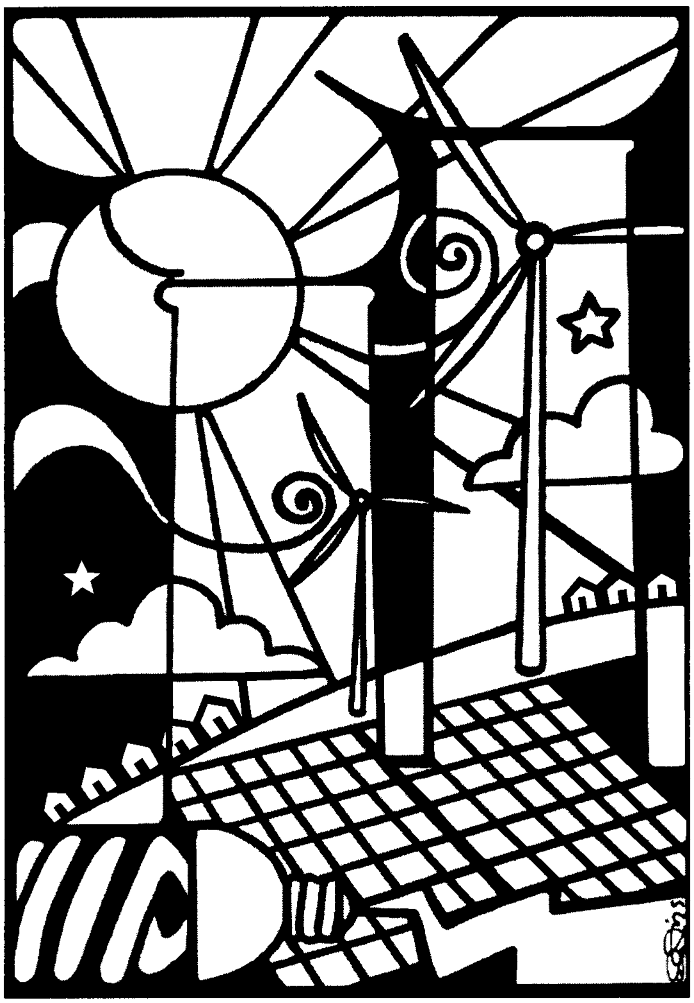
A Portfolio of Energy Efficiency and Renewable Energy Options for East Kentucky Power Cooperative



By Susan M. Zinga and Andy McDonald

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INTRODUCTION

Kentucky is at an energy crossroads. As nations and many U.S. states are taking swift action toward renewable energy and energy efficiency, Kentucky remains reliant on burning coal for our electricity needs. There are several problems with this approach. First, the cost of coal is increasing, a trend that is likely to continue due to the higher price of coal itself, the need for advanced pollution control on power plants, impending greenhouse gas regulation, dramatically increasing construction costs for coal-fired power plants, and other factors. These increased costs will be felt by utilities, cooperatives, and customers alike. Second, coal is harming the health of Kentuckians and taking a toll on the quality of the environment on which we depend. This report notes just a few of these many health threats as they have been extensively documented elsewhere.

We cannot deny the harmful, costly impacts of coal. Fortunately we have the option to diversify our electricity sources by using clean, renewable energy, and by deploying energy efficiency programs to lower our electricity needs while still receiving the same services. Kentucky's electric cooperatives can take leadership in this area, fulfilling their mission to serve the best interests of their communities. East Kentucky Power Cooperative (EKPC) is particularly well-suited for this task. East Kentucky Power Company (EKPC) is a not-for-profit generation and transmission company providing wholesale electricity to 16 distribution companies serving 89 counties in Kentucky. It generates over 97% of its electricity from coal-fired power plants.[1] EKPC currently intends to construct a new coal-fired power plant in Clark County, Kentucky, near the Madison County line. Such power plants will contribute additional greenhouse gases, particulate matter (soot), mercury, and other hazardous compounds into the air, endangering our health and the environment upon which we depend.

[1] Coalition for Responsible Economies, Natural Resources Defense Council, and Public Service Enterprise Group, Benchmarking *Air Emissions of the 100 Largest Electric Power Producers in the United States, 2004*, April 2006, p. 20.

This paper details how East Kentucky Power Cooperative can meet its projected demand for electricity through a portfolio of energy efficiency programs and renewable energy resources while helping its customers realize savings on their monthly electric bills.[2] This portfolio of options:

- Offers low-income residents, among others, the opportunity to lower their monthly bills.
- Helps businesses be more competitive by reducing their energy bills.
- Facilitates the penetration of high-efficiency appliances and equipment in homes and businesses.
- Induces lower prices for high-efficiency equipment by encouraging greater demand for these products, which in turn necessitates a greater supply at a lower average cost.
- Educates energy users and makes them more knowledgeable about their future product purchases and wiser about their daily energy consumption.
- Avoids the additional financial risk inherent in constructing and operating fossil-fuel power plants at a time when new federal legislation seems very likely to make the use of coal much more expensive.
- Helps protect Kentucky's air quality and the health of Kentucky's people and ecosystems, thus allowing them to be more productive.

Through the implementation of this portfolio over ten years, EKPC could potentially obviate its need for coal-fired generation with energy efficiency measures that will save 743,544 megawatt-hours (MWh) per year, while offering 455 megawatts (MW) of demand reduction, and providing electricity from renewable energy resources totaling 1,076,761 MWh annually and with 210 MW of capacity. By supplanting discrete fossil-fuel generating units with smaller, scalable energy efficiency projects and renewable energy generation, EKPC customers can respond to increases in

[2] An approach to meeting EKPC's needs through renewable energy and energy efficiency would also provide a significant boost to the local economy. However, quantification of this economic benefit is beyond the scope of this paper.

customer energy consumption over time instead of paying for generating capacity that remains unused in the short-term.

It is important to note that cooperatives like EKPC don't have to take on this task alone. Numerous environmental, public health, economic development, and service organizations are willing to assist in executing energy efficiency and renewable energy programs; in fact this paper serves as an example of such groups' willingness to shape strategies that help meet our energy needs.

Overview of East Kentucky Power Cooperative

EKPC's member cooperatives, also known as distribution co-ops, are heavily weighted with energy sales to residential customers. In fact, this customer class serves nearly 470,000 residential customers, representing more than half of EKPC's annual energy sales. EKPC member co-ops also serve more than 28,000 commercial customers and 1,400 industrial customers with energy sales that are 11% and 32% respectively of total sales (see Tables 1 and 2).[3]

EKPC's Dominant Customer Class—Residential

According to estimates by the U.S. Department of Energy, average residential electricity consumption by Kentucky households is 12,893 kWh per year, which is the highest across nine Midwest states.[4] This is due in part to the fact that Kentucky has the highest penetration rate of electric water and space heating of any of these Midwest states. Twenty-eight percent of all households in Kentucky use electricity for space heating, which includes an 8% penetration rate for heat pumps.[5] Additionally, 89% of all clothes dryers and 83% of stoves in Kentucky are electric, and at 61%, more than half of all water heating is electric.[6] For EKPC however, the penetration rate for electric water heating is even higher at 87%.[7]

Annual revenue and sales data submitted to the Kentucky Public Service Commission by EKPC's distribution co-ops shows that rural electric cooperative customers clearly hover close to the statewide average for household electricity usage. The lowest average monthly usage for residential customers is 1,043 kWh in Grayson RECC, and the highest is 1,264 kWh for customers in the Salt River Electric

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[3] 2006 Annual Report Statistics from the Commonwealth of Kentucky Public Service Commission.

[4] Kentucky is one of nine states comprising the Midwest Energy Efficiency Alliance. The other states are Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. Average annual usage by state is listed on Table 4-7 in a report of the Midwest Energy Efficiency Alliance entitled *Midwest Residential Market Assessment and DSM Potential Study* (March 2006), based on data gathered from the U.S. Energy Information Administration, *Electric Sales and Revenue 2003 Spreadsheets*.

[5] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, March 2006, p. 38.

[6] Ibid., Table 4-16, p. 43.

[7] Penetration rate as reported in EKPC 2006 Integrated Resource Plan.

Cooperative. Of course, these averages vary due to a number of factors, including differences in income levels and home size, which can affect the quantity and size of appliances as well as the type and size of heating and cooling equipment. Nevertheless, valid comparisons can be made between the average electricity price paid by customers in each of EKPC's distribution cooperatives. Grayson RECC's residential customers pay the highest average price per kWh, at $0.0910, of all 16 EKPC distribution co-ops, while Nolin RECC's residential customers enjoy the lowest at $0.0774 per kWh (see Table 3).[8]

EKPC's Low-Income Customers

According to the U.S. Census Bureau, there are over 500,000 people living in poverty in the 89 counties served by EKPC. At 35%, Owsley County has the highest percentage of low-income residents in the EKPC service territory, and is one of the poorest counties in the nation given its proportion of households below the federal poverty rate.[9] Table A-1 in the Appendix shows the percentage of individuals of all ages living in poverty for all counties served by an EKPC distribution cooperative. It seems clear that low-income households constitute a significant portion of EKPC's residential customer class.

Income constraints often make it difficult for poverty-level households to pay their electric bills. These same financial constraints mean low-income customers typically face challenges allocating their monetary resources or lack the cash flow to invest in energy efficiency or renewable energy programs, even if these programs can reduce their monthly bills and save them money over time. Understandably, EKPC member co-ops may have reservations about developing and promoting energy efficiency programs targeting customers unable to make the necessary investments. But this hurdle can be overcome in two ways. First, programs can be designed to eliminate the barrier of high up-front energy efficiency and/or renewable energy investments. Such programs are successfully underway at other rural electric cooperatives. Effective marketing can help clarify the benefits of these programs and correct any misinformation or false perceptions about economic

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[8] The average residential price of electricity is provided by annual data from the Kentucky Public Service Commission website for Rural Electric Cooperatives. Annual Report Statistics for 2006 present revenues and kWh sales by customer class, which is used to determine cost per kWh. It is reasonable to assume that revenue data includes flat monthly customer charges as well as variable monthly environmental and fuel surcharges.

[9] U.S. Census Bureau, *Small Area Income & Poverty Estimates for Kentucky Counties, 2004.*

barriers. Second, program measures can be delivered in ways that leverage the resources of the social welfare infrastructure and volunteer community. These approaches are discussed later in more detail as part of the recommended portfolio.

Table 1

Member Distribution Cooperatives of East Kentucky Power Cooperative with Number of Customers by Class

Rural Electric Cooperative	Residential	Commercial	Industrial	Other	Total	Residential % of Total	Non-Residential % of Total
Big Sandy RECC	11,985	953	151	0	13,089	92%	8%
Blue Grass Energy Cooperative Corp.	51,000	2,090	17	46	53,153	96%	4%
Clark Energy Cooperative	23,868	1,608	3	29	25,508	94%	6%
Cumberland Valley Electric, Inc.	21,861	1,325	117	0	23,303	94%	6%
Farmers RECC	21,745	1,618	6	8	23,377	93%	7%
Fleming-Mason Energy Cooperative	21,530	1,561	5	268	23,364	92%	8%
Grayson RECC	14,239	1,200	76	1	15,516	92%	8%
Inter-County Energy Cooperative Corporation	23,629	1,122	118	0	24,869	95%	5%
Jackson Energy Cooperative	46,652	3,289	185	758	50,884	92%	8%
Licking Valley RECC	15,961	1,119	5	0	17,085	93%	7%
Nolin RECC	28,643	1,974	2	30	30,649	93%	7%
Owen Electric Cooperative	52,935	1,930	27	249	55,141	96%	4%
Salt River Electric Cooperative	41,770	2,462	12	229	44,473	94%	6%
Shelby Energy Cooperative	14,485	536	8	24	15,053	96%	4%
South Kentucky RECC	57,044	3,689	414	722	61,869	92%	8%
Taylor County RECC	21,774	2,158	254	297	24,483	89%	11%
TOTAL CUSTOMERS	**469,121**	**28,634**	**1,400**	**2,661**	**501,816**	**93%**	**7%**

Table 2
2006 Energy Usage by Customer Class

Rural Electric Cooperative	Residential MWh Sales	Commercial MWh Sales	Industrial MWh Sales	Other MWh Sales	Total Energy Sales (MWh)	Res. % of Total	Comm. % of Total	Ind. % of Total
Big Sandy RECC	176,295	13,640	57,196	0	247,131	71%	6%	23%
Blue Grass Energy Cooperative Corp.	766,303	126,275	282,633	980	1,176,191	65%	11%	24%
Clark Energy Cooperative	317,021	86,096	16,391	649	420,158	75%	20%	4%
Cumberland Valley Electric, Inc.	309,629	22,238	161,824	0	493,691	63%	5%	33%
Farmers RECC	305,876	69,610	120,167	436	496,089	62%	14%	24%
Fleming-Mason Energy Cooperative	272,831	124,938	495,549	2,516	895,834	30%	14%	55%
Grayson RECC	178,207	16,829	54,965	83	250,083	71%	7%	22%
Inter-County Energy Cooperative Corporation	340,651	18,596	76,296	0	435,544	78%	4%	18%
Jackson Energy Cooperative	655,386	58,696	165,128	20,686	899,897	73%	7%	18%
Licking Valley RECC	218,403	46,232	14,675	0	279,309	78%	17%	5%
Nolin RECC	433,904	107,326	204,511	1,460	747,200	58%	14%	27%
Owen Electric Cooperative	679,964	207,408	1,177,002	12,267	2,076,642	33%	10%	57%
Salt River Electric Cooperative	633,657	170,088	140,023	2,440	946,208	67%	18%	15%
Shelby Energy Cooperative	217,782	68,136	156,441	126	442,486	49%	15%	35%
South Kentucky RECC	739,246	62,694	304,038	11,359	1,117,337	66%	6%	27%
Taylor County RECC	291,187	31,422	173,846	4,723	501,177	58%	6%	35%
TOTAL ENERGY SALES (MWh)	**6,536,341**	**1,230,225**	**3,600,687**	**57,726**	**11,424,978**	**57%**	**11%**	**32%**

Table 3

East Kentucky Power Cooperative
2006 Residential Rate Statistics by Distribution Co-op

EKPC Cooperative	Average kWh Usage	Average Monthly Residential Bill	Average Price per kWh
Big Sandy RECC	1,226	$98.68	$0.081
Blue Grass Energy Cooperative Corp.	1,252	$100.44	$0.080
Clark Energy Cooperative	1,107	$95.41	$0.086
Cumberland Valley Electric, Inc.	1,180	$95.10	$0.081
Farmers RECC	1,172	$90.99	$0.078
Fleming-Mason Energy Cooperative	1,056	$85.56	$0.081
Grayson RECC	1,043	$94.95	$0.091
Inter-County Energy Cooperative Corporation	1,201	$99.46	$0.083
Jackson Energy Cooperative	1,171	$104.40	$0.089
Licking Valley RECC	1,140	$95.93	$0.084
Nolin RECC	1,262	$97.73	$0.077
Owen Electric Cooperative	1,070	$92.59	$0.087
Salt River Electric Cooperative	1,264	$99.35	$0.079
Shelby Energy Cooperative	1,253	$102.32	$0.082
South Kentucky RECC	1,080	$86.66	$0.080
Taylor County RECC	1,114	$90.80	$0.082
Maximum Residential Electricity Price ($/kWh)			$0.091
Minimum Residential Electricity Price ($/kWh)			$0.077
Median Residential Electricity Price ($/kWh)			$0.081

Financial Risks Associated with Coal

At first glance, the cost of producing each megawatt-hour of electricity with coal may seem deceptively appealing. Yet upon further investigation, there are many reasons why coal-fired generation is actually the least attractive option for addressing future electricity needs. Price escalation for the construction of new coal-fired plants, which are already the most expensive fossil fuel option in terms of capital costs, coupled with "carbon risk," makes investments in new coal-fired power plants fiscally irresponsible. In addition, there are many outright and implicit costs borne by citizens and taxpayers which disguise the true price of this fuel.

Many of these costs are associated with coal pollution and the increasing regulatory measures that try to control this pollution. Sulfur dioxide and nitrogen oxides released from coal-fired power plants are currently regulated, although the stringency of these regulations will increase substantially in 2009 and again in 2015 under the Clean Air Interstate Rule. As air quality regulations become more stringent, the cost of using coal increases relative to other supply-side and demand-side options because coal-fired plants are the most polluting sources. This increase is a result of the cost of pollution control equipment (or pollution credits), and because the efficiency of a coal-fired plant diminishes as additional pollution control devices are added, lowering its output and further jeopardizing its status as a potentially low-cost alternative.

Further regulation, especially of greenhouse gases like carbon dioxide (CO_2) and nitrous oxide, seems inevitable. This will greatly raise the cost of coal-fired generation once again. One study estimates that the cost of CO_2 from a coal-fired power plant will be $18.45 per MWh.[10] Even the staff of the Kentucky Public Service Commission recommends that Integrated Resource Plans submitted by electric utilities estimate the impact of future CO_2 emission restrictions.[11]

In addition to increased generation costs caused by regulatory pressures, the cost of the fuel itself has been rising steadily with no signs of relenting. EKPC's cost

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[10] Synapse Energy Economics, *Climate Change and Power: Carbon Dioxide Emission Costs and Electricity Resource Planning*, June 8, 2006, p. 3.

[11] Staff Report of the Kentucky Public Service Commission in the matter of the 2005 Integrated Resource Plan of Louisville Gas and Electric Company and Kentucky Utilities Company, February 15, 2006, p. 24.

of coal has risen by 72% in 5 years.[12] This trend is likely to continue. According to the U.S. Department of Energy, ". . . the Appalachian basin has been mined extensively, and production costs have been increasing more rapidly than in other regions."[13]

Although the costs of mining, transporting, and preparing coal for electricity production are already embedded in its market price, there are many additional costs borne by society, not the coal industry. These are known as externalities, and they include the costs of damage to our health, water resources, air quality, mountain and forest ecosystems, highways, bridges, and humans—both individuals and communities—who find themselves in the midst of coal extraction activity.

Coal-fired power plants emit a wide range of air pollutants whose harmful health effects are well-established. These power plants are the nation's major source of sulfur dioxide, and emit tons of arsenic, lead, and chromium compounds, as well as hydrogen fluoride and hydrochloric acid, each year.[14] Additionally, these facilities are the largest U.S. source of human-made mercury pollution, emitting approximately 48 tons per year. These chemicals are hazardous to human health, and they contaminate our environment.

Many studies demonstrate that poor air quality results in increased asthma attacks, lung cancer, heart attacks, emergency room visits, and even mortality. One study estimates that every year in Kentucky alone, emissions from power plants cause nearly 1,000 deaths, over 600 hospitalizations, and 19,000 asthma attacks.[15] These costs are paid not only by the families of those who are ill, but by society at large as insurance companies and the government cover their medical costs and their employers suffer from work absences.

In addition to the harmful effects on human health, coal-fired power plants have a huge impact on natural ecosystems. The chemical pollution produced by acid mine drainage from coal mining operations significantly impacts the purity of the region's water systems, necessitating mitigation costs of more than $40 million

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[12] East Kentucky Power Cooperative, *2006 Annual Report*, Five-Year Statistical Summary.

[13] U.S. Department of Energy, Energy Information Administration, *Annual Energy Outlook 2007*, p. 98.

[14] Natural Resources Defense Council, *Coal in a Changing Climate*, February 2007, p. 13.

[15] Clean Air Task Force, *Death, Disease and Dirty Power: Mortality and Health Damage Due to Air Pollution from Power Plants*, October 2000, p. 6.

annually in Kentucky, Tennessee, Virginia, and West Virginia alone.[16] Other costs borne by Kentucky taxpayers include recovering from catastrophes such as breaks in sludge impoundments created from the waste of washing coal. In 2000, Kentuckians were faced with a break in a sludge impoundment of more than 300 million gallons of slurry that destroyed homes and killed aquatic life in more than 20 miles of streams.[17]

[16] Natural Resources Defense Council, *Coal in a Changing Climate*, p. 8.

[17] Ibid., p. 9.

ENERGY EFFICIENCY POTENTIAL IN KENTUCKY

Unlike other Midwest states, Kentucky has high residential electric usage and relatively few state or utility-sponsored energy efficiency programs. Therefore, it's not surprising that the Midwest Energy Efficiency Alliance (MEEA) found that Kentucky's technical potential[18] for energy efficiency is greater than 30%, which is higher than any of the other Midwest states analyzed in their 2006 study.[19] More than half of the achievable energy efficiency can be captured at a cost of 10 cents or less per kWh conserved.[20] Approximately 85% of these savings can be achieved by focusing on three main areas: space heating and cooling, water heating, and lighting.

In addition, refrigeration represents 7% of Kentucky's achievable residential energy efficiency potential. Total residential electric consumption can be reduced 0.3%, by replacing inefficient refrigerators with EnergyStar refrigerators.[21] It seems reasonable to assume that these statewide characteristics are reflected in EKPC's service territory. In the case of EKPC, if all inefficient refrigerators were replaced, residential energy usage would decline by almost 20,000 MWh annually.

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[18] Technical potential is generally regarded as the quantification of energy savings that could be realized if energy efficiency measures were applied in all technically feasible applications regardless of cost. Achievable potential is a subset of technical potential. It refers to the energy savings that could be realistically achieved through program or policy interventions. Some of the achievable potential is considered naturally occurring, such as changes in the marketplace for energy efficiency measures. The second component of achievable potential is due to higher appliance and equipment standards. The remaining portion of achievable potential comes from energy efficiency gains resulting from programs and policies specifically designed to advance the penetration of energy efficient appliances and equipment in society.

[19] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, Table 5-15, p. 62.

[20] Ibid.

[21] Ibid., p. 7.

ENERGY EFFICIENCY PROGRAMS FOR EKPC

The energy efficiency programs recommended as part of this portfolio are based on mature programs that have been adopted by numerous other utilities (see Table 4). Brief descriptions of each program can be found in Table A-2 in the Appendix. As should be the case with any robust energy efficiency portfolio, the one recommended here offers all customer classes at least one program to meet their needs. The following 11 programs are in no way meant to represent all of the achievable energy efficiency programs available to EKPC.

Although electric rates will rise minimally when energy efficiency is delivered by utilities and their partners, they will rise less than the incremental amount incurred when the cost of new baseload generation is added to rates. By participating in energy efficiency programs, EKPC customers will be able to partially or fully negate the impact of slightly higher kilowatt-hour rates through actual savings on their electric bills due to decreased energy usage. In addition, the energy-efficient equipment and appliances offered in these programs provide comparable or improved functionality to the consumer.

Table 4

Energy Efficiency Programs Recommended for East Kentucky Power Cooperative

Program Name	Cost of Saved Energy ($/kWh)	Measure Lifetime	Cumulative Lifetime Energy Savings (MWh)	Cumulative Program Annual Energy Savings in Year 10 (MWh)	Cumulative Annual Summer Demand Savings (MW)	Cumulative Annual Winter Demand Savings (MW)
Air Source Heat Pump Retrofit	0.017	20	3,486,000	174,300	9	244
Residential Lighting	0.018	4	240,000	60,000	8	8
Load Control Programmable Thermostat	0.018	10	1,926,000	192,600	140	0
Air Conditioner Exchange	0.058	12	54,000	4,500	7	0
Residential Water Heater Replacement	0.071	12	223,488	18,624	4	4
Residential Installment Payment Refrigerators	0.093	15	133,950	8,930	3	3
Commercial/Industrial Air Conditioner Tune-up	0.015	10	374,100	37,410	33	0
Commercial/Industrial Demand Response	0.025	10	525,000	52,500	175	175
Commercial Energy Efficient Lighting	0.040	10	1,134,000	113,400	23	12
Industrial Variable Speed Drives	0.018	15	1,033,200	68,880	14	7
Industrial Energy Efficient Motors	0.028	15	186,000	12,400	2	1
Portfolio Total			**9,315,738**	**743,544**	**418**	**455**

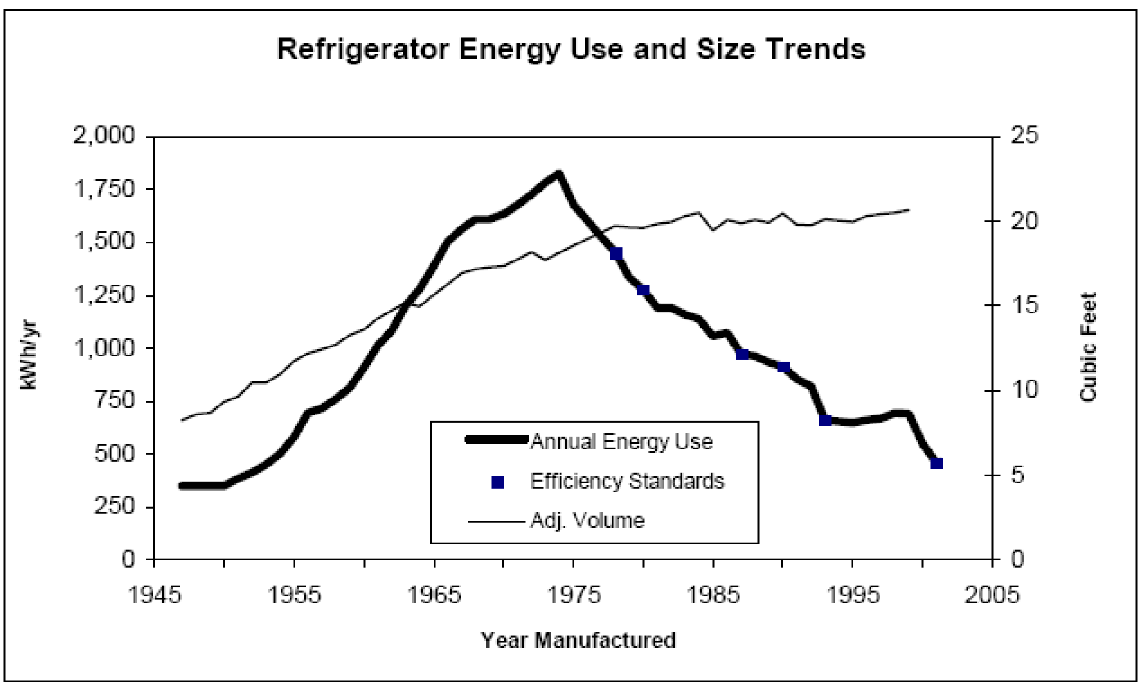
Refrigerator Replacement Programs

According to a report by the Natural Resource Defense Council (NRDC), over 30% of homes with annual income of $10,000 to $24,999 have a refrigerator that is 10 years or older.[22] Over 300,000 EKPC residential customers live in counties where the median household income is within this range, which creates the potential for replacement of more than 46,000 old, inefficient refrigerators.

The age of a household's refrigerator is important because electricity consumption of refrigerators has declined substantially since 1974 with new refrigerators consuming approximately 70% less than their peak.[23] Figure 1 shows the dramatic savings potential for the replacement of old refrigerators compared with new, higher efficiency ones.

Figure 1

Refrigerator Energy Usage



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[22] Natural Resources Defense Council, *Out with the Old, In with the New: Why Refrigerator and Room Air Conditioner Programs Should Target Replacement to Maximize Energy Savings*, November 2001, Figure 9, p. 25.

[23] Ibid., Figure 2, p. 7.

Utilities across the country have instituted refrigerator replacement programs to tap into this potential for energy savings. These programs are being delivered in large metropolitan areas and small municipalities alike.[24]

Recent studies show that the size of a typical refrigerator being replaced is 16 to 19 cubic feet with an average age of 18 years.[25] The savings estimates for refrigerator replacement programs vary widely from 663 kWh/year in a New York study to 1,327 kWh/year in an Iowa study. The Low-Income Retrofit Program in New Hampshire, for example, reveals that savings from program participants at a rural electric cooperative were 1,056 kWh/yr while the weighted average for all utilities across the state is 893 kWh/year.

In some cases, a recycling component is added to the program and the customer's old refrigerator is taken away by a qualified recycling center to have its components recycled in an environmentally friendly manner.

Installment Payment Refrigerator Program

Low-income households are not the only market segment that faces competing demands on their cash flows. Many residential customers are not able, or choose not to prioritize their spending to meet the up-front costs necessary to purchase energy efficient appliances, especially when there is remaining life on the existing ones. An innovative program called Pay As You Save, or PAYS®, has been successfully implemented by the distribution co-ops of the New Hampshire Electric Cooperative.

The main goal of an installment payment program similar to PAYS® is to advance the penetration of energy efficient equipment and appliances in households by helping consumers who lack capital and the inability or unwillingness to incur additional debt to acquire these energy-saving measures. This type of program is particularly well-suited to meet the barriers facing increased energy efficiency at rental properties. Tenants are frequently unwilling to invest in energy saving

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[24] Ibid., p. 27.

[25] Table 2.5 of the *Final Report: The New Hampshire Electric Utilities' Low-Income Retrofit Program, Impact Evaluation* (January 16, 2006) reveals 16 cubic feet as the average refrigerator size of program participants for all New Hampshire utilities with an average annual savings of 893 kWh. Another program sponsored by AmerenUE and not limited to low-income participants, reports an average size of 18 cubic feet with an average age of 18 years (2005 Missouri EnergyStar® Refrigerator Rebate and Recycling Program Final Report, p. 9).

measures as they may not stay at that premises long enough to realize a return on their investment. Landlords may be unwilling to make the investment because their tenants are responsible for payment of energy bills. This decision-making can lead to an untapped potential for energy efficiency.

In this program, installment payments for a new energy-efficient refrigerator are made monthly as part of the customer's electric bill. In the successful PAYS® program, the duration of installment payments are structured not to exceed three-fourths of the appliance life nor will the monthly payment amount be more than the expected average monthly bill savings. Bulk purchases of refrigerators for the program also lead to cost savings for all. In rental properties, landlords must agree in writing that they will inform future tenants of the continued responsibility to meet these payment obligations on their monthly electric bills.

A refrigerator replacement program with installment payments is recommended as part of this portfolio for EKPC. Replacing the old refrigerator of a customer of an EKPC member co-op can save nearly 900 kWh per year, translating into bill reductions totaling up to $80 per year at the current cost of electricity. As the cost of electricity increases, as it surely will considering EKPC's over-dependence on coal, the bill savings from replacing an old refrigerator will also increase.

Room Air Conditioner Exchange Program

Room air conditioning units have also realized significant efficiency gains over the last two decades (see Figure 2).[26] Yet many low-income households cannot take advantage of the bill savings these new units would afford due to difficulty with cash flow or credit access.

A very successful program targeting low-income customers, one that may be particularly attractive in Kentucky, is the Room Air Conditioner Exchange Program. In this program, a co-op customer would exchange an old, inefficient room air conditioner for a new, EnergyStar model at no cost. Turn-in events are scheduled in the community, and customers must reserve one of a limited number of high-efficiency units available for trade. Prior to the trade-in event, a customer must provide information about his/her existing unit so that one of the same size can be made available at the event.

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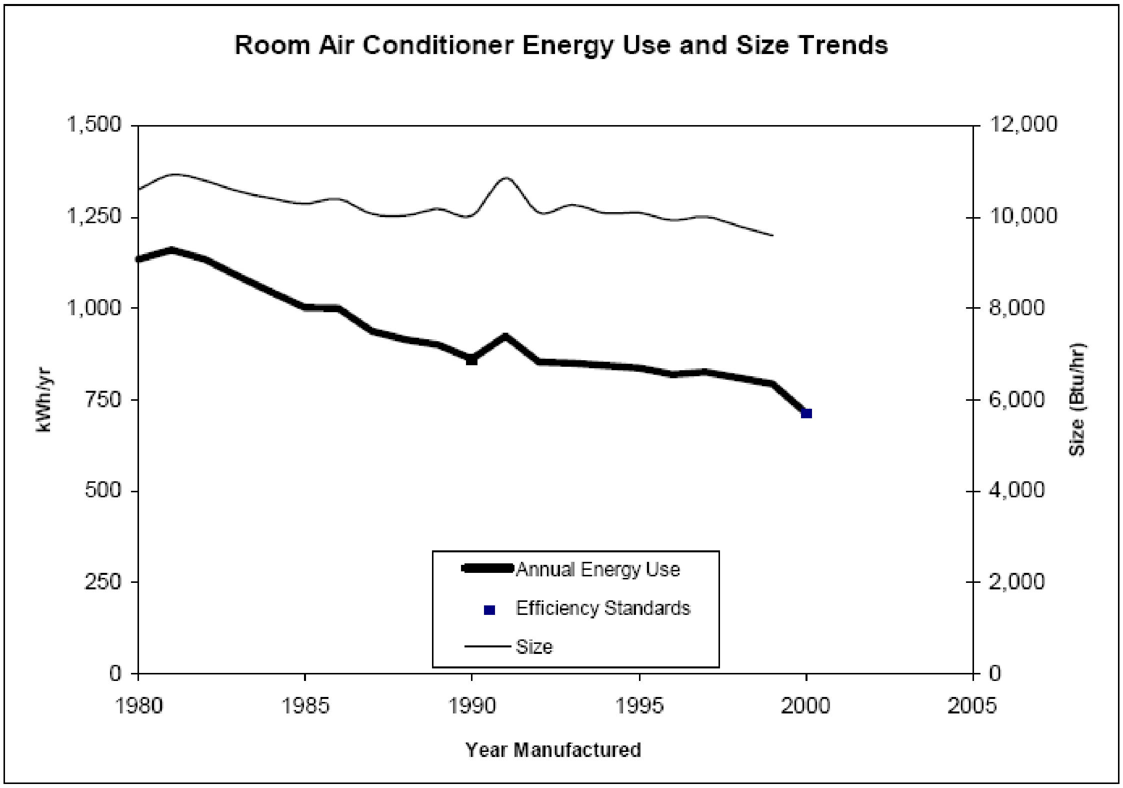
[26] Natural Resources Defense Council, *Out with the Old, In with the New*, Figure 1, p. 6.

Figure 2
Room Air Conditioner Use



In a replacement and recycling program conducted in New York, the average Energy Efficiency Ratio (EER)[27] of a room air conditioner replaced by participants was 8. By contrast, most EnergyStar room air conditioners today have a 10 to 11 EER, which means that the replaced units could be operating over one-third more efficiently. Previous program implementers have also found that units submitted for exchange were ill-maintained, so they concluded that actual savings may have been even higher than the engineering estimates, possibly reaching efficiency gains of nearly 50%.[28]

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[27] Energy Efficiency Ratio (EER) is a way to describe and compare the efficiency of air conditioning units and refrigeration compressors as it measures the relationship of equipment output in Btu/hr to electric input in kW.

[28] Natural Resources Defense Council, *Out with the Old, In with the New*, p. 21.

A 2006 room air conditioner exchange program in Chicago realized annual energy savings of 230 kWh per average unit where cooling seasons are shorter and may be less severe than states in the Central Southeast. In Kentucky, a room air conditioner exchange program can expect to achieve average annual energy savings of 300 kWh per unit at a cost of saved energy less than 6 cents/kWh.

The Midwest Energy Efficiency Alliance has assisted utilities in making this type of program a success.[29] To keep program costs low, volunteers from community-based nonprofit organizations supplemented the human resources provided by utilities. Another way to minimize program costs is to affiliate the program with a recycling center. Because materials such as copper, iron residue, and steel in the old air conditioners can be recycled, a utility may receive reimbursement to help offset a small portion of program costs.[30]

Since estimates show that 15% of households in Kentucky have at least one room air conditioner, there are thousands of old, inefficient air conditioning units available for replacement available across the state.[31] Therefore, should East Kentucky Power Cooperative provide an exchange program similar to ones in other Midwest states, it is reasonable to assume that 1,500 units could be replaced over ten years with a 4,500 MWh reduction in energy consumption annually.[32]

Residential Compact Fluorescent Lighting

Since a 20% energy savings in the residential sector can be achieved by adopting compact fluorescent lighting over incandescent lamps, any good energy efficiency portfolio contains a program to promote energy efficient residential lighting.

Lights for Learning, a program offered in conjunction with the Midwest Energy Efficiency Alliance, leverages the efforts of volunteers to maximize the

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[29] The Kentucky Department of Natural Resources is a member of the Midwest Energy Efficiency Alliance.

[30] ComEd, *2006 Room Air Conditioner Exchange Program Final Report*, p. 23.

[31] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, Table 4-15, p. 41.

[32] Energy savings represent the effects of cumulative program participation in the tenth year of the recommended energy efficiency portfolio. See Appendix Table A-4 for participation assumptions.

effectiveness of program delivery. In this program, compact fluorescent lights (CFLs) are sold as fundraising products through schools. Although it is not targeted at the low-income community, it can simultaneously achieve multiple goals. First, it helps local schools raise much-needed funds by allowing educational organizations to keep 50% of the profits. Second, it provides a low-cost way to educate people on the benefits of energy-efficient lighting in their homes. Third, the program allows households an easy and low-cost way to achieve energy savings while helping to meet the financial needs of their schools. By once again using volunteers to market the program and deliver the products, costs can be kept to a minimum.

EKPC could implement a similar program through both educational institutions and religious organizations to maximize the impact within the community. With 20,000 program participants annually, and each participant purchasing 3 compact fluorescent bulbs, EKPC can realize a savings of 60,000 MWh each year after the program is fully implemented in 10 years. Studies show that for CFLs used 6 hours per day, the cost of conserved energy is 1.2 cents/kWh, while those used 2 hours per day yield a cost of 2.3 cents/kWh.[33]

Programmable Thermostats with Utility Load Control Capability

Because summers in the East South Central region of the United States are 31% hotter than the U.S. average,[34] it's not surprising that Kentucky has a 76% penetration rate for central air conditioners.[35] However, the penetration rate for programmable thermostats in Kentucky households is only 19%.[36] In comparison, neighboring Illinois has a 47% penetration rate for programmable thermostats.[37] Installing programmable thermostats in single and multi-family dwellings can achieve substantial energy savings because residents don't have to remember to adjust the temperature settings for their space heating and cooling equipment when

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[33] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*.

[34] U.S. Department of Energy, Energy Information Administration, *Regional Energy Profile: East South Central Appliance Report 2001*.

[35] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, Table 4-15, p. 41.

[36] Ibid., Table 4-14, p. 40.

[37] Ibid.

they leave the premises or go to sleep. In addition to these obvious benefits, new technology now allows the utility to communicate directly with the customer's thermostat. The advantage of this new capability is that with the customer's permission, the utility can control the duty cycle of the central air conditioning compressor during periods of summer peak demand. This will enable fewer compressors to operate at the same time, thereby creating less peak demand on the EKPC system.

Load control devices such as these have been used for decades by investor-owned utilities and not-for-profit generation and transmission companies. Even in the early 1980s, Oklahoma Gas & Electric successfully controlled peak summer loads using a less sophisticated radio-controlled device. Wabash Valley Power Authority (WVPA), a not-for-profit generation and transmission company serving rural areas in Indiana, has also been using load control for well over two decades. WVPA has used load control as a mechanism to reduce customer demand at the most-costly, high-voltage service points, thereby avoiding ratchet penalties for wholesale power purchases.[38]

Air Source Retrofit Heat Pump Program

Another way to achieve significant benefits in energy efficiency is to convert inefficient electric space heating equipment to high-efficiency ground or air source heat pumps. With the exception of Missouri, Kentucky households, at a 20% penetration rate, use conventional electric space heating more than any other Midwest state studied by the Midwest Alliance for Energy Efficiency.[39] At 8%, its penetration of heat pumps is admirably the highest of these Midwest states, with Indiana a distant second at 5%. However, if the EKPC service area is representative of the state as a whole, there could be nearly 94,000 homes with significant energy savings potential. At a cost of conserved energy less than 2 cents per kWh, EKPC can administer a program, including incentives, to install air source heat pumps in 3,000 households per year. In addition to the incentives to help offset installation

[38] Ratchet penalties are commonly applied to the billing demand of wholesale and large commercial/industrial retail power transactions that require the purchaser to pay a portion of their highest annual demand on every subsequent bill until a new demand is established in the following year.

[39] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, Table 4-14, p. 40.

costs, each program participant could realize $470 annually from their electric bill.[40] After 10 years at this level of program participation, EKPC could achieve 174,300 MWh in energy savings each year.

Residential Water Heater Replacement

Electric water heaters provide another source for electric energy savings. The MEEA estimates that 66% of Kentucky's electric water heaters operate at the minimum efficiency level.[41] Further, only 15% of water heaters in Kentucky have insulated tank wraps to decrease heat loss.[42] MEEA's study found that a 20% savings is attainable by installing thermal blankets to water heaters; wrapping pipes with insulation; and upgrading water heaters to higher efficiency models. They found that in the Midwest, the total cost of conserved energy for a high-efficiency water heater is 6.9 cents/kWh. With a slightly higher cost of conserved energy at 7.1 per kWh, EKPC can avoid generating over 18,000 MWh annually by replacing electric water heaters with new, high-efficiency models in a ten-year program.[43]

Energy Efficiency Options for Commercial and Industrial Customers

Although customers in the residential sector may live in multi-family dwellings or single family residences, including manufactured homes, their usage patterns and load characteristics are quite homogenous. However, the commercial customer class has much more diversity as it serves everything from the small retail boutique to the large hospital. This diversity in customer type carries with it a broad range of daily and annual usage patterns. Restaurants demand more electricity during meal times when cooking equipment is heavily utilized and cooling load increases. Schools see a drop in the need for electricity during the summer.

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[40] This value assumes 5,810 kWh savings per year at the median residential electric rate for all EKPC distribution companies.

[41] Midwest Energy Efficiency Alliance, *Midwest Residential Market Assessment and DSM Potential Study*, Table 4-16, p. 43.

[42] Ibid.

[43] The cost of conserved energy in the Midwest is 6.9 cents/kWh per the *Midwest Residential Market Assessment and DSM Potential Study*, p. 7, commissioned by the Midwest Energy Efficiency Alliance.

Religious institutions typically experience spikes in electricity demand when their congregations meet.

Large industrial customers frequently have unique contracts with their power supplier listing the specific conditions and provisions of their power supply. Gallatin Steel, for example, receives electricity from EKPC through Owen Electric Cooperative. The 120 MW load requirements of its arc furnace are interruptible for as many as 360 hours per year. Gallatin also offers another 40 MW of its power requirements to be curtailed when the utility experiences periods of high system demand. In return, Gallatin is given credit on its monthly electric bill, as specified in the provisions of its contract. The compact between a utility and its customer that allows for the periodic curtailment of load is frequently referred to as demand response.

Commercial/Industrial Demand Response Programs

A demand response program aimed at commercial and industrial customers is an important part of a demand-side management portfolio because it helps defer or eliminate the need for an additional power plant by providing substantial reductions in demand at the time of the utility's system peak. It can be a good complement to other programs that offer high energy savings, but only minimal demand reductions coincident with the utility's system peak.

Demand response programs offer benefits in many ways. They allow the utility to provide credit on customers' bills instead of purchasing expensive power in the wholesale marketplace or generating power at peak demand periods. Further, demand response programs make use of available distributed generation resources within the service territory as customers transfer some or all of the electric requirements to their on-site generation facilities. They also offer increased system reliability because customers are under contractual obligation to reduce load when notified, in exchange for financial compensation.

For EKPC and its customers, the cost of saved energy from a commercial/industrial demand response program is $0.028 per kWh. This program, as modeled in the recommended portfolio is projected to show potential system energy savings of 52,500 MWh after 10 years with 5,000 participants. This represents approximately 17% of EKPC's commercial/industrial customers and a reduction of roughly 1% of the annual consumption of the commercial and industrial classes combined. Demand savings under such a program would reach 175 MW per year after 10 years and full program participation.

Commercial Industrial Lighting

Lighting in commercial and industrial buildings is a significant source of electricity usage. Table 5 below shows the percent of energy consumed by lighting in typical commercial building types.[44]

EKPC has designed a commercial/industrial lighting program providing generous financial incentives that should be offered by all EKPC distribution cooperatives and remain a part of a robust demand-side management portfolio with significant participation levels. If, after 10 years, approximately 50% of EKPC's commercial and industrial customers were to install energy-efficient lighting systems, over 113,000 MWh could be saved *each year.*

Table 5

Lighting Consumption as a Percentage of Total Building Energy Usage by Type

Building Type	Lighting as a Percent of Total Energy Consumed
Health Care	16%
Lodging	20%
Office	30%
Schools	19%

Commercial/Industrial Air Conditioner Tune-up Program

Space cooling requirements typically run between 5 to 10% of all energy use in commercial buildings.[45] Further, many of these air conditioning systems are operating at less than optimal levels, which means that it takes more energy to achieve and maintain the desired temperature. A cost-effective Commercial Air Conditioner Tune-up Program has been proposed in the 2005 Integrated Resource

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44 U.S. Department of Energy, Building Technologies Program.

45 U.S. Department of Energy, *Scenarios for a Clean Energy Future*, November 2000, p. 42.

Plan of Louisville Gas & Electric and Kentucky Utilities. In this program, commercial air conditioning units are examined and then services are provided at a discount to bring each space cooling system to its optimal operating level. EKPC is a good candidate for a similar program. With potential demand reductions of 2.2 kW per participant and nearly 2,500 kWh savings annually, this program can have a significant impact on EKPC's system load requirements. If about half of EKPC's commercial and industrial customers participated in the program, EKPC would realize a cumulative summer demand reduction of 33 MW and an energy savings of 37,410 MWh.

High Efficiency Motors and Variable Speed Drives

Motors are an important part of many businesses. They are essential in a wide array of applications from cold storage in grocery stores to manufacturing in large industrial facilities. Energy savings from these sources can result in substantial expense reductions for the customer. Identified by the U.S. Department of Energy as an example of best practices, a performance optimization project of Minnesota Mining and Manufacturing (3M) reduced electricity consumption by 41% and cut expenditures by $77,554 annually due to increasing the efficiency of approximately 1,000 electric motors at its main campus.[46]

In steel mills, fluid handling systems such as pumps, fans, and air compressors consume close to 40% of all motor energy and are strong candidates for cost saving opportunities.[47] EKPC along with Owen RECC should work closely with and provide incentives for Gallatin Steel, its largest customer, so that all parties can benefit from high-efficiency motors, and where applicable, variable speed drives (VSDs). With the cost of saved energy at 1.8 to 2.8 cents per kWh for installing high-efficiency motors and VSDs, it is worthwhile to pursue these types of programs as a way of achieving long-term expense reduction for the customer, and optimal system planning for the utility.

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[46] U.S. Department of Energy, *Best Practices Technical Case Study*, May 2002.

[47] U.S. Dept. of Energy, Office of Industrial Technologies, *Improving the Energy Efficiency of Motor Systems*, December 2001.

RENEWABLE ENERGY PROGRAM OPTIONS FOR EKPC

In addition to investing in the kinds of energy efficiency and demand response programs discussed so far, EKPC must also invest in clean, renewable energy resources. Wind, solar, and small-scale hydroelectric can provide needed power without the harmful and costly attributes which accompany coal-fired generation. In fact, over *one million* MWh of power from renewable energy resources can be made available to EKPC and its member co-ops annually (see Table 6).

Table 6

Renewable Energy Program Recommended for East Kentucky Power Cooperative[48]

Renewable Energy Resource	Annual Generation (MWh)	Maximum Demand (MW)	Cost ($/kWh)
Residential Solar Water Heaters	24,530	11	$0.075
Commercial Solar Water Heaters	17,456	7	$0.053
Wind-Powered Generators[49]	192,720		$0.035
Hydroelectric Power	842,055	191.5	$0.036
TOTAL	1,076,761	209.5	$0.037

Residential and Commercial Solar Water Heater Programs

Solar water heating systems serve as a source of distributed power generation and a load reducing, demand-side-management tool. Solar water heating systems are in widespread use in many parts of the world, including the Unites States. While the U.S market for solar water heating is presently quite small, the global market grew by 14% in 2005, with worldwide installations reaching 46 million homes using technology that is mature and well-established.[50]

48 The total cost per kWh represents a weighted average based on the net costs for each resource.

49 Since wind is not a dispatchable electric generation source, it is common practice to exclude capacity values for demand planning purposes.

50 Http://www.environmentcalifornia.org/reports/energy/energy-program-reports/solar-water-heating-how-california-can-reduce-its-dependence-on-natural-gas.

Solar water heating systems are well-suited for residential domestic water heating; space heating; and many commercial, institutional, and industrial water heating applications. Common non-residential applications include swimming pool heating, laundromats, hotels, dormitories, multi-family dwellings, restaurants, food processing facilities, schools, and fire stations.

Systems typically operate for at least 25 years. A solar water heater provides the owner with a fixed cost for water heating energy, providing security against future energy price increases. This is especially important for customers of utilities like EKPC that face an extraordinary "carbon risk" when greenhouse gases are eventually regulated.

Solar water heating systems in Kentucky can typically meet 50–80% of a home's domestic hot water needs on an annual basis. Systems are normally installed with a back-up heating system to ensure that hot water is always available. Systems are also designed with freeze protection so they can operate through the winter without trouble. For larger, non-residential (or multi-family/dormitory) facilities, the portion of energy provided by the solar thermal system will depend upon the system design and economic considerations, and can range from 25–80%, depending upon the circumstances. In both residential and commercial applications, solar water heaters offer the highest demand savings in the summer, during the utility's peak demand periods on hot afternoons. At these times solar water heating systems are operating and avoid the use of electric heating elements.

Using data from East Kentucky Power Company's Integrated Resource Plan, the typical residential customer consumes 4,821 kWh per year for water heating. A solar water heating system using a 40 square foot solar collector on such a home will save approximately 2,453 kWh per year. Such a system could be equipped with a single hot water storage tank that includes a back-up heating element, or could use two storage tanks, one to store solar-heated water and the other using the back-up heating element.

Table 7 shows the expected energy production and financial analysis for a typical residential solar water heating system. Maintenance requirements are relatively low and maintenance costs are small relative to the annual and long-term financial savings generated by the systems. The lifecycle operating and maintenance (O&M) costs represent periodic parts replacement, including the hot water storage tank, a pump, and the non-toxic antifreeze used in the solar plumbing. The solar thermal collector itself should require no servicing during the first 25 years of operation. As shown, a residential solar water heater will save its owner 61,325 kWh during the first 25 years of operation, at a cost to the customer of $0.055/kWh. This cost is significantly below the 2006 retail residential rate for all of the distribution cooperatives serviced by EKPC and will be even more so at the end of the life of a solar water heater.

Table 7

Residential Solar Water Heater
Energy and Financial Savings per Participant

Annual Energy Savings	2,453 kWh
Lifecycle Energy Savings (25 years)	61,325 kWh
Installed Cost	$4,500
Lifecycle Operating & Maintenance Costs	$1,000
EKPC Rebate	$1,104
Federal Tax Credit	$1,019
Final Lifecycle Cost to Participant	$3,377
Final Purchase Price to Participant	$2,377
Lifecycle Cost of Energy Savings to Participant, after incentives	$0.055/kWh

Note that even without the federal tax credit, the lifecycle cost of energy savings to participants will be $0.072 cents per kWh. This is still less than the current retail rate for electricity from all of EKPC's distribution cooperatives and it is a fixed price over the 25 years of the solar water heating system, whereas the retail rate of electricity from the distribution cooperatives will surely increase substantially in the next 25 years.

Commercial-scale solar water heating systems can generate and save many times more energy than a residential system. Table 8 shows the expected energy savings from a solar water heating system on a medium-sized commercial scale project, such as a laundromat or 50-bedroom hotel. The average hot water demand for such a facility is estimated to be 30,000 kWh/year. A solar water heating system with 320 square feet of solar thermal collectors would save 17,456 kWh/year. The estimated installation cost for such a solar water heating system is $24,000, and the 25-year lifecycle operations and maintenance costs are estimated at $3,600.

Table 8 also shows that a commercial solar water heating system of this size would save the customer 436,400 kWh during the first 25 years of operation and would produce energy savings at a cost of $0.034/kWh. Again this is significantly below the 2006 cost of electricity for commercial customers of all EKPC member co-ops, and may be dramatically below the cost 25 years from now.

Table 8

Commercial Solar Water Heater
Energy and Financial Savings per Participant

Annual Energy Savings	17,456 kWh
Lifecycle Energy Savings (25 years)	436,400 kWh
Installed Cost	$24,000
Lifecycle Operating & Maintenance Costs	$3,600
EKPC Rebate	$7,855
Federal Tax Credit	$4,843
Final Lifecycle Cost to Participant	$14,901
Final Purchase Price to participant	$11,301
Lifecycle Cost of Energy Savings to Participant, after incentives	$0.034/kWh

Even without the federal tax credit, the lifecycle cost of energy savings to participants still comes out to 4.5 cents per kilowatt-hour. This is still less expensive than the 2006 commercial and industrial rates of all EKPC's distribution cooperatives, except one, which was 4.42 cents per kWh. It is difficult to imagine a scenario in which the 4.5 cents per kilowatt-hour will not be a fraction of industrial and commercial rates two decades from today when the solar hot water system is still providing hot water.

A residential solar water heater program could achieve annual energy savings of 24,530 MWh in its tenth year with 10,000 participants (only 2% of EKPC's residential customer base). The summer demand reduction from this program would be 11 MW. A commercial solar water heater program with 1,000 participants could achieve 17,456 MWh in annual energy savings in its tenth year, with a 7 MW summer demand reduction.

Twenty-three states offer utility-based or state-sponsored financial incentives such as rebates, grants, tax credits, and low- or zero-interest loans for solar water heater installations.[51] Some programs offer a flat dollar amount back to the customer, regardless of the size or cost of the solar energy system. Others offer a percentage of the installed system cost. Some states have started to use performance-based incentives, which calculate the value of the incentive on the expected (or measured) energy output from the system. Performance-based incentives encourage system designs that emphasize energy savings and avoid the risk of contractors over-sizing or over-pricing systems simply to generate larger rebates. They also allow larger systems to reap proportionally larger incentives in contrast to programs that offer flat dollar amounts.

The program recommended for EKPC is a performance-based incentive based on the projected annual kilowatt-hour savings for the solar water heating system. For both residential and commercial customers, the incentive value is $0.45 per kWh saved during the first year of operation. An incentive at this level would cover roughly 25% and 33% of the equipment and installation cost respectively for residential and commercial customers.

In addition to these rebates, low- or zero-interest loans or a "Pay As You Go" program should also be used to further mitigate the financial barrier presented by the up-front capital cost of such systems. Similar to the PAYS® program discussed earlier in this paper, the utility pays for the full installation of the solar water heating system and then adds a charge to the utility bill each month until the solar water heating system is paid off. For residential units, if the loan term or payment plan is over 15 years, the customer will see immediate reductions in their expenses as energy savings exceed the value of the monthly payments. For commercial customers, a loan or payment term of ten years would provide immediate savings in monthly expenses for the customer.[52]

Small Scale Hydroelectric Generation

Kentucky's abundance of rivers has the potential to provide clean and economical power from a proven technology. Yet, many of these sites remain undeveloped. The Kentucky River Authority owns sites with estimated generation

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[51] These states are Arizona, California, Delaware, Florida, Hawaii, Illinois, Iowa, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New York, North Carolina, North Dakota, Ohio, Oregon, Rhode Island, South Carolina, Texas, Utah, Vermont, and Washington (http://www.dsireusa.org).

[52] This is based on a current electricity rate of $0.07 per kWh.

capacity of 19.5 MW, while sites controlled by the Army Corps of Engineers could account for an additional 172 MW, bringing the total to 191.5 MW of power waiting to be tapped. To construct hydroelectric generation at all undeveloped sites in Kentucky would cost between $455 and $550 million.[53] With capacity factors ranging from 45–55%, these sites combined could produce a total of over 842,000 MWh annually at a median cost of $0.036 per kWh.[54] (See Appendix Table A-5 for detailed data.)

Wind Generated Power

As of September 2007, there were 16,819 MW of installed wind capacity in the United States with 3,506 more MW under construction. Nineteen percent of that installed capacity was built in 2006, demonstrating the rapid increase in the popularity of this generation source which has been driven largely by state renewable-energy portfolio standards and its increasing cost-effectiveness compared to fossil fuels. Texas alone has over 4,356 MW of installed wind-powered generating facilities. All states bordering on Kentucky have developed or are in the process of constructing wind resources. Appalachian Power Company, a subsidiary of American Electric Power (AEP) in West Virginia, recently signed a 20-year power purchase agreement for 75 MW of wind energy from the 150 MW Camp Grove Wind Farm in Illinois. During August 2007, AEP also announced that Indiana Michigan Power, another of its subsidiaries, had entered into a long-term agreement for 100 MW of capacity from Fowler Ridge Wind Farm in Indiana. Illinois has a total of 699 MW of installed wind power generating facilities with another 108 MW currently under construction.

Adding 100 MW of wind energy to an EKPC renewable energy portfolio would provide conservatively at least 192,720 MWh of clean energy to EKPC member cooperatives each year at a cost of approximately $0.035 per kWh.[55] These wind

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[53] Identification of potential hydroelectric generation sites, development costs, and capacity factors prepared by David H. Brown Kinloch of Soft Energy Associates, Louisville, Kentucky.

[54] Includes operation and maintenance expenses of $0.017 per kWh over the 30-year lifetime of the generation facility based on an average of O&M for Georgia Power hydroelectric generating plants, as reported in the Federal Energy Regulatory Commission Form 1, filed for 2006.

[55] A 22% capacity factor is assumed on a purchased power agreement at $0.06 per kWh, less $0.025 per kWh for the "green tag," that is the income from EKPC's green pricing program, Envirowatts. We are assuming $0.25 per kWh of the Envirowatts program would go to administrative costs.

projects could be developed at suitable sites in Kentucky or in other states, as many other utilities have done.

Funding Opportunities for Energy Efficiency and Renewable Energy Programs

Historically, energy efficiency programs have been funded through costs embedded in electric rates or through supplemental charges on electric bills. Programs were typically delivered by the utilities and their contractors or energy service companies. Today, however, there are a number of additional funding sources ranging from not-for-profit organizations to corporate foundations to state-sponsored energy grants and low-cost loans that can be used to support energy efficiency market transformation costs. For example, the Mountain Association for Community Economic Development (MACED), a nonprofit organization working in Eastern Kentucky and Central Appalachia, is launching a new initiative to provide affordable loans to Kentucky businesses to assist with the costs of installing energy efficiency measures. Such programs may provide fruitful partnering opportunities for EKPC.

In 2006, the Kentucky Solar Partnership (KSP) administered a pilot rebate program for residential solar water heaters, offering rebates worth $500. KSP had sufficient funding to provide 25 rebates, and all funds were committed in less than one year. In fact, KSP received 8 more applications than it had rebates. In addition, KSP is partnering with MACED to offer low-interest loans that cover the full cost of equipment and installation for solar water heaters and are repaid in monthly installments over six years.[56]

Another prime funding source is the Federal government, which allocates money to State Energy Offices, who in turn distribute funds for energy efficiency activities based on the priorities of each participating state. These programs have been very successful, and EKPC should consider partnering with the Kentucky State Energy Office to leverage these resources for their customers. A recent report of the National Association of State Energy Officials (NASEO) highlights some of the many success stories in other states that could be replicated in Kentucky.[57]

In Alabama, the School Retrofit Program provided $52,000 in energy efficiency improvements to 8 schools, resulting in energy cost savings of more than

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[56] Http://www.dsireusa.org.

[57] National Association of State Energy Officials, *State Energy Program and Activity Update*, winter 2007.

$20,000 during the first year alone. In a second example, the South Carolina Energy Office reported that it had certified over 2,000 manufactured homes as energy efficient during fiscal year 2005–06. These homebuyers are able to reduce their monthly energy bills and qualify for an energy efficient mobile home tax credit. Through this and other State Energy Programs, South Carolina calculates that $17.40 in energy savings has been achieved for each federal dollar spent.

The Small Business $mart Energy Program in Illinois is one of the many State Energy Programs funded by the U.S. Department of Energy. It provides free technical assistance to a full range of businesses including groceries, restaurants, hotels, and assisted living centers. Thirty-six businesses have implemented some or all of the recommended energy improvements, saving an estimated 3.6 million kWh per year. In addition, the cost of saved energy has declined from $0.04 per kWh in 2005 to $0.01 per kWh in 2006.

Maine uses a portion of its federal funding to make loans for energy efficiency to small businesses. Each loan is capped at $35,000 with a current interest rate of 3%. Maine businesses are able to achieve electric savings of 561,466 kWh per year in addition to hundreds of thousands of therms of natural gas annually.

The U.S. Department of Energy is not the only federal source of funding for energy efficiency and renewable energy programs. On September 24, 2007, the U.S. Department of Agriculture announced that it selected 345 proposals in 37 states totaling $18.2 million for energy efficiency and renewable energy projects. EKPC should be particularly interested in this funding source because it targets agricultural producers and small rural businesses.

This is by no means a complete listing of all funding sources for programs involving energy efficiency and renewable energy. There are a wealth of nonprofit and public entities offering various forms of financial assistance. EKPC is encouraged to investigate all potential opportunities in order to leverage their resources, maximize program participation, and provide the cleanest and most fiscally responsible solutions to its customers.

Conclusion

EKPC can develop and implement a portfolio of energy efficiency programs at a lower cost than constructing, maintaining and operating a coal-fired power plant in this financially turbulent time. For an investment of less than $11 million dollars each year, EKPC can avoid the need to generate 743,544 MWh annually. The program life for most of the equipment and appliances recommended here is ten to twenty years, far beyond the ten-year implementation period of the portfolio, bringing the average cost of saved energy for the entire set of recommended programs to 2.4 cents per kWh.[58] Add to this a solar water heater program, combined with a 100-MW power purchase agreement for wind generation, and the development of undeveloped hydroelectric sites in the state, and there is no longer a need for a new coal-fired power plant. A key point worth repeating is that the portfolio of energy efficiency and renewable energy sources is flexible so that it can be tailored to meet the EKPC's electric needs if and when they arrive.

Table 9

Recommended Energy Efficiency & Renewable Energy Portfolio for East Kentucky Power Cooperative

	Annual Energy (MWh)	Maximum Demand (MW)	Cost ($/kWh)
Energy Efficiency Solutions	743,544	455	0.024
Renewable Energy Solutions	1,076,761	209.5	0.037
Total Energy Efficiency and Renewable Energy Portfolio	1,820,305	664.5	0.032

Through a committed effort to a portfolio of energy efficiency programs and the implementation of renewable energy resources, East Kentucky Power Cooperatives can defer or eliminate the need for its next planned coal-fired power plant and instead contribute to the long-term health and quality of life for its customers, Kentucky's citizens, and the environment.

[58] This analysis assumes a 4-year life for compact fluorescent lamps.

APPENDIX

Table A-1

Counties Fully or Partially Served by East Kentucky Power Cooperatives

County Name	% People Living in Poverty		County Name	% People Living in Poverty
Adair	21.5		Knott	27.0
Anderson	9.6		Knox	29.1
Barren	16.6		Larue	15.4
Bath	20.1		Laurel	20.4
Bell	28.8		Lawrence	24.8
Boone	7.7		Lee	29.8
Bourbon	14.3		Leslie	28.6
Boyle	14.8		Letcher	24.0
Bracken	12.8		Lewis	26.9
Breathitt	29.5		Lincoln	18.8
Breckinridge	16.3		McCreary	30.1
Bullitt	10.4		Madison	16.3
Campbell	10.9		Magoffin	29.9
Carroll	14.3		Marion	16.4
Carter	22.7		Martin	30.5
Casey	22.9		Mason	16.7
Clark	13.5		Meade	11.9
Clay	34.3		Menifee	24.2
Clinton	23.5		Mercer	13.6
Cumberland	22.1		Metcalfe	20.6
Edmonson	17.5		Montgomery	15.4
Elliott	25.3		Morgan	27.0
Estill	23.6		Nelson	12.9
Fayette	14.2		Nicholas	15.3
Fleming	17.8		Oldham	6.3
Floyd	26.8		Owen	16.0
Franklin	12.3		Owsley	35.5
Gallatin	17.2		Pendleton	13.6
Garrard	14.6		Powell	23.3
Grant	13.3		Robertson	19.0
Grayson	17.9		Rockcastle	21.4
Green	18.3		Rowan	20.7
Greenup	16.0		Russell	21.5
Hardin	13.0		Scott	10.5
Harlan	29.3		Shelby	11.0
Harrison	13.6		Spencer	9.3
Hart	20.5		Taylor	17.8
Henry	13.7		Trimble	14.1
Jackson	25.2		Washington	15.1
Jefferson	14.8		Wayne	24.3
Jessamine	13.2		Whitley	25.3
Johnson	23.3		Wolfe	29.4
Kenton	11.3		Woodford	9.6

Source: U.S. Census Bureau, Small Area Income and Poverty Estimates for Kentucky Counties, 2004

Table A-2

Energy Efficiency Portfolio Recommended for East Kentucky Power Cooperative

Program	Program Description	Targeted Customer Sector	Annual Energy Savings per Program Participant (kWh)	Summer Demand Savings per Program Particpant (kW)	Winter Demand Savings per Program Participant (kW)	Annual Number of New Participants	Cumulative Number of Program Participants	Annual Incremental Program Energy Savings (MWh)	Program Year 10 Cumulative Annual Energy Savings (MWh)	Cumulative Lifetime Energy Savings (MWh)	Cumulative Annual Summer Demand Savings (MW)	Cumulative Annual Winter Demand Savings (MW)	Cost of Saved Energy ($/kWh)
Air Source Heat Pump Retrofit	Offers incentives to customers who replace electric space heating equipment with high-efficiency air source heat pumps.	Residential Customers with Electric Space Heat	5,810	0.3	1.5	3,000	30,000	17,430	174,300	3,486,000	9	244	$0.017
Residential Lighting	Acts as a multi-purpose program that increases the penetration rate of compact flourescent lamps in households while raising money for schools by utilizing the efforts of school children and their families to take orders for and deliver CFLs to their families, friends & neighbors.	Residential	300	0.04	0.04	20,000	200,000	6,000	60,000	240,000	8	8	$0.018
Load Control Programmable Thermostat	Installs a programmable thermostat at a residential customer's location at no charge for the ability to remotely curtail the customer's air conditioner during periods of peak utility system demand.	Residential Customers with Central A/C	1,926	1.4	0	10,000	100,000	19,260	192,600	1,926,000	140	0	$0.018
Air Conditioner Exchange	Distributes new ENERGY STAR® qualified room air conditioners in exchange for old-inefficient ones at no cost to the customer.	Low-Income Residential	300	0.49	0	1,500	15,000	450	4,500	54,000	7	0	$0.058
Residential Water Heater Replacement	Replaces standard water heaters with high-efficiency water heaters	Residential Customers	388	0.09	0.09	4,800	48,000	1,862	18,624	223,488	4	4	$0.071
Residential Installment Payment Refrigerators	Provides consumers with energy efficient refrigerators without an up-front payment and payments made on monthy electric bills from bill savings.	Low-Income Residential	893	0.258	0.283	1,000	10,000	893	8,930	133,950	3	3	$0.093
Commercial/Industrial Air Conditioner Tune-up	Offers commercial customers an analysis of their existing air conditioning systems and discounted services on corrective action needed for the system to operate at maximum efficiency.	Commercial Customers	2,494	2.2	0	1,500	15,000	3,741	37,410	374,100	33	0	$0.015
Commercial/Industrial Demand Response	A program that offers financial incentives for a customer to reduce load to a pre-determined level during periods of high system demand.	Commercial & Industrial Customers	10,500	35	35	500	5,000	5,250	52,500	525,000	175	175	$0.025
Commercial Energy Efficient Lighting	Offers rebates for upgrading existing lighting in commercial establishments for energy efficient lighting systems.	Commercial & Industrial Customers	4,725	0.94	0.51	2,400	24,000	11,340	113,400	1,134,000	23	12	$0.040
Commercial/Industrial Variable Speed Drives	Offers technical assistance and rebates for variable speed drives to industrial and large commercial customers.	Industrial	98,400	19.4	10.7	70	700	6,888	68,880	1,033,200	14	7	$0.018
Commercial/Industrial Energy Efficient Motors	Offers rebates for replacement of existing motors with high-efficiency motors.	Industrial	12,400	2.4	1.3	100	1,000	1,240	12,400	186,000	2	1	$0.028
Program Portfolio Total								74,354	**743,544**	**9,315,738**	**418**	**455**	

Table A-3
Program Costs and Assumptions

Program Name	Annual Levelized Administrative Costs	EKPC Incremental Program Expenses	Total Utility Annual Program Costs	Comments
Residential Heat Pump	$2,500	$1,896,000	$1,898,500	Assumes $632 total cost per participant, including $182 per participant for marketing and related costs, and $450 in customer rebates. Costs from EKPC 2006 Integrated Resource Plan (IRP)
Residential Lighting	$1,000	$132,000	$133,000	This expense is $6.60 per participant, which assumes that EKPC subsidizes the cost of 3 bulbs per participant. Bulb costs at $2.20 each are from EKPC 2006 IRP.
Load Control Thermostat	$25,000	$3,500,000	$3,525,000	$350 per participant includes cost of customer acquisition and installing load control programmable thermostat at customer site. Costs based on estimates from EKPC 2006 IRP.
Air Conditioner Exchange	$15,000	$300,000	$315,000	Assumes $200 per new participant: Best Buy offers a 10,000 Btu A/C unit for $250, so a bulk discount is assumed. A levelized cost of $15,000/yr. covers marketing and customer contact. Similar programs in other service territories used many community volunteers on the actual exchange day to minimize costs.
Residential Water Heater Replacement	$5,000	$1,032,000	$1,037,000	Assumes $215 per new participant, with $65 per participant for marketing costs and customer communication, and $150 rebate to each participant per EKPC 2006 IRP.
Residential Installment Payment Refrigerators	$20,000	$225,000	$245,000	Assumes $225 per participant to assist with program paperwork and cover refrigerator delivery and finance charges. Marketing costs will come out of the $20,000/yr. administrative expenses.
Commercial A/C Tune-up	$25,000	$300,000	$325,000	This is based on a cost of $200 per new participant taken from the details of a similar program proposed in the LGE/KU IRP. The administrative cost of $25,000 per year assumes 20% of a full-time employee's time and other expenses to support program implementation.

Table A-3 (Cont'd)

Program Costs and Assumptions

Program Name	Annual Levelized Administrative Costs	EKPC Incremental Program Expenses	Total Utility Annual Program Costs	Comments
Commercial/Industrial Demand Response	$35,000	$687,500	$722,500	These amounts are based on a per participant cost of $1,375 for incentives to the customer. These numbers are from the EKPC 2006 IRP. Annual administrative costs for this program are estimated at $35,000 because it reflects the levelized cost of setting up a curtailment request infrastructure for software, communications, etc.
Commercial/Industrial Lighting	$20,000	$1,598,521	$1,618,521	These estimates are from the EKPC 2006 IRP. In addition to the $20,000 annual administrative costs, there will be $150 per new participant; average rebate to the customer based on EKPC current offer of $213 per kW load reduction at customer's site with a 90% system coincidence factor and $320 in lost revenues per program participant which would be recovered in rates as approved by the KY PSC.
Industrial Variable Speed Drives	$10,000	$689,500	$699,500	This amount assumes a payment of $0.10 per annual kWh saved to the customer plus a $10 per participant expense for administration, in addition to the annual administrative expense. A participant represents an average replacement of 100 horsepower of motors. Estimates from the EKPC 2006 IRP.
Energy Efficient Motors	$2,000	$300,000	$302,000	This assumes an average rebate to the participant of $3,000 based on a rebate of $5 per horsepower and customer will replace motors totaling more than 100 horsepower. Estimates from the EKPC 2006 IRP where it states that the rebate amount was determined based on review of other utility motor programs. The annual $2,000 administrative expense was also taken from the EKPC IRP.
Annual Total	**$160,500**	**$10,660,521**	**$10,821,021**	

Table A-4

Program Participation Rate Assumptions

Program Name	Annual Number of New Participants	Cumulative 10-Year Number of Participants	Assumptions
Residential Air Source Heat Pumps	3,000	30,000	EKPC served 469,121 residential customers in 2006 (see Table 1). A Midwest Energy Efficiency Alliance report estimates that 20% of Kentucky residences have electric space heating that is not heat pumps (see footnote 5), Therefore, there may be 93,824 households with the potential for converting electric resistance heat to air-source heat pumps. Additionally, assuming that less than one-third of this potential participates in the program over 10 years is quite reasonable.
Residential Lighting	20,000	200,000	This is an estimated amount that approximately 40% of EKPC customers would participate through a school fundraiser or through their religious organizations.
Residential Programmable Thermostats with Air Conditioner Load Control	10,000	100,000	EKPC served 469,121 residential customers in 2006 (see Table 1). A Midwest Energy Efficiency Alliance report estimates that 76% of Kentucky residences have central air conditioners (see footnote 35). Therefore, there may be 356,532 households with the potential for programmable thermostats that would also allow for EKPC direct load control of their central air conditioning units. Assuming that 28% of the 2006 number of EKPC's residential customers would participate over 10 years is quite reasonable.
Residential Room Air Conditioner Exchange	1,500	15,000	Room air conditioner penetration rate estimated at 15% of households (see footnote 31). Fifteen percent of EKPC's 469,121 residential customers assumes 70,368 households have at least one room air conditioning unit. Recommended program participation levels would result in the replacement of slightly more than 20% of room air conditioning units over 10 years.
Residential Water Heater Replacement	4,800	48,000	Penetration of electric residential electric water heaters in the EKPC service territory is 87%, which results in approximately 408,135 electric water heaters based on EKPC 2006 residential customers. Sixty-six percent of these operate at a minimum efficiency (see footnote 39). Therefore, there is a potential of replacing 269,369 water heaters for higher efficiency units. If 48,000 are replaced over 10 years as part of the program, it will represent approximately 18% of all electric water heaters.

Table A-4 (Cont'd)

Program Participation Rate Assumptions

Program Name	Annual Number of New Participants	Cumulative 10-Year Number of Participants	Assumptions
Residential Installment Payment Refrigerators	1,000	10,000	According to an NRDC report, over 30% of households with annual income levels between $10,000 and $24,999 have a refrigerator that is more than 10 years old (see footnote 22). Eleven EKPC member cooperatives partially or fully serve counties that have median household incomes less than $25,000 annually. The total number of customers served by these eleven co-ops is 309,543 in 2006. If half of these customers have an annual income less than $25,000 per year, then there could be as many as 46,431 refrigerators that are over 10 years old. A total of 10,000 replaced as part of this program represents about 21% of the estimated older refrigerators in low-income households.
Commercial/Industrial Air Conditioner Tune-up	1,500	15,000	There are a total of 46,431 commercial and industrial customers served by EKPC member cooperatives according to numbers reported to the Kentucky Public Service Commission for 2006. Fifteen thousand program participants represent approximately 15% of the total number of commercial and industrial customers. Although the number of program participants may vary due to the large variance in the size and usage of the customers in these two classes, the typical energy and demand savings across all program participants is reasonable (see Table 1).
Commercial/Industrial Demand Response	500	5,000	Although there is great diversity among the types of customers that comprise the commercial and industrial classes, there are many opportunities for customers of all types to shed load during specified hours when system load is unusually high. The projected cumulative participation rate in Year 10 represents nearly 11% of EKPC's 2006 total number of commercial and industrial customers.
Commercial/Industrial Lighting	2,400	24,000	Virtually all commercial customers have opportunities to reduce energy usage from lighting sources by switching to high-efficiency lighting products. Therefore, a 10-year cumulative program participation of 24,000, which represents nearly 52% of existing customers, is not unreasonable.
Industrial Variable Speed Drives	70	700	Applications of variable speed drives are frequently implemented at industrial customer sites. For EKPC, this would represent 50% of their 2006 industrial customer class. But these applications can be implemented at large commercial customer sites as well.
Commercial/Industrial Energy Efficiency Motors	100	1,000	Assumes replacement of motors for all applications in both commercial and industrial sectors totaling 20,000 horsepower per year. These applications may include motors used for fans, compressors, pumps, and material handling and processing operations. Program participants may come from a wide range of market sectors such as grocery stores, schools, and health care facilities; as well as manufacturing facilities including, but not limited to, steel-making operations.

Table A-5

Potential Hydroelectric Sites in Kentucky

Name	Water Source	Generation Potential (MW)	Site Owner	Development Status	Estimated Capacity Factor (%)	Estimated Development Cost ($/kW)	Annual Energy Production (kWh)	Minimum Investment and O&M ($/kWh)	Maximum Investment and O&M ($/kWh)
KY River L&D 5	Kentucky River	2	KY River Authority	No Development	50	2000–2500	8,760,000	0.032	0.036
KY River L&D 6	Kentucky River	1.5	KY River Authority	No Development	50	2500–3000	6,570,000	0.036	0.040
KY River L&D 8	Kentucky River	2	KY River Authority	No Development	50	2000–2500	8,760,000	0.032	0.036
KY River L&D 9	Kentucky River	2	KY River Authority	No Development	50	2000–2500	8,760,000	0.032	0.036
KY River L&D 10	Kentucky River	2	KY River Authority	No Development	50	2000–2500	8,760,000	0.032	0.036
KY River L&D 11	Kentucky River	2.5	KY River Authority	No Development	55	2000–2500	12,045,000	0.031	0.034
KY River L&D 12	Kentucky River	2.5	KY River Authority	No Development	55	2000–2500	12,045,000	0.031	0.034
KY River L&D 13	Kentucky River	2.5	KY River Authority	No Development	55	2000–2500	12,045,000	0.031	0.034
KY River L&D 14	Kentucky River	2.5	KY River Authority	No Development	55	2000–2500	12,045,000	0.031	0.034
Meldahl L&D	Ohio River	80	US Army COE	License Application	55	2000–2500			
Myer L&D	Ohio River	60	US Army COE	No Development	50	2500–3000	262,800,000	0.036	0.040
Newburgh L&D	Ohio River	60	US Army COE	No Development	50	2500–3000	262,800,000	0.036	0.040
Nolin River Lake	Nolin River	5	US Army COE	No Development	50	2000–2500	21,900,000	0.032	0.036
Rough River Lake	Rough River	4	US Army COE	No Development	50	2000–2500	17,520,000	0.032	0.036
Barren River Lake	Barren River	5	US Army COE	No Development	50	2000–2500	21,900,000	0.032	0.036
Cave Run Lake	Licking River	5	US Army COE	No Development	50	2000–2500	21,900,000	0.032	0.036

Table A-5 (Cont'd)

Potential Hydroelectric Sites in Kentucky

Name	Water Source	Generation Potential (MW)	Site Owner	Development Status	Estimated Capacity Factor (%)	Estimated Development Cost ($/kW)	Annual Energy Production (kWh)	Minimum Investment and O&M ($/kWh)	Maximum Investment and O&M ($/kWh)
Carr Fork Lake	Carr Fork	1.5	US Army COE	No Development	50	2500–3000	6,570,000	0.036	0.040
Taylorsville Lake	Salt River	2	US Army COE	No Development	50	2500–3000	8,760,000	0.036	0.040
Buckhorn Lake	Middle Fork KY River	2	US Army COE	No Development	50	2500–3000	8,760,000	0.036	0.040
Fishtrap Lake	Levisa Fork	2	US Army COE	No Development	50	2500–3000	8,760,000	0.036	0.040
Yatesville Lake		2	US Army COE	No Development	50	2500–3000	8,760,000	0.036	0.040
Dewey Lake	John's Creek	1.5	US Army COE	No Development	50	2500–3000	6,570,000	0.036	0.040
Paintsville Lake	Paint Creek	1.5	US Army COE	No Development	50	2500–3000	6,570,000	0.036	0.040
Grayson Lake	Little Sandy River	2	US Army COE	No Development	50	2500–3000	8,760,000	0.036	0.040
KY River L&D 1	Kentucky River	1.5	US Army COE	No Development	45	2500–3000	5,913,000	0.038	0.042
KY River L&D 2	Kentucky River	1.5	US Army COE	No Development	45	2500–3000	5,913,000	0.038	0.042
KY River L&D 3	Kentucky River	1.5	US Army COE	No Development	45	2500–3000	5,913,000	0.038	0.042
KY River L&D 4	Kentucky River	2	US Army COE	No Development	50	2000–2500	8,760,000	0.032	0.036
Green River L&D 1	Green River	1.5	US Army COE	No Development	45	2500–3000	5,913,000	0.038	0.042
Green River L&D 2	Green River	1.5	US Army COE	No Development	45	2500–3000	5,913,000	0.038	0.042
Green River L&D 3	Green River	2	US Army COE	No Development	50	2000–2500	8,760,000	0.032	0.036

Table A-5 (Cont'd)

Potential Hydroelectric Sites in Kentucky

Name	Water Source	Generation Potential (MW)	Site Owner	Development Status	Estimated Capacity Factor (%)	Estimated Development Cost ($/kW)	Annual Energy Production (kWh)	Minimum Investment and O&M ($/kWh)	Maximum Investment and O&M ($/kWh)
Green River L&D 5	Green River	2.5	US Army COE	No Development	55	2000–2500	12,045,000	0.031	0.034
Green River L&D 6	Green River	2	US Army COE	No Development	50	2000–2500	8,760,000	0.032	0.036
Barren River L&D 1	Barren River	2.5	US Army COE	No Development	55	2000–2500	12,045,000	0.031	0.034
Green River Lake	Green River	5	US Army COE	Preliminary Permit	50	2000–2500			
Cannelton L&D	Ohio River	80	US Army COE	Under Development	55	2000–2500			
Smithland L&D	Ohio River	90	US Army COE	Under Development	55	2000–2500			
	Total	**191.5**					**842,055,000**	**Median Cost ($/kWh)**	**0.036**

About the Authors

Susan M. Zinga has twenty-five years experience working with a variety of organizations involved in the electric and natural gas industries in the United States, Europe, and Asia. Her breadth of experience includes projects for federal and state regulatory agencies; municipal and state-regulated utilities; service providers operating in a deregulated marketplace; and nonprofit organizations focused on environmental concerns.

Ms. Zinga was employed as the Director of Energy Policy at Southface Energy Institute, a nonprofit organization promoting renewable energy, "green pricing," and energy efficiency. In addition to her many responsibilities, she participated as a technical expert to the members of Georgia Governor Barnes' Energy Task Force, and was a leader in determining the statewide techno-economic potential for energy efficiency. She also worked directly with U.S. Secretary of Energy Spencer Abraham, as well as Assistant Secretary David Garman, on complex energy issues confronting the southeastern United States.

Her experience also includes a leadership role on the pricing team at MEAG Power, a wholesale electric generation and transmission corporation made up of 48 municipalities across Georgia; serving as a manager at Energy Management Associates (later a division of EDS), where she led projects for several domestic and international utilities; employment with PSI Energy, an investor-owned electric utility in Indiana; and working with the Indiana Utility Regulatory Commission as a member of a specialized team of experts formed by legislative mandate to produce independent energy forecasts for Indiana electric utilities. In addition to constructing econometric models for forecasting purposes, she provided written and oral testimony in regulatory proceedings on economic, financial, and prudency issues. She was also charged with authoring multiple reports for Governors Orr and Bayh examining the wholesale power marketplace within the state.

Ms. Zinga holds two degrees from Purdue University: a Master of Science in Public Policy and Public Administration with a concentration in Economics, and a Bachelor of Arts in Political Science.

Andy McDonald is author of the solar hot water section of this report. Andy is the coordinator of the Kentucky Solar Partnership, a project of the nonprofit organization Appalachia—Science in the Public Interest, and co-author of *The Kentucky Solar Energy Guide*, published in 2005. He has a Master's Degree in Sustainable Systems from Slippery Rock University of Pennsylvania (2003), and a Bachelor of Arts in Philosophy from the University of Buffalo (1992). He is a co-founder and Chair of the Kentucky Solar Energy Society.

Andy has been working to promote a socially just, sustainable society for over fifteen years and has worked on sustainable development projects in Kentucky, Pennsylvania, the Texas-Mexico border, and Peru. He lives with his wife and step-daughter on a farm in Franklin County, where his wife operates an organic market garden.