The Berea Energy Cost-Savings Plan

ENERGY INVENTORY REPORT: BASE YEAR 2010

City of Berea, Kentucky

December 9, 2011

A Joint Venture of the:

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Kentucky Environmental Foundation,
and Sustainable Berea, Inc.

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Executive Summary and Introduction

The economic recession, rising power costs, and climate concerns have motivated government to embrace energy efficiency as a way to create local jobs, lower energy bills, and promote sustainability. This coincides with the Berea City Comprehensive Plan objectives to conserve energy and foster economic development. It's a potential strategy to improve the city's economic sustainability through energy conservation, renewable resources, and related cost-savings.

In the summer, 2010, the City of Berea applied for and received an Appalachian Regional Commission matching grant to develop an energy cost-savings plan. The basis for the program (BECS) is the "ICLEI" 5-step planning process: a comprehensive energy inventory, identifying energy saving goals, writing a plan, developing an implementation program, and monitoring results over time to adjust the plan as needed. The City of Berea is a member of ICLEI since 2009, the International Council of Local Environmental Initiatives (please see icleiusa.org for complete information).

The BECS plan will be in 2 parts: One, addressing energy cost-saving priorities and programs for the city as a whole. The second part will focus on energy cost-savings within city government; the idea being that the city serve as both a role model and testing ground for energy-saving best practices and to share its experience

with the community-at -large. Generally speaking, energy-saving practices are oriented to local climate conditions.

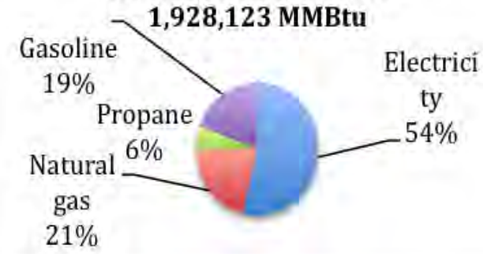
The main distinction of this planning process is that it's quantitative. The main value of the energy inventory is that it provides a baseline to measure future energy cost-savings over time. The establishment of this baseline means that all energy reduction strategies can be evaluated based on their projected energy cost savings and the payback or return on investment (ROI) of solutions. These strategies can be broken into short, medium and long-term strategy plans, which can then be prioritized by their overall savings.

Some of the main findings of the city's energy inventory are that Berea consumed 1.9 million MMBtu (million British Thermal Units) per year or 142 MMBtu per capita in 2010; with industry being its largest stationary energy consumer, accounting for 36% of all energy consumed in the city. In terms of energy sources, electricity is by far the largest energy source accounting for 54%, with natural gas being second place at 21% of all energy consumed in the city.

This report represents completion of the first step in the planning process: a comprehensive energy inventory for the year 2010 that has been entered into ICLEI's exclusive database software. This energy inventory is divided in 2 parts: A community-wide inventory and a separate inventory of city government energy consumption. In so doing, the software also calculates the city carbon footprint at 22.9 equivalent metric tons per capita or a net 20.2 tons (see Methodology section for explanation). Virtually all improved energy efficiency also has a direct impact in reducing greenhouse gas emissions. This reduction in greenhouse gas emissions can be viewed purely as additional benefit of energy efficiency solutions.

Some additional findings in the data inventory are detailed in the key statistics figures below and on page 3.

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



KEY COMMUNITY-WIDE ENERGY STATISTICS:

- **2010 city population: 13,561, 2010, city housing units: 5,633**
- **Largest stationary energy consumer: Industrial sector at 36%**
- **Average monthly residential electrical use: 1,251 kWh**
- **Est 2010 gasoline as a percent of total energy consumed in the city: 19%**
- **2010 transit ridership: 6,846 passengers (not including college and other shuttle services)**
- **Est 2010 avg daily water use per capita: 53 gallons**
- **Forecast average annual BMU peak load growth rate to 2023: 0.95%**
- **2010 total building permits new housing count: 69 DUs (ie, Dwelling Units, ie, single-family and multifamily units)**
- **Largest source of city greenhouse gas emissions: Electricity at 70%**

KEY GOVERNMENT ENERGY STATISTICS:

- **2010 total city government energy expenditure: $833,225 or about 11% of total Fiscal Year 2009-10 expenditures**
- **2010 city government energy as a percent of total city energy consumption: 1.6%**
- **Largest 2010 city government energy expenditure: Waterworks & Wastewater at 41%**
- **Gasoline purchase as a percent of total city government energy budget: 22%**
- **Percent of city government employees that live within 5 miles of work: 62%**
- **2010 City government operations as a % of total city carbon footprint: 1.7% ("net:" 1.9%)**

Methodology

The methodology used here in the energy inventory is ICLEI's Clean Air and Climate Protection Software. The jurisdiction of the inventory is for the City of Berea proper (except as noted otherwise), totaling 16.3 square miles. The base year for the data is the calendar year 2010. All of the data has been entered into the software and housed in the city intern computer in the City's GIS Office.

Important Note: Based on a September 7, 2011 meeting of the BECS Community Advisory Committee (CAC), it was decided to exclude the US interstate I-75 highway vehicle miles traveled (VMT) from the energy portion of the plan. The CAC felt it unfair to count the I-75 traffic, which represents 57% of the total VMT in the city but at the same time is well beyond the control of the local community to affect that situation. (1) However, following the normal ICLEI software protocol to measure carbon footprint, that calculation retains the full VMT count so as to keep Berea's footprint consistent with the ICLEI data protocol and database. Restated, the I-75 traffic count is out for the energy measurements but in for the carbon footprint calculations.

Thus, the citywide data and analysis here is a "net" analysis, ie, minus the I-75 traffic count, except as noted for the city's carbon footprint. This "net" database is shown in the computer inventory as the year 2011 (and profusely flagged there to alert any future users). However, in the final analysis, it really doesn't matter which base year is used to measure progress – so long as the same base year is used for each periodic update and comparison.

In the interest of clarity on this one point, the following findings are offered:

1) The city carbon footprint is 22.9 equivalent metric tons per person (ie, including I-75 traffic)

2) The "net " city carbon footprint is 20.2 EMT per person (ie, excluding I-75 traffic)

The inventory is a comprehensive collection that includes a wide range of detailed information, including among other things, a complete energy inventory of each city facility and each vehicle in the city fleet and much more. There are also Excel workbooks with still more detailed information that is part of the study record.

The source of all city government information is city staff and as noted in the software comments. A special thanks to the City Finance Dept, GIS Office, and Utilities Dept for their generous work and assistance. Other source agencies are also noted in the software comments. The estimated propane fuel usage is a stepped-down ratio from state statistics as there are no local records.

The author of this report is the project manager of this initial inventory. He will be available to meet with the next energy inventory coordinator to walk through the software and inventory records and at no charge. This is a standing offer to help assure an orderly transition in this most important part of the plan, ie, to periodically update the database to measure plan progress over time.

ICLEI

Local Governments for Sustainability

Energy Savings Scope

City Government
Buildings & Facilities
Street/ Traffic Lights
Water Delivery
Waste Water
Vehicle Fleet
Solid Waste

Community
Residential
Commercial
Industrial
Transportation
Water

Community Energy Profile

With a 2010 population of 13,561 and the home of Berea College, the city's industrial base is the largest part of city's stationary energy usage. The city is served by 2 electrical power providers, Berea Municipal Utilities (BMU) and the Blue Grass Energy Cooperative (BGE), and one natural gas supplier, Delta Gas. The city contains no power generation facilities and provides all utilities to Berea College as provided other city customers, including city trash collection.

The city consumed a total energy budget of 1.9 million MMBtu in 2010. The City's power mix is dominated by electricity, with 54% provided by BGE and the balance by BMU. All of BMU electricity is purchased from the Kentucky Utilities Company, based in Lexington.

With an estimated overall energy consumption of 477.5 million British Thermal Units (MMBtu) per capita in 2007, Kentucky ranked 7th highest per capita energy usage in the country. However, although Ky ranked the fifth lowest in the nation then for residential electrical rates, its average monthly bill was 20 percent higher than the national average. Consequently, Kentucky's low electric rates have discouraged efficiency practices and resulted in higher than average energy bills. (2)

Berea's average electrical usage is on par with the regional average usage as show in Table 1 (located on the adjacent page).

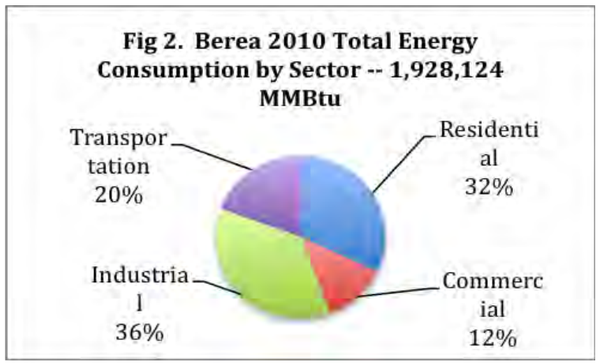
KEY COMMUNITY STATISTICS:

- **2010 population: 13,561, housing units: 5,633**
- **Largest energy source: Electricity at 54%**
- **Largest stationary energy consumer: Industrial sector at 36%**
- **Est avg annual BMU peak load growth rate to 2023: 0.95%**
- **Fall, 2010 Berea College enrollment: 1,613 (about 84% residing in campus housing)**

The state's overall energy consumption (residential, commercial, industrial, and transportation sectors) is projected to increase 5% from 2010 to 2030. (3) However, current Energy Information Agency (EIA) estimates show a decline in national per capita electrical usage of 0.3 percent per year on average from 2013 to 2035 , from an estimated 310 MMBtus per capita in 2009 to 293 MMBtus in 2035. The reasons for this projected decline include an increasingly service economy and higher national fuel efficiency and lighting standards to begin soon. (4)

These larger trends are only intended to provide a context for the local situation in Berea, where the total energy use per capita is 142 MMBtus. Although indicative of a low consumption level, this index is a function of a wide range of local factors such as climate, land use, mass transit, airports, pavement coverage, etc. Berea's 12% college population and regional employment center may help explain the comparatively lower energy consumption.

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



Equally important is peak demand, ie, the maximum required amount of power at a given time. Using a straight-line projection, BMU forecasts the overall average peak load to increase by an average 0.95 % to the year 2023.

There is a limitation in the following sector analysis due to a lack of sector statistics for Berea's transportation energy consumption. Restated, transportation energy consumption is not broken down into its residential, commercial, and industrial sectors because that data does not exist even at the state level (except for outdated gasoline and diesel fuel consumption data). This lack of quality transportation energy data by sector is an area that might be explored at a later juncture.

Table 1 – Recent City, State, and Regional Electrical Consumption

Area	Average Monthly Residential Electrical Usage	Average Monthly Commercial Electrical Usage	Average Monthly Industrial Electrical Usage
2009 East South Central Region (AL, KY, MS, TN)	1,256 kWh	5,230 kWh	433,001 kWh
2009 Kentucky	1,191 kWh	5,536 kWh	610,694 kWh
2010 Berea	1,251 kWh	(Reserved)	(Reserved)

State and Regional Sources: Energy Information Agency (www.eia.gov/cneaf/electricity/esr/table5.html)
City Sources: Only Berea Municipal Utilities data available at this time.

Residential Energy Consumption

Electric power is provided by 2 sources in Berea. BMU provides 73% of the city's residential power with BGE providing the balance. The inventory data is sorted by their rate structures, cognizant that the providers follow somewhat differing land use definitions, eg, city rates charge by transformer sizing that does not necessarily capture larger apartment buildings or college dormitories that would otherwise be expected to be classified as residential use, etc. Nonetheless, the consistent use of their sector categories over the years will permit apples-to-apples measurement over time.

In 2010, Berea's residential sector consumed 618,514 MMBtu of thermal energy, and comprised of the sources indicated in Figure 3:

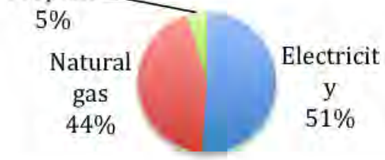
The average Kentucky monthly electrical use in 2009 was 1,191 kWh. However, the BMU Berea 2010 average monthly electrical use was 1,251 kWh per household. Despite the difference of one year in the comparison, it suggests a significant potential in residential energy conservation in Berea.

The 2010 weighted average base residential electrical rate (ie, BMU & BGE) in Berea was 7.93c / kWh compared with national price of 10.74c/ kWh. However, the current EIA "Reference Case" forecasts that average electricity rates in the South are to raise by 23% by 2030 (or an average of 1.15% per year). But the reality is that electricity and the larger national power mix is facing a range of uncertainties in its production and delivery, including new EPA clean air requirements due 2013. All increases in electrical energy prices will compound energy cost-savings over time. By one EIA index, overall

KEY RESIDENTIAL STATISTICS:

- **Berea 2010 housing units: 5.633**
- **Berea 2010 avg monthly household electrical consumption: 1,251 kWh**
- **2010 total building permits new hsg count: 69 DUs (ie, SFD & apts)**

Fig 3. Berea 2010 Residential Sector Stationary Energy Consumption -- 618,514 MMBtu



electrical rates have increased by an annual average rate of 4% since 1996.

Although natural gas supplies seem to continue to outpace demand in the short term, there are continuing concerns about the viability of long-term supplies, ie, necessitated by hydraulic fracturing and new pipeline development, both controversial processes involving possible hazardous environmental impacts.

A review of the 2010 city building permits shows that 51 single-family home permits were issued and multi-family permits totaling 18 structures (ie, duplexes and 4-unit buildings) for a grand total of 69 DUs or an approximate 1.3% annual growth rate.

Commercial & Industrial Energy Consumption

Commercial
The commercial sector is a generic term for non-manufacturing land uses such as office buildings, warehouses, retail outlets, schools, and similar facilities. It represents 235,570 MMBtu or about 12% of total energy consumption in the city. However, there is some variation within these categories, such as BMU rates where certain multifamily buildings over a certain transformer size are classed as commercial use; and under BGE rates, all customers over 1,000 kW power are in the industrial category. Nonetheless and as noted earlier, the consistent use of these categories over the years should permit apples-to-apples measurement over time.

There is limited data about the scope of existing commercial development within the city limits and only proportional data for the surrounding area. A count of the Berea of Chamber of Commerce members with Berea locational affiliations totaled 161 members.

These members include landmark commercial entities such as Boone Tavern, Berea Center for the Arts and the Appalachian Arts, Crafts, & Quilt Shop. They also include small local entities such as coffee shops, gift shops, basic services, franchise restaurants and box chain stores.

Industrial
With an industrial base of an estimated 3,200 employees and continuing to grow, the city industrial sector represents 36% of all energy consumed in the city. However, its electrical consumption was 567,181 MMBtu or 55% of all electricity consumed, 17% more than both residential and commercial electrical usage combined. At 121 million kWh, BGE provides almost three-quarters of the industrial electrical power in Berea.

Entities that make up the industrial base include: Hitachi Automotive Systems of America, NACCO Material Handling, KI USA, Lighthouse Home Products, Motor Wheel Commercial Vehicle System, and Novelis Recycling to name a few of the largest.

Fig 4. Berea 2010 Commercial Sector Stationary Energy Consumption -- 235,570 MMBtu

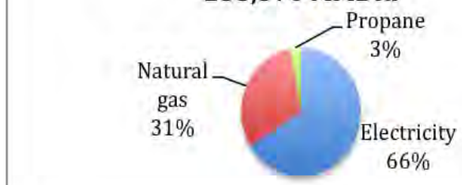
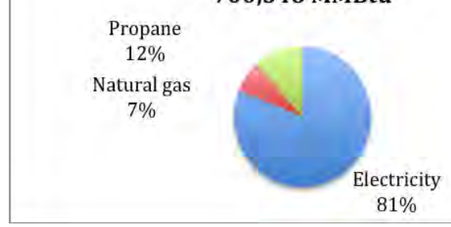


Fig 5. Berea 2010 Industrial Sector Stationary Energy Consumption -- 700,548 MMBtu



Transportation Energy Consumption

Transportation
At 41 million vehicle miles travelled (VMT) (see highlighted note under "Methodology"), transportation accounts for 19% of total energy consumed in the city.

The city has a public bus service, Foothills Express, a single 14-passenger bus that make 8 one-hour loops through the city each weekday, 9 AM to 5 PM. It served 6,846 passengers in 2010 but accounted for only a miniscule fraction of transportation energy in the city. The college provides a limited student express shuttle service and is separate from the Foothills service. Both the College and Foothills transit services need to be better understood in the planning process.

The City Comprehensive Plan contains a comprehensive trails and greenways plan for the city. The City area currently has 6 designated scenic bike rides ranging 3 to 20 miles each or an average of 14 miles per looped trail ride. However, there is a potential demand for commuter bike trails in and around the center of town and the college. The Berea College 2008 Staff Commuter Survey includes recurrent suggestions for priority trails and connections. (5) More recently, the city decided to develop a shared use path connecting nearly 7 miles of trails through the city, in an alignment essentially from the southeast-most part of the city to the northwest-most part.

The latest EIA "Reference Case" forecasts the world average price of oil to increase of 5.2 percent per year to the year 2020 and thereafter one percent per year to 2035, to arrive at $125 per barrel in today's dollars. The same forecast also shows another scenario where the price rises to $200/barrel by 2035. (6) (The Nymex crude price on Aug 31, 2011 was $88.76.)

KEY TRANSPORTATION STATISTICS:

- **Est 2010 gasoline as a % of total energy consumed in the city: 19%**
- **2010 in-city transit ridership: 6,846 passengers**

The EIA is one of the most respected prognostications of petroleum prices. However, at the risk of venturing an opinion, there are few things less certain than the future price of oil, either tomorrow or in the year 2035. (For an in-depth analysis of this topic, please see "2000s energy crisis" online at wikepedia.org)

Water Conservation

Water
Water represents one of the highest areas of taxpayer energy usage in Berea. Between water pumping, purification, movement to customers, heating for usage and waste management it uses considerable amounts of energy. Also, due to it historic low cost and abundance in the Eastern United States, it is not appreciated as the precious commodity in terms of expended energy and high quality potable resource.

Water conservation practices can have a significant savings in city electricity costs and customer charges and thereby also reducing the stream of wastewater. The Berea per capita residential water usage in 2010 was 53 gallons per day; compared with the national average of 60 to70 gals per capita per day. The comparatively low use rate is hard to explain, except that 2010 precipitation was a record year, roughly 15% above average.

The BMU 2010 residential water volume was 155 million gallons in Municipal water and 107 million gallons from the Southern Madison Water District. The total BMU 2010 tap water output was 1.04 billion gallons; the total wastewater treated was 1.05 billion gallons. Based on an average family monthly consumption of tap water, the city base rate of water is less than one cent per gallon.

There are a number of strategies that can be employed to reduce and manage water. These strategies include onsite rainwater collection on resident and commercial properties for not potable applications such as lawn and exterior cleaning applications. Advanced gray water systems for using filtered gray water or non-tap water for internal building usages, such as flushing toilets and plant watering. Replacing water fixtures, such as toilets, showerheads, sink aerators with low-flow or high pressure new fixtures that use two or three times less water. When purchasing new kitchen equipment, choosing water efficient appliances and when replacing water heaters, utilize inline heaters, look at solar thermal applications or properly "right-size" tanks to fit occupant usage. Together, these strategies could represent a significant reduction in overall water consumption and associated energy costs.

KEY WATER STATISTICS:

- **Est 2010 avg daily water use per capita: 53 gallons**
- **Total BMU 2010 tap water output: 1.04 billion gallons**
- **Total 2010 S Madison Water District city water sold: 107 million gals**

Community Carbon Footprint

An additional benefit of energy conservation is that it also serves to reduce the emission of greenhouse gases (GHG). Berea's community–wide GHG emissions for 2010 totaled 309,695 equivalent metric tons or about 22.9 tons per capita. Electricity is the largest source of GHG emissions, accounting for 70% of community-wide emissions as shown in Figure 6. Gasoline for transportation is the second largest source of community-wide emissions and accounts for 20% of the total. Natural gas and propane represented the other piece of this pie with 7% and 2% of the total emissions respectively.

As of July 2011, global atmospheric carbon dioxide concentrations were 392 parts per million (ppm). The upper safe limit has been estimated to be 350 ppm. Atmospheric carbon dioxide content has increased at a fairly steady rate from about 315 ppm in 1958 to 392 ppm today. Although a worldwide problem, the central purpose of ICLEI is to encourage local action to reduce carbon emissions, the most important action of which is improved energy efficiency and using clean energy.

Greenhouse gas emissions are comprised of several gases; but for our purposes the inventory software computes carbon dioxide, methane, and nitrous oxide. The term carbon footprint is actually the total set of greenhouse gas emissions caused by a given activity. The city's per capita carbon footprint is 22.9 equivalent metric tons of GHG emissions. This is far less than the state's 35 tons per capita and Louisville's 2006 footprint of 27.3, yet moderately higher than the latest US average of 19.5 tons per capita in 2009.

Under the full traffic data, Berea's GHG emissions in 2010 was composed of the following energy sources identified in the full inventory and as shown in Figure 6.

However, as explained under the Methodology section, the BECS Community Advisory Committee decided that it was unwise to include I-75 traffic in the city's energy conservation plans because the city has virtually no control over interstate traffic. While the larger 22.9 tonnes figure is reported back to ICLEI, the community's "net"

Fig 6. Berea 2010 Community Greenhouse Gases Emission Sources

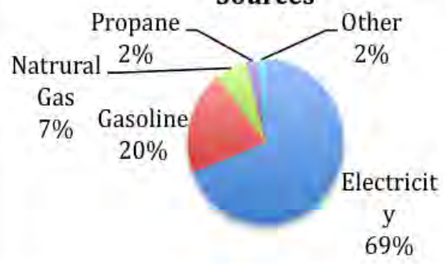
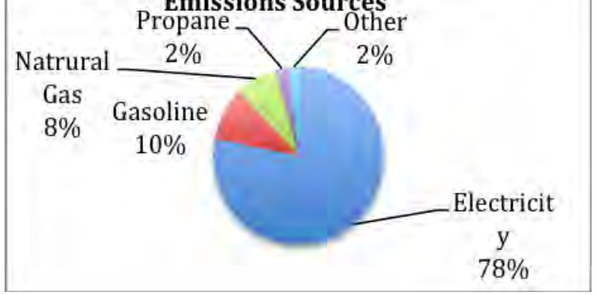


Fig 6A. Berea Net Greenhouse Gases Emissions Sources



carbon footprint for our purposes here is 20.2 tonnes per capita -- with a proportionate reduction in gasoline as a part of city emissions and a corresponding increase in electricity as the main source; increasing from 69% to 78% of total emissions, and as shown in Figure 6A.

In one study, it calculated that in Kentucky that each residential megawatt hour (Mwh) produces a 0.931 metric ton of CO_2. (7) Inversely, each saved residential Mwh reduces CO_2 emissions by 0.931 metric ton. Albeit a rough approximation, it shows that energy conservation can have a significant impact on climate stabilization, while at the same time saving money.

City Government Energy Profile

Berea municipal government total energy consumption in 2010 was 92,332 MMBtu, accounting for about 1.6% of the total city energy consumption. The city's total energy cost for 2010 was $833,225 or about 11% of the fiscal year 2009 -10 city budget (actual) expenditures. Electricity was the largest part of the energy budget at 69% and as shown in Figure 7 (on the following page).

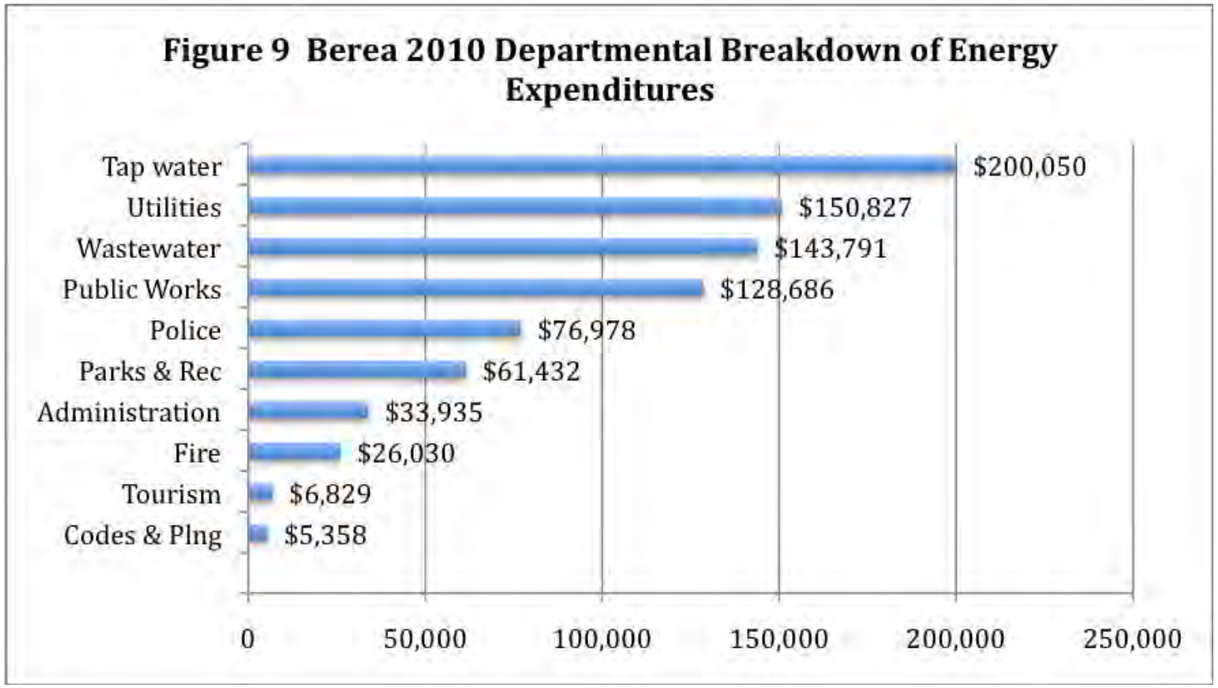
Water treatment and wastewater treatment comprised 41% of the total energy budget, with city buildings and facilities in second place with 26% and the vehicle fleet a close third place finish (see Figure 8 on the following page).

In a departmental breakdown, the Utilities Department, including tap water, wastewater, and power operations comprise 59% of the city's total energy budget. This high percentage is consistent with most other municipal utility operations.

KEY CITY GOVERNMENT STATISTICS:

- **2010 total number of employees: 120**
- **2010 total city energy expenditure: $833,014, about 11% of total expenditures**
- **2010 buildings and facilities: 29**
- **2010 motor vehicle fleet: 145 vehicles**
- **2010 city energy as a % of total city energy consumption: 1.6%**
- **Largest 2010 city gov user of energy: Waterworks & Wastewater at 41%**
- **Gasoline as a percent of total city energy budget: 22%**
- **2010 City gov operations as a percent of total city carbon footprint: 1.7%**

Figure 9 Berea 2010 Departmental Breakdown of Energy Expenditures



City Government Energy Profile (cont.)

Fig 7 Berea 2010 Municipal Energy Expenditures by Type

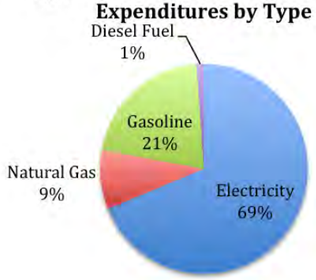


Fig 8 Berea 2010 Municipal Energy Expenditure Areas

City Department Energy Consumption

City Buildings

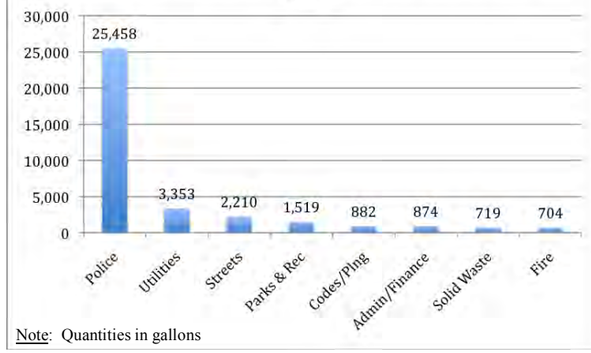
City Buildings and facilities represent about 26% of the city's total energy cost. Table 2 shows the electricity per square foot listed in the order of the highest costs per foot (excluding the water plant, wastewater operations, and very small accessory facilities). Also shown are the total energy costs per square foot including natural gas, where used. The database includes an approximate square footage for each building but will require on-the-ground measurements for any future auditing.

Vehicle Fleet

There were a total of 145 vehicles in the city fleet in 2010, incurring a total fuel cost of $185,508 or 22% of the total city energy budget. All vehicles fuel at a city fuel station, having consumed a total of 70,254 gallons of fuel.

Figure 10 shows the total passenger vehicle fuel used, totaling 35,719 gallons for a cost of $94,099 or 51% of the total city fuel cost. As is usually the case, police patrol used the most fuel by a wide margin, 25,458 gallons or 36% of the total 2010 fleet fuel.

Fig 10 Berea 2010 Municipal Passenger Vehicle Fuel Use



Note: Quantities in gallons

Employee Commuter Survey

During the month of July, 2011, a survey of city employee commuting patterns was conducted. The survey had an 86% response rate from its 120 full time employees. The survey found that 64 employees or 62% live within

Table 2. Berea 2010 Municipal Building Energy Use

Buildings	Electrical Use (Annual kWh)	Approx kWh/sq ft	Total Energy Cost / sq ft
New Park Concession (& lighting)	121,588	30	$2.47
Detective House	19,208	26	$1.82
Fire House #2	58,138	24	$2.97
Broadway Center	119,189	20	$1.56
Municipal Bldg (Police Dept)	154,160	19	$1.49
City Park	175,805	19	$1.54
Food Bank	22,732	12	$2.50
City Hall & Fire Sta #1	177,680	16	$1.49
Intergenerational Center	109,800	13	$1.64
Codes House	13,384	11	$1.39
Russell Acton Folk Center	57,354	9	$1.42
Depot	32,971	9	$1.73
Utilities/Streets Bldg	790,560	8	$1.01
"Shop"	15,090	3	$0.17

Table 1. Data Source; Utility bills. Cost data does not include taxes. Electric cost includes usage and demand charges. All building square footages are approximate only and based on gross footprints taken from aerial photos, courtesy City GIS Office.

City Department Energy Consumption (cont.)

5 miles of work. Six employees responded that they usually get to work other than driving alone. However, given the relatively close proximity of many employees to their work locations and the significant interest in Berea College staff in drive-alone alternatives, there seems to be some town-gown possibilities worth exploring in greater detail.

Municipal Operations Carbon Footprint

In 2010, GHG emissions from City of Berea public facilities and operations totaled 5,213 equivalent metric tons. Energy consumption from city buildings and facilities is the largest source of emissions, accounting for 83% of total municipal emissions. The vehicle fleet was the next only viable contributor accounting for 12% of total emissions. Total municipal GHG emissions represent 1.7% of total city emissions, and a slightly higher proportion of the net community emissions, 1.9%.

Fig 11. Berea 2010 Gov Operations Greenhouse Gas Emissions

KEY COMMUTING STATISTICS:

- **Percent of respondents that live within 5 miles of work: 62%**
- **Number of employees that commute other than driving alone: 6**

Table 3. Berea 2010 Municipal Vehicle Fleet

Vehicle Fuel Type	Number of Vehicles	Total Fuel Used (gals)	Total Fuel
Gasoline	125	66,827	$176,079
Diesel Fuel*	20	3,427	$9,429
Totals	**145**	**70,254**	**$185,508**

*All off-road vehicles

Future Data Collection

Developing systematic data reporting functions is the key to measuring both community and city government progress in meeting plan goals over time. Some immediate things to think about and which are in different stages of development are:

1. Post monthly energy consumption data and costs for all city buildings and facilities and water usage.

2. Develop uniform employee mileage reporting when filling up and by fuel type. This will help track fuel efficiency.

3. Contractually require solid waste vendors to report hauling volumes for both the entire city and city government.

Existing Programs & Future Energy Demand

Existing Berea Energy Efficiency Programs

Twenty-one local energy efficiency programs currently underway have been identified. The next step is to identify their program measures in coordination with the development of the city's energy savings plan.

Another excellent source of potential cooperation is with Berea College as they have an extensive sustainable practices program throughout the campus and 2 on-line directories of programs and contact information. The programs need to be reviewed for measurable energy savings and possible coordination with planned city programs, such as possible employee commuting alternatives discussed earlier, etc. or, at the very least, to include measurable results as they contribute to the overall plan program.

Future Energy Demand

Using the current comprehensive plan population growth rate applied to the 2010 Census population count of 13,561 in Berea, the 2030 forecast population would be 18,407, or an average annual growth rate of 1.8% for an approximate 36% percent increase over the 20-yeart period.

This may seem overly optimistic, but the city's average annual growth rate for the past decade was 3.4%. Additionally, the past 15–year national growth rate in electrical fees is approximately 4% per year, not including likely upward pressure on prices resulting from increased utility expenses in complying with federal clean air regulations by 2013, and exacerbated by future increases in the cost-of -living and a possible, continued lag in growth in personal income.

The desire to save on energy costs is not only advantageous for discretionary spending but may also prove required in maintaining the current standard of living. And there is a huge advantage in starting to save energy as soon a possible because of the compound effect of increasing energy costs outpacing most others. Using the utility growth rates cited earlier, an 8-cent kWh hour today would be 17 cents in 2030. Assuming a modest 3% average annual increase, a $3.25 gallon of gas today would cost $5.70 then.

The importance of starting energy cost-savings as early as possible cannot be overstated; it isn't just the savings in the higher rate. It is also the accumulated savings over time; the earlier savings start, the increasingly more saved over time as prices rise. The same effect is true in reducing greenhouse gas emissions; although those reduction rates are to be determined in the next stage of the planning process. And, as the world is well beyond the maximum GHG limit now, any and all forms of energy efficiency are needed to help stabilize the situation.

In fairness, a certain amount of future savings will be through improved technology and products. But those improvements tend to occur over comparatively longer periods as improvements come to market, their prices decline, and as obsolete appliances and vehicles are replaced over time.

The city government stands to make similar strides in energy cost savings with the earlier start the better. A modest 10% savings in, say, the fourth year of the plan would result in $85,000/year savings in today's dollars. So over the next 15 years, the city would save $1,275,000. However, assuming a 2.5% average annual increase in energy costs over the same 15-year period, city government would save an additional $572,000 in increased fees over the same period of time, for a total savings of about $1.8 million over 15 years (ie, calculated as a principal invested at a compound interest rate).

Footnotes

1 - Segregating “background” or “through” traffic is actually a much more complex calculation than time and resources permit here; mainly because there are a certain number of trips using I-75 that originate and arrive within Berea, as well as local trips that may use I-75 to get north an south in the city, ie, using the 2 interchanges.. However, all other things being equal, segregating the total of 1-75 VMT is a convenient and consistent way to measure the truer nature of local traffic than including the overwhelming volumes of I-75 traffic.

2 – KY DEDI 2009 Annual Summary, P.2

3- Southeast Energy Alliance, Energy Efficiency in the South, Appendix G Kentucky Profile, 2010, P.2

4- US EIA, Annual Energy Outlook 2010, P 55

5 - Berea College Office of Institutional Research an Assessment, Fall 2008 Berea College Faculty, and Staff Commuter Survey, Dec 2008, 48% response rate

6- EIA Annual Energy Outlook 2011, P. 23

7- Table B-9, Brown, Marilyn and Logan, Elise, “The Residential Energy and Carbon Footprints of the 100 Largest Metropolitan Areas”, Georgia Tech Working Paper Series, #39, May, 2008

Glossary

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

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

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

Energy Budget - As used here, a balance sheet of available energy vs. energy usage. More simply, a designated amount of energy to accomplish a given task.

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

GHG - Greenhouse gas

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

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

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

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

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

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

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

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


BEREA COLLEGE
BOONE TAVERN
WELCOME CENTER
OLD TOWN
N BROADWAY

Notes: