Energy Efficiency and Economic Development in Illinois

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PREFACE

The American Council for an Energy-Efficient Economy (ACEEE) is a non-profit research organization dedicated to advancing energy efficiency as a means of promoting both economic prosperity and environmental protection. It is based in Washington, DC.

ACEEE has been conducting a series of national, state, and regional studies to examine the potential employment and macroeconomic benefits of increased investments in energy technologies. Funding for this study was provided by the Illinois Department of Commerce and Community Affairs.

Many people worked together to produce this report. Steve Nadel served as the project manager and provided overall guidance and review. Marshall Goldberg served as the lead researcher and analyst. He was also responsible for compiling the necessary background data and writing much of the report. To accomplish this he worked with a number of others to develop, coordinate, and refine the efficiency analysis and results. Skip Laitner developed the economic modeling tool and assisted with the macroeconomic analysis. Steve Nadel provided the preliminary modeling tool for the buildings and appliance analysis and review of the necessary data for analysis. Neal Elliot developed the modeling tool for the industrial analysis. Martin Thomas developed the modeling tool and conducted the preliminary analysis for the transportation sector. Marty Kushler wrote the policy section with the assistance of others noted above.

In addition to the ACEEE project team, extensive assistance preparing this report was provided by many other people. In particular we are indebted to David Kramer at the Illinois Department of Commerce and Community Affairs for conceiving the project, providing broad direction, and coordinating input from state agencies. We are also thankful to the many energy efficiency businesses in Illinois who provided information on their operations and to Val Jensen at the Chicago Support Office of the U.S. Department of Energy, Julia Klee at the Joyce Foundation, David Kramer and other Department of Commerce and Community Affairs staff, and Dan Rosenblum at the Energy and Environmental Policy Center of the Midwest for providing helpful comments on a draft of this report. However, while we are thankful for the important contributions of others, their participation does not mean they fully endorse our analysis, conclusions and recommendations; for these the authors retain full responsibility.

EXECUTIVE SUMMARY

The purpose of this report is to better understand how additional investments in energy efficiency technologies can contribute to lower energy expenditures and new employment opportunities for residents of Illinois, as well as generally strengthen economic activity and quality of life.

Energy is needed for light, heating and air conditioning, for production machinery, transportation, and in homes, schools, and businesses. Many of the electricity needs in Illinois have traditionally been met primarily by coal and nuclear power plants with a smaller portion from natural gas, petroleum and hydro resources. Yet, the inefficient use of these energy resources will likely constrain economic activity in Illinois.

High energy costs make the state's businesses less competitive and high energy bills reduce the amount of money the state's consumers can spend on goods and services. When money is spent on energy, much of it leaves the state. When money is spent on other goods and services, much more stays locally, creating economic growth and jobs.

In spite of significant reductions in energy use and real energy prices due to national trends in the past two decades, significant opportunities for cost-effective, energy-efficient investments exist in all sectors of the Illinois economy. Furthermore, many of these investments offer opportunities to improve product quality and productivity and lower operating and maintenance costs. Investments in energy-saving products and practices can lower energy bills for residents and businesses. Lower energy bills, in turn, will promote overall economic efficiency and create local jobs. Investments in energy efficiency can increase cash flow and operating margins, providing businesses a critical competitive edge.

Accelerated investments in energy efficiency will enhance the state's air quality by reducing emissions associated with energy production and use. Investments in energy efficiency can encourage the development of new, clean, energy-saving technologies and industries in Illinois. Improvements in energy efficiency can also help protect the state against the impacts of possible new taxes on pollutants contributing to global climate change and other air quality problems and help offset the need for spending on pollution control technologies.

In 1995, consumers in Illinois spent approximately $23 billion to provide heat, light, power, and transportation for their homes, schools, and businesses. To put these totals in perspective, energy bills were 40 percent higher than state tax collections in that year. Many community and business leaders are looking for ways to use state tax dollars more efficiently. The size of the total energy bill suggests that Illinois policy makers may also want to explore ways to use energy more efficiently.

This report examines the current energy consumption patterns and expenditures within the Illinois economy. It projects what "business-as-usual" or "baseline" energy patterns might look like through the year 2015. These findings suggest that by 2015 the state as a whole will be

approximately 6 percent more efficient in how much energy it uses to support a dollar of economic activity (compared to 1995 as measured by Gross State Product [GSP]) due primarily to the fact that new equipment and buildings are generally more efficient than aging equipment and facilities that will be replaced over the next decade. But the findings also show that total energy consumption will increase by 28 percent as a result of a growing economy.
The study then develops two high-efficiency scenarios (one for total energy consumption and one for electricity consumption only) for the region through the year 2015. These high-efficiency scenarios are based upon detailed analysis of energy efficiency potential in buildings in the residential, commercial, and industrial sector (including industrial process improvements), as well as efficiency improvements in light duty vehicles in the transportation sector. The analysis provides estimates of the investments needed to achieve these additional energy savings as well as the resulting economic and environmental benefits.

The findings of the study show that by 2015, cost-effective investments in energy efficiency in Illinois can:

- Reduce energy use in Illinois by just under 32 percent, reducing consumer and business energy bills by more than $76 billion cumulatively over the 1999-2015 period;

- Create 59,400 jobs; and

- Reduce emissions of critical air pollutants by up to 30 percent, helping to improve environmental quality.

In other words, the untapped potential for energy efficiency represents a critical economic development and environmental protection strategy for Illinois. Increased investments in energy efficiency are an important step toward promoting a sustainable energy future for Illinois. More specific findings of the report include:

- Cost-effective investments in energy efficiency technologies can reduce energy use by just over 31 percent in 2015 relative to the baseline, including 43 percent reductions in electricity use and over 25 percent in fossil and other fuels outside of the utility sector.

- The additional investment in energy efficiency will increase Illinois' employment base — from a net increase of 20,700 jobs in the year 2005 to a net increase of 59,400 jobs by the year 2015. The rise in employment, driven largely by the spending of energy bill savings, is equivalent to the number of jobs supported by the expansion or relocation of almost 400 small manufacturing plants in Illinois. Wage and salary compensation would similarly rise by a net of $1.6 billion by 2015 (in 1995 dollars), the equivalent of tourist expenditures from approximately 10.8 million visitor days.

- As a result of these additional energy savings, Illinois ratepayers would enjoy cumulative energy bill savings of $76.3 billion over the 1999-2015 period. The high-efficiency scenario will require a $37.8 billion cumulative investment over the same period of time. This relatively small level of investment (less than 1 percent of the state's cumulative GSP over the period) can be achieved by redirecting a small portion of other investments toward productive energy investments. Only a small portion of these investments will be financed by government or through electricity rates; the vast majority of funds will come from homeowners and businesses making cost-effective investments in their homes and facilities. With all values in 1995 dollars, the energy efficiency scenario generates a positive benefit-cost ratio of 2.02 over the 17-year period of analysis. But even this value understates the cost effectiveness of the energy savings investments since the energy savings and environmental benefits will continue for many years after the year 2015.

- The alternative energy strategy would have a positive benefit for the state's air quality as well. Carbon dioxide emissions, which contribute to global climate change, would be reduced by over 85 million short tons in 2015. Energy related pollutants such as sulfur and nitrogen oxides would be reduced by over 700 thousand short tons in 2015, also providing significant reductions over baseline emissions.

Many of these findings are summarized in Table ES-1 on the following page.

Table ES-1. Summary of Input-Output Analysis For 2015	
	Illinois
Baseline Scenario	
GDP (Billion 1995$)	$479
Jobs (Thousands)	7,993
Income (Billion 1995$)	$388
Energy (Trillion Btu)	4,853
Btu/GDP (1995$)	10,136
Carbon Dioxide Emissions (Thousand Short Tons)	290,200
High-Efficiency Scenario	
GDP (Billion 1995$)	$478
Jobs (Thousands)	8,053
Income (Billion 1995$)	$390
Energy (Trillion Btu)	3,330
Btu/GDP (1995$)	6,966
Carbon Dioxide Emissions (Thousand Short Tons)	204,930
Net Efficiency Gains	
GDP (Billion 1995$)	($0.7)
Jobs (Thousands)	59
Income (Million 1995$)	$1,620
Energy (Trillion Btu)	(1,523)
Btu/GDP (1995$)	(3,170)
Carbon Dioxide Emissions (Thousand Short Tons)	(85,270)

Notes: Individual columns may not add up due to rounding.

However, achieving these benefits will not be easy. Policy makers and business leaders will need to play an active role in helping to develop and implement a series of initiatives to make the high-efficiency scenario a reality. The types of actions should include:

- Developing strong and well designed policies to ensure that energy efficiency services play a major role in Illinois' restructured utility industry. These include a substantial "system benefits charge" to fund greater levels of energy efficiency, and carefully structured regulatory mechanisms for distribution utilities to make sure that these utilities have incentives to pursue cost-effective energy efficiency.

- Implementing strong building energy codes for residential and commercial buildings, including adoption of BOCA 1996 (including the residential Model Energy Code and the ASHRAE 90.1 code for commercial and high rise residential buildings), with the Illinois-specific increased lighting and chiller efficiencies described in the report.

- Developing and instituting a comprehensive and systematic set of policies to encourage industrial energy efficiency. These would include mechanisms and techniques for: opportunity identification, technical and design assistance, financial analysis, financing, operation improvements, promoting advanced technologies, and facilitating the adoption of combined heat and power (CHP) technologies.

- Promoting wherever possible policies which would improve the fuel economy of cars and light trucks operated in Illinois. These include incorporating "best in class" vehicle efficiency as an important criterion in state and municipal fleet decisions, and exploring creative policies such as "feebates" to encourage the purchase of fuel efficient vehicles. In addition, promoting policies that discourage urban sprawl and increased use of mass transit will help reduce transportation related energy use.

- Creating a Sustainable Energy Development Agency in Illinois that would fund applied R&D and demonstrations of advanced energy efficiency and renewable energy technologies; fund technology and market assessments; and provide support for technology transfer and commercialization. The agency could also help the state's utilities and state agencies in the design and evaluation of energy efficiency and renewable energy programs, and possibly assist with training or technical assistance concerning building code implementation or improving industrial energy efficiency.

I. INTRODUCTION

The state of Illinois is blessed with many resources. In addition to its historical sites and natural beauty, Illinois is home to a strong and diverse commercial and industrial center. The diversity of activities and healthy business climate combine to make Illinois both a popular tourist destination and a desirable place to live and work. However, while the state's population growth has been relatively modest, energy consumption continues to rise.

Energy is needed for light, heating and air conditioning, for production machinery, transportation, and in homes, schools, and businesses. Many of these energy needs have traditionally been met primarily by coal and nuclear power plants with a smaller portion from natural gas, petroleum and hydro resources. Yet, the inefficient use of these energy resources will likely constrain economic activity in Illinois. This, in turn, will reduce the state's capacity to provide new employment opportunities for its residents. Alternately, the efficient use of energy will create jobs and help reduce environmental degradation.

Residents and businesses in Illinois are faced with electric utility rates and annual bills above the national average. Despite the size of their electricity bills, few people understand the magnitude of energy expenditures within their individual home or business. One interesting way to underscore the importance of those expenditures is to compare them with the amount of taxes collected by state government.

One recent study notes that Illinois residents and businesses spent over $23 billion to meet their total energy needs in 1995. In contrast, Illinois collected an estimated $16.6 billion in state-generated taxes in that year. Thus, energy bills in Illinois are the equivalent of 140 percent of all the state taxes collected.[1] While citizens and public officials are asking good questions about how better to spend their state tax dollars, they often ignore the equally important issue of how to more efficiently use their energy resources.

The inefficient use of energy raises the cost of living and doing business in Illinois. As a result, it will continue to act as a brake on the state economy — offsetting other economic development and environmental initiatives. For these reasons, efforts to accelerate investments in energy efficiency technologies are generating interest in Illinois and throughout the nation.

1. See *Comparing State Energy Expenditures with State Government Tax Collections*, Economic Research Associates, Alexandria, VA, 1998. The data are for calendar year 1995, the latest year for which information on both energy expenditures and tax revenues are available. Taxes and energy bills overlap to a moderate degree as approximately 8 percent of regional energy bills go to state energy taxes.

The importance of maximizing energy efficiency as a strategy for enhancing both environmental quality and economic development opportunities is evidenced by the findings of many recent studies. Promoting energy efficiency investments not only cuts costs for the user, but it reduces pollutant emissions and yields positive benefits for the larger economy.[2]

In spite of the economic benefits documented by these recent studies, many states have been slow to develop and implement energy efficiency technologies and renewable energy resources. One reason is the significant up-front investment needed in order to reap full advantage of these alternative resources. In short, it takes money to make money.

Unfortunately, alternative energy strategies are also forced to compete against the significantly larger federal and state tax subsidies given traditional energy resources such as coal, oil, and nuclear.[3] Also, in contrast to many other business investments, the benefits of energy efficiency investments tend to be diffuse, accruing to many people over the long run rather than for a few investors in the short run.

New policy initiatives can go a long way to overcome the bias of present energy subsidies and provide energy efficiency and renewable energy technologies with the level playing field needed to encourage their widespread adoption. These same policies can also help bolster public trust in state energy decision making. In survey after survey, when voters are asked to rank energy sources from those most to least in need of government encouragement, energy efficiency and renewable energy come out at the top of the list and fossil fuels and nuclear power at the bottom of the list.

For example, in a December 1996 survey by the Republican pollster Research/Strategy/Management, Inc., when asked to select the energy source that should be the

2. Among others, see *Energy Innovations: A Prosperous Path to a Clean Environment*, Alliance to Save Energy, American Council for an Energy-Efficient Economy, Natural Resources Defense Council, Tellus Institute, and Union of Concerned Scientists, Washington, DC, 1997; H. Geller, J. DeCicco and S. Laitner, *Energy Efficiency and Job Creation: The Employment and Income Benefits from Investing in Energy Conserving Technologies*, American Council for an Energy-Efficient Economy, Washington, DC, 1992; S. Nadel, S. Laitner, M. Goldberg, N. Elliot, J. DeCicco, H. Geller, and R. Mowris, *Energy efficiency and Economic Development in New York, New Jersey, and Pennsylvania,* American Council for an Energy-Efficient Economy, Washington, DC, 1997; and S. Laitner, J. DeCicco, N. Elliott, H. Geller, M. Goldberg, R. Mowris, and S. Nadel, *Energy Efficiency and Economic Development in the Midwest*, American Council for an Energy-Efficient Economy, Washington, DC, 1995.

3. See, for example, D.N. Koplow, *Federal Energy Subsidies: Energy, Environmental, and Fiscal Impacts*, Alliance to Save Energy, Washington, DC, 1993. According to this study, federal energy subsidies alone totaled $39 billion in 1989. Fossil and nuclear resources received 88 percent of this amount, while energy efficiency and renewable energy resources received only 12 percent of the benefit. Determining the actual benefits to Illinois from these subsidies is difficult and beyond the scope of this study. Nevertheless, the near total reliance on traditional energy resources in Illinois suggests that the cost to Illinois (absent these subsidies) would be significant.

highest priority for U.S. Department of Energy funding, two-thirds selected energy efficiency or renewable energy and only one-third selected natural gas, other fossil fuels, or nuclear power.[4]

The purpose of this report is to better understand how additional investments in energy efficient technologies can contribute to lower energy expenditures, new employment opportunities for residents of Illinois, and generally strengthened economic activity and quality of life. Recognizing that energy consumption and expenditure patterns depend upon the social and economic makeup of a state or region, Appendix A provides a brief economic profile of Illinois and background information on the state's energy use patterns. It includes information on energy resources, expenditures, and electricity consumption in Illinois.

We see that energy expenditures play an important role in Illinois. Although energy intensity (i.e., energy use per dollar of Gross State Product) is lower in Illinois than the national average (10,779 Btu per $GSP versus 12,527 Btu per $GSP in 1995), energy prices are higher than the national average — 2.7 percent higher in 1995. Overall, Illinois spent a combined total of over $23 billion on energy in 1995. These energy expenditures represent the equivalent of almost 7 percent of the state's combined GSP. In 1995, Illinois' electricity bill was almost $9.7 billion, followed by $9.1 billion for petroleum, primarily for transportation uses.

Energy policies designed to increase energy efficiency can go a long way towards reducing these expenditures. These same policies can reduce economic leakages for imported fuels, foster a more competitive environment for the state's industries, and provide environmental benefits for all.

The balance of this report expands on these themes. Section II provides a profile of some of the manufacturers and suppliers of these energy efficiency technologies and services in Illinois. Section III develops both a business-as-usual (baseline scenario) and a series of two high-efficiency scenarios for the state through the year 2015. It provides an estimate of the investment needed to achieve the resulting energy bill savings in the high-efficiency scenario based upon detailed analysis of the energy efficiency potential in each end-use sector.

Section IV summarizes the analytical method used to identify the net employment gains and other net economic benefits from the high-efficiency scenario. Section V presents the results of the economic impact analysis. Section VI identifies some of the past and current policy initiatives designed to promote energy efficiency improvements. The report then offers specific policy recommendations to help Illinois secure the full benefits of greater energy efficiency. Finally, Section VII draws some brief conclusions and summarizes the policy recommendations needed to capture the greater efficiency potential.

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4. R. Hinckley and V. Breglio, *America Speaks Out on Energy: A Survey of 1996 Post-Election Views*, Research/Strategy/Management Inc., Lantham MD and Sustainable Energy Coalition, Takoma Park, MD, Dec. 1996.

II. PROFILES OF MANUFACTURERS OF ENERGY EFFICIENCY TECHNOLOGIES IN ILLINOIS

Saving energy creates and helps retain jobs in a number of ways. First, jobs are directly created and retained from manufacturing, selling, and installing energy efficiency measures. In addition, many jobs are indirectly created and retained when consumers respend energy bill savings in sectors of the economy that are more labor-intensive then producing and supplying electricity and fossil fuels. There are a large number of companies in Illinois that manufacture and/or install energy efficiency technologies.

The following brief profiles demonstrate that energy efficiency technologies are a growth area for many manufacturers. In some instances, millions of dollars have been invested to design and produce high-efficiency products. In other cases, existing plants have been expanded to meet rising demand for high-efficiency products. The case studies presented below are only a small sampling of the many companies currently doing business in Illinois. These case studies include both Fortune 500 corporations and smaller entrepreneurial firms in order to give a flavor of the direct job creation and job retention potential from energy efficiency technologies and services.

Honeywell, Inc.

Honeywell's Microswitch Division is located in Freeport, Illinois. Microswitch is a leading manufacturer of component parts for ventilation, control, and security systems. Among a number of other products, Microswitch manufacturers thermostats for building control systems, switches and sensors for industrial control applications, turbidity sensors and switches for high efficiency dishwashers (to help reduce water usage and process times), and is moving into industrial controls for batch processes to improve productivity and efficiency in industries such as pulp and paper, gas and oil, and chemicals.

Components produced at Microswitch supply a number of other Honeywell divisions as well as other equipment manufacturers throughout the world. Combined, Honeywell now employs approximately 2,700 persons in Illinois, primarily at their Freeport plant, but also including employees at their nearby Galena branch plant and sales and service persons in other areas of the state.[5]

Motorola Corp.

Motorola Lighting Division, headquartered in Buffalo Grove, Illinois, is now a major manufacturer of high quality electronic ballasts. Motorola has approximately 300 employees in manufacturing and engineering in the Buffalo Grove area. Motorola began manufacturing

5. Personal communications with Paula Prahl, Honeywell, Inc., Minneapolis, MN, August 1998.

here in 1991. Employment rose slightly in recent years as a result of production of other energy-efficient lighting products.[6]

Maytag Corporation

Maytag—Galesburg Refrigeration Products, is located in Galesburg, Illinois. The plant's manufacturing operations are focused on producing top-mount and side-by-side refrigerators. Brand names produced at the plant include Maytag, Admiral, Jenn-air, and Magic Chef, and are sold in more than 160 countries. In 1993, Maytag Corporation announced the investment of $180 million in the Galesburg facility to design and produce a totally new line of super efficient refrigerators known as Advance Performance Design (APD). New advanced equipment was purchased and installed to build the new manufacturing line. With the upgrade and expansion complete, the new top-mount refrigerators were introduced in March 1997 and the new side-by-sides in 1998.

The Maytag plant is the single largest employer in the area. Maytag employment has grown in recent years and Maytag now employs more than 2,400 employees in Galesburg. The total plant payroll exceeds $70 million annually. Maytag also manufactures washers and dryers at their facility in Herrin, Illinois. The Herrin plant employs an additional 870 persons.[7]

Duray Fluorescent Mfg.

Duray Fluorescent has been manufacturing fluorescent light fixtures in Chicago since 1946. Duray purchases most of their parts and does all the fixture assembly on-site. Fixtures are primarily for residential and commercial applications. Duray now employees approximately 100 persons.[8]

Siemens and Furnas Controls

Siemens and Furnas manufacture motor controls primarily for the industrial sector. They have three locations in Illinois, including plants in Batavia, West Chicago, and Morrison. The Batavia plant manufactures starters, push buttons, and pressure switches, and employs over 500 persons. The West Chicago plant manufactures controls for large motors and employs another 450 persons. The Morison plant manufacturers coils and other controls for motors and employees approximately 200 persons.[9]

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6. Personal communications with Regina Manitote, Motorola Lighting Division, Buffalo Grove, IL, July 1998.

7. Personal communications with Jacky Kronstad, Maytag Marketing Information Analyst, Galesburg, IL, July 1998.

8. Person communications with Robin Weissberger, Duray Fluorescent Mfg., Chicago, IL, August 1998.

9. Personal communications with Sue Weiler, Human Resources, Siemens & Furnas Controls, Energy and Automation Group, Batavia, IL, August 1998.

Cooper Lighting

Cooper Lighting is located in Elk Grove, Illinois. Cooper produces lighting fixtures and lamps for residential, commercial, and industrial applications. They have more than 500 employees.

Siebe Environmental Controls

Siebe Environmental Controls is located in Loves Park, Illinois. Siebe, a division of the English Company, manufactures heating, ventilation, and air conditioning controls primarily for commercial applications. Siebe also has a sales and service location for temperature controls in Mt. Prospect, IL. Combined, Siebe employs a total of more than 2,000 persons in Illinois.[10]

Energy Masters International, Inc.

Energy Masters International (EMI), a subsidiary of Northern States Power Company, is an energy services company (ESCO). EMI, based in St. Paul, Minn., has maintained offices in Illinois for almost 10 years. The company offers a full range of services including providing energy auditing and design engineering, project and construction management, customized energy services, professional engineering, asset management, and other services to businesses and government customers throughout the country.

EMI, through its Chicago area field office, was selected to improve the energy efficiency of the facilities at Governors State University (GSU) located in Chicago's south suburbs. EMI was awarded a contract (estimated to be roughly $2 million) by GSU to improve the energy efficiency of four buildings. The company will improve the heating, ventilating and air conditioning (HVAC) systems and install new lighting. Energy savings at the university are projected to exceed $2,85 million over a 10-year period. EMI was also recently awarded a $15 million energy services contract with the Chicago Public Schools. EMI will replace existing electric heating with high-efficiency natural gas units and install efficient lighting and energy controls at 11 elementary and high schools during the next year.
In addition to these projects EMI has completed energy efficient upgrades at a number of other institutional and commercial sites in Illinois. Among others, these include; Menard Correctional Center, Eastern Illinois University, St. Mary's Hospital, and Trinity Hospital.

EMI has been increasing its number of employees annually and expects this trend to continue. Currently, EMI employs a total of approximately 110 persons in Illinois. This number includes:

10. Personal communications with Siebe Environmental Controls, Loves Park, IL, August 1998.

engineers, installers, construction managers, administrative staff, sales and marketing staff, as well as management personnel.[11]

11. Personal communications with Energy Masters International, St. Paul, MN, in August 1998; personal communications with Virginia Tate, Chicago Division Manager, in September 1998; and information contained in "EMI Selected For Governors State University Energy Improvement Program," *PRNews Wire*, May 13, 1998.

III. ENERGY CONSUMPTION SCENARIOS

This section of the study offers an insight into what an energy-efficient future might look like) both in terms of the needed investment to develop energy efficient technologies and in terms of the energy bill savings that might accrue from such investments.

The section begins by mapping out three energy scenarios: a baseline growth projection and two high-efficiency scenarios. The baseline projection of energy consumption in Illinois builds on historic energy use patterns and then adapts projections for residential, commercial, and industrial building growth trends as well as projections for vehicle fuel economy and miles traveled.

The first alternative scenario includes efficiency investments among all major energy resources in the period 1999-2015. The second examines efficiency investments only in electricity end-uses. It should be noted that the intent of the analysis is not to "forecast" energy trends but to "project" reasonable energy use patterns for purposes of evaluating the impact of a high-efficiency scenario.

A. BASELINE ENERGY CONSUMPTION SCENARIO

We began by establishing a baseline projection of energy consumption patterns in the period 1995-2015, assuming current trends and policies are continued. A variety of Energy Information Administration (EIA) and Census data from the *City and County Data Book* were used for this purpose.[12] The starting point for the baseline projection was the actual primary energy use in Illinois in 1995. These statistics covered energy use in the residential, commercial, industrial, and transportation sectors.[13]

The projected changes in energy consumption in the residential and commercial sectors reflect an analysis of residential and commercial building prototypes. This analysis was developed by ACEEE using the DOE-2.1E building energy simulation computer program.[14] For each prototype, average 1995 energy use was estimated and then multiplied by the number of buildings of that type in Illinois.

12. *City and County Data Book*, U.S. Department of Commerce, U.S. Census Bureau, Washington, DC, 1995.

13. See *State Energy Data Report 1995*, Energy Information Administration, U.S. Department of Energy, Washington, DC, 1997.

14. Use of the DOE-2.1E model and the data assumptions that underpinned the analysis are documented in a June 1994 unpublished technical memorandum prepared for ACEEE by Robert Mowris, a consulting engineer based in Orinda, CA. More details of the buildings analysis are provided in Appendix B of this report.

In this analysis total energy use in the residential sector is forecast to grow at a rate of 0.44 percent annually in the period 1995-2015. These trends are significantly slower than the annual 0.97 percent national growth estimate for the residential sector projected in the Energy Information Administration's *Annual Energy Outlook 1998* (AEO98) and reflect Illinois-specific growth trends in homes over the 1980-92 period. The growth in housing stock was adjusted by a 0.6 percent demolition and replacement rate.[15]

The energy growth rate for the commercial sector was based on trends in new floor area in the region for 1990-95, taken from the *Commercial Building Energy Consumption and Expenditures 1995 (*CBECS).[16] The energy growth rate for the commercial sector was forecast to increase approximately 0.89 percent annually. This rate is essentially the same as the national growth rate of 0.90 percent annually in the AEO98.

Based on an analysis of vehicle miles traveled and fuel efficiency improvements, transportation energy growth was forecast to grow approximately 2.3 percent annually in Illinois. This rate is somewhat higher than the 1.9 percent national growth rate in the AEO98, although in recent years the AEO has under forecast transportation energy use. Transportation uses of electricity were omitted in this analysis.

For electricity only, it was found that the annual growth rate for residential uses would increase approximately 0.74 percent. Commercial uses were forecast to increase approximately 0.92 percent annually. Our baseline estimates project that electricity consumption in both of these sectors will increase somewhat slower than the AEO98 forecasts for the nation of 0.96 and 1.03, respectively**.**

Because the industrial sector represents a group of end-users that is significantly different at the state level than at the national level, a different approach was used. As described in more detail below, the result was a projected annual industrial growth rate of 1.37 percent for total energy and 1.46 percent for electricity use. The AEO98 projects a slightly smaller increase of 1.21 percent annually for all end-uses in the industrial sector and a somewhat smaller 1.03 percent annual increase for electricity end-uses only.

Figures 1 through 3 highlight the overall trends for the baseline projections and alternative efficiency scenarios in the period 1995-2015. Figure 1 identifies total energy consumption,

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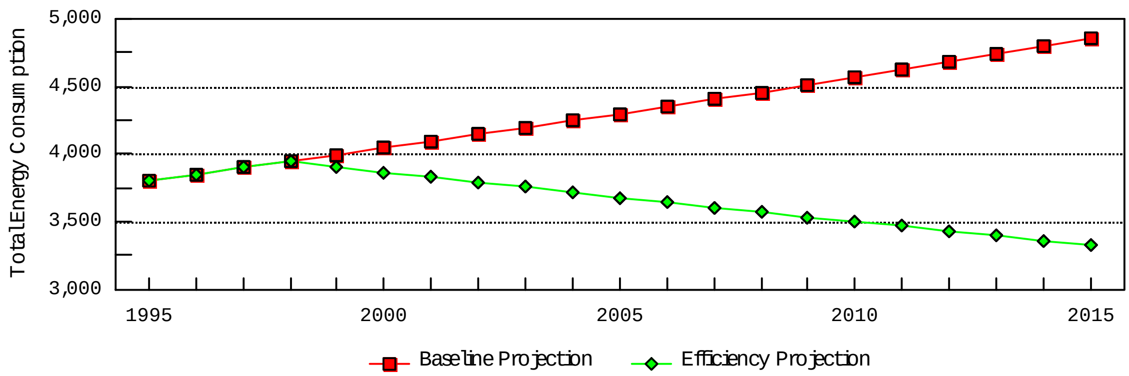
15. These rates are based on information contained in the *Annual Energy Outlook 1998,* Energy Information Administration, U.S. Department of Energy, Washington, DC, 1997, and S. Nadel and H. Tress, *The Achievable Electricity Conservation Potential: The Role of Utility and Non-Utility Programs,* American Council for an Energy-Efficient Economy, Washington, DC, 1990.

16. *Commercial Buildings Energy Consumption and Expenditures 1995*, Energy Information Administration, U.S. Department of Energy, Office of Energy Markets and End Use, Washington, DC, 1998.

Figure 2 shows electricity only consumption, and Figure 3 displays transportation fuels consumption.

Using the sectoral growth assumptions, we project that total primary energy use will rise from 3,804 TBtu in 1995 to 4,853 TBtu in 2015, a 28 percent increase in consumption over that period. This trend is illustrated as the "Baseline Projection" in Figure 1 below.

FIGURE 1. ILLINOIS TOTAL ENERGY SCENARIO (IN TBTU)



Electricity use is projected to rise from 126 billion kilowatt-hours (kWh) in 1995 to 155 billion kWh in 2015, a 23 percent increase in consumption over that same period. The baseline electricity trend is illustrated as the "Baseline Projection" in Figure 2 below.

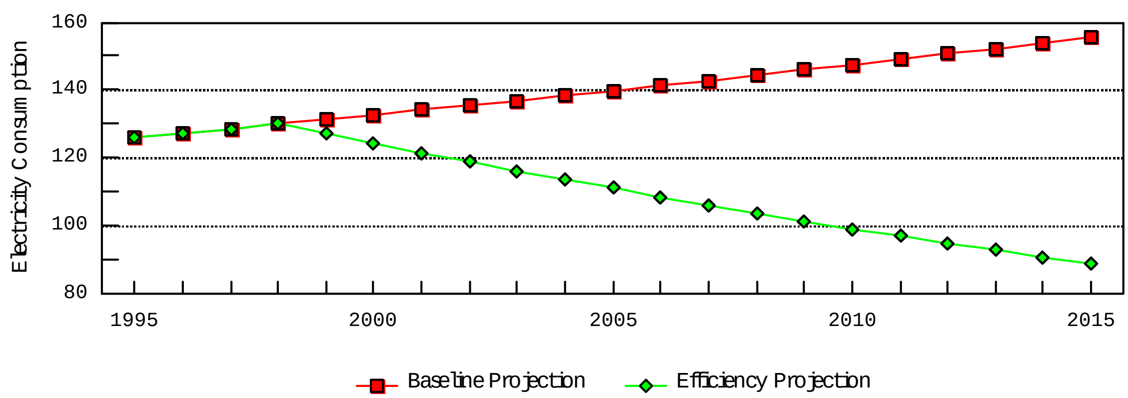
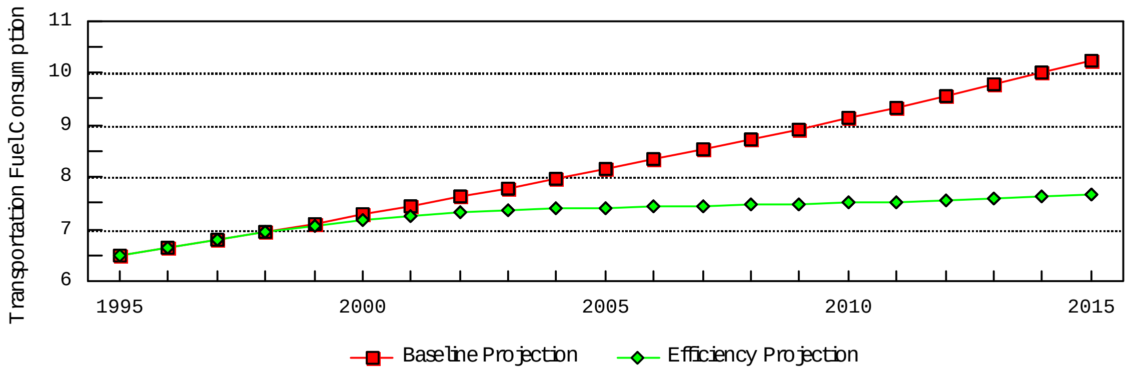


FIGURE 2. ILLINOIS ELECTRICITY SCENARIO (IN BILLION KWH)

Finally, the growth of transportation fuels was projected to increase from 6.5 billion gallons in 1995 to 10.2 billion gallons in 2015, a 58 percent increase. The baseline growth in these transportation fuels is illustrated as the "Baseline Projection" in Figure 3 on the following page.

FIGURE 3. ILLINOIS TRANSPORTATION SCENARIO (IN BILLION GALLONS)



Source: Data for all three figures were developed by the American Council for an Energy-Efficient Economy based upon assumptions described in the text.

B. HIGH-EFFICIENCY SCENARIOS

The efficiency trends for both the total energy and the electricity-only scenarios were adapted from scenarios that build on assumptions about cost-effective energy efficiency investments. The data are taken from a variety of industry and other published sources. For the most part, the efficiency scenarios are based upon technologies that are now cost-effective and available in the marketplace. A few of the energy efficiency measures are advanced technologies that are expected to be available in the near future.

To build the energy efficiency scenarios, the economy was disaggregated into the four basic end-use sectors as in the baseline projections. These are: (1) residential buildings, (2) commercial buildings, (3) industrial applications in the agricultural, mining, construction, and manufacturing sectors; and (4) automobiles and light-duty trucks within the transportation sector. Analytical models unique to each of the four end-use sectors were used to construct the efficiency scenarios.

The analysis attempted to identify an optimum level of cost-effective energy efficiency improvements that could be obtained by the year 2015. The economic analysis (for energy efficiency) assumed the amortized cost of saved energy for a given energy efficiency technology would be less than or equal to the long-run retail cost of conventional energy resources. For the purpose of this analysis, long-run energy prices (with the exception of electricity prices) in real terms are assumed to be level with the 1995 price paid by each end-use sector in Illinois for each energy resource.

Electricity prices in the residential, commercial, and industrial sectors are assumed to decline approximately 10 percent below 1995 prices. These assumptions are broadly consistent with the latest Energy Information Administration forecast contained in AEO98, which forecasts that electricity prices in 2015 will be lower than 1995 levels, and rate reductions which are expected to take place in Illinois as a part of deregulation.[17]

Each efficiency investment is assumed to be amortized over its effective life using a 5 percent real discount rate. For example, installing more efficient lighting fixtures in an existing office building might reduce electricity consumption annually by about 4.73 kWh per square foot of occupied space at a cost of $0.50 per square foot. Once the change is made, the equipment can be expected to last 20 years.

At a 5 percent discount rate, the investment would be amortized at a rate of 8.02 percent annually.[18] Thus, the annualized cost is $0.50 times 0.0802, or $0.0401 per square foot. Saving 4.73 kWh implies a cost of saved energy (CSE) of $0.0401 divided by 4.73, or $0.0085 per kWh. Since the 1995 commercial cost of electricity in Illinois was approximately $0.073 per kWh, this particular measure would clearly be considered cost effective. All technology choices were treated in this manner. A more complete description of the end-use analyses and the assumptions that feed into that analysis follows.

An important caveat should be noted at this point. The intent of the high-efficiency scenario is to construct a reasonable profile of investments and energy use impacts, assuming that cost-effective efficiency measures are widely adopted over the 17-year period of the analysis (i.e., 1999-2015). Hence, this analysis is not a forecast of what will likely occur given current trends. The high-efficiency scenarios represent, however, a highly possible energy future and, as we will show, a desirable economic future for Illinois.

The "Efficiency Scenario" shown in Figure 1, suggests that consumption for total primary energy in the year 2015 could be lowered by just over 31 percent, from 4,957 TBtu to only 3,330. This would put Illinois' total energy consumption at almost 13 percent below its 1995 level. The "Efficiency Scenario" for electricity shown in Figure 2, suggests that electricity consumption could be reduced by 43 percent, or about 30 percent below the 1995 levels. The transportation "Efficiency Scenario" shown in Figure 3, suggests that transportation fuels could be reduced by 25 percent, or about 18 percent above the 1995 levels.

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17. EIA's latest forecast estimates that electricity prices will decline by an average of 1.1 percent annually, natural gas prices will increase by an average of 0.1 percent annually, and petroleum product prices will increase by an average of 0.5 percent annually. See *Annual Energy Outlook 1998*, Energy Information Administration, U.S. Department of Energy, Washington, DC, 1997, Table 3. Current legislation for utility deregulation in Illinois mandates that residential electricity rates will decline by as much as 15 percent for many residential customers of regulated utilities with more than 12,500 customers. The 15 percent reduction currently applies to two of the state's utilities. Residential rates at four other utilities serving Illinois will also decline, but by a smaller percentage. For more information on deregulation legislation in Illinois see, House Bill 362, House Bill 1817, and Senate Bill 56. These bills are available for viewing on the Illinois Commerce Commission web site at http://icc.state.il.us/icc/dereg/.

18. This is based upon the standard amortization formula, $I/(1-(1/(1+I)^n))$, where I is the discount rate and n is the life of the measure.

Table 1, on the following page, summarizes both the cumulative investment required for each major end-use sector to achieve the 31 percent total energy savings, the 43 percent electricity savings, and the 25 percent savings in transportation fuels, over the 17-year period from 1999-2015. It also highlights the cumulative energy bill savings for the state as well as the benefit-cost ratios associated with each end-use sector. This ratio understates the overall cost-effectiveness (from the consumer perspective) of the energy efficiency investments in the region because energy savings will continue well beyond 2015.

1. Building Efficiency

ACEEE developed residential and commercial building prototypes using the DOE-2.1E building energy simulation program.[19] Building prototypes were developed using prototypes from a 1995 ACEEE study on the Midwestern states modified with data from the 1997 ACEEE study on the Mid-Atlantic states.[20] The residential prototypes were augmented by an ACEEE analysis of the costs and savings of a variety of appliance efficiency improvements pertaining to water heaters, clothes washers and dryers, refrigerators, freezers, dishwashers, and lighting. The appliance and efficiency measures analyzed in the residential and commercial building prototypes are not meant to be all inclusive, rather they are meant to capture a large portion of potential efficiency measures.

Four residential and eight commercial building prototypes were developed. The residential prototypes include Existing Multifamily Apartment, New Multifamily Apartment, Existing Single Family Detached, and New Single Family Detached. The commercial prototypes included Existing Medium Office, New Medium Office, Existing Medium Retail, New Medium Retail, Existing School, New School, Existing Warehouse, and New Warehouse.

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19. Use of the DOE-2.1E model and the data assumptions that underpinned the analysis are documented in Appendix B of this report.

20. See S. Laitner et al., *Energy Efficiency and Economic Development in the Midwest*, American Council for an Energy-Efficient Economy, Washington, DC, 1995; and S. Nadel et al., *Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania*, American Council for an Energy-Efficient Economy, Washington, DC, 1997.

TABLE 1. CUMULATIVE EFFICIENCY INVESTMENTS AND SAVINGS: 1999-2015 (IN BILLIONS OF 1995 DOLLARS)

	Residential	Commercial	Industrial	Transportation	Total
Full-Efficiency Scenario					
Investment	$11.3	$5.2	$12.7	$8.7	$37.8
Savings	$20.7	$13.3	$17.9	$24.4	$76.3
Benefit-Cost Ratio	1.84	2.57	1.41	2.80	2.02
Electricity Only Scenario					
Investment	$3.7	$4.5	$8.0	NA	$16.3
Savings	$9.2	$12.3	$12.7	NA	$34.3
Benefit-Cost Ratio	2.50	2.72	1.58	NA	2.11

Notes: Energy investments, savings, and benefit-cost ratios are based on the 17-year study period. Had the analysis been extended to include the savings over the life of the measures, rather than limited to the study period, the respective savings and benefit-cost ratios would have been greater

For weather-sensitive heating and cooling loads, weather patterns for the East North Central Census Region were used to adapt the DOE-2.1E model.

Each prototype incorporates average 1997 saturation levels of many energy efficiency measures. For each prototype we then applied a series of additional energy efficiency measures and estimated how much energy would be saved using DOE-2.1E. Aggregate energy savings potential is estimated by applying that measure in the proportion of the building stock for which that measure was appropriate (i.e., had not been installed yet, was technically feasible, and cost effective to consumers on a life-cycle cost basis).

Measures were applied sequentially in order of cost effectiveness (as measured by cost of saved energy) up to the cost-effectiveness limit (i.e., when cost of saved energy equals current retail energy prices adjusted for the 10 percent electricity rate reduction in the residential sector, noted earlier). Savings estimates for each measure are incremental savings not achieved by any previous measure. Tables reporting these results for each of the prototypes are contained in Appendix B. Key summary information for each of the prototypes are reported in Table 2, on the following page.

Table 2. Summary Data from Building Efficiency Analysis

Building Type	Baseline Electric kWh/unit	Baseline Gas kBtu/unit	Electric Saved kWh/unit	Gas Saved kBtu/unit	Electric Savings (percent)	Gas Savings (percent	Total Savings (percent	Effic. Invest ($/unit)	1st yr Savings ($/unit)	Simple Payback (years)	Cost of Svd Energy ($/MMBtu)
Residential (units = dwelling units)											
Existing											
Single family	10,213	215,800	3,264	147,421	32.0%	68.3%	56.2%	$7,134	$978	7.3	$2.69
Multifamily	6,066	93,089	2,141	51,708	35.3%	55.5%	47.3%	$3,295	$436	7.6	$2.05
New											
Single family	10,688	112,700	2,943	55,209	27.5%	49.0%	38.3%	$1,898	$527	3.6	$2.55
Townhouse	6,000	69,490	2,133	24,544	35.5%	35.3%	35.4%	$1,490	$311	4.8	$2.45
Commercial (units = sq. ft. of floor area)											
Existing											
Office	17.5	62.5	10.9	15.0	62.1%	24.0%	52.4%	$2.98	$0.82	3.6	$1.74
Retail	12.1	48.8	5.4	3.3	44.8%	6.8%	34.3%	$0.85	$0.39	2.2	$1.13
School	8.7	85.2	3.4	11.2	39.5%	13.2%	26.8%	$1.70	$0.29	5.9	$3.01
Warehouse	5.9	55.3	2.6	7.7	44.4%	13.8%	30.0%	$1.11	$0.21	5.2	$2.67
New											
Office	13.0	36.2	6.9	-3.2	53.1%	-8.8%	40.2%	$0.95	$0.46	2.1	$1.11
Retail	9.9	27.7	4.0	-0.2	39.9%	-0.8%	31.4%	$0.87	$0.27	3.2	$1.52
School	6.7	67.9	1.5	3.6	22.9%	5.4%	14.3%	$0.62	$0.12	5.1	$2.71
Warehouse	5.0	41.0	1.9	2.6	37.6%	6.4%	23.9%	$0.71	$0.14	5.0	$2.65

Notes: All energy values and prices reflect primary rather than end-use perspectives. Electricity was converted using the average heat rate in 1995 — 10,519 Btu/kWh. The simple payback periods are based on 1995 weighted average sectoral energy prices. The cost of saved energy reflects the cost of the efficiency investment (in dollars per million Btu) as amortized over the life of the investment, using a five percent real discount rate. Negative values for gas savings reflect additional fuel requirements due to implementation of electric efficiency measures.

Savings from these analyses of prototype buildings were then applied to projected energy use in Illinois, based on new construction trends (for the new building prototypes) and an ACEEE estimated implementation rate for each package of measures. The implementation rate assumes an aggressive set of policies is adopted to encourage implementation of cost-effective energy-saving measures. For the existing building prototypes, we assumed that measures would be gradually installed over the 1999-2015 period on a linear path, resulting in installation of 80 percent of the measures by 2015.

Thus, over the 17-year analysis period, nearly 5 percent of the measures are implemented each year (80 percent per 17 years). For the new building prototypes, we assumed that updated building codes that incorporate all of the measures become effective in 2003, with voluntary adoption of these efficiency levels growing from 22 percent of new buildings in 1999, 34 percent in 2000, 50 percent in 2001, and to 75 percent in 2002.

The result of all of these assumptions is that by the year 2015, residential energy consumption would be 40 percent lower than the baseline projections. In order to achieve these savings substantial investments will be required, primarily by energy users. These investments will be repaid with energy savings but the investments are significant none the less. For the residential sector, based on the average costs of saved energy reported in Table 1, investment over the 1999-2015 period will total $11.3 billion. However, cumulative energy bill savings from these measures, during the same period, will total $20.7 billion. Hence, the benefit-cost ratio to residents (i.e., savings divided by investment) for the high-efficiency scenario is 1.84.

For the commercial sector, by 2015 energy use will be just under 30 percent lower than the baseline projections. The savings are not as large (in percentage terms) as in the residential sector because savings opportunities in the commercial sector for natural gas are limited. Nevertheless, the commercial sector has a very large electricity saving potential — almost 39 percent.

Commercial sector investments are also large (although significantly lower than in the residential sector), totaling $5.2 billion over the 1999-2015 period. However, cumulative energy bill savings from these measures are estimated to be $13.3 billion, resulting in a commercial building benefit-cost ratio to businesses of 2.57.

2. Industrial Efficiency

The industrial sector represents a diverse grouping of entities including: farming, agricultural services, forestry, fisheries, mining, construction, and manufacturing. Because of this diversity and the fact that energy use is an integral part of many of the operations performed in this sector, a different approach was required from that used for buildings.

ACEEE has developed a methodology for the estimation of baseline energy consumption in the industrial sector at the state level and the potential for cost-effective energy efficiency improvements; this methodology is discussed in Appendix C.[21]

Information on energy consumption within the industrial sector at any level other than the national level has been difficult to obtain and is of varying quality. Energy end-use varies widely among the different industry groups, and even among industries within some of those groups, so the energy efficiency opportunities also vary substantially.[22] Therefore, it is important to have representative disaggregations of energy use within the industrial sector in order to make meaningful estimates of the potential for energy efficiency improvements and identify areas of greatest opportunity for energy savings. This study uses state employment data to apportion *State Energy Data Report*[23] estimates of industrial energy consumption at the state level to twelve industrial groupings.

As figure 4, on the following page, indicates, the petroleum refining industry is the state's largest industrial fuel user. This industry is closely followed by the primary metals and chemicals industries. Consistent with the overall high fuel use, figure 5, on the following page, illustrates, these same two industry groups, with the addition of the fabricated metals industry, represent the state's highest industrial electricity users as well. Combined, they account for 54 percent of industrial electricity consumption.

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21. This analysis methodology was developed for a previous study by S. Laitner et al., *Energy Efficiency and Economic Development in the Midwest*, American Council for an Energy-Efficient Economy, Washington, DC, 1995.

22. R. N. Elliott, *Electricity Consumption and the Potential for Electric Energy Savings in the Manufacturing Sector*, American Council for an Energy-Efficient Economy, Washington, DC, 1994; M.H. Ross, P. Thimmapuram, R.E. Fisher, and W. Maciorowski, *Long Term Industrial Energy Forecasting (LIEF) Model (18 Sector Model),* Argonne National Laboratory, Argonne, IL, 1993.

23. *State Energy Data Report 1995*, see note 13.

FIGURE 4. ESTIMATED 1995 INDUSTRIAL FUEL CONSUMPTION (IN TBTU)

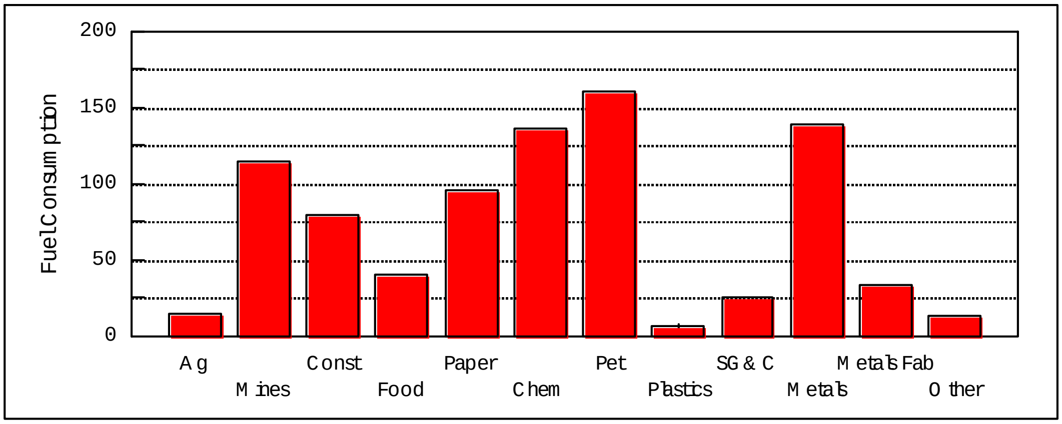
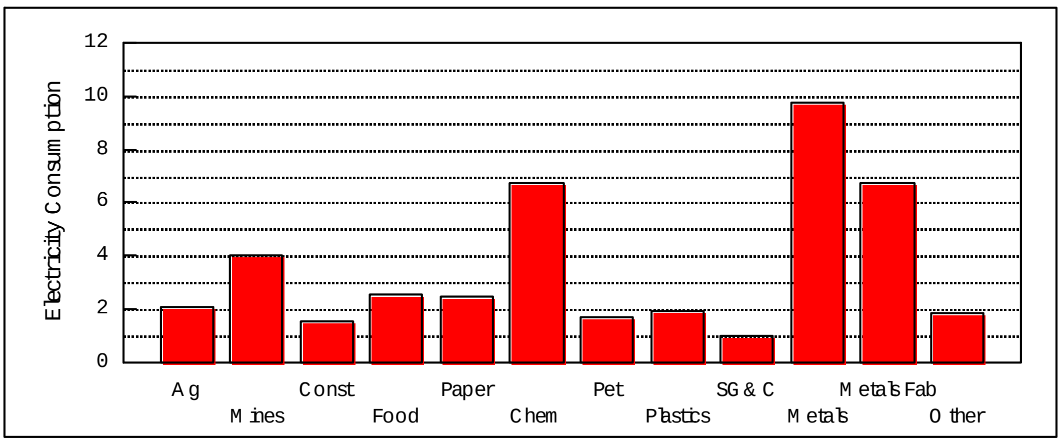


FIGURE 5. ESTIMATED 1995 INDUSTRIAL ELECTRICITY CONSUMPTION



(IN BILLION KWH)

Source: Calculations by the American Council for an Energy-Efficient Economy based upon assumptions described in the text.

The energy efficiency potential in the industrial sector was estimated using conservation supply curves derived from the Long-Term Industrial Energy Forecasting (LIEF) model[24] and ACEEE estimates for additional savings from investments in combined heat and power generation. Most conservation supply curves have been developed by combining various characteristic measures for a particular market. Such an approach is impractical for the industrial sector because of the complexity and site-specific nature of many efficiency measures. The LIEF curves were developed from a historical analysis of sectoral energy intensities and prices.

24. Ross et al., see note 22.

Industrial sector energy savings estimates are based on the average industrial energy prices in Illinois in 1995. By 2015, primary energy consumption in the industrial sector is reduced by just under 32 percent compared to the baseline projections. Total electricity consumption decreases even more significantly over time in the high-efficiency scenario, resulting in a 60 percent reduction in electricity consumption in 2015 compared to baseline projections. Approximately 37 percent of the electricity savings are directly attributable to savings from investments in combined heat and power generation.

The potential for conserving industrial fuels is a more modest 17 percent. In large part, this is because average fuel prices are relatively low in key industries such as primary metals, chemicals, and petroleum refining. Potential fuel reductions are also impacted by the additional fuel requirements necessary to take advantage of electricity savings from combined heat and power generation.

The high-efficiency scenario requires $12.7 billion in energy efficiency investments over the period 1999-2015 (in constant 1995 dollars). Cumulative bill savings (based upon 1995 energy prices) would be $17.9 billion. Hence, the benefit-cost ratio for the industrial sector is 1.41.[25]

25. At first glance, the industrial benefit-cost ratio may appear to be unusually low. But we need to make a distinction between the benefit-cost ratio of a project and of a scenario. A single project with a payback of 4 years and a life of 10 years will have a benefit-cost ratio of 2.5. But a scenario with investments made annually over a 17-year period will always be incurring new investments, especially in the outlying years. Therefore, some of the benefits accrue outside of the scenario time frame. This is all the more important to understand within the industrial sector since many projects may have effective lives of less than 10 years (compared to commercial buildings, for example, which may last 20, 30, 40 or more years). This means that in the 11th year new investments are made to keep the same level of efficiency benefit.

TABLE 3. ESTIMATED CUMULATIVE ENERGY SAVING AND EFFICIENCY INVESTMENTS 1999-2015

Category	Industrial Sector
Fuel Savings	16.6%
Electricity Savings	60.3%
Primary Energy Savings(1)	31.8%
Bill Savings (million$) (2)	$17,895
Efficiency Investments (million$)	$12,689
Benefit-Cost Ratio (3)	1.41

Notes: (1) Based on an electricity system heat rate of 10,519 Btu/kWh.
(2) Calculated using industry consumption-weighted, average fuel prices in 1995 and state average industrial electricity prices in 1995 reduced by 10 percent
(3) Ratio of cumulative bill savings to cumulative capital investment in efficiency improvements. Energy savings after 2015 that result from investments made before 2015 are not considered in this calculation.

3. Transportation Efficiency

As throughout the nation, the transportation sector accounts for major portions of energy use and energy-related emissions in Illinois. Moreover, the transportation sector is almost wholly dependent on petroleum. A breakdown of energy use by transportation mode is not available for Illinois; indeed, such a breakdown is difficult to define since a significant portion of the traffic, particularly freight, crosses state and national boundaries. Nevertheless, using national statistics as a guide, light duty vehicles (LDVs, i.e., cars and light trucks) account for the majority of transportation energy use. Thus, our analysis focuses on LDVs, taken here to include passenger cars and 2-axle, 4-tire, light trucks, as defined in the U.S. Department of Transportation's *Highway Statistics* (HS) report.[26] Nationally, LDVs account for 94 percent of highway vehicle miles of travel (VMT), about 80 percent of highway energy consumption, and 60 percent of overall transportation energy use.

26. *Highway Statistics, 1996*, FHWA-PL-98-003, Federal Highway Administration of the U.S. Department of Transportation, Washington, DC, 1997.

Transportation energy efficiency, particularly for light duty vehicles and aircraft, has improved substantially over the past two decades. Today, however, ongoing improvements are only being seen in aircraft, and even those improvements are insufficient to keep up with rising travel demand. Efficiency improvements have almost completely halted for the largest contributor to transportation energy use, cars and light trucks.[27] Thus, motor vehicle energy use is now rising in step with increased driving, which, as we note below, is expected to grow at an average rate of 2.3 percent per year in Illinois.

Previous work indicates a substantial energy savings opportunity for improving vehicle efficiency using technologies already available for conventional cars and light trucks.[28] Our analysis is based on estimating the potential energy savings obtainable through vehicle efficiency improvement. We do not examine the use of alternative fuels, such as natural gas, biofuels, hydrogen, or electricity, which have a long-term potential for displacing petroleum. These alternative technologies are still entering the early stages of commercialization and further research and development is needed for many of them. Battery-powered electric vehicles (EVs) are just now becoming commercially available but are still inhibited by battery technology limitations and associated price premiums. Therefore, we restrict our analysis to conventional vehicle technologies, which still have considerable unmet potential for low-cost energy savings and pollution reduction over the time horizon of this study.

Also critical for improving transportation system efficiency are measures to reduce VMT by shifting to more efficient modes, including higher vehicle occupancy, transit, walking, and bicycling; reducing the need to travel through more efficient planning or use of electronic communications; and reforming transportation pricing and spending policies that subsidize car and truck travel. These broader aspects of transportation planning transcend energy concerns and fall beyond the scope of this analysis; these issues are well covered in the study by Ketcham and Komanoff. [29]

A key factor underlying energy analysis for the transportation sector is expected growth in travel demand in the state. Figure 6 shows the recent history of VMT growth for Illinois along with the projected growth assumed for our analysis. Although this growth can, and for efficiency reasons, should be dampened through policy and planning reforms, for the purposes of estimating the potential energy savings from vehicle efficiency improvements we take it as a given that travel demand will increase.

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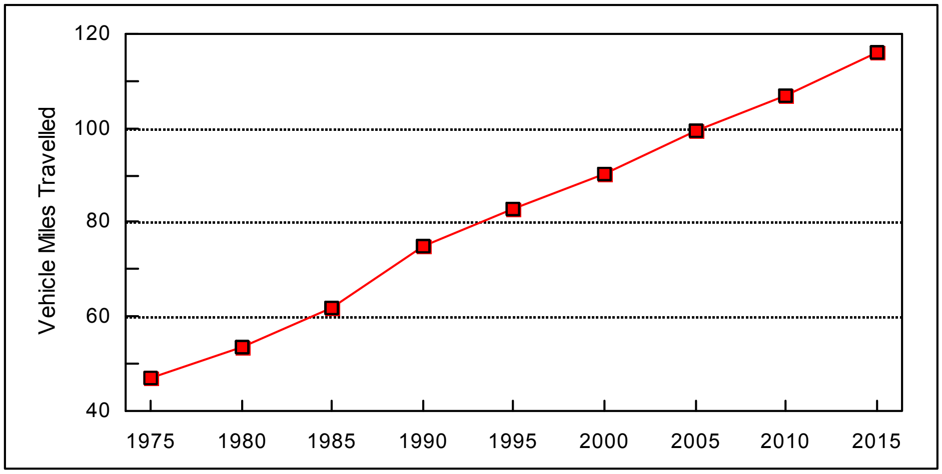
27. The motor vehicle and parts manufacturing industry (which will be affected by policies to improve vehicle efficiency) is well represented in Illinois. Among others, Chrysler, Ford, and Diamond Star each have manufacturing plants in Illinois. In addition, Navistar has its headquarters and engine and parts distribution in Illinois.

28. J.M. DeCicco and M. Ross, *An Updated Assessment of the Near-Term Potential for Improving Automotive Fuel Economy*, American Council for an Energy-Efficient Economy, Washington, DC, 1993.

29. B. Ketcham, and C. Komanoff., *Win-Win Transportation: A No-Losers Approach to Financing Transport in New York City and the Region*, Transportation Alternatives, New York, NY, 1992.

FIGURE 6. PAST AND PROJECTED LIGHT DUTY VEHICLE TRAVEL IN ILLINOIS (IN BILLIONS OF MILES PER YEAR)

Notes: Vehicle miles traveled for 1975-1995 represents historical data. Data for 1996-2015 is projected based on descriptions in the text.



For projections of travel growth, we adopted national forecasts for VMT and adjusted these using Illinois specific VMT data obtained from HS.[30] The resulting forecast is for 1995-2015 VMT growth of 1.7 percent per year. Consistent with nationwide trends (largely influenced by demographic changes), the expected future growth rate is slower than over the past two decades, when the state's VMT growth rate averaged approximately 2.9 percent per year.

The transportation energy savings calculation involves combining projections of annual VMT, new car miles per gallon (mpg), the per unit cost to achieve that efficiency level, and annual new LDV sales. For our analysis, base year data were compiled for 1995 and vehicle efficiency improvements were assumed to begin in 1999. Base year car sales[31] were scaled up to estimate car and light truck sales by applying the ratio of LDV VMT to car VMT as reported in HS.[32] Estimates of annual new LDV sales for future years were made in proportion to growth in VMT. The energy and fuel cost savings were calculated relative to a baseline assumption of frozen vehicle efficiency, accounting for the vehicle stock (all cars and trucks, new and used, in service within a given year) and its turnover.

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30. *Highway Statistics, 1996,* see note 26.

31. *AAMA Motor Vehicle Facts and Figures*, American Automobile Manufacturers Association, Washington, DC, 1994.

32. *Highway Statistics, 1996,* see note 26.

The stock retirement model uses vehicle usage and scrappage statistics from Davis and Strang,[33] further described by DeCicco. [34] Because on-road fuel economy is lower than EPA-rated fuel economy, a 20 percent downward adjustment is made to account for the shortfall, based on estimates by Mintz, Vyas, and Conley.[35] Fuel savings estimates were also adjusted downward to account for the takeback (rebound) effect of greater driving because higher fuel economy lowers the cost per mile, using an elasticity of travel with respect to fuel cost of -0.1 based on Greene.[36] The result is a series of estimates of the projected real-world average fuel economy of all cars and light trucks on the road (new and used) in each future year.

DeCicco and Ross[37] estimated the costs of achieving higher new car fuel economy under varying assumptions about technology availability. The analysis examined a set of conventional car and light truck technologies, including engine improvements, transmission improvements, and measures to reduce mass, rolling resistance, and aerodynamic drag. Measures were screened for cost and ranked in a "cost curve" representing the slate of technical options for improving new vehicle efficiency without reducing average vehicle size and performance or compromising safety. (In fact, adjustments were made to account for potential safety improvements that might add some mass back to the vehicles.)

The DeCicco and Ross mid-range estimates indicate that a 65 percent improvement in new car fuel economy is achievable with about 10 years of lead time. With additional time, further technology improvements would be possible, as indicated by a significantly higher ("Level 3") set of estimates developed by DeCicco and Ross. Based on this analysis, we adopt a higher improvement level as attainable by 2015. We estimate that by 2015 average new car fuel economy can improve to 50.3 mpg, just over double the 1995 level which averaged 24.6 mpg. Further, we estimate an average added retail cost of approximately $770 per car (1995$). Similar degrees of improvement are also achievable in light trucks (pickups, minivans, sport utilities), relative to their current (lower) average efficiency levels.

For our analysis, we assume the efficiency improvements are phased-in at an average rate of 1.5 mpg per year, relative to a combined new car and light truck average fuel economy of 25 mpg.

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33. S. Davis and S. Strang, *Transportation Energy Data Book: Edition 13*, ORNL-6743, Oak Ridge National Laboratory, Oak Ridge, TN, 1993.

34. J. DeCicco, "Projected Fuel Savings and Emissions Reductions from Light Duty Vehicle Fuel Economy Standards," *Transportation Research* 29A(3): 205-228, 1995.

35. M. Mintz, A. Vyas, and L. Conley, *Differences Between EPA-Test and In-Use Fuel Economy: Are the Correction Factors Correct?* 931104, Transportation Research Board, Washington, DC, 1993.

36. D. Greene, "Vehicle Use and Fuel Economy: How Big is the 'Rebound' Effect?" *Energy Journal* 13(1), 1992.

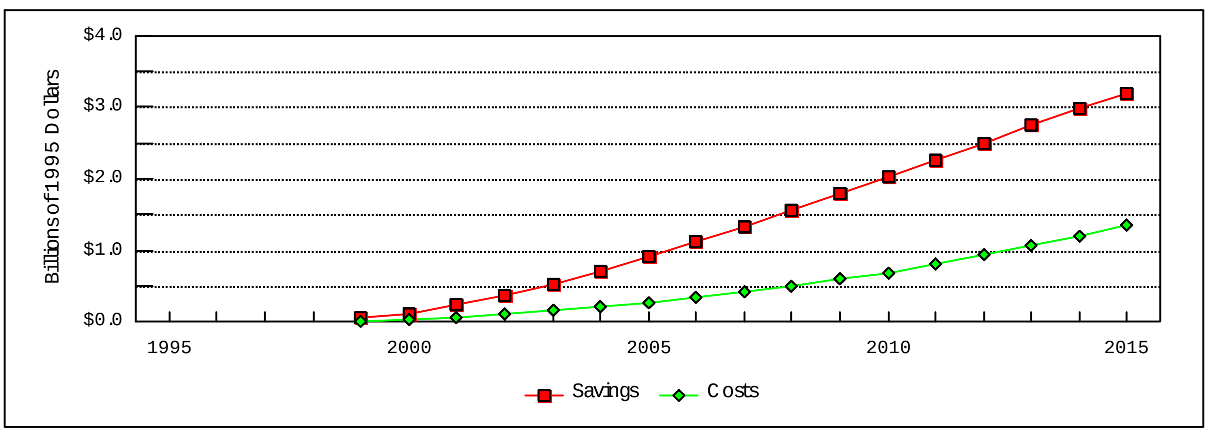
37. J.M. DeCicco and M. Ross, *An Updated Assessment of the Near-Term Potential for Improving Automotive Fuel Economy,* American Council for an Energy-Efficient Economy, Washington, DC, 1993.

Given the assumption of improvements starting in 1999, the result is average new light vehicle efficiency levels of 34.7 mpg by 2005, 42.2 mpg by 2010, and 50.3 mpg by 2015. The costs of achieving the phased-in higher fuel economy levels in each year were calculated using an analytic form of the DeCicco and Ross cost curve. Total annual costs are shown in Figure 7, below. Costs grow in accordance with our assumption of ongoing efficiency improvements through the horizon of analysis.

Improvements in new car and light truck efficiency take time to “trickle-down” throughout the total on-road stock of vehicles (new and used), since the average vehicle lifetime is about 12 years. Results from the stock model show that the 98 percent improvement in new light duty fleet efficiency by 2015, compared to the current level, will have induced a 62 percent improvement in stock average efficiency by that time. The result is a roughly one-quarter savings in light vehicle fuel use per mile of driving. The resulting savings stream is shown as the upper curve in Figure 7. Savings exceed investments from the start since the initial technological improvements have payback times of less than one year.

FIGURE 7. COSTS AND SAVINGS FOR LDV EFFICIENCY IMPROVEMENTS

The cumulative investment in vehicle technology improvements, realized as modest increases in the average price of new cars and light trucks, would amount to $8.7 billion over 1999-2015. The cumulative value of the resulting fuel savings would be much larger, at $24.4 billion over the same period. The resulting benefit/cost ratio is 2.80. This ratio would, moreover, continue to grow as years went on, since the overall consumer savings from higher vehicle efficiency will



keep growing as improved vehicles continue to replace older, less efficient vehicles in the on-road stock in the post-2015 period.

IV. ECONOMIC IMPACT ANALYSIS

With both the baseline projection and the efficiency scenarios established, the question now posed by this analysis is: "What are the employment and other macroeconomic impacts for

Illinois if the baseline energy use were reduced by just over 31 percent, or about 1,523 TBtus, by the year 2015?"

In effect, we are examining the benefits of lowering energy consumption from a projected average growth rate of about 1.2 percent annually to a growth rate of a negative 0.66 percent annually. One way to understand this issue is to think of it as increasing the productivity of the state's economy by reducing its overall energy costs. One tool that can assist in this type of macroeconomic evaluation is referred to as input-output modeling, sometimes called multiplier analysis.

A. Input-Output Analysis

Input-output models initially were developed to trace supply linkages in the economy. For example, they show how purchases of lighting equipment not only benefit lighting manufacturers but also the fabricated metal industries and other businesses supplying inputs to those manufacturers.

The employment that is ultimately generated by expenditures for energy efficiency will depend on the structure of a local economy. States that produce fabricated metal products, for instance, will likely benefit from expanded sales of locally manufactured, high-efficiency ballasts; states without such production will not benefit in the same way.

Different expenditures support a different level of total employment. Table 4 compares the total number of jobs in Illinois that are directly and indirectly supported for each one million dollars of expenditures made by consumers and businesses. To capture the full economic impacts of the investment in energy efficiency technologies, three separate effects (i.e., direct, indirect, and induced) must be examined for each change in expenditure.[38]

Direct effect refers to the on-site or immediate effects created by an expenditure. In the case of installing the energy efficiency upgrades in a manufacturing plant, the direct effect would be the on-site expenditures and jobs of the electrical or special trade contractors hired to carry out the work.

The indirect effect refers to the increase in economic activity that occurs when a contractor or vendor receives payment for goods or services delivered and he or she is able to pay others who support their own businesses. It includes the equipment manufacturer or wholesaler who provided the new technology. It also includes such people as the banker who finances the

38. In this study we have adapted the 1995 IMPLAN model for the analysis. See, for example, *Micro IMPLAN User's Guide*, Minnesota IMPLAN Group, Stillwater, MN, 1993. Table 7 presents what are referred to as Type I multipliers, incorporating only the direct and indirect effects of an expenditure. Adding the induced effect would generate what are known as the Type II multipliers (or Type III multipliers as referenced in the IMPLAN model).

contractor, the accountant who keeps the books for the vendor, and the building owner where the contractor maintains its local offices.

The induced effect derives from the change in wealth that the energy efficiency investment program creates. Businesses and households are able to meet their power, heating, cooling, lighting, and transport needs at a lower total cost, due to efficiency investments. This lower cost of doing business and operating households makes available greater wealth for firms and families to spend or invest in the state economies.

The sum of these three effects yields a total effect that results from a single expenditure. However, since household spending is included as part of the final demand changes in the analysis, the employment and other macroeconomic impacts have been limited to the direct and indirect effects only. This will tend to understate the net effect of the efficiency scenario.[39] Table 4 provides employment multipliers for key sectors such as agriculture, construction, manufacturing, utility services, wholesale and retail trade, services, and government.

For purposes of this study, a job is defined as sufficient wages to employ one person full-time for one year. Of immediate interest in Table 4 is the relatively small number of jobs supported for each one million dollars spent on fuel production and utility services. As it turns out, much of the job creation from energy efficiency programs is derived by the difference between jobs within the utility supply sectors and jobs that are supported by the respending of energy bill savings in other sectors of the economy.

B. An Illustration: Jobs from Energy Improvements in Government

To illustrate how a job impact analysis might be done, we will use the simplified example of a state agency that installs $1.0 million of efficiency improvements. Government agencies, traditionally large users of energy due to heating and air-conditioning loads, significant use

39. For more information on this point, see R.E. Miller and P.D. Blair, *Input-Output Analysis: Foundations and Extensions*, Prentice-Hall, Inc., Englewood, NJ, 1985, pages 25-30.

Table 4. Illinois Employment Multipliers for Selected Economic Sectors

Sector	Employment Multipliers (Jobs per $1 Million of Expenditures)
Oil Refining	2.6
Natural Gas Utilities	3.7
Electric Utilities	4.2
Oil/Gas Mining	5.3
Insurance/Real Estate	6.9
Coal Mining	7.0
Motor Vehicles	7.4
Primary Metals	8.0
Food Processing	8.2
Other Mining	8.8
Pulp and Paper Mills	9.2
Metal Durables	9.6
Other Manufacturing	10.2
Stone, Glass, and Clay	10.8
Transportation, Communication, and Utilities	12.4
Finance	12.6
Wholesale Trade	12.6
Construction	15.1
Agriculture	20.1
Services	21.1
Government	22.3
Education	27.0
Retail Trade	29.6

Source: Adapted from the 1995 IMPLAN database for Illinois. The employment multipliers represent the direct and indirect jobs supported by a one million dollar expenditure for the goods and/or services purchased from a given sector.

of electronic office equipment, and the large numbers of persons employed and served, provide substantial opportunities for energy-saving investments. The results of this example are summarized in Table 5.

The assumption used in this example is that the investment has a positive benefit-cost ratio of 2.00. This ratio is comparable to those shown in Table 1. If we anticipate that the efficiency changes will have an expected life of 15 years or more, then we can establish a 15-year period of analysis. We further assume that the efficiency upgrades take place in the first year of the analysis, while the energy savings occur in years 1 through 15.

The analysis also assumes that we are interested in the *net effect* of employment and other economic changes. This means we must first examine all changes in business or consumer expenditures — both positive and negative — that result from a movement toward energy efficiency. Each change in expenditures must then be multiplied by the appropriate multiplier (taken from Table 4) for each sector affected by the change in expenditures. The sum of these products will then yield the net result for which we are looking.

In our example there are four separate changes in expenditures identified in Table 5, each with their separate multiplier effect. As Table 5 indicates, the net impact of the scenario suggests a gain of 29.0 job-years in the 15-year period of analysis. This translates into a net increase of 1.9 jobs each year for 15 years. In other words, the efficiency investment made in government facilities is projected to sustain an average of just under two jobs each year over a 15-year period compared to a baseline or "business-as-usual" scenario.[40]

C. EVALUATING THE ALTERNATIVE ENERGY SCENARIO

The employment analysis of the alternative energy efficiency scenario was carried out in a very similar manner as the example described above. That is, the changes in energy expenditures brought about by investments in energy efficiency technologies were matched with their appropriate employment multipliers. There are several modifications to this technique, however.[41]

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40. The estimate may be conservative when we recall that the commercial sector as a whole was shown to have a benefit-cost ratio of almost 3.0 (noted earlier in Table 1), which compares with the benefit-cost ratio assumption of 2.0 used in this example.

41. For a more complete review of how this type of analysis is carried out, see H. Geller, J. DeCicco, and S. Laitner, *Energy Efficiency and Job Creation: The Employment and Income Benefits from Investing in Energy Conserving Technologies*, American Council for an Energy-Efficient Economy, Washington, DC, 1992.

Table 5. Job Impacts from Government Energy Efficiency Improvements

Expenditure Category	Amount ($ Million)	Job Multiplier	Job Impact
Government Efficiency Improvements in Year One	$1.0	15.1	15.1
Diverting Government Expenditures to Fund Efficiency Improvements	-$1.0	22.3	-22.3
Respending of Energy Bill Savings in Years One through Fifteen	$2.0	22.3	44.6
Lower Utility Revenues in Years One through Fifteen	-$2.0	4.2	-8.4
Net Fifteen-Year Change	**$0.0**		**29.0**

Note: The employment multipliers are derived from the appropriate sectors (average of the three states) found in Table 7. The jobs impact is the result of multiplying the row expenditure change by the row multiplier. For more details, see the text.

First, it was assumed that only 80 percent of the efficiency investments would be spent within Illinois. Interviews with personnel from various state agencies in the region suggest this to be a conservative value since almost all efficiency investments are carried out by local contractors and dealers.

As it turns out, the level of locally installed efficiency upgrades does matter, especially in the early years of the analysis; that is, before the energy bill savings begin to show a significant return. For example, in 2000 the employment benefits for the region would turn negative if more than 50 percent of the upgrades were performed by out-of-region contractors or other businesses. By 2015, however, this level would have to rise to more than 95 percent before the employment gains are fully eroded. Thus, to maximize employment within the region, investments in the early years should emphasize the use of locally based businesses as much as possible.

Second, we made an adjustment in the employment impacts to account for specific sector changes in labor productivity. As outlined in the Bureau of Labor Statistics *Outlook 1995-2005*, productivity rates are expected to vary widely among sectors, ranging from a 0.1 percent annual productivity gain in the service sectors (which will experience a large influx of employment as those sectors become more important to the economy) to a 4.0 percent annual productivity gain in coal mining (where such gains have already led to significant job losses).[42]

To illustrate the impact of productivity gains, let us assume a typical labor productivity increase of 1 percent per year in manufacturing. This means, for example, that compared to 1997 a one million dollar expenditure in the year 2015 will support only 85 percent of the number of jobs as in 1999.[43]

Third, for purposes of estimating energy bill savings it was assumed that fossil fuel energy prices would remain at their 1995 levels and electricity prices decline by 10 percent from 1995 prices (as noted earlier). This is, in part, to simplify the matching of energy prices with an input-output model based upon 1995 price relationships but also in line with the Energy Information Administration's new price forecasts. The new forecast is substantially lower than previous forecasts in order to recognize the price-lowering impacts associated with utility restructuring.[44]

There are two important exceptions to the presumption that fossil fuel energy prices would remain at 1995 levels: (1) that a decline in consumption would cause a downward pressure in the variable costs of supplying energy resources, and (2) that in the early years of the study the fixed costs associated with producing energy would prompt a small increase in energy prices.[45] While this might represent a "deadweight loss" in some respects, the effect will be overcome by a reduction in energy consumption that is larger than the very small energy price increase.

Fourth, it was assumed that approximately 80 percent of the investment upgrades would be financed by bank loans that carried an average 10 percent nominal interest rate over a five-year period. To limit the scope of the analysis, however, no parameters were established to account for any changes in interest rates as less capital-intensive technologies (i.e., efficiency investments) are substituted for conventional supply strategies, or in labor participation rates — all of which might affect overall spending patterns.

While the higher cost premiums associated with the energy efficiency investments might be expected to drive up the level of borrowing (in the short term) and, therefore, interest rates, this

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42. The productivity trends were calculated by Economic Research Associates using data from the Bureau of Labor Statistics employment projections, *Outlook 1995-2005*, as downloaded from the BLS FTP site <ftp.bls.gov/pub/special.requests/ep>, U.S. Department of Labor, Washington, DC, February 1996.

43. The calculation is $1/(1.01)^{16} * 100$ which equals $1/1.173 * 100$, or 85 percent.

44. *Annual Energy Outlook 1998*, see note 15.

45. This is a working estimate by Economic Research Associates for use in this analysis. Based upon a 40 percent average fixed cost, energy prices would go up by an estimated 7 percent in the year 2010, for example. On the other hand, a 24 percent drop in consumption would put a similar downward pressure on energy prices that would likely offset this trend) particularly in later years as fixed costs are fully depreciated.

upward pressure would be offset to some degree by the investment avoided in new power plant capacity, exploratory well drilling, and new pipelines. Similarly, while an increase in demand for labor would tend to increase the overall level of wages (and thus lessen economic activity), the modest job benefits are small compared to the current level of unemployment or underemployment. Hence the effect would be negligible.

Fifth, for the buildings and industrial sectors it was assumed that a program and marketing expenditure would be required to promote market penetration of the efficiency improvements. This was set at 15 percent of the efficiency investment for those sectors.[46] For the transportation scenario it was assumed that, since the efficiency improvements would be an integral part of all new vehicle purchases, a "program" expenditure would not be necessary. Finally, it should again be noted that the full effects of the efficiency investments are not accounted for since the energy bill savings beyond 2015 are not incorporated in the analysis.
Nor does the analysis include other productivity benefits that are likely to stem from the efficiency investments. These can be substantial, especially in the industrial sector. Industrial investments that increase energy efficiency often result in achieving other economic goals such as improved product quality, lower capital and operating costs, increased employee productivity, or capturing specialized product markets.[47] To the extent these "co-benefits" are realized in addition to the energy savings, the economic impacts would be amplified beyond those reported here.

46. For example, this was the same value as used in *Energy Efficiency and Job Creation*, see note 2.

47. Office of Technology Assessment, *Industrial Energy Efficiency*, Congress of the United States, Washington, DC, 1993, page 65. For a more complete discussion on this point, see S. Laitner, *Energy Efficiency as a Productivity Strategy for the United States*, Economic Research Associates, Alexandria, VA, 1995; and J. J. Romm, *Lean and Clean Management: How to Boost Profits and Productivity by Reducing Pollution*, Kodansha American, Ltd., 1994.

V. MACROECONOMIC RESULTS

The investment and savings data from the efficiency scenario were used to estimate three sets of impacts for the five-year periods of 2005, 2010, and 2015. The procedure was similar to the steps outlined in Section IV(B) of this report, and as modified by the assumptions in Section IV(C). For each benchmark year, each change in a sector's spending pattern for a given year was matched to the appropriate sectoral multiplier. These negative and positive changes were summed to generate a net result shown in the tables that follow.

The first of the three impacts evaluated here is the net contribution to Gross State Product (GSP) measured in millions of 1995 dollars. In other words, once the gains and losses are sorted out in each scenario, the analysis provides the net benefit of a scenario in terms of the state's overall economy. The second impact is the net gain to the state's wage and salary compensation, also measured in millions of 1995 dollars. The final category of impact is the contribution to the state's employment base as measured by full-time jobs equivalent. The following parts of this section identify these impacts for the total energy efficiency scenario as well as for electricity only.

In addition, the final part of this section presents the estimated reductions in air emissions that result from the efficiency scenario.

An important caveat should again be noted at this point. The intent of the high-efficiency scenario is to construct a reasonable profile of investments and economic impacts, assuming that cost-effective efficiency measures are widely adopted over the 17-year period of the analysis (i.e., 1999-2015). Given future changes in the electric utility industry and potential changes in consumption patterns in the economy, this analysis is not intended to provide a precise forecast, but rather approximate estimates of overall impact.

A. FULL EFFICIENCY SCENARIO

Table 6 summarizes the economic impacts of the alternative energy scenario for selected benchmark years. It provides the estimated economic benefits of the accelerated use of energy efficiency technologies in all sectors. While these increases are significant, the impacts are relatively small in comparison to overall activity of the state economy. By the year 2015, for instance, Illinois' GSP might grow to $479 billion (in 1995 dollars). Thus, reducing the state's GSP by $700 million (the impact from the full efficiency scenario) in that year will keep the GSP essentially level. Similarly, the increases in wage and salary compensation and jobs in 2015, brought about by implementing the full efficiency scenario, represent an increase of only 0.4 percent in compensation and 0.7 percent in total jobs by 2015.[48]

48. These projections are taken from *BEA Regional Economic Projections to 2045: States*, U.S. Department of Commerce, Bureau of Economic Analysis, 1995. The projections were originally reported in 1987 dollar values by BEA but have been adjusted to reflect 1995 dollar values for our analysis.

On the other hand, if the impacts are small in relation to the larger economy, it is only because the scale of investment is also relatively small. The anticipated $37.8 billion in cumulative efficiency investments (from Table 1) are well under 1 percent of the region's cumulative GSP in the period 1999-2015.

Table 6. Impact of the Full Efficiency Scenario

Year	Net Jobs Gain	Change in Wage and Salary Compensation (Million$)	Change in Gross State Product (Million$)
2005	20,700	$540	($150)
2010	40,600	$1,090	($280)
2015	59,400	$1,620	($700)

Notes: Dollar figures are in millions of 1995 dollars while employment reflects the actual job total. The implied benefit-cost ratio across the 17-year period is 2.02. The calculations are based upon a working analysis by Economic Research Associates, November 1998. They assume a 31 percent reduction in energy use over the year 2015 forecasted values and a displacement of conventional electric-generating resources by the use of energy efficiency technologies and combined heat and power. Totals may not equal the sum of components (as shown) due to independent rounding.

There are a number of different aspects of Table 6 worth noting before commenting on the impacts in more detail. The first is that the impacts are largely positive. By the year 2015, wage and salary earnings as well as employment are positive in each of the years shown — reaching a net total of $1.62 billion (in 1995 dollars) and 59,400 jobs, respectively, in 2015. GSP, however, shows a small decline in each of the years.

This apparent contradiction (i.e., rising earnings with declining GSP) is the result of three different influences at work in the economy. First, many of the initial outlays for energy efficiency investments have not begun to pay for themselves in terms of energy bill savings. This tends to dampen the growth of GSP. At the same time, changes in the production recipe of the economy — largely the turn toward more labor-intensive purchases in the efficiency scenario — increase the share of benefit enjoyed by working men and women. And finally, the emphasis on supply (i.e., investments in combined heat and power generation in the industrial sector) offset some of the gains from efficiency.

Wage and salary compensation is one of the elements that comprise GSP, constituting about 60 percent of the GSP total. Thus, while overall GSP can fall, wage and salary compensation can rise as labor payments are substituted for investment capital in the larger economy. Thus, the tradeoff between capital and labor continues.

The employment impacts start modestly in 2005 with net employment gains of 20,700 jobs. The annual totals continue to climb to a net gain of 40,600 in 2010, and 59,400 in 2015. We can think of the net job gains as if they were provided by the relocation of a series of small manufacturing plants to Illinois. In that case, we then can say that a 31 percent energy savings would produce new employment that is equivalent to the jobs supported by about 396 small manufacturing plants that might open in Illinois in the year 2015.[49]

Alternately, we can think of the additional wage and salary compensation from the energy savings as an equivalent amount of spending by tourists and visitors. In this instance, the 31 percent energy savings would provide the dollar equivalent of spending from over 10.8 million visitor days.[50]

Perhaps another way to look at this issue is to see how the alternative energy future would change the unemployment rate. In July 1998 Illinois' unemployment rate was estimated at 4.4 percent.[51] If that continues through the year 2015 when total non-farm employment is estimated to rise to just under 8 million jobs,[52] then the state's unemployment level would be about 275 thousand persons. Adding another 59,400 jobs to the state economy would be sufficient to lower the average unemployment rate from 4.4 percent to 3.7 percent.

Table 7, on the following page, offers yet another insight into the projections. It shows how each of the major economic sectors are affected in the year 2015 in the alternative energy scenario. These are sorted according to the anticipated job impacts beginning with those sectors that have the largest employment gains.

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49. This estimate is based on the net gain of 59,400 jobs in Illinois. It assumes that a small manufacturing plant would employ 50 persons directly. For each job in the manufacturing plant, a total of 3.0 (2 additional) jobs would be supported in the economy for a total impact of 150 jobs. Therefore, each 150 jobs created by the alternative energy scenario is equivalent to the output of one small manufacturing plant. Dividing the total jobs created by 150 suggests the equivalent of a total of 396 (59,400/150) small manufacturing plants equivalent within the economy.

50. This estimate is based on the net gain in wage and salary compensation of $1.62 billion in the year 2015. It assumes that tourists and visitors to Illinois spend approximately $150 per day per person on recreation, eating and drinking, and lodging. Dividing the gain in wage and salary compensation by 150 suggests the equivalent of 10.8 million visitor day expenditures within Illinois economy. Visitor expenditures are based on averages compiled by Economic Research Associates.

51. The unemployment statistics for July 1998 (the most recent available) were downloaded from the U.S. Department of Labor Bulletin Board, at http://stats.bls.gov/ro5econ1.htm in September, 1998.

52. *BEA Regional Economic Projections*, see note 47. Illinois' total non-farm labor force in 2015 is estimated to be 7.99 million.

As elsewhere, it should be noted that the results in this table are not intended to be precise forecasts but rather approximate estimates of overall impact. Indeed, while the aggregate totals offer reasonable insights into the benefits of energy efficiency, some of the individual

Table 7. Energy Efficiency Impacts in Illinois by Sector in 2015

Sectors	Jobs	Compensation (Million$)	GSP (Million$)
Services	23,400	$650	$880
Construction	14,500	$510	$680
Retail Trade	9,000	$190	$310
Government	4,700	$180	$200
Finance	4,700	$250	$450
Other Manufacturing	3,200	$210	$350
Motor Vehicles	2,200	$210	$290
Transportation, Communication, and Utilities	2,200	$150	$280
Education	1,600	$60	$60
Metal Durables	1,400	$140	$220
Agriculture	900	$10	$20
Insurance/Real Estate	800	$40	$250
Food Processing	600	$30	$60
Other Mining	200	$20	$40
Pulp and Paper Mills	200	$10	$20
Primary Metals	200	$10	$20
Stone, Glass, and Clay	100	$10	$10
Wholesale Trade	0	$0	($10)
Oil Refining	(100)	($10)	($30)
Coal Mining	(100)	($20)	($40)
Natural Gas Utilities	(2,000)	($230)	($770)
Oil/Gas Mining	(2,600)	($130)	($640)
Electric Utilities	(5,700)	($670)	($3,350)
Total	59,400	$1,620	($700)

Notes: The numbers in parentheses reflect losses that are projected to occur in that sector as a result of the alternative energy scenario. Jobs refer to the net jobs created or lost in each sector. Compensation refers to the net gain in wage and salary income by sector. GSP refers to the net gain or loss in Illinois' Gross State Product created in each sector. All dollar values are in millions of 1995 dollars.

sectors show impacts that are sufficiently small that the results may swing one way or the other depending upon even modest changes in the assumptions.

As might be expected, the energy industries incur overall losses in jobs, compensation, and GSP. But this result must be tempered somewhat as the industries themselves are undergoing internal restructuring. For example, as restructuring takes place and the electric utilities engage in more energy efficiency services and other alternative energy investment activities, they will undoubtedly employ more people from the business services and engineering sectors. Hence the negative employment impacts should not necessarily be seen as job losses; rather they might be more appropriately seen as a redistribution of jobs in the overall economy and future occupational tradeoffs.

Explained differently, while the electric utilities may lose an estimated 5,700 traditional jobs due to selling less energy, they could gain many of those jobs back if they move aggressively into the energy efficiency business, thereby absorbing some of the job gains assigned to other sectors such as the construction and service sectors. In effect, if they expand their participation in the energy efficiency market, their job totals could increase relative to the estimates based on a more conventional definition of an electric utility as an energy supplier.

Table 7 shows three big "winners" under the alternative energy scenario. These are the service sectors (23,400 jobs), construction (14,500), and retail trade (9,000 jobs). Retail trade and the service sectors are winners largely for two reasons. First, they benefit from the actual investments in energy efficiency programs and technologies made in the year 2015. Second, they benefit from the higher level of goods and services sold as ratepayers and businesses respend their energy bill savings elsewhere in the economy.

The construction sector is a winner primarily because it is the industry that benefits most directly as special trade contractors and others are hired to install the new technologies and make the requisite efficiency upgrades. The construction sector alone pulls in about 24 percent of the net job increases in the year 2015. Using the construction industry as a benchmark for evaluation, it might be noted that about 1 out of 4 net job impacts in 2015 are from the efficiency investments made in that year. The remaining impacts are the result of respending the energy bill savings by ratepayers and businesses.

B. ELECTRICITY-ONLY SCENARIO

This section reviews the impacts of energy efficiency investments made only to reduce electricity use within Illinois. In the high-efficiency scenario, electricity use in 2015 drops approximately 43 percent relative to electricity use in that year in the baseline scenario. The cumulative investment in energy efficiency measures during 1999 through 2015 is estimated at $16.3 billion while energy bill savings reach $34.3 billion in that same period of time. Table 8, below, summarizes the results for the same five-year periods as in the total efficiency scenario.

Table 8. Impact of the Energy Efficiency Scenario — Electricity Only			
Year	**Net Jobs Gain**	**Change in Wage and Salary Compensation (Million$)**	**Change in Gross State Product (Million$)**
2005	10,900	$230	($360)
2010	22,300	$440	($740)
2015	35,200	$690	($1,310)

Notes: Dollar figures are in millions of 1995 dollars while employment reflects the actual job total. The implied benefit-cost ratio across the 17-year period is 2.11. The calculations are based upon a working analysis by Economic Research Associates, September 1998. They assume a 43 percent reduction in electricity use over the year 2015 forecasted values and a displacement of conventional electric-generating resources by the use of energy efficiency technologies and combined heat and power generation in the industrial sector. Totals may not equal the sum of components (as shown) due to independent rounding.

Perhaps the most interesting result is the drop in GSP for each year that is reviewed. Similar to the total energy scenario, this reflects the capital-intensive nature of the electric utility industry. As the revenues of electric utilities decrease under an accelerated energy efficiency scenario, the amount of capital investment also decreases (i.e., fewer new power plants are built). This, in turn, lowers the overall value-added and GSP.

On the other hand, the wage and salary compensation share of GSP actually increases in all three periods evaluated here. This is for two reasons. First, new electric plants are displaced by more cost-effective efficiency investments that are also more labor intensive. Second, the respending of energy bill savings is used for consumer and business purchases that are also more labor intensive.

As a result of this change in the economic mix, net employment rises. We might note, for example, that while electricity efficiency investments account for about 43 percent of the total investment in energy efficiency (as shown in Table 1), by the year 2015, electricity efficiency improvements account for 60 percent of the net employment benefits. This is the result of greater savings in the later years and the respending of the bill savings (and the induced effects from these). The latter is shown by comparing the results in Tables 6 and 8.

As might be expected, the traditional electric utilities sector would lose the most jobs, similar to the results from the total efficiency scenario noted earlier. The loss of jobs assumes a traditional economic structure for electric utilities in 2015. Thus, as fewer conventional power plants are needed as a result of efficiency gains, fewer traditional utility jobs are sustained. Once again, this points to an important opportunity for utilities: if utilities become more proactive in the area of energy efficiency services and other similar programs, they could take on new employees to carry out these new responsibilities.[53] One might assume, therefore, that utilities could incorporate at least part of the jobs gained in the construction and service sectors.

It should also be remembered that these estimates are not job losses in the strict sense of the word. Rather, they reflect differences between a business-as-usual (baseline) projection of future employment and jobs made available from an accelerated energy efficiency scenario. In the aggregate, there is a significant positive gain in both employment and wage and salary compensation, and a drop in the unemployment rate.

C. Air Quality Impacts

One of the benefits of the high-efficiency scenario will be the impacts on pollutant emissions and air quality in Illinois. This positive impact is the direct result of the reduced burning of fossil fuels (primarily coal for electricity generation) associated with improving the efficiency of energy consumption. The following analysis was undertaken to approximate carbon dioxide (CO_2), sulfur dioxide (SO_2), and nitrogen oxide (NO_x) emission savings associated with the efficiency scenario. It is not meant to represent a comprehensive analysis of the emission reductions, but rather to identify the magnitude of emission savings available and provide a reasonable estimate. To accomplish this task the analysis incorporates average marginal emission coefficients (by fuel type) adapted for Illinois from a number of sources.[54]

As Table 9, on the following page, shows, projected energy savings from implementation of the high-efficiency scenario, described earlier, suggest that carbon dioxide emissions would be reduced by approximately 85.3 million short tons by the year 2015. Just over 40 percent of these would be emissions reductions from reduced electricity consumption. These savings represent a reduction of almost 30 percent over the baseline scenario for 2015. These same savings will

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53. As restructuring occurs, providing additional services may also help utilities to retain existing customers and potentially expand their customer base.

54. Emission coefficients for the respective fuel types and end-use sectors are adapted from a number of sources. These include: 1995 carbon values for electricity generation contained in *Annual Energy Outlook 1998*, see note 15; 1995 SO_2 and NO_x values for electricity generation from the *Electric Power Annual 1995, Volume II*, Energy Information Administration, U.S. Department of Energy, Washington, DC, 1996; and 1995 SO_2, NO_x, and Carbon values for fossil fuels from *National Air Pollution Emission Trends 1900-1995*, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC, 1996. The emission estimates are based on the use of fuel-specific coefficients derived from national and state values that are multiplied by each of the major fuels consumed in each of the end-use sectors reviewed in this study. The emission coefficients are average coefficients, across all hours of the year, and do not differentiate by time of day or season.

reduce the total amount of carbon emissions reductions necessary to meet national carbon stabilization goals by 4.3 percent.[55]

The high efficiency scenario will also reduce emissions of sulfur dioxide by 352 thousand short tons and nitrogen oxides by 370 thousand short tons by the year 2015. Once again, electricity savings account for a significant percentage of the total savings, 94 percent of the SO_2 and 51 percent of the NO_x. These savings also represent a significant reduction over baseline emissions for 2015.

Table 9. Avoided Air Emissions in 2015 (in Thousand Short Tons)

	SO_2	NO_x	CO_2
Total Savings	352	370	85,270
Electricity Only Savings	330	187	34,494

Note: Emission reductions are derived from energy saving in the residential, commercial, industrial, and transportation sectors from implementation of the high-efficiency scenario.

55. According to the Climate Change Action Plan (CCAP) 1994, developed by the Clinton administration, the national goal is to stabilize carbon emissions at 1990 levels. For energy-related emissions this is 1,344 million metric tons (MMT). See *Emission of Greenhouse Gases in the United States 1987-1994*, Energy Information Administration, U.S. Department of energy, Washington, DC, 1995. According to the *Annual Energy Outlook 1998*, see note 15, carbon emissions in 2015 are projected to be 1,888 MMT. To meet the 1990 stabilization goals carbon emission will need to be reduced by 544 MMT. Converting the 85.3 million short tons of carbon dioxide emission savings (from the high-efficiency scenario) to carbon equivalent equals 23 MMT. Illinois' 23 MMT contribution would therefore represent 4.3 percent of the total needed (23/544 = 4.3 percent).

VI. Policy Review and Recommendations

With an annual energy bill of over $23 billion, the economic costs of energy use in Illinois are clearly enormous. Moreover, if current business as usual trends continue, total energy consumption is projected to increase by 28 percent by the year 2015, bringing with it all the associated economic and environmental costs.

However, there is an alternate path to the future. As the analyses presented earlier in this report document, an aggressive yet cost-effective commitment to energy efficiency could generate huge savings for Illinois, reducing energy bills for residential and business customers by over $76 billion during the 1999 to 2015 period.

The remainder of this chapter is devoted to discussing seven major policy areas (utilities, building codes, additional measures to support building energy efficiency, industrial strategies, combined heat and power (CHP) technologies, transportation, and a state-level sustainable energy agency) where creative and aggressive actions are needed to achieve significant energy efficiency improvements. In each of those areas, specific policy recommendations are provided. It is understood that many of these recommendations face significant obstacles to implementation and may be politically difficult to achieve. However, the magnitude of potential economic and environmental benefits available should make these recommendations at least worthy of consideration. That is the spirit in which this discussion and these recommendations are offered.

A. Utility Energy Efficiency Programs

History and Current Situation

The history of regulatory and utility company involvement in promoting energy efficiency in Illinois is largely a story of great potential gone unrealized. Public Act 84-617, effective January 1, 1986, contained excellent language supporting the use of energy efficiency. For example, Section 8-402(a) stated:

"The objective of this Section shall be ... to utilize, to the fullest extent practicable, all economical means of conservation, nonconventional technologies relying on renewable energy resources, cogeneration and improvements in energy efficiency as the initial sources of new energy supply."

The statute required the Department of Energy and Natural Resources to "analyze, prepare and recommend a comprehensive utility energy plan for the state" (Sec. 8-042(b)) and required each public utility to file, every 2 years, an "energy plan for its service territory consistent with the planning objectives and requirements described in the Article." (Sec. 8-042(c)) Furthermore, the legislation specified that these plans should include:

"a discussion of all existing and proposed programs and policies to promote and ensure the full utilization of all practical and economical energy conservation." (Sec. 8-042(d)(ii)(C))

and

"a demonstration that the plan fully considers and utilizes all available, practical and economical conservation, renewable resources, cogeneration and improvements in energy efficiency." (Sec. 8-042 (d)(iii)(B))

Yet in spite of this seemingly specific and clear legislative intent, little of substance actually materialized. It wasn't until two years after the effective date of the legislation that the Illinois Commerce Commission entered an Interim Order submitting its proposed rule responding to Section 8-402 to the Secretary of State, and it wasn't until three years after the effective date of the legislation that the proposed rule finally took effect. Utilities weren't actually required to file a plan until mid 1989, nearly four years after the effective date of the legislation. (ICC Order #87-0261, December 21, 1988)

Subsequently, very little was accomplished in terms of actually implementing the energy efficiency envisioned in the legislation. In the assessment of individuals close to the process, the ICC never really supported the process and the utilities used a number of tactics to create roadblocks and avoid any commitment to energy efficiency. Ultimately, the energy efficiency components of the legislation enacted in 1986 were eliminated as a part of Illinois' electric restructuring legislation in 1997 (the Electric Service Customer Choice and Rate Relief Law of 1997, P.A. 90-561).

Precise information on historical spending on energy efficiency by Illinois utility companies is difficult to obtain. Repeated inquiries with the Illinois Commerce Commission were unsuccessful, as the organizational unit that used to be responsible for least cost planning and DSM has been disbanded in response to electric utility restructuring in Illinois. Utilities are not required to report any such information now, and ICC staff were unable to locate any historical spending data. What is generally acknowledged by all parties, however, is that utility energy efficiency spending in Illinois has been minimal.

Perhaps the most illustrative information available comes from an analysis by ACEEE of 1996 utility energy efficiency spending data obtained from the U.S. Energy Information Administration, together with data from the U.S. Census Bureau. That analysis compared the fifty states in terms of energy efficiency spending per capita, and found that Illinois ranked among a group of eight states with the very lowest spending ratios in the nation. Illinois was tied with Alabama and Alaska with a spending level of only 20 cents per person in the state. Only the states of Arkansas, Mississippi, Oklahoma, Nebraska and Kansas had lower spending levels. The national average utility energy efficiency spending level per capita was 20 times higher than in Illinois.

As for current plans, the recently passed restructuring legislation in Illinois (the "Electric Service Customer Choice and Rate Relief Law of 1997, P.A. 90-561) provides for $3 million per year for an "energy efficiency trust fund", paid for through assessments on utility companies, to support residential energy efficiency programs administered by the Illinois Department of Commerce and Community Affairs.[56] It is significant to note that this $3 million annual funding level for energy efficiency would only provide essentially the same level of spending seen in that 1996 analysis discussed above, i.e., approximately 20 cents per person in the state. This would appear to perpetuate Illinois' history of extremely low energy efficiency spending.[57]

Finally, in response to severe electric capacity shortage problems this past summer, it is noteworthy that two Illinois utilities announced voluntary energy efficiency programs (Commonwealth Edison announced a $5 million program targeting residential and commercial lighting efficiency and Illinois Power announced a small pilot test of a commercial lighting program). While tiny in the context of the overall capacity shortfall situation, they at least mark an important acknowledgment of the value of including energy efficiency in the package of responses to system capacity needs.

Recommendations

The good news about Illinois' historically low spending on electricity efficiency programs is that the remaining potential for efficiency savings should be enormous. A glimpse of this latent potential was seen in the response to a small commercial lighting pilot by Commonwealth Edison in 1994. What was intended to be a 6 month pilot was fully subscribed in a matter of days. Similarly, a small $3 million commercial lighting pilot announced by Comm Ed this past summer, in response to supply shortage concerns, was sold out in three weeks. The relative lack of any significant utility DSM efforts over the years means that there are tremendous opportunities to improve the energy efficiency of the building and equipment stock in Illinois.

In view of this great potential, and in recognition of the very strained electric supply situation in Illinois and the Midwest, this report identifies three key recommendations which are presented below.

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56. The legislation also establishes a "Supplemental Energy Assistance Fund" for low income customers. This fund is estimated to raise approximately $76 million annually, of which 10% would be allocated for weatherization and related conservation services for low income households. This fund essentially replaced existing funding mechanisms for weatherization and utility bill payments.

57. Of the nine states which have thus far specified energy efficiency spending levels in their restructuring legislation or regulatory orders, Illinois would rank last in energy efficiency spending per capita. The average required energy efficiency spending per capita in the other eight states is over 50 times higher than for Illinois. (See the ACEEE report "An Updated Status Report of Public Benefit Programs in an Evolving Electric Utility Industry", July 1998, for data on restructuring related spending for energy efficiency.)

Adopt A Significant System Benefits Charge (SBC) To Fund Energy Efficiency Programs On A Statewide Basis

P.A. 90-561 actually includes a funding mechanism for energy efficiency (the "Energy Efficiency Trust Fund") which is similar in concept to a System Benefit Charge[58]. Unfortunately, the amount of funding generated ($3 million/year) is clearly inadequate, both in terms of the tremendous untapped potential for energy efficiency in Illinois, and in terms of what other major states proceeding with restructuring have allocated to energy efficiency. Furthermore, the energy efficiency required in P.A. 90-561 is restricted to the residential sector, thereby missing the extremely cost-effective efficiency savings available in the commercial and industrial sectors.

While some believe that private energy service companies (ESCOs) will step in and serve those sectors, the history of the ESCO industry gives little reason to believe that will happen. Due to the high "transaction costs" of marketing, contracting, measurement and verification, etc., ESCO's have tended to pursue only the largest of commercial and industrial customers. Moreover, most work performed by ESCOs nationally continues to be done in connection with utility incentive programs of one type or another. A statewide System Benefits Charge placed on distribution service would provide Illinois with a competitively neutral way to help fund significant energy efficiency improvements in the state.

As for the appropriate amount, Illinois could easily spend 10 to 20 times the amount specified in P.A. 90-561 on cost-effective energy efficiency initiatives. As an example, in neighboring Michigan, a single utility spent over $40 million per year in the early to mid 1990's, achieving a very attractive cost of conserved energy of 2.6 cents per kWh.[59] Similar results should easily be obtainable in Illinois.

Programs supported by the energy efficiency systems benefits charge should include a comprehensive and complementary mix of direct savings acquisition programs featuring competitive procurement (e.g., through Energy Service Companies) and innovative "upstream" programs focused on capturing "lost opportunities" (e.g., emergency replacement of equipment, new construction, etc.) and transforming existing markets for buildings and equipment to better capture efficiency opportunities. This type of comprehensive approach is being pursued in

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58. A System Benefit Charge is a small surcharge (typically 1 or 2 mills, i.e., 1 or 2 tenths of a cent per kWh) put on electricity delivered through the distribution system, regardless of the generation supplier. This competitively neutral mechanism has been adopted in a number of states as a way to fund public benefit programs such as energy efficiency.

59. M. Kushler, "Testimony of Martin G. Kushler, Michigan Public Service Commission", Staff testimony in Case No. U-10554, Lansing, Michigan, November 18, 1994.

several leading states (e.g., New York, Massachusetts, California, etc.). There are a number of references available that describe these types of program initiatives.[60]

Decouple Utility Company Profits From Sales

In establishing the new regulatory structure for electric utilities in Illinois, it will be critical to devise mechanisms to ensure that utilities are not financially averse toward energy efficiency. In particular, it is important to decouple distribution company profits from sales. Under the rate freeze which has been instituted in Illinois, the utilities will have a powerful incentive to increase sales, and conversely, to not wish their customers to pursue energy efficiency. This is because additional sales would increase revenues by a greater amount than needed to cover the incremental costs from those sales, thus resulting in greater profits. Similarly, reductions in sales from efficiency would lower revenues by more than they would lower costs, thus resulting in lower profits.

One example of a potential remedy to this situation is to modify the rate freeze requirement so that, at the end of the year, actual sales levels and forecasted sales levels are compared, and, if actual sales are greater than forecasted sales, the fixed cost portion of these excess sales are refunded to customers. Conversely, if actual sales are less than forecast, the fixed cost portion of below forecast sales are charged to customers. These adjustments would remove the otherwise embedded disincentive to the utility regarding having its customers pursue energy efficiency. Such a system was included in a recent settlement agreement in Oregon between PacifiCorp and interveners.[61] Similar approaches have been proposed in New York in a proceeding involving Niagara Mohawk Power Corp.[62]

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60. For example, see Eto, J., C. Goldman, and S. Nadel "Ratepayer-funded Energy-Efficiency Programs in a Restructured Electricity Industry: Issues and Options for Regulators and Legislators" ACEEE, Washington, D.C. May 1998.

61. "Oregon Alternative Regulation Settlement Proposal," Joint Parties, filing to Oregon Pubic Utilities Commission, Portland, OR, October 1996.

62. P. Centollela, "Testimony of Paul Centollela in Case 94-E-0098, Proceeding on Motion of the Commission as to Rates, Charges, Rules and Regulations of Niagara Mohawk Power Corporation," NYPSC, Albany, NY, 1996.

Adopt Least Cost Planning Principles For Restructured Utility Companies

During much of the past decade, integrated resource planning (IRP) was a planning technique in which a wide array of possible investments for meeting future load growth were examined and an optimum mix selected that minimized cost while providing good levels of reliability. In recent years, IRP has been extensively used by utilities to determine optimum new investments in generation, transmission, distribution, and DSM resources. With the restructuring of the utility industry, distribution companies in many areas will be primarily concerned with only distribution investments. However, utilities in Illinois are also required to be the electricity supplier of last resort for customers who do not choose an alternative supplier. For these generation services, utility companies should still be responsible for securing least cost electricity services, which could include the use of energy efficiency.

Furthermore, in some cases, energy efficiency investments can be a lower cost alternative than investments in new distribution facilities and equipment because efficiency induced load reductions can postpone the need to reinforce the distribution system in areas where growing loads threaten to make existing distribution capacity inadequate. For example, Con Ed and Rochester Gas & Electric have both targeted some of their energy efficiency programs in this manner. Similarly, energy efficiency investments that reduce loads can be an alternative to increased power purchases made by distribution companies to serve customers who elect not to choose alternative power providers. Illinois utilities should be required to use a least cost planning approach toward meeting their responsibilities as distribution utilities as well as their obligations as suppliers of last resort to Illinois customers.

Back when utilities were responsible for all generation, transmission, and distribution services, IRPs were large and complex undertakings. Now, if planning focuses on the distribution and power purchase roles, the planning processes can be significantly simplified. For example, instead of screening a wide array of potential generation resources, prices in the futures market can be used. Instead of planning for 20 year time horizons typical for generation, much shorter (5 to 10-year) time horizons used for distribution and power purchase planning can be used. In these ways, a distribution utility planning requirement can serve a useful purpose — optimization of investments — without becoming a major burden.

However, it is important to note that Illinois' utilities are unlikely to embrace least cost planning principles on their own initiative. If they are regulated in the old "cost of service" manner, they will have the traditional embedded incentive to increase the capital investment upon which they can earn a rate of return. If they are regulated through a simple price cap or rate freeze mechanism, they will have the previously discussed embedded incentive to maximize profits by maximizing sales levels. It will require a carefully designed regulatory least cost planning mechanism to provide the utility with the proper economic incentives to seek to lower total system costs through the incorporation of demand side measures.

B. BUILDING CODES

History and Current Situation

In February 1991, the Illinois Department of Energy and Natural Resources (DENR) filed its second Statewide Electric Utility Plan with the Illinois Commerce Commission (ICC). Included as part of this plan was a recommendation that cost-effective improvements in building energy and end-use device efficiency be vigorously promoted throughout the State by developing and evaluating energy efficiency standards for commercial lighting, industrial motors, and residential and commercial buildings. The ICC approved this recommendation, and specified that DENR lead a collaborative effort to develop a detailed proposal including the state's electric utilities, ICC staff, and other interested and affected parties.

As a part of that effort, ACEEE was commissioned to perform a study to explore options for a statewide building code as well as statewide equipment efficiency standards, and to evaluate the cost-effectiveness of a statewide building energy code for reducing energy demand in Illinois. That study was completed and a comprehensive final report published in May 1994.

The results of that study demonstrated that upgrading the residential and commercial building codes in Illinois would be extremely cost-effective and produce significant energy savings. Quoting from the report:

"Based upon this review, we recommend that Illinois adopt the 1992 CABO Model Energy Code for low-rise residential buildings, and the ASHRAE 90.1 code for commercial and high-rise residential buildings with Illinois-specific modifications to increase lighting and chiller efficiencies. Cost and savings analyses show that these two codes will be extremely cost-effective from both building owner and societal perspectives. The codes will increase the energy-efficiency of buildings, over those being built today by 10 to 18% while not radically departing from current construction practices." (P. 2-1)

Unfortunately, no formal action was ever taken to implement the recommendations contained in that 1994 report. As of this writing, there is still no statewide building energy code for residential or commercial buildings.

Recommendations

Adopt Statewide Residential and Commercial Building Energy Codes To Improve The Efficiency Of New Buildings

Building energy codes are an effective and widely used strategy for ensuring that new buildings are constructed to be relatively energy efficient. Illinois should revisit the 1994 report and pursue actions to implement the recommendations contained in that report: i.e., to implement the residential 1992 Model Energy Code and the ASHRAE 90.1 code for commercial and high rise residential buildings, with the Illinois-specific increased lighting and chiller efficiencies described in the report. These would be modest and cost-effective steps to help ensure that newly constructed buildings in Illinois are reasonably energy efficient, and should produce significant energy savings for the state over time.

To help address the practical problems of trying to get a statewide residential energy code passed, it may be helpful to open discussions with home builders. Under the current situation in Illinois, many municipalities in the state have their own energy related code provisions, while many others have none. This patchwork quilt of code coverages presents difficulties for builders, who frequently construct homes in more than one municipality. They could be of assistance in securing a uniform statewide code. If opposition from the city of Chicago presents a special barrier, perhaps legislation could specify that cities above 1 million in population could be exempt, and a code could still cover the rest of the state. Admittedly, a statewide code is difficult in Illinois due to Home Rule limitations. However, other states such as Pennsylvania are pursuing a statewide code in spite of similar Home Rule constraints, and the benefits to be obtained from a good statewide code make it worthwhile to at least pursue the issue.

C. ADDITIONAL MEASURES IN SUPPORT OF BUILDING ENERGY EFFICIENCY

History and Current Situation

In addition to the policies discussed in the previous two sections, there are a number of other miscellaneous policy areas which can support improved energy efficiency in buildings. These include: energy codes for state owned buildings; energy standards for equipment; home energy rating systems; and having a state energy office to pursue energy efficiency opportunities. Illinois' record in these areas is mixed, but better than the first two policy areas discussed in this chapter.

For example, Illinois has been able to maintain the functions of a state energy office, which were transferred to the Department of Commerce and Community affairs in 1995. That office has been active in supporting such policies as a home energy rating system (HERS) program and an Affordable Housing Program, and in facilitating some industrial energy initiatives. Also, Illinois does have a statewide building energy code for state owned buildings, and has undertaken a number of activities to pursue energy efficiency in state owned buildings. The State Buildings Energy Program did detailed energy surveys of state facilities and documented savings of one million dollars annually from 1987 until 1995. Efforts continue, at a reduced pace, involving such things as motor surveys and lighting surveys in state facilities. Nevertheless, there are a number of areas where the policy efforts in Illinois could be improved.

Recommendations

Consider Adopting Equipment Efficiency Standards

Although federal standards cover a number of appliances and types of equipment, there are still a number of mass-produced products for which a substantial amount of energy can be saved by establishing minimum efficiency standards. For these products, high-efficiency levels are very cost effective to consumers, but due to a variety of market barriers, low efficiency products still dominate the market. Among these products are dry-type distribution transformers (used in many commercial buildings) and packaged commercial refrigeration equipment (e.g., vending machines, ice makers, and water coolers). These and other opportunities for state efficiency standards are discussed in detail elsewhere.[63]

In addition, the earlier referenced ACEEE study on "Energy Efficiency Codes and Standards For Illinois" specifically examined the opportunities for improving the efficiency of equipment not covered by federal standards. The study found that there were nine product types for which state standards appeared to be justified. Illinois should re-visit and update that 1994 study and seriously explore the possibility of adopting targeted state equipment efficiency standards.

Continue To Improve The Energy Efficiency Of State Owned Buildings

Illinois has updated its statewide building energy code for state owned buildings. It is based upon ASHRAE 90.1-1989. The State Capitol Development Board has authority to approve code updates and should pursue this option when the new ASHRAE code becomes available (currently expected in 1999).

In addition, Illinois should consider establishing a revolving loan fund to finance energy-saving improvements in state and municipal facilities. A highly successful program of this type, the LoanStar program, is operating in Texas and to date has achieved measured energy cost savings of more than $19.9 million in public buildings and schools. A key feature of this program is that it devotes extensive attention to properly commissioning energy-saving measures (making sure they operate correctly) and to monitoring actual energy savings, both to catch problems that may develop and to make a compelling case that the program is providing a substantial return on the state's investment. Funding for the Texas program comes from oil overcharge funds but programs in Illinois could just as well be funded through state bonds.[64]

D. INDUSTRIAL ENERGY EFFICIENCY

History and Current Situation

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63. Nadel and Suozzo, *The Need and Opportunities for State Action on Equipment Efficiency Standards,* American Council for an Energy-Efficient Economy, Washington, DC, 1996; Nadel, *Minimum Efficiency Standards: Options for Federal and State Action*, American Council for an Energy-Efficient Economy, Washington, DC, 1994.

64. J. Haberl, et al., *Measuring Energy-Savings Retrofits: Experiences from the Texas LoanStar Program*, Oak Ridge National Laboratory, Oak Ridge, TN, 1995; "LoanSTAR Program Saves Texas Taxpayers Millions in Energy Bills," *TEES Engineering Issues*, Texas A&M Univ.,Texas Engineering Experiment Station, College Station, TX, 1995.

Several adjoining mid-western states have a history of effective industrial energy efficiency programs run either by utilities or directly by the state (Laitner et al, 1995, Elliott, Pye and Nadel 1996, Elliott and Pye 1997). Industrial energy efficiency activities in Illinois have been more limited, although the Department of Commerce and Community Affairs (DCCA), Division of Energy Conservation and Alternative Energy does have a small scale ongoing industrial effort. These efforts have included programs focused on specific industrial groups.

The first area addressed by DCCA was plastics, in which a survey of the industry was conducted and a solicitation was made to the industry for energy efficiency projects, with matching grants of a maximum $50,000 being provided. In all, 13 grants were provided, totaling $432,271. Over $1.2 million of total investment was achieved. Projected savings from this solicitation are over $600,000 annually. A similar program is now at the solicitation phase for the fastener industry, and plans are under consideration for a similar initiative for the food industry. In addition, DCCA has been working with the Energy Resource Center at the University of Illinois Chicago and the North American Diecasters Association to develop an energy efficiency workbook and one-day seminar. DCCA also funds energy efficiency programs at five Small Business Development centers, and two CEMOI centers in the southern part of the state that provide surveys to small business. DCCA also participates as a Motor Challenge Allied Partner, coordinating with utilities in the state and has assisted in 15 Motor Master workshops attended by almost 250 participants. (David Kramer 1998). DCCA is also a sponsor of the Compressed Air Challenge, a national partnership to develop and deliver compressed air efficiency information and training.

As can be seen from the earlier analysis in this report, significant cost-justified energy efficiency potential clearly remains within the industrial sector. However, energy savings alone have not proven sufficient to motivate industry to action. Fortunately, many energy efficiency opportunities have additional benefits in the areas of productivity, safety, product quality, and environmental compliance. In many cases it is these other benefits, which may far exceed the energy benefits, that determine whether a project is implemented. An integrated strategy is needed to capture this potential, focusing on a broad range of benefits and looking at the manufacturing system, rather than focusing exclusively on its components, and the project must be presented in financial terms that are commonly used by industrial decision makers (Pye 1998; Elliott, Pye, and Laitner 1997).

Additional initiatives are needed to realize the full industrial energy efficiency opportunities in the State. Program opportunities fall into the six broad strategic categories listed below, and could be undertaken at the regional and state level.

Recommendations

Illinois Should Establish And Promote A Comprehensive Industrial Energy Efficiency Strategy

The industrial energy efficiency strategy should address all aspects of the opportunity implementation process:

- opportunity identification,
- technical and design assistance,
- financial analysis,
- financing,
- operation improvements, and
- promoting advanced technologies.

An example of a well-integrated approach can be seen in the experience of New York. In the past, the New York State Energy Office (NYSEO) conducted comprehensive industrial energy efficiency programs with these characteristics. NYSEO's *Flexible Technical Assistance Program* provided audit, design assistance, procurement and implementation services. The *Energy Investment Loan Program* provided financing with interest rate subsidies to commercial lenders for their customers' energy-efficiency projects, and the *Construction Services and Professional Training Programs* provided training, technical assistance and resources to all levels of industrial staff from engineers to operators. Also, utilities in New York have conducted industrial DSM programs complementing the state's activities. These combined programs have achieved impressive results, especially in encouraging industrial facilities to make process-related improvements (Elliott and Weidenbaum 1994). With the closing of NYSEO, the program has been continued successfully by the New York State Energy Research and Development Authority (NYSERDA) (Platt 1998).

Government and utility programs can help to reduce the cost and hassle of identifying efficiency improvements (e.g., through surveys and technical and purchasing assistance) and the cost of installing efficiency measures (e.g., through rebates, loans, and creative private market financing). While large companies can benefit from these programs, they are especially critical for many smaller companies that lack the financial and human resources available in many larger companies to implement these energy efficiency and process improvement projects (Elliott, Pye and Nadel 1996).

The following material discusses each of the six components of the industrial efficiency strategy listed above in more detail.

Opportunity Identification

Identification of energy efficiency opportunities is the first step in the process. Illinois should consider establishing a program similar to the NYSERDA FlexTech design. This could be housed within state agencies, but it would be preferable to establish a statewide nonprofit center to provide these services, as has occurred with the Energy Center of Wisconsin and Advanced Energy in North Carolina. Another option is to locate the center at an academic institution as has been done with the Iowa Energy Center. Initial operating funding for an industrial assessment initiative of $500,000 - $1,000,000 annually would allow hiring several experienced staff engineers, as well as establishing consulting relationships with technical experts. Funding should be expanded as the demand for the center's services grow.

The Industrial Assessment Centers (IACs) (formally known as the Energy Analysis and Diagnostic Centers) are an existing resource of technical assistance that could be augmented with funds from either state revenues or a utility systems benefit change. Illinois has an IAC at Bradley University, and there are five centers in adjoining states that service most of Illinois.[65] In addition, the University of Illinois-Chicago has applied to become an IAC. This successful program, which receives its core funding from the U.S. Department of Energy (DOE), provides low-cost audits to small- and medium-sized firms. Nationally, 29 IACs each conduct approximately 30 assessments annually. Assessments identify energy savings opportunities that can be pursued by other key players, such as gas and electric utilities, or by the companies themselves. The overall IAC program achieves an average of 10 percent implemented energy savings with the average measures at a facility having a simple payback of less than two years. In addition, the program trains engineers in industrial energy efficiency techniques and these individuals often seek employment as energy managers in local industries (DOE 1998; Woodruff et al. 1996). Although the five IACs mentioned above cover most of the state, the number of assessments they can offer represents a small fraction of the need of eligible firms.

Several opportunities exist to expand and enhance the IACs in the region. The state could follow the example of Texas, which is now using oil overcharge funds to expand the activities of the IAC at Texas A&M in support of the new Texas Industrial LoanStar program. In addition, the IAC at Texas A&M University College Station has created an affiliate relationship with Texas A&M University in Prairie View to expand the coverage in the state (Eggebrecht 1996).

Based upon the precedent in Texas, Illinois could expand the activities of the five IACs in order to increase their services to small- and medium-sized manufacturers, who have been shown to benefit the most from this type of assistance (Hopkins and Jones 1995). In addition, new state-supported IACs could be established at Illinois universities or community colleges, either as affiliates of existing IACs or as new, independent centers. By expanding the level of activity at existing IACs as well as the number of IACs, a larger fraction of the eligible firms could be served. Increasing the number of centers would also allow closer relationships to develop between the IACs and firms in their immediate area.

Another opportunity is for DCCA to partner with Illinois EPA's (IEPA) Partners in Pollution Prevention (PIPP) program. (DCCA currently operates the Recycling Industry Modernization (RIM) program that provides assessment and grants to sites to implement recycling and source reductions.) PIPP, which has 200 partners, is a voluntary program that encourages companies

65. The University of Missouri-Rolla serves the southwest part of the state while the southeast is served by the University of Louisville. The north and central sections are served by University of Notre Dame, University of Wisconsin, and Iowa State University (DOE 1998).

to prevent pollution, rather than using end-of-pipe pollution control approaches. Energy efficiency is an excellent example of pollution prevention, and while it is not currently included in PIPP, EPA is restructuring the program and seriously considering adding an energy efficiency component, making it an opportune time to consider partnering (Gerberding 1998). Experience shows that energy efficiency and non-energy forms of pollution prevention often occur simultaneously, expanding the benefits of such projects, and presenting an opportunity to leverage expertise, funding, and industrial contacts (Pye 1998).

Technical and Design Assistance

Industries' lack of access to specialized expertise and energy efficiency services can be barriers to implementing efficiency opportunities (Alliance et al. 1997). The NYSERDA FlexTech program is one example of the kind of resource that can be made available to a region. Other centers sponsored by the states, utilities, and industry could be developed, increasing the scope and availability of expertise to assist industry with energy efficiency and productivity enhancements.

Since development of this expertise is costly, it would be reasonable for state agencies and utilities in the region to pool their resources. A regional effort along these lines has been established in the southeastern United States, and could be copied in the Midwest. Advanced Energy (formerly the North Carolina Alternative Energy Corporation) established an Industrial Electrotechnology Laboratory (IEL), which now operates in South Carolina and Virginia as well as North Carolina. The IEL provides technical training, assistance, and testing services to industrial users in areas such as electric motor systems, product heating and drying, and low-emission coatings. The IEL allows industrial customers to develop and evaluate process technology changes in a near-production environment without disrupting the manufacturing operation (Koger 1996).

Electric motor systems offer one of the most attractive opportunities for energy efficiency improvements but the expertise necessary to support motor programs is in limited supply. A state or regional motor systems program could address this problem. Several national initiatives have emerged that are intended to be the foundation for local initiatives. The DOE Motor Challenge offers extensive resource to program implementors through their Allied Partners program (DOE 1997). The DCCA is currently making only limited use of the range of available resources. The Consortium for Energy Efficiency (CEE) has developed programs for premium efficiency motors, motor repair and energy efficient transformers (CEE 1998). Compressed Air Challenge (for which DCCA is a sponsor) has been formed by a unique group of government entities, utilities, private interest, and public interest groups to produce information and training on efficient compressed air system operation and design, and will offer operator certification in the future (CAC 1998).

An example of a successful motor program is the Electric League of Washington State (a coalition of electric utilities), which has retained a motor expert to coordinate motor programs among its members. The program uses brochures and efficiency levels developed by CEE. This effort to promote motor management and encourage efficient motor purchases has expanded to the entire Pacific Northwest under the new Northwest Energy Efficiency Alliance. The effort is being expanded to include compressed air and motor repair, both based on national initiatives (Zdebski 1998).

The Energy Center of Wisconsin (ECW) also offers two model motor-system programs: Responsible Power Management (RPM) and Performance Optimization Service (POS), which promote energy-efficient equipment and improved optimization of motor-driven systems. RPM offers a consistent motor-driven equipment incentive program for all the state's electric utilities, coupled with technical support that is coordinated with the CEE initiative. The POS program, which uses the systems approach to identify, assess, and optimize the performance of industrial motor systems, offers comprehensive technical training and support to end-users and motor system design engineers. The ECW was a founding sponsor of the Compressed Air Challenge and is now hosting the organization during its formative period (Meadows 1998).

Programs similar to the Washington and Wisconsin initiatives to improve motor system efficiency should be considered at the state or regional level in Illinois. A northeast regional utility motor initiative, led by the Northeast Energy Efficiency Partnership, Inc., has been formed (NEEP 1998). The opportunity exists to either start a broad Illinois state initiative or revive the Midwest motor consortium that was started in the early 1990s. It is important that utilities in the state be encouraged to support and participate in these initiatives, and that groups coordinate their efforts.

Financial Analysis

Many businesses operate with a tight constraint on their capital budgeting. Hence, the allocation of capital remains a significant barrier to achieving greater levels of energy efficiency. Given a choice between expanding existing production capability and introducing new products, and reducing energy bills, the production-related projects will invariably win out. Hence, presenting projects based on total benefits will likely be more effective than building a case on the energy savings alone because, as mentioned earlier, investments in energy efficiency often have significant non-energy "co-benefits." By quantifying both energy and non-energy benefits, energy efficiency investments can be elevated from being simply "cost justified" to becoming as attractive or more attractive than alternative capital investments.

The financial analysis of an efficiency project is the basis for making the investment decision. The financial analysis may range in sophistication from a simple payback (investment/annual net savings) or rate of return (average annual net savings/total investment) to more accurate calculations, such as net present value (NPV) or internal rate of return (IRR), which take into account the time value of money. Regardless of which calculation is used, *the most important part of a financial analysis is the comprehensive estimation of project costs and benefits*.

The financial analysis is not only an important part of a company's investment decision-making process, but is also critical to obtaining project financing. The more information that can be provided to a lender regarding the costs and benefits of a project, the easier it is for the lender to accurately determine the level of risk and appropriate interest rate. The more non-energy benefits can be quantified, the more attractive the investment is in terms of minimizing risk and interest rates.

Financing

Some industrial customers, particularly many small- to medium-sized companies, lack the capital to finance energy-saving improvements. The existing grants program at DCCA is a successful effort, but could benefit from substantial expansion. A financing program may offer a lower cost option for overcoming this barrier. Such a program could be: specifically for industry (e.g., NYSEO's Energy Investment Loan Program); part of the utility system benefit charge, discussed in the utility section; or operated in conjunction with loan programs for other sectors (e.g., Texas' LoanStar program). Based on the New York experience, we suggest a state total industrial loan pool of approximately$125 million.[66] Such a program could use private capital with interest-rate reductions for small- and medium-sized companies, financed with system-benefit charge monies, or state funds could be issued at interest rates somewhat below market rates.

Operation Improvements

Once energy efficiency measures and process improvements are installed, individual plant staff must learn how to operate this equipment correctly. FlexTech is unique in that it provides customized training as part of its energy services program (Elliott and Weidenbaum 1994). As the Energy Center of Wisconsin's POS program has discovered, an important aspect of process optimization frequently involves changes to the operating procedures. These can frequently be more important than the equipment changes (Meadows 1998). On-the-job training services in Illinois would help insure that industrial equipment is operated and maintained properly and that the energy savings potential of efficiency improvements is realized. Funding for these efforts is included in the recommended budgets for the industrial assistance center initiative discussed above.

Efficient operation requires properly trained engineers and technicians who are aware of the benefits of energy efficiency to the success of the company. Companies such as Dow and 3M have achieved impressive bottom-line benefits when they "empowered" their staffs to look for efficiency opportunities (Nelson 1993 and Schultz 1996). One opportunity to create trained and

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66. These levels are based on subsidizing the financing of an additional 3 percent of industrial capital investment in Illinois (as reported by the Census [1993]) for an average five 5-year term. The cost of the subsidy is 29 percent of the dollar value of the realized capital investments, as was achieved in the NYSEO program (Elliott and Weidenbaum, 1994).

aware engineers is through IACs. In addition to providing immediate benefits to companies, IACs are creating a pool of engineers with energy efficiency expertise for companies to draw upon. Technicians are as important to the efficient operation of industrial process as engineers. The region's community college systems should be encouraged and funded to incorporate energy efficiency into the engineering technology curriculum, as has occurred with programs in North Carolina and Wisconsin. As mentioned above, the Compressed Air Challenge offers a nationally developed training program that can be deployed at state, local, and regional levels by a range of entities.

Promoting Advanced Technologies

In addition to promoting currently available energy efficiency measures, the state and utilities should encourage technological innovation in the industrial sector. This can lower energy intensity as well as create new opportunities for economic growth. Technological innovation is also critical for industrial competitiveness and environmental protection over the long run.

NYSERDA has an active state program supporting research and demonstration in industrial energy efficiency and pollution prevention technologies. NYSERDA’s industrial research program funding is currently about $4 million annually. This represents about a quarter of the Authority’s annual research budget. In recent years, the program has averaged about 35 active programs. NYSERDA documents annual benefits from industrial sector projects undertaken after 1990 of $8 million in 1995 and $9.4 million in 1996. These energy savings represent only a portion of the true benefits since benefits estimates are unavailable for a fraction of the projects. NYSERDA is attempting to make a more accurate projection and forecasted program benefits of more than $15 million for 1997 (Peter Douglas 1997).

The state of Illinois has already been actively involved with the DOE’s National Industrial Competitiveness through Energy, Environment, and Economics ($NICE^3$) program (Kramer 1998), which can be viewed as a model effort in this area. $NICE^3$ provides matching grants to state government and industry partnerships that demonstrate innovative energy efficiency and waste-reducing technologies. Many projects have successfully demonstrated new techniques for reducing energy use, cutting emissions, and saving businesses money. The state and utilities should provide additional resources for $NICE^3$ or similar projects.

Another opportunity is to establish a state *Industries of the Future* (IOF) program. A state-level initiative would build on the successful U.S. DOE IOF program, which has developed industry-led initiatives for nine energy- and waste-intensive industries.[67] IOF creates partnerships among industry, government, and supporting laboratories and institutions to accelerate technology research, development, and deployment. The DOE Office of Industrial Technologies (OIT) has a program to assist states that develop industry-led initiatives for both national IOF industries

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67. The IOF industries are Forest Products, Chemicals, Glass, Aluminum, Iron and Steel, Petroleum, Mining, Agriculture, and Metals Casting.

and industries critical to individual states. These initiatives undertake cooperative programs to address specific needs of a state's industries (Quinn 1998).

Coordination Of Efforts

Because of the limited existing program framework, it is important that Illinois leverage available program resources at least initially. An expanded use of resources such as those developed by Motor Challenge, Compressed Air Challenge and CEE, could be coordinated with other potential players such as utilities and universities, and would represent an opportunity to expand industrial programs in the state. In addition, the state should consider initiating a formal state-level IOF program, since this effort will not only allow the State program to develop programs appropriate to the needs of the state's industries, but will also develop channels for program deployment. Partnering of DCCA and IEPA's PIPP presents yet another opportunity to leverage resources — both human and financial.

Moreover, the state would benefit from the establishment of a technology center similar to Advanced Energy's IEL, which would provide comprehensive assistance to industry on energy efficiency and the accompanying benefits of reduced production costs, improved product quality, and lower environmental emissions. This center might be part of a multi-sector center or could be specifically targeted at the industrial sector alone. Because of the costs associated with establishing this type of center and retaining expert staff, regional joint efforts should be seriously considered. The state also might consider funding IAC assessments from one of the centers in adjoining states or establishment of a state-funded center, perhaps at Bradley University which has an IAC.

A comprehensive approach, such as the NYSERDA FlexTech approach, either housed within existing agencies, utilities or at an energy center should be the goal for the development of a program. Included in this should be a loan program for Illinois industrial companies, with an initial capitalization of $125 million, which could be structured using either the New York or Texas models. This funding could be provided by bonds, repaid with utility system benefit charge (SBC) funds.

With focused effort, the state can plot a more productive and secure future for its industrial sector with broad benefits from industrial process improvements and modernization, as have already been realized in New York and Texas.

E. COMBINED HEAT AND POWER

History and Current Situation

Combined heat and power (CHP), also known as cogeneration, is a system configuration that generates electricity and thermal energy in a single, integrated system, rather than with separate electric power plant and heating and cooling equipment. Thermal energy recovered in CHP can be used for heating or cooling in industry or be distributed to buildings in the form of steam, hot water or chilled water via district energy systems. The total efficiency of these integrated systems is much greater than from separate systems.

CHP systems comprise a somewhat unique but very promising policy opportunity. Issues surrounding CHP bridge across several of the four policy categories discussed in this chapter. While the industrial sector is the prime candidate near-term for application of CHP, opportunities also exist in the institutional, commercial, and now even in the residential sectors.

Many manufacturing plants and district heating plants operated CHP facilities at the turn of the century. As a separate electric power industry emerged in the U.S., the electric generation capacity at most of these facilities was abandoned in favor of more convenient purchased electricity. However, some industries, such as pulp and paper and petroleum refining, have continued to operate their CHP facilities. In the past two decades, new interest has emerged in CHP, influenced significantly by the Public Utilities Regulatory Policies Act (PURPA) as discussed below.

PURPA played a critical role in moving cogeneration into the marketplace by addressing many barriers that were present in the early 1980s. These barriers included high standby charges from utilities and unwillingness to buy excess power. PURPA limited the standby charges and required utilities to purchase at their "avoided cost." Due to PURPA, many independent power producers found a use for some of their waste thermal energy. However, because PURPA allowed system as little as 5% useful thermal energy to qualify, many systems were optimized for electricity production and were not very efficient (Bluestein 1998).

The 1990s saw a change in the power market with the emergence of independent power producers (IPP) who did not need to find a use for waste heat. The barriers that PURPA was intended to address changed with the market, and a new set of barriers to efficient cogeneration emerged. "Avoided costs" were falling rapidly, driven by declining fuel cost and changes in generation mix. Rather than buying power at their avoided cost, utilities were purchasing power in wholesale markets based on market conditions. Concurrently, many utilities increased standby charges to cogenerators in part to discourage cogeneration and the resulting loss of sales revenue. These developments taken together slowed, but by no means eliminated, expansion of cogeneration capacity during the 1990s (Bluestein 1998).

These developments increased the attractiveness of generating power only for the wholesale markets, and discouraged independent power producers from seeking steam customers for their new plants.

Combined heat and power (CHP) systems initially consisted primarily of boilers that generated steam, some of which was used to turn steam turbines that generated electricity. Due to the cost and complexity of these systems, they were mostly confined to sizes of more than 50 MW_{e},[68] precluding their installation at many manufacturing facilities or in commercial buildings. Recent advances in electricity generation technologies, in particular advanced combustion turbines and reciprocating engines, are reducing system costs, enabling much smaller CHP systems and increasing potential electricity output per unit of fuel input. Combustion turbines are now cost-effective in many applications down to 500 kW_e and reciprocating engines can be cost-effective down to 50 kW_e, with even smaller equipment on the horizon. This smaller equipment dramatically expands the number of sites where CHP can be installed. In fact, a turbine or engine can replace fuel burners in some existing boilers, adding electricity generation capability while reducing on-site emissions of pollutants (Interlaboratory Working Group 1997).

In addition to those operating cost and environmental benefits, CHP implementation could also have beneficial effects on the electric system in the state. Since new generation and transmission capacity will be needed to meet Illinois's growing energy requirements, and to replace aging existing facilities, one strategy is to address this need with electricity generated by combined heat and power systems. Conventional electricity generation is relatively inefficient, converting only about one-third of the fuel's potential energy into useful energy, with the remaining energy rejected to the environment in the form of heat. CHP systems reclaim most of this heat for use in industrial processes or conditioning buildings. Overall system efficiency of CHP systems can approach 85%. In addition, by locating the generation at the point of use (so-called distributed generation) the pressure to build additional electricity transmission capacity is reduced.

Although the technical performance and cost of CHP systems have greatly improved, significant barriers limit widespread use of CHP in the United States (Casten and Hall 1998). These barriers influence investments in capital equipment and tend to "lock-in" continued use of polluting and less-efficient utility infrastructure. The Sears Tower in Chicago is a typical example of the problems frequently encountered by CHP projects. The building owners sought to install a CHP system to deliver steam, chilled water and electricity to their tenants. They were unable to reach an agreement with their local utility on the issues of interconnecting their generation to the utility, which has already delayed the system's installation by several years.

If CHP is not considered for future generation, transmission, and distribution requirements, the new investments that must made in utility capacity to meet load growth may preclude future deployment of CHP. (Com Ed has acknowledged this opportunity, and is developing a list of suggested CHP locations.) The main barriers to CHP fall into two broad categories:

> *Permitting* — Many current permitting regulations do not take into consideration the technology developments that have taken place with CHP, nor the environmental benefits inherent with CHP. Most air emissions regulations currently are based on emissions per unit of fuel used by the system. This approach does not take into account

68. $_e$ signifies electricity.

differences in the efficiency of energy using equipment. CHP systems make much more efficient use of the fuel used than do separate generation systems. Since a CHP system will use more fuel than a conventional boiler system, companies seeking to install CHP systems frequently encounter problems obtaining environmental permits, because they receive no credit for additional usable energy they produce.

Other regulations can unintentionally discourage CHP. Many communities are concerned that because many CHP systems use turbines or engines, there will be a local noise problem, in spite of fact that new turbines and engines are frequently quieter than existing equipment. In addition, local regulations may require full time operators for all engines, based upon past experiences with old style equipment in the days before computer controls. New systems have an excellent record in automated operation (Carroll 1998).

Utility Regulations — When new capacity is added at a customer facility, the customer is faced with a number of issues. Many utilities will require an "exit fee" to recover the cost of their investment in generation, transmission and distribution equipment that was made to satisfy the load. In addition, as part of restructuring, the customer may also be asked to pay a stranded-cost recovery fee to pay for past non-economic investment by the utility, as well as a competitive transition fee. Utilities can also charge fees to provide backup power, which have frequently been at artificially high levels. These fees can total to almost the cost of the electricity that is no longer being purchased.

In addition, utilities can erect barriers to connecting the customer's system to utility grid. These barriers include complicated and expensive technical interconnect requirements which exceed that which is required to insure safe and reliable operation of the grid.

Experts are confident that the declining trend in new projects can be reversed, and significant new CHP capacity could be installed if these barriers are removed (Casten and Hall 1998; Davidson 1998; Kaarsberg and Elliott 1998). While federal action may be the long-term solution to some barriers, changes in policy and regulations by states can overcome many of the barriers.

Recommendations

Set up expedited permitting for CHP systems

Permitting for CHP systems that use smaller, standardized packages, engines and turbines should be streamlined. The state should certify emissions from this equipment, in cooperation with manufacturers, and the state should issue permits expeditiously, based on this certification using a standard form.

Implement output-based air pollution regulations

CHP's efficient use of energy will be recognized if permitting is based on the emissions per unit of *usable energy out* rather than *per unit of fuel consumed*. EPA has recently begun to consider "output" based standards, which are based on the emissions per unit of usable energy delivered by the system. A new EPA rule gives credit for the greater efficiency of CHP systems with an electricity generating capacity of great than 25 MW_e (Lainter 1998). The state regulators should adopt output-based standards for NOx and other criteria pollutants accounting for both the useful heat and power produced by CHP systems.

Address issues of utility access and stranded-cost recovery through a national restructuring bill, FERC jurisdiction, and actions by individual states

Some states, such as Massachusetts, have already enacted restructuring plans that give favorable treatment to CHP by exempting owners of CHP systems from paying stranded cost recovery for new, efficient CHP system that are built in the state. However, other states, like Pennsylvania, have rejected such measures (Bluestein 1998). Likewise, some states allow their utilities to specify overly complex interconnection procedures as well as charge high rates for backup power. Illinois should provide for reduced exit and stranded cost recovery fees for new CHP capacity since it will allow the state to meet its future generation and transmission in a efficient, environmentally friendly and cost effective manner. In addition, the state should establish a standard for interconnect of all distributed generation systems.

Evaluate State Facilities for CHP Potential

State institutions, such as universities and hospitals, represent a promising candidate for conversion to CHP since many have an existing district energy system and centralized electrical distribution. Many of these facilities are faced with aging infrastructure, so the infusion of cost savings from CHP can help to rehabilitate these systems. CHP systems are currently installed at several state facilities (including the University of Illinois Urbana-Champaign, University of Illinois-Chicago, NEIU, SIU-Carbondale, and the Illinois Veterans Home in Quincy). The state should evaluate all state facilities to determine which others would be attractive candidates for CHP.

F. TRANSPORTATION

History And Current Situation

As throughout the nation, the transportation sector accounts for major portions of energy use and energy-related emissions in Illinois. Moreover, the transportation sector is almost wholly dependent on petroleum, which presents additional air pollution, energy imports, and national security concerns. A breakdown of energy use by transportation mode is not available for Illinois. However, using national statistics as a guide, light duty vehicles (LDVs, i.e., cars and light trucks) account for the majority of transportation energy use. Nationally, LDVs account for 94 percent of highway vehicle miles of travel (VMT), about 80 percent of highway energy consumption, and 60 percent of overall transportation energy use.

Transportation energy efficiency has improved substantially over the past two decades. Today, however, efficiency improvements have almost completely halted for the largest contributor to transportation energy use: cars and light trucks. Thus motor vehicle energy use is now rising in step with increased driving, which, as we note earlier in this report, is expected to grow at an average rate of 2.3 percent per year in Illinois.

Unfortunately, while existing federal regulations are acting as a driver for lower vehicle emissions, and some federal and state programs exist to demonstrate and promote use of alternative fuels, no policy drivers are in place to advance automobile (both car and light truck) efficiency above the minimum levels required by the now 20-year old Corporate Average Fuel Economy (CAFE) standards.

It is important to recognize that a significant transformation of the automobile market, which is inherently a national market, is unlikely to follow from piecemeal efforts focusing on one or another aspect of vehicle energy use and emissions. Therefore, Illinois should begin a process to join with other states, municipalities, and the federal government in developing a broad-based Green Vehicle Strategy that can foster the introduction of advanced technologies while encouraging consumers to purchase the "greenest" (cleanest and most fuel-efficient) vehicles currently available. A Green Vehicle Strategy is essential for reducing both conventional air pollution, particularly in the Chicago region and other metropolitan areas, as well as for reducing greenhouse gas emissions and the economic risks of oil dependence.

An existing fleet strategy is already underway for alternative fuel vehicles, with national coordination by DOE's Clean Cities Program. These efforts are valuable for exploring and cultivating potential alternative fuel options. Among the most promising long-term options are biomass-based ethanol produced by advanced cellulosic conversion processes and biomass-based hydrogen produced by advanced gasification processes. It is too soon, however, to tell which of these will prove most competitive and cost-effective for meeting future needs. The scope for public participation in such efforts is limited by fuel infrastructure needs and high startup costs. Therefore, a state's green vehicle strategy should include campaigns to promote cleaner and more efficient gasoline vehicles, which can have a much broader scope and would be more likely to deliver measurable fuel conservation and emissions reduction benefits over the next decade.

Three types of state policy options are available for improving the energy efficiency and lowering the environmental damages due to cars and light trucks. One is state leadership, both in its own fleet procurement policies and by facilitating local government and private fleet programs within Illinois. Second, the state should enact vehicle purchase price incentives ("feebates") linked to higher efficiency and lower emissions. Finally, the region should provide concerted political support for stronger federal policies to advance vehicle efficiency nationwide, through stronger CAFE standards, nationwide incentives, and federal support for state incentive and fleet leadership programs. Illinois can pursue these options through legislation and resolutions to implement them in appropriate forms, given state fiscal policies and economic interests.

Recommendations

Establish State Procurement Policies To Obtain Efficient Vehicles

Illinois can lead the way to more efficient vehicles by establishing procurement policies for state fleets to buy the most efficient vehicles in a given class and make commitments to buy advanced technology vehicles as they become available. ACEEE has analyzed and outlined the potential for such a program, which we term the Green Machine Challenge.[69] To provide practical guidance for both consumer and fleet purchases, we publish an annual *Green Guide to Cars and Trucks*.[70] The state can use this publication to guide its own procurements and also promote the use of the guide by consumers throughout the state. The State and Territorial Air Pollution Program Administrators Association (STAPPA) are considering the development of a green vehicle education project, using ACEEE's *Guide* as a tool, and Illinois can support and participate in that initiative. The state can greatly leverage the effects of its own green vehicle procurement efforts by coordinating similar efforts by county and municipal fleets along with voluntary efforts by private fleets.

A Green Machine Challenge procurement strategy can be designed with two stages. One stage would be directed toward bulk purchases of current production vehicles that are "best in class" in terms of fuel efficiency and low emissions. ACEEE's *Green Guide to Cars and Trucks* identifies these models in each major class. The second stage would be directed to purchasing advanced, next-generation vehicles having substantially higher efficiencies, tied to a nationwide effort to provide a "Golden Carrot" for ultra-efficient vehicles. This "step-forward" efficiency challenge can accelerate the commercialization of promising advanced technologies. Such a program can be viewed as a market pull complement to the advanced efficient vehicle technology research and development efforts being pursued by U.S. automakers through the Partnership for a New Generation of Vehicles. It would also speed U.S. introduction of hybrid vehicles, such as the Toyota Prius, which is now in production and seeing strong sales in Japan, and encourage U.S. automakers to bring their own hybrid designs to market sooner rather than later.

ACEEE is now collaborating with U.S. DOE, EPA, state and local government organizations including STAPPA and the U.S. Cities for Climate Protection campaign (of which Chicago is a member), and other organizations to explore planning options for a Green Machine Challenge. Illinois should affirm its commitment to these efforts, update its state vehicle procurement guidelines with a strong "buy green" component, provide state official liaisons to the nascent

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69. DeCicco, J.M., *Developing a Market Creation Program to Promote Efficient Cars and Light Trucks*, Washington, DC: American Council for an Energy-Efficient Economy. August 1997.

70. DeCicco, J., and M. Thomas, *Green Guide to Cars and Trucks: Model Year 1998,* Washington, DC: American Council for an Energy-Efficient Economy, 1998.

green vehicle campaign efforts, and fund program planning and coordination work within the state.

Explore The Establishment Of A Feebate Policy To Encourage The Purchase Of Higher Efficiency Vehicles

Under current market conditions and those likely to prevail in the absence of a major oil supply disruption, there is low consumer and manufacturer interest in higher fuel economy. A state can create revenue neutral incentive for higher efficiency by establishing feebates.[71] Feebates involve rebates or lower taxes on vehicles that are more efficient than average. These rebates would be financed by higher taxes or fees on less efficient vehicles. In Illinois, there is an existing vehicle license fee as well as a vehicle sales tax which varies by county. These fees could be converted to a sliding scale based on efficiency and emissions, thus encouraging higher efficiency vehicles with no net increase in fees or taxes.

Support Strong Federal Policies To Encourage Vehicle Efficiency

Additionally, Illinois should support stronger federal vehicle efficiency policies, recognizing that cars and light trucks are produced for a national--and increasingly international--market, in which any one state holds only a relatively small share. All states will benefit from an overall improvement in car and light truck efficiency. While the leverage of any one state's market is limited, all bear a responsibility to help set the nationwide direction.

For this reason, federal policy plays a determining role in the types of vehicles consumers can buy. This role is particularly crucial in areas of public concern, such as safety, emissions, and efficiency. Since a state stands to greatly benefit from a nationwide effort for higher vehicle efficiency, states should play an active role in pressing for the full range of federal policies to induce greater vehicle efficiency, including stronger fuel economy standards, feebates linked to higher efficiency (in which state feebates can complement a more widespread federal program), and a nationwide Green Machine Challenge. States should also support federal policies that enable and encourage the states to have their own green vehicle programs. In this regard, Illinois should encourage expansion of DOE's Clean Cities program to incorporate promotion of efficient vehicles and the state should lobby for clarification and reform as needed of federal guidelines which may inhibit state efficient vehicle incentives on the basis of preemption concerns.

71. DeCicco, J.M., H.S. Geller, and J.H. Morrill, *Feebates for Fuel Economy: Market Incentives for Encouraging Production and Sales of Efficient Vehicles*, Washington, DC: American Council for an Energy-Efficient Economy, May 1993.

Take Steps To Implement Comprehensive Transportation Planning

Finally, vehicle efficiency improvement is just one -- albeit the largest -- of the opportunities for improving energy efficiency in a state and regional transportation system. Particularly in cities and in corridors connecting the state's many centers of economic activity, policies for reducing vehicle-miles traveled and providing better transit, intercity rail, and intermodal services are also important. While analyzing the potential role for such broader transport efficiency measures is beyond the scope of this study, these approaches can make an additional contribution to reducing energy and environmental costs in the state. This broader range of transportation energy efficiency options is addressed at the national level in the *Energy Innovations* study, on which the state can draw to help inform its own comprehensive transportation efficiency strategy. A model state study could be conducted along the lines of what was done for Texas.[72]

G. A SUSTAINABLE ENERGY DEVELOPMENT AGENCY

History and Current Situation

Several states have developed agencies specifically devoted to promoting energy efficiency and sustainable energy development. As an example, New York has a highly effective agency, the New York State Energy Research and Development Authority (NYSERDA), which could serve as an excellent model (other potential models include sustainable energy development agencies in California, Florida, Iowa, North Carolina, and Wisconsin). These agencies support technology research and development, demonstrations, field monitoring, and (in some cases) education, training, and other implementation activities.[73] They can also be powerful tools for economic development. A sustainable energy development agency can be a useful complement to state energy offices and related state agencies (like DCCA) because sustainable energy development agencies tend to be less political and broader-based (government-representatives generally comprise only a portion of their board), which better enables them to obtain substantial private sector co-funding and to engage in multi-year projects. In fact, sustainable energy development agencies and state energy offices work closely together in most of the states listed above.

For example, NYSERDA's research and development (R&D) program encourages economic development by promoting energy efficiency and environmental products manufactured in New York. It accomplishes this through five program areas — Applications, Buildings, Energy

72. CTR, *Texas Transportation Energy Savings*, Report prepared by the Center for Transportation Research, University of Texas, Austin, and the Tellus Institute, Boston. Austin, TX: Texas Sustainable Energy Development Council, April 1995.

73. For more information on these state energy RD&D agencies, see M. Pye et al., *Energy Technology Innovation at the State Level: Review of State Energy Research, Development, and Demonstration ((RD&D) Programs*, Washington, DC: American Council for an Energy-Efficient Economy. July 1997.

Resources, Transportation, and Environmental Research. NYSERDA's R&D projects develop new technologies, create and retain jobs, reduce energy imports (which promotes economic development by allowing more discretionary money to be spent in-state), and mitigate environmental effects of energy production and use.

NYSERDA has more than 300 projects aimed at helping the state's businesses and municipalities, of which 185 are developing new products.[74] One of these projects improved turbine efficiency, which saves New York up to $12 million per year in energy costs and could save $108 million a year nationwide. Another example of NYSERDA's contribution to the state's economic development is its support for the development of an energy-efficient window-insulation system that can be operated automatically using a photovoltaic power source. Over a few years time, this product helped a New York company grow from two people to 200 people, with $12 million in annual sales.[75]

Funding for state energy development agencies has often come through utility contributions or small utility surcharges. In some cases an independent organization performs these types of functions as a compliment to their state energy office. Among others, Wisconsin and Iowa each have independent energy organizations of this type as well as a state energy office. With the utility industry restructuring, a systems benefit charge is often a funding source. This is the approach being used in both California and New York.

Recommendation

Our final policy recommendation is for Illinois to establish some type of a Sustainable Energy Development Agency. A Sustainable Energy Development Agency in Illinois could provide a number of functions in working with manufactures and consumers in their state, including: (1) applied R&D and demonstrations of advanced energy efficiency and renewable energy technologies; (2) technology and market assessments; and (3) support for technology transfer and commercialization. Such an agency could also help the state's utilities and state agencies in the design and evaluation of energy efficiency and renewable energy programs, and possibly assist with training or technical assistance concerning building code implementation or improving industrial energy efficiency. In many respects, a Sustainable Energy Development Agency could be of great value in helping Illinois achieve the economic and environmental benefits outlined in this report.

H. SUMMARY

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74. *1995-96 Annual Report,* New York State Energy Research and Development Authority, Albany, NY, 1996.

75. *Top 75 NYSERDA R&D Program Achievements,* New York State Energy Research and Development Authority, Albany, NY, 1996.

This chapter has identified a number of recommendations for policies to increase energy efficiency in Illinois. The questions may arise as to which of these options are most important and in what order might they be pursued. While it is not possible to rank these recommendations in terms of importance for action, it may be reasonable to indicate some type of relative rating of the recommendations along certain relevant dimensions. For that purpose, Table 10 (on the following pages) provides a rating (low, medium, or high) of each recommendation in terms of three factors: the magnitude of impact in terms of energy savings; the technical difficulty of implementation; and the political difficulty of implementation. The table also provides a brief listing of the key agencies or entities that would need to address the recommendation.

Such ratings are, of course, subjective in nature, and others may well have a different assessment of any individual recommendation. The use of such ratings is also subjective. Some may believe that options with high savings should be pursued even if the difficulty is high. Others may prefer to pursue options with lower difficulty of implementation, even if the savings impact is relatively low. The intent of this table is merely to provide a starting point assessment of the relative impact and potential difficulty of implementation of these various recommendations. Moving forward in any of these areas is obviously up to the judgement of citizens and decision makers within Illinois.

I. CONCLUSION

Based on the analyses presented in the earlier chapters of this report, it is clear that Illinois has the opportunity to achieve substantial cost savings and reductions in air pollutants through the pursuit of a high-efficiency policy scenario. An aggressive yet cost-effective commitment to energy efficiency could significantly reduce energy bills for residential and business customers during the 1999 to 2015 period, with further savings continuing beyond 2015.

However, large benefits do not come without large effort. In that spirit, this chapter has presented a number of ambitious policy initiatives that Illinois could consider as options in pursuing substantial energy efficiency improvements. While some simpler steps which might be achieved by administrative action are also included in the text, many of the major recommendations are admittedly challenging and would require significant commitment and leadership from both the executive branch and the legislature. Those major recommendations included the following areas:

Table 10. Relative Impact and Feasibility Assessment				
Recommendation	**Magnitude of Impact**	**Technical Difficulty**	**Political Difficulty**	**Key Players**
Regulatory				
SBC for Efficiency	High	Low	Medium	Legislature/ ICC/Utilities
Decoupling	Low	Medium	Medium to High	
IRP for Distribution Utilities	Medium	Medium	Medium	
Statewide Building Codes				
Residential	High	Low to Medium	High	Legislature/ Code Officials/ Municipalities/ Builders
Commercial	High	Low to Medium	High	
Additional Building Measures				
Equipment Standards	Medium to High	Medium to High	Medium to High	Legislature/ DCCA
State Buildings Strategies	Low to Medium	Low	Low	State Capital Development Board
Industrial				
Opportunity Identification	Medium	Medium	Low	IAC/DCCA/ Utilities
Technical and Design Assistance	High	High	Low	DCCA/Utilities Universities
Financial Assistance	High	Medium	Medium	DCCA/ICC/ Utilities
Financing	High	Medium	High	DCCA/Banks/ Legislature
Operation Improvement	Medium	Medium	Medium	IAC/Utilities
Advanced Technologies	Medium	High	Low	DCCA/Utilities Universities

Table 10. Relative Impact and Feasibility Assessment(Continued)

Recommendation	Magnitude of Impact	Technical Difficulty	Political Difficulty	Key Players
CHP				
Expedited Permitting	Medium	Medium	Medium	IEPA
Output-based Air Regulations	High	High	High	IEPA
Stranded Cost/Hookup Regulations	High	Low	High	Legislature/ICC
Evaluate State Facilities	High	High	Medium	Legislature/ DCCA/Utilities/ State Facilities Office
Transportation				
State Procurement	Low	Low	Low	Legislature/ State Purchasing
Feebate Policy	Medium	Low	High	Legislature
Federal Policy	Low	Low	Low	Legislature/ Govenor
Comprehensive Transportation Planning	High	Medium to High	High	Legislature/ Govenor
Sustainable Energy Development Agency	Medium to High	Low to Medium	Medium to High	Legislature/ Govenor/DCCA

- Key regulatory strategies of establishing of a substantial "system benefits charge" to fund energy efficiency, and developing carefully structured regulatory mechanisms for distribution utilities to make sure that these utilities have incentives to pursue cost-effective energy efficiency.

- Implementing strong statewide building energy codes for residential and commercial buildings.

- Developing and instituting an expanded and systematic set of policies to encourage industrial energy efficiency.

- Promoting a number of innovative policies to improve transportation energy efficiency.

- Creating or designating a dedicated Sustainable Energy Development Agency in Illinois to coordinate ambitious statewide energy efficiency R&D and implementation efforts.

These policies, together with other actions which could be developed by experts within the state, would help move Illinois forward toward realizing the substantial economic and environmental benefits available through increased energy efficiency. While no-one should under-estimate the challenges involved in accomplishing these strategies, the good news is that (as described earlier in the chapter) these types of policy options have been successfully implemented in other states.

VII. CONCLUSION

Based on the analysis of the high-efficiency scenarios, it is clear that accelerated energy efficiency improvements can help ensure that citizens and businesses in Illinois obtain energy-related services at the lowest possible overall cost. Total expenditures for energy services (including energy efficiency expenditures) in 2015 are projected to be about 25 percent lower in the high-efficiency scenario relative to the baseline projections.

Moreover, accelerated energy efficiency investments would provide significant macroeconomic and environmental benefits. For example, we estimate a net increase of 59,400 jobs by 2015 as a result of pursuing the high-efficiency scenario. Those jobs are equivalent to the employment supported directly and indirectly by about 400 small manufacturing plants throughout the state. This would represent a reduction in the state-wide unemployment rate of about 0.7 percent in 2015.

On the environmental side, we estimate that the energy savings projected in this analysis will reduce carbon dioxide emissions by 85.3 million short tons by the year 2015 (a projected reduction of 30 percent). The high-efficiency scenario will also reduce sulfur dioxide emissions by 352 thousand short tons, and nitrogen oxides by 370 thousand short tons by the year 2015. In this way, energy efficiency will help utilities and the state of Illinois meet their Clean Air Act requirements and national carbon stabilization goals defined in the Climate Change Action Plan.

Hence, energy efficiency investments are more than mere cost-cutting measures. They yield both positive environmental benefits and net employment gains. Given the additional net employment and income that would be generated, energy efficiency investments should be viewed as an important economic development strategy for Illinois.[76]

One important aspect of the high-efficiency scenario is that "it takes money to make money." In order to achieve the level of economic benefits illustrated in Table 6, policies must be adopted and effectively implemented to encourage a $37.8 billion investment in the period 1999-2015. Averaged out over the 17-year period, this implies an average annual investment of $2.2 billion) about 10 percent of the state's current annual energy bill.

Overcoming institutional barriers and redirecting financial investments away from conventional energy resources and towards energy efficiency measures will not occur without concerted action by policy makers, along with critical support from the federal government.

76. A recent report analyzing a balanced national strategy to put the United States on an innovative, economically and environmentally sound energy path reached a similar conclusion. The authors note that the plan could lead to over 770,000 more jobs for the United States in the year 2010. See *Energy Innovations*, note 2.

If Illinois wishes to capture the full economic benefits of the high-efficiency scenario, we suggest that a number of policies be adopted, including:

- Developing strong and well designed policies to ensure that energy efficiency services play a major role in Illinois' restructured utility industry. These include the establishment of a substantial "system benefits charge" to fund energy efficiency, and carefully structured regulatory mechanisms for distribution utilities to make sure that these utilities have incentives to pursue cost-effective energy efficiency.

- Implementing strong building energy codes for residential and commercial buildings, including adoption of BOCA 1996 (including the residential Model Energy Code and the ASHRAE 90.1 code for commercial and high rise residential buildings), with the Illinois-specific increased lighting and chiller efficiencies described in the report.

- Developing and instituting a comprehensive and systematic set of policies to encourage industrial energy efficiency. These would include mechanisms and techniques for: opportunity identification, technical and design assistance, financial analysis, financing, operation improvements, promoting advanced technologies, and facilitating the adoption of combined heat and power (CHP) technologies.

- Promoting wherever possible policies which would improve the fuel economy of cars and light trucks operated in Illinois. These include incorporating "best in class" vehicle efficiency as an important criterion in state and municipal fleet decisions, and exploring creative policies such as "feebates" to encourage the purchase of fuel efficient vehicles.

- Creating a Sustainable Energy Development Agency in Illinois that would fund applied R&D and demonstrations of advanced energy efficiency and renewable energy technologies; fund technology and market assessments; and provide support for technology transfer and commercialization. Such an agency could also help the state's utilities and state agencies in the design and evaluation of energy efficiency and renewable energy programs, and possibly assist with training or technical assistance concerning building code implementation or improving industrial energy efficiency.

These initiatives, along with other actions that can be taken to increase energy efficiency and economic productivity, can help to ensure a healthier economy and a cleaner environment in Illinois in the coming decades.

APPENDIX A

Appendix B

Appendix C