as the bulbs wear out with equivalent high-pressure sodium bulbs; at a rate of about 10 bulbs per year of the existing 531 MV bulbs. That is what shown in the calculation above. Although the fixed-pole utility rate ought to be periodically reviewed to estimate the reduced electrical consumption and then set a revised savings rate.

The city is currently testing LED bulbs for possible use in the future, especially concerned about the viability of their bulb life, estimated 10 - 15 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, lasts 12 years, and allows cost recovery through energy savings in only three years. 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

Another possible scenario the city should explore light is solar LED lighting. This comes in 2 types, one for new construction where there is no power provided. And the second type is for retrofits of existing lights. The first type or "independent systems'" is the likely to be cost effective and usually found in park or new industrial park settings.

The second type is retrofit of an existing system and 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 street lights (the city currently has a total 899 lights) to see 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. Likewise Berea College has solar power street furniture experience.

As described in item #A7. above, 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.

GB4. Firehouse #2 EE Upgrades
Implementation year(s): (To be determined.)

Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

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 the Firehouse #2. At our estimated $3.00 per sq ft energy costs per year, it is clearly far above the normal average cost. An immediate audit and review of possible EE improvements could save the city significant money.

GB5. Energy Efficient Construction Policy
Implementation year(s): 2012 - 2017
Projected average annual energy savings: 19,450 kWh and 438 therms ($1,715)
Projected average annual GHG reduction: 17 equiv metric tons
Simple payback: 0

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. (www.energystar.gov/ia/partners/publications/pubdocs/C+I_brochure.pdf?2230-5030)

Or, alternatively, the policy can also permit the city to pursue LEED Silver certification (but be aware that LEED certification involves considerable expense preparing the needed documentation -- the Energy Star building label is a significantly less and reasonable cost.). LEED is the highest level of sustainable construction (in addition to energy efficiency, its criteria also stresses sustainable materials and interior air quality). The acronym stands for Leadership in Energy and Environmental Design. An independent study concluded that LEED Silver rated buildings are, on average, 25%-30% more energy efficient than non-LEED buildings. (ww.buildinggreen.com/auth/article.cfm/2007/12/4/LEED-Delivers-on-Predicted-Energy-Savings/)

At least one design firm in the state has sort of blended the approaches following a predominately Energy Star tact but also incorporating many LEED ideas. This can still result in LEED certification as it's a point system and can still add up to their Silver level.

Also the ICLEI software notes that, on average, today's high performance buildings, does not necessarily cost more that conventional buildings. Relatedly, their calculation doesn't show a payback.

GB6. LED Holiday Lighting
Implementation year(s):
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback: 4 years

(Staff is researching a count of existing holiday lights inventory to complete this recommendation.)

GC. ENERGY EFFICIENCY INVESTMENTS

GC1. Incremental EE Building Upgrades
Implementation year(s): 2014 - 2034
Projected average annual energy savings: 60,000 kWh / 570 ccf ($5,230)
Projected average annual GHG reduction: 8 equiv metric tons
Simple payback: 7.4 years (on average)

Corresponding to Recommendation #C1. above, this activity represents an incremental approach to comparatively major EE 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 year(s): (To be determined)
Projected average annual energy savings: up to 20 percent of demand
Projected average annual GHG reduction:
Simple payback:

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 a sophisticated software that monitors and adjusts all HVAC, lighting, systems, and security including an optimized air exchange rates and 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 and estimates a savings of . . . (pending)

CG3. Solar Farm Leasing Program
Implementation year(s): 2012 -- 2032
Projected average annual energy savings: 20,600 kWh (assuming avg 4 hrs sun/day)
Projected average annual GHG reduction: 15 equiv metric tons

In its landmark demonstration effort, BMU leases 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 2 arrays totaling 120 panels for a total 28.2 kW of collection capacity. As of this writing there are about 12 panels left to lease in the second array.

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 KU 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; ie, to create a sustainable business approach and capital for future 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.

GC4. Peak Load Reduction
Implementation year(s):
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

(Pending – to describe 2 techniques, a BGE "Beat-the-Peak" like program and "peak shaving")

GC5. Distributed Energy Feasibility
Implementation year(s): (To be determined)
Projected average annual energy savings:
Projected average annual GHG reduction:
Simple payback:

Having made the decision above to pursue a significant amount of local renewable energy, there is a promising trend in the field: a new international trend called distributed energy. The basic idea is that a significant percentage of the population produce their own renewable energy and then share it with each other in an energy Internet, just like how we now create and share of information.

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.

A full explanation of the vision and its implementation can begin with a one hour presentation at 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*.

If this opportunity were to materialize, there are 2 things for Berea to bear in mind: (1) This 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 such as the current wholesale provider.

Utilizing this new approach would permit BMU to purchase unlimited, renewable local power. However, there is one important caveat, and that is the starting point for their new s 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, ie, 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 and ability to carry such a long term commitment.

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 one.

(Citation of feed-in tariff case study coming.)

GC6. Emerging Energy Generation Technologies
Implementation year(s): 2021 - 2025
Projected average annual energy savings: (Not applicable)
Projected average annual GHG reduction:

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 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 4 years before the last utilities acquisition bond payment is made on January 1, 2025. The city should evaluate its options in whatever the current technologies are and be prepared to act when the bond payments are completed.

An excellent assessment of current renewable energy technologies in the Ky region is the 2010 SEEA study, *Renewable Energy in the South* . In addition to review of the utility-scaled renewables (eg, wind, biopower, hydro, and solar), it also assesses customer-owned renewables as well (combined heat and power, distributed bioppower, geothermal heat pumps, solar hot water, distributed solar PV). In fact, a systematic review of this report and its applicability to Berea, would make for an excellent independent study college project and to subsequently begin monitoring this rapidly changing field over the next 14 years.