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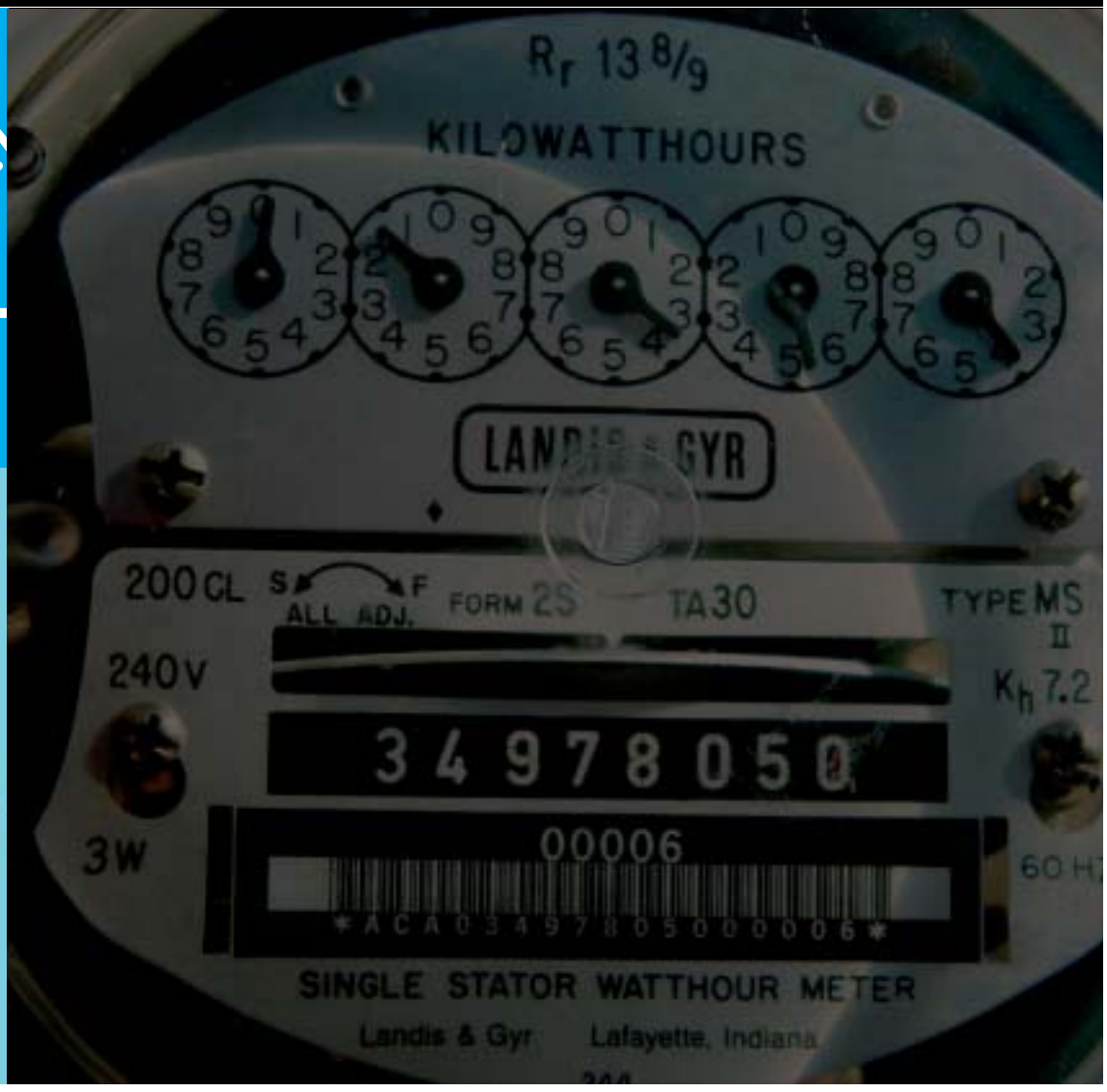
On the Road to Energy Independence

Controlling New Jersey's Runaway Energy Demand Through Energy Efficiency



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Controlling New Jersey's Runaway Energy Demand Through Energy Efficiency

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NJPIRG Law & Policy Center

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Executive Summary

New Jersey consumes far more electricity and natural gas than it needs to in homes and businesses. High energy use leaves consumers vulnerable to price spikes and supply disruptions. With stronger building codes, expanded appliance efficiency standards and stronger energy efficiency programs, New Jersey could reduce its use of electricity by 16 percent and natural gas by 15 percent by 2020 and reduce the impacts of energy use on New Jersey's economy and environment.

Demand for both electricity and natural gas has risen dramatically in recent years and is projected to continue to grow.

- Electricity use grew by 28 percent in homes and businesses from 1994 to 2004, and natural gas use increased by 15 percent.
- By 2020, total demand for electricity is projected to increase by 29 percent in the absence of any efficiency measures. Natural gas use could rise by 9 percent.

Spending on electricity and natural gas already is a significant cost, and spikes in natural gas prices strain consumers' budgets. Rising consumption compounds both the economic and environmental consequences of energy use.

- New Jersey residents and businesses spent $7.7 billion for electricity in 2004, equal to 1.9 percent of the state's total economic output. Spending for natural gas was $5.1 billion, or 1.2 percent of output.
- Natural gas prices for this winter are projected to be 28 percent higher than they were last year and 70 percent higher than three winters ago, raising the cost of lighting and heating New Jersey homes and businesses.
- In addition, the generation of electricity creates a series of environmental problems including health-damaging air pollution, radioactive waste and global warming.

New Jersey has tremendous potential for reducing its consumption of electricity, natural gas and other fuels, potentially

saving money for consumers. Existing efficiency efforts, while a good start, are projected to capture only a portion of this potential.

- Investing in energy efficiency to reduce demand for natural gas or electricity can cost less per unit of energy than purchasing power. According to the New Jersey Board of Public Utilities, recent energy efficiency improvements were accomplished for roughly one-fifth the cost of electricity purchases and about one-fourth natural gas prices.

Existing efficiency programs in New Jersey will reduce electricity consumption by 9 percent below projected levels by 2020 and natural gas use by 2.3 percent. Three key energy efficiency measures the state should pursue to boost savings include:

Figure ES-1. Projected Electricity Demand in 2020 Under Business as Usual Versus With Energy Efficiency[1]

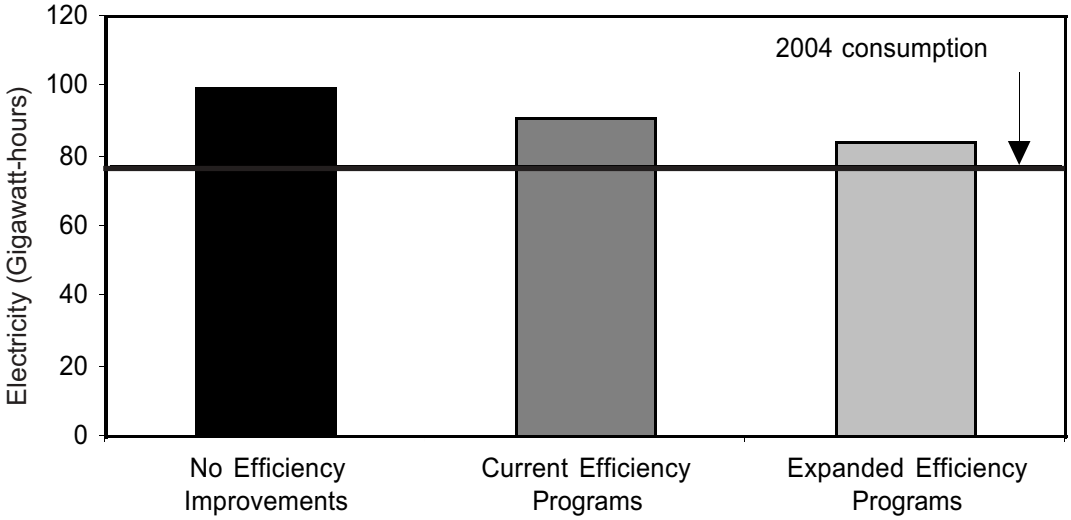
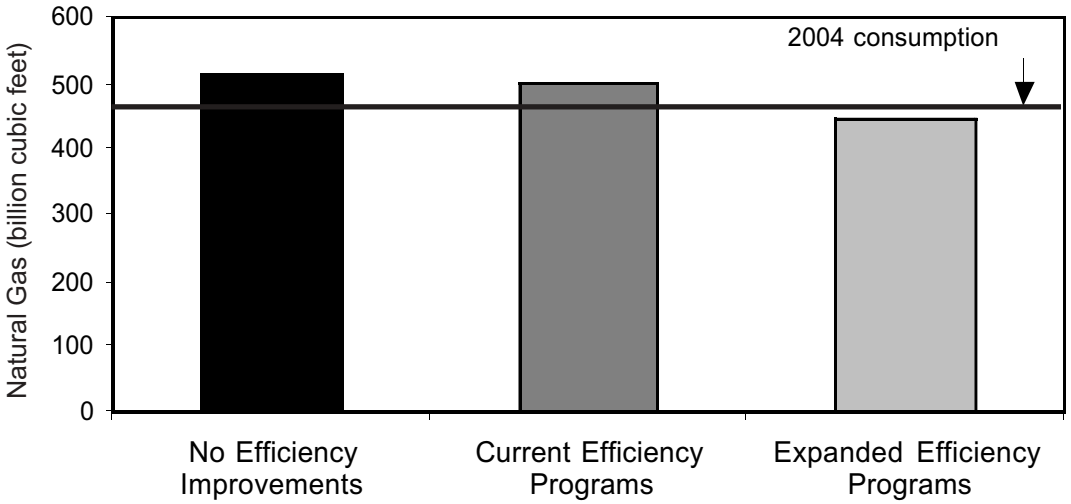


Figure ES-2. Projected Natural Gas Demand in 2020 Under Business as Usual Versus With Energy Efficiency[2]



- **Stronger building codes** for residential and commercial buildings to reduce energy needs for heating, cooling and lighting. New Jersey could improve the energy efficiency of new residential and commercial buildings by up to 25 percent, resulting in a 6 percent reduction in projected electricity use and a 5 percent reduction in natural gas use by 2020.
- **Appliance efficiency standards** for additional equipment used in homes and businesses. Though recently adopted standards will reduce electricity and natural gas consumption, standards are needed for other common appliances such as home furnaces and boilers and walk-in refrigerators. Adopting available standards for this equipment would reduce electricity use by 1,442 GWh in 2020, equal to 1.4 percent of projected 2020 electricity consumption. Natural gas use could drop by 0.7 percent.
- **Greater investment in energy efficiency programs**, which are especially important for reducing energy use in existing buildings. Expanded funding can help support the replacement of old, inefficient equipment; retrofit existing buildings with new windows, better insulation and tighter seals; and provide public education about available energy efficiency measures. Increased funding for natural gas efficiency could reduce consumption by 36 billion cubic feet of natural gas, or 7 percent of consumption.

Other programs also could help the state achieve energy efficiency savings. Possibilities include an energy efficiency portfolio standard, which would require electricity suppliers to get a certain amount of their power from efficiency measures.

New Jersey has already adopted a variety of energy efficiency programs and policies, but those measures will not capture the state's full efficiency potential. To protect the environment and limit consumers' exposure to spiking fuel costs, New Jersey should adopt stronger energy efficiency policies.

Introduction

New Jersey faces unprecedented challenges regarding its energy system. The state's energy supplies are growing ever more expensive and unreliable, and hurricanes along the Gulf Coast this past year have exacerbated the problem by cutting natural gas production. The economic scope of the problem is becoming apparent this winter as New Jersey residents try to heat their homes and still be able to pay other bills. Burning fossil fuels to produce electricity pollutes the air and contributes to global warming, while the state's aging nuclear power plants add to their stockpile of radioactive material every day.

Though New Jersey cannot produce its own conventional fuels, the state has another resource to help address its energy problems—abundant energy efficiency potential that can help lessen the impact of higher fuel costs by allowing the state to use less energy without reducing residents' quality of life. Existing efficiency programs offer a strong start, but need to be improved.

Energy efficiency is possible everywhere that energy is used. Homes, offices and businesses are filled with light fixtures that could be replaced with more efficient ones. Heating systems can be upgraded and buildings can be better insulated. In new facilities, energy use can be reduced through higher construction standards and efficiency standards for appliances.

Developing energy efficiency resources is cost-effective because it is less expensive than buying electricity or natural gas in today's markets. Electricity saved through energy efficiency measures such as efficient appliances and lighting is less expensive for New Jersey residents than power generated from existing power plants, especially those that rely on fossil fuels. The same is true of natural gas efficiency measures. Reducing electricity consumption also reduces future costs: there is less need to build new generation capacity and transmission lines to distribute electricity to homes and businesses across the state.

But tapping energy efficiency will require public leadership. Persistent economic barriers and other obstacles keep energy efficiency investment from happening at the rate needed to provide real relief to New Jersey's consumers. As a distributed resource, efficiency is hobbled by the information and other transaction costs

needed to make good investment decisions. The average consumer or business owner needs help to understand efficiency options and to complete the purchase. Policy and program intervention is needed to build minimum standards into the market, and to provide the information and incentives needed to produce good economic decisions.

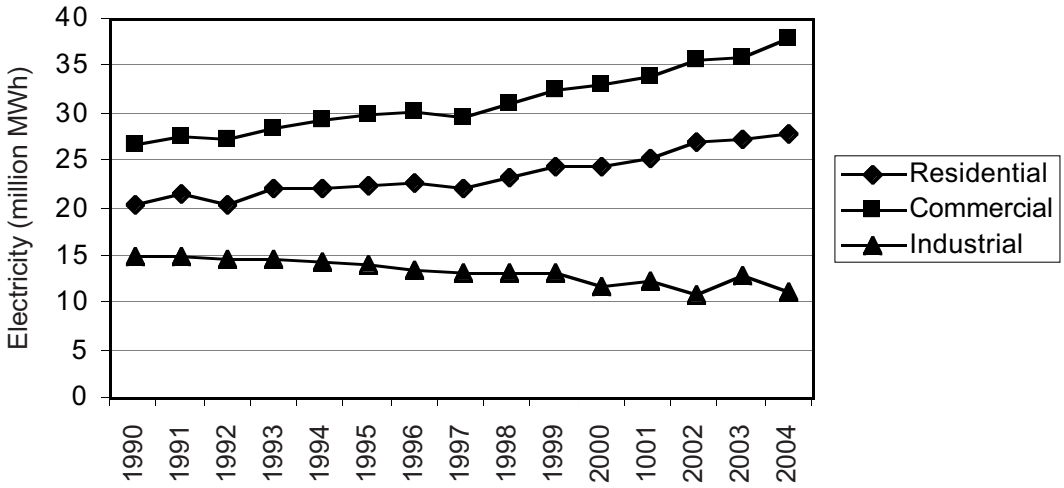
New Jersey needs to act now to lessen the brunt of higher energy prices this winter and in years to come.

Energy Use in New Jersey

Our daily lives and New Jersey's economy depend on a reliable supply of energy. Electricity powers lights, computers, refrigerators, factories and innumerable other items that are part of daily existence. Natural gas heats homes and offices and powers industrial processes.

Unfortunately, New Jersey uses more energy than it needs to and much of that energy comes from dirty sources that are vulnerable to price spikes. Most of the electricity consumed in New Jersey creates air pollution, triggering asthma attacks and other respiratory diseases, and contributes to global warming. Further, in recent years, natural gas prices have risen, forcing consumers to spend a larger portion of their incomes on energy purchases.

Figure 1. Residential and Commercial Electricity Consumption Is Rising[4]



A Note On Electricity Units

Megawatts (MW) are the standard measure of a power plant's generating capacity, or the amount of power it could produce if operating at full speed. Utilities measure their ability to supply demand on the grid at any one time in terms of MW. One MW equals 1,000 kilowatts (kW). One thousand MW equals one gigawatt (GW). Power plant output and electricity consumption over a fixed length of time are measured in terms of megawatt-hours (MWh). For example, a 50 MW power plant operating at full capacity for one hour produces 50 MWh of electricity. If that plant operates for a year at full capacity, it generates 438,000 MWh of electricity (50 MW capacity x 8,760 hours/year). To give a sense of scale, an average household uses about 10 MWh of electricity each year.

Most plants do not operate at full capacity all the time; they may be shut down for planned maintenance or they may be operated at only part of their maximum generating potential because their power is not needed or their power source (such as wind) is not available. The actual amount of power that a plant generates compared to its full potential is reported as its capacity factor. Thus a 50 MW plant with a 33 percent capacity factor would produce 144,540 MWh of electricity in a year (50 MW x 8,760 hours/year x 33% capacity factor).

Current Energy Use

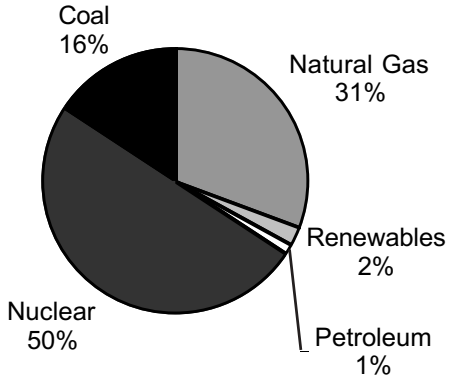
Electricity

More than 77 million megawatt-hours (MWh) of electricity were consumed in New Jersey homes, businesses, and factories in 2004.[3] Consumption in the residential and commercial sectors has been rising steadily, but demand from industrial users has been declining. (See Figure 1.)

Most of New Jersey's electricity comes from polluting power plants that burn coal, oil or natural gas or that use the heat from a nuclear reaction. Nuclear power is the biggest source of New Jersey's electricity, generating 50 percent of the state's power, followed by natural gas with 31 percent and coal with 16 percent. Renewable energy such as wind and solar power provides only 2 percent of the state's power.[5] (See Figure 2.)

In 2004, New Jersey spent $7.7 billion on electricity for residential, commercial, and industrial uses. This is equal to 1.9 percent of New Jersey's gross state product, the total value of all goods and services produced in the state for the year.[7] Recent disruptions in U.S. natural gas and oil production in the Gulf of Mexico caused energy prices to spike; while these price impacts have eased since fall 2005, the market fundamentals assure that high fuel prices will continue to affect the cost of electricity and increase the amount of money New Jersey spends on electricity.

Figure 2. Source of Electricity Generated in New Jersey in 2002[6]



Natural Gas

New Jersey uses 400 billion cubic feet of natural gas annually in residential and commercial settings.[8] Industrial use accounts for another 75 billion cubic feet.

In homes, natural gas is used for heating, cooking, water heating and other uses. Commercial users may have similar applications for natural gas. Industrial users rely on natural gas for heat, for generating power and as a feedstock for chemicals. In addition, natural gas generates 31 percent of the electricity produced in New Jersey.[9]

As seen in Figure 3, natural gas use has risen significantly over the years. Residential consumption has shown the steadiest increase. Commercial use rose from 1980 to 1997 but has been stagnant since then. Industrial use (not shown in Figure 3) has declined since 2000.

New Jersey residents and businesses (excluding electricity generators) spent $5.1 billion—or 1.2 percent of New Jersey's gross state product—on natural gas in 2004.[11]

Economic and Health Impacts of Inefficient Energy Use

New Jersey's inefficient use of energy is imposing increasing costs on our economy and security. It also produces health-threatening air pollution and emissions that contribute to global warming.

Rising Consumption, Rising Prices, and Decreasing Reliability

Consumption of electricity and natural gas is rising and the cost of energy is increasing, deepening the economic impact of energy use. Continued increases in consumption may require expensive new electric power plants and transmission lines, and may continue to push up the price of natural gas. In addition, as the electricity grid operates closer to its limit to meet power needs, reliability may drop.

As seen in Figure 1, electricity consumption in New Jersey has been rising in the

Figure 3. Residential and Commercial Natural Gas Consumption Is Rising[10]

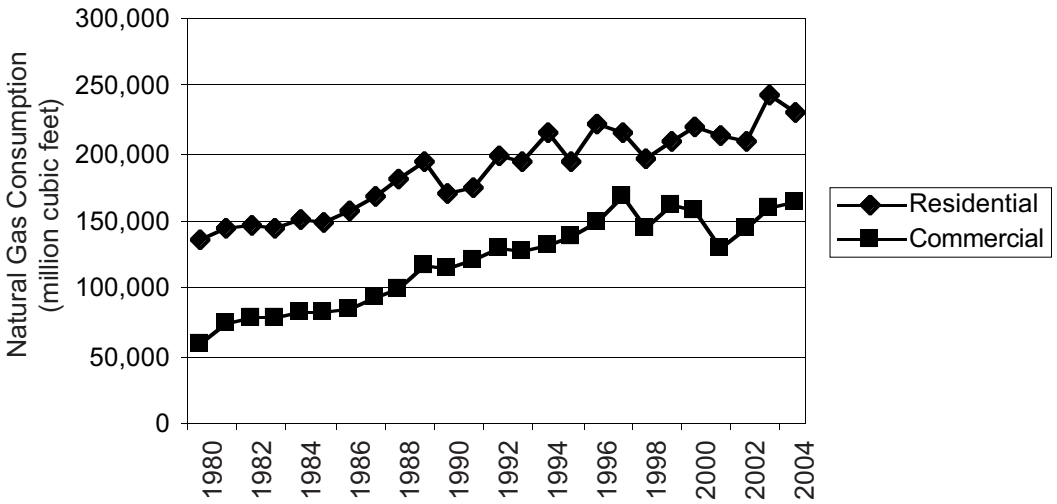
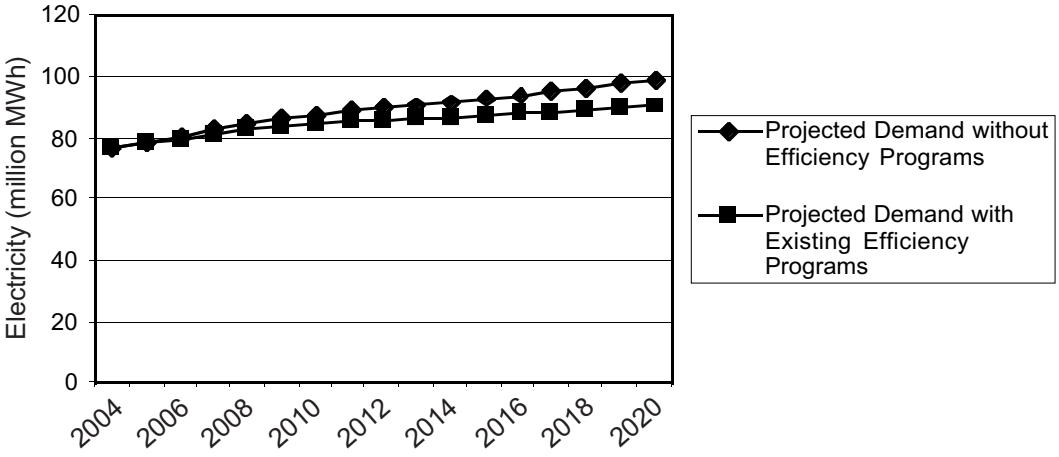


Figure 4. Projected Increase in Electricity Consumption[13]



residential and commercial sectors, increasing by 26 percent and 29 percent, respectively, from 1994 to 2004, while industrial consumption declined.[12] Data from the federal government's Energy Information Administration suggest that total electricity consumption could increase by 29 percent by 2020, reaching 99 million MWh per year by 2020, compared to 77 million MWh in 2004, in the absence of any efficiency measures. New Jersey has implemented some efficiency programs that will slow the growth in electricity use. (See Figure 4.) However, these programs need to be funded continuously over a sustained period to realize these benefits.

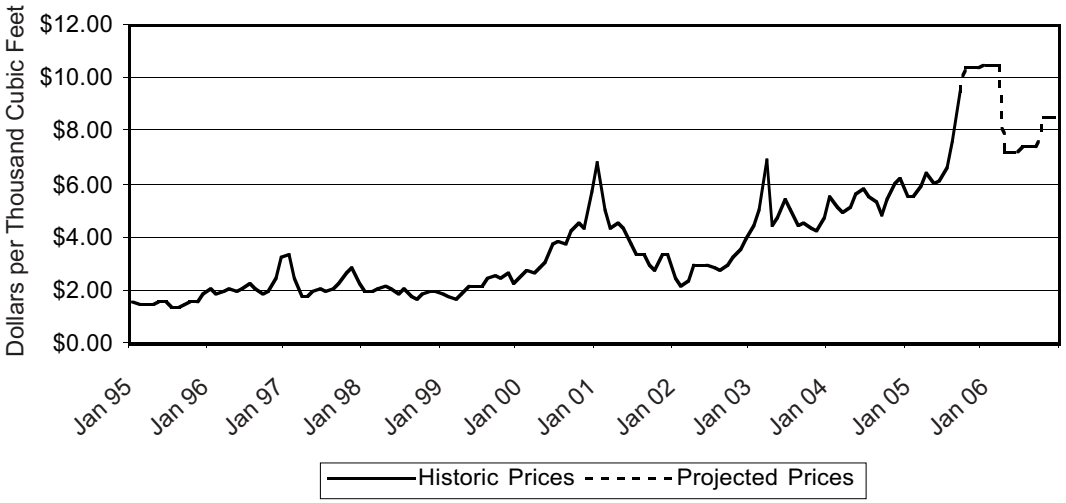
Trends in natural gas use have been similar to those in electricity use. Natural gas is the predominant fuel for heating homes and businesses.[14] Residential use of natural gas increased 12 percent from the period of 1992-1994 compared to 2002-2004.[15] Commercial use rose 20 percent. According to federal predictions of future natural gas use in the residential and commercial demand growth will slow, increasing by 9 percent by 2020 to a total of 516 billion cubic feet from 473 billion cubic feet in 2004.[16] Natural gas efficiency measures that New Jersey has already adopted will further slow demand growth.

Unfortunately, natural gas is growing more expensive, increasing the cost consumers pay to heat their homes and businesses and for electricity. From 2000 to 2004, average natural gas wellhead prices rose by 50 percent.[17] (See Figure 5.) Because of rising demand across the country and limited supplies, especially since last year's devastating hurricanes, natural gas prices are projected to be 28 percent higher in winter 2005-2006 than in winter 2004-2005 and 70 percent higher than three winters ago.[18] The longer price outlook, while subject to continued volatility, is for prices to remain near these historic highs for several years.

National demand for natural gas has risen in recent years, at the same time that North American production has declined. Much of this demand has been driven by the use of natural gas to generate electricity. Across the country, more than 90 percent of new power plants constructed in the 1990s were fueled by natural gas, which emits less toxic and global warming air pollution than coal.[20]

Production of natural gas in the U.S. has not kept pace with demand. Though the number of producing wells in the U.S. rose by 24 percent between 1999 and 2003, production from those wells increased only

Figure 5. Natural Gas Prices Are High and Unstable[19]



1 percent.[21] This trend of declining production will continue. Domestic natural gas production is expected to drop by 3 percent in 2005.[22]

Some have suggested that declining North American production of natural gas does not matter because increased imports of natural gas will offset the shortfall. Importing natural gas, however, is costly. Before it can be shipped, natural gas must be super-cooled to -259° F to turn it into a liquid, known as liquefied natural gas (LNG). At its destination, LNG is regasified before being delivered into a natural gas pipeline.[23] This process is expensive. Despite the cost, demand is spurring plans for construction of an environmentally damaging and dangerous new terminal on the Delaware River at Logan Township (see text box).

BP's Proposed LNG Terminal in Logan Township

BP has proposed constructing a $500 million LNG terminal in Logan Township, on the banks of the Delaware River. Occupying a 175-acre site, the facility would have three large storage tanks and a 1,900-foot pier for docking tanker ships.[24] The New Jersey Economic Development Authority may help with construction of the project by selling $50 to $100 million in tax-exempt bonds.

In addition to the environmental damage caused by developing acres of sensitive coastal land and constructing a dock for supertankers, an LNG terminal presents an explosion hazard. A study conducted at Sandia National Laboratories found that if a spill from an LNG tanker were ignited, it could generate enough heat to melt steel in nearby buildings and cause second-degree burns in people nearly a mile away.[25]

Higher demand for electricity and natural gas increases the environmental impacts of energy use and may exacerbate existing reliability problems within the energy system. Rising electricity consumption puts additional strain on the power transmission system, which has experienced greater reliability problems in the last several years—most notably the 2003 Northeast blackout. Natural gas delivery systems may be stretched to their limit and seasonal supplies are likely to be especially tight, spiking prices.

Environmental Damage

Using dirty energy sources causes environmental damage. Higher consumption exacerbates the problem.

Health-Threatening Air Pollution

Coal and natural gas-fired power plants produce health-threatening air pollution.

Burning fossil fuels releases nitrogen oxides (NOx) and sulfur dioxide (SO2). In addition, burning coal releases mercury. NOx is a major contributor to ground-level ozone, also known as smog, which can trigger asthma attacks, impair lung growth in children, and lead to emphysema and other respiratory problems. During 2004, the eight-hour health standard for ground-level ozone was exceeded 79 times in New Jersey, an unusually low number due to mild weather.[26]

SO2 leads to the formation of particulate matter, or soot, which can cause cancer, trigger respiratory problems, and increase infant mortality rates. Mercury is a neurotoxin that can impair development in children. Electricity generators in New Jersey are major contributors to the state's air quality problems. (See Table 1.)

Table 1. Releases of Major Air Pollutants in 2002 from Electricity Generation in New Jersey[27]

	Short Tons
Nitrogen Oxide	41,000.00
Sulfur Dioxide	98,000.00
Mercury	0.11

Global Warming

Perhaps the most dangerous impact of New Jersey's current fossil-fuel based energy system is global warming. Emissions from the burning of fossil fuels such as coal and natural gas are the leading cause of global warming.

Global warming will affect the region's climate, environment, and economy. Temperatures in New Jersey could increase by 2 to 8° F by 2100, and precipitation could increase by 10 to 20 percent, with much of the added rain or snow occurring on extreme weather days. The likely impacts of these higher temperatures and changed weather patterns include a five-fold increase in heat-related deaths during heat waves, degraded air quality, higher sea levels that will flood coastal areas, erode beaches, and introduce salt water into drinking water aquifers, and increases in insect-borne diseases such as West Nile Virus and Lyme disease.[28]

Burning coal, natural gas and other fossil fuels in homes and businesses and for producing electricity accounted for 45 percent of New Jersey's in-state global warming pollution in 2001.[29] This does not include emissions from electricity consumed in New Jersey but generated outside the state.

Hazardous Waste

Approximately half of the electricity generated in New Jersey comes from the state's four nuclear power plants.[30] The uranium fuel used in reactors and its waste products produce intense radiation. Exposure to this radiation causes serious health problems, including cancer, developmental disorders, hereditary disease, accelerated aging and immune system damage. New Jersey is at risk from the vast quantities of radioactive

material used and stored at its four aging nuclear power plants, where human error, mechanical failure or a terrorist strike could produce a dangerous release.

New Jersey's Energy Efficiency Potential

Energy efficiency means using less energy to accomplish the same result as a more energy-intensive process. Common household items such as refrigerators and light bulbs, residential and commercial heating and cooling systems, and industrial equipment are examples of products that can be made to use less power. Reduced energy use can also be accomplished through constructing buildings that are better designed and insulated, thus requiring less energy to heat, cool and light.

Several recent studies have shown the potential for significant energy efficiency improvements in New Jersey and nationwide. A recent report by KEMA—conducted for the Rutgers University Center for Energy, Economic and Environmental Policy as part of the state's effort to improve its existing energy efficiency programs—found that electricity savings of nearly 8,014 GWh per year are achievable—the equivalent of 8 percent of projected consumption in 2020—by using energy efficiency programs (KEMA did not include new standards in its analysis).[31] The American Council for an Energy Efficient Economy (ACEEE), in an analysis of efficiency studies from across the country, reports that greater savings are achievable. Assuming that the ACEEE estimate represents energy efficiency savings that are achievable with more aggressive public policy measures in New Jersey than those envisioned by KEMA, it suggests the state could reduce consumption by 15.5 percent or 15,400 GWh per year by 2020.[32]

New Jersey has similarly great efficiency potential for natural gas. KEMA's statewide analysis of natural gas efficiency through efficiency programs, not standards, found potential savings of 9 percent of projected consumption by 2020.[33] Adding the potential benefits of stronger building energy codes and appliance standards to this estimate suggests New Jersey has the potential to reduce consumption by 15 percent in 2020 compared to a scenario without any efficiency measures.[34]

Several factors suggest that the amount of energy New Jersey can save with energy efficiency by 2020 may be greater than the estimates above. First, over time, energy efficiency potential likely will increase. New technologies will be invented or niche applications of efficiency techniques will become mainstream, increasing energy efficiency potential. Second, current estimates reflect savings that analysts think are realistic to implement, not an absolute cap on New Jersey's efficiency potential. Greater public awareness or incentives can increase the amount of potential that is captured. And finally, higher prices for electricity and natural gas will make more efficiency gains economically attractive without incentives. As energy prices rise, policies that might not have been included in these studies will become cost-effective. In fact, some policies are newly cost-effective because of recent increases in energy prices.

The state already supports significant energy efficiency programs for both natural gas and electricity, but those existing programs are too limited to capture New Jersey's full efficiency potential. New Jersey should expand those programs and adopt new standards and incentives.

Energy Efficiency: A Win-Win for the Environment and the Economy

Energy efficiency provides multiple benefits, including lower costs, reduced pollution,

improved electric system reliability and the ability to address energy supply problems quickly.

Investing in energy efficiency to reduce consumption of natural gas or electricity costs less per unit of energy than purchasing power. For example, reducing power consumption in 2004 through the state's energy efficiency programs cost an estimated $0.019 per kWh, compared to purchasing power for an average cost of $0.10 per kWh, according to the New Jersey Board of Public Utilities (BPU).[35] This means the state achieved efficiency savings at one fifth the cost of purchasing electricity. The BPU reports that natural gas savings cost $2.89 per thousand cubic feet, compared to $10.31 per thousand cubic feet for residential customers, and a projected winter 2005-2006 cost of $15.67 per thousand cubic feet for residential customers.[36] Thus, natural gas efficiency savings were achieved at one quarter the expense of purchasing natural gas. As a result of efficiency investments, New Jersey consumers paid $37.8 million less on their electricity and natural gas bills in 2004.[37]

Improving energy efficiency also reduces consumers' vulnerability to changes in the price of power. For example, if natural gas prices rise, increasing the cost of electricity from natural gas-fired power plants and the cost to consumers who use natural gas directly, consumers whose consumption has been reduced through efficiency measures will not be as affected.

Energy efficiency investments made by a subset of energy users can help to bring down energy prices for all consumers. For electricity, lower demand at peak times, such as on a hot summer afternoon, means that power producers do not generate as much power at expensive back-up plants. This helps to keep utilities' peak electricity costs down, savings that consumers experience directly, whether they are large consumers who use time-of-use pricing or residential consumers who pay a flat fee to cover the utility's expenses.

Reduced demand can lower natural gas prices also. A study by researchers at Lawrence Berkeley National Laboratory has suggested that reducing demand for natural gas by just 1 percent nationally can help lower the cost of natural gas by 0.8 to 2 percent because the market is so tight.[38] ACEEE performed a similar analysis and concluded that, in the especially tight markets predicted for the near future, reducing consumption by 1.9 percent nationally could reduce natural gas prices by as much as 25 percent.[39]

Energy efficiency measures not only are cheaper than producing power, but they also reduce emissions of the health-threatening pollution and global warming pollutants discussed earlier. An efficient appliance requires less energy and thus curtails pollution.

The stability and reliability of the region's electricity system may be improved with efficiency measures. Reducing demand for power during times of peak use relieves pressure on the system when it is most stressed, reducing the likelihood of a service interruption.

Despite the clear long-term and system-wide benefits of implementing energy efficiency measures, such investments do not occur as often as is economically reasonable. One barrier to increasing energy efficiency is the split incentive in which landlords or developers purchase the cheapest but not necessarily most efficient product because tenants pay operating costs. Transaction costs, such as lack of information about how to improve efficiency, are another barrier to improving efficiency. A number of public policies are available for the state to adopt that help overcome these barriers.

How to Improve Energy Efficiency

Building Codes

Energy saved in 2020: 5.4 GWh of electricty, or 5.5 percent of projected consumption; 24 billion cubic feet of natural gas, or 4.6 percent of projected consumption

Building codes, originally designed to ensure the safety of buildings, can also determine how much energy is used to light, heat, and cool buildings. New Jersey's current energy codes could be updated and strengthened to produce up to a 25 percent improvement in the energy efficiency of new buildings.

Residential Building Codes

New residential buildings in New Jersey must comply with the 1995 Model Energy Code (MEC). The MEC, also known as the International Energy Conservation Code (IECC), is developed by the International Code Council. The IECC is regularly updated to incorporate cost-effective efficiency upgrades, with another update currently in progress. New Jersey updates its own code no more than once every three years; the most recent update was in 2001.[40] Because the IECC includes only cost-effective requirements, a stronger code is compatible with keeping housing affordable. The building code is enforced by municipal officials who are licensed by the state's Bureau of Code Services.[41]

In addition, a significant portion of new homes in New Jersey are built to higher standards through the New Jersey Energy Star Homes Program. Energy Star homes consume 30 percent less energy than homes built to the 1993 MEC standard.[42] Such homes typically have more efficient heating and cooling systems, better-sealed ductwork, high-performance windows, improved insulation and other measures.

In 2004, 16 percent of new homes were New Jersey Energy Star certified. Of residential building permits issued in the state in 2004, 34 percent were for Energy Star homes.[43] Not all building permits result in building construction, but the high percentage issued for Energy Star homes suggests the number of efficient homes in New Jersey will increase. Annual energy savings from these built homes will be 4,551 MWh of electricity and 1.8 million cubic feet of natural gas.[44] Though New Jersey already certifies far more homes to Energy Star standards than the national average—only 6 percent of new homes nationally met

Energy Star standards in 2003, compared to 15 percent in New Jersey that year—there is more the state can do.[45]

Significant energy savings are possible from all residential buildings through more stringent energy building codes. New Jersey should increase its residential code so that all homes meet federal Energy Star standards. Establishing these higher standards as a mandatory statewide minimum is possible. Oregon's energy codes, for example, are approximately equal to federal Energy Star standards and as a result Oregon credits strong building codes for 35 percent of the state's total energy efficiency savings.[46] In addition, Oregon participates in the Northwest Energy Star standard that creates an optional 30 percent improvement over energy efficiency savings in the federal Energy Star standard.

If New Jersey were to adopt a residential building code comparable to Energy Star standards and new homes achieve savings similar to those achieved in Energy Star homes built in New Jersey in 2004, the state could reduce electricity use by approximately 416,000 MWh in 2020, or 0.4 percent of projected electricity consumption. Natural gas savings would be 9.7 billion cubic feet of natural gas, or 1.9 percent of projected natural gas use.

Commercial Building Codes

Commercial buildings are evaluated by different standards than residential construction. New Jersey has adopted standards for commercial buildings that are roughly equivalent to the ASHRAE 90.1-1999 standard, established by the American Society of Heating, Refrigerating and Air-Conditioning Engineers.[47] Like the residential code, the commercial code is updated regularly. ASHRAE issued a new version of the code in 2004.

Builders can comply with the code by submitting a software analysis with their building permit request.[48] The building may also be inspected.

New Jersey could update the state's commercial code to achieve 10 to 25 percent savings from new commercial buildings. Updating the current standard from ASHRAE 90.1-1999 to ASHRAE 90.1-2004 would reduce energy consumption in new commercial buildings by approximately 10 percent. In addition, the newer code is easier for builders to use.[49] Doing so would reduce electricity consumption by 2,000 GWh in 2020, a 2 percent reduction in total projected electricity use, assuming high compliance rates. Natural gas use could fall by 5.6 billion cubic feet in 2020, a 1.1 percent reduction from projected use.

The state could achieve greater savings of 25 percent in all commercial buildings by adopting the Advanced Building Benchmark standards.[50] Developed by the New Buildings Institute and the Energy Center of Wisconsin, the Advanced Building Benchmark standards guide the construction of commercial buildings with improved energy efficiency and better indoor air quality.[51] Though buildings constructed to Benchmark standards cost more initially, they have lower operating costs and save money over the life of the building. In a typical large office building, Benchmark standards raise construction costs by $1 per square foot but reduce energy costs by $0.40 per square foot per year.[52] The Benchmark standards are compatible with other green building standards, such as the federal Energy Star standard and the U.S. Green Building Council's Leadership in Energy & Environmental Design (LEED) standards.

Were New Jersey to adopt the Advanced Building Benchmark standards, the state could reduce electricity use in commercial buildings by 5,000 GWh in 2020, a 5 percent cut in projected electricity use. Natural gas consumption could decline by 14 billion cubic feet, or 2.7 percent.

Additional energy savings can be achieved through retrofitting existing buildings, which were constructed under less stringent building codes. Given the

longevity of homes and other buildings, renovations that improve efficiency can be important, as discussed in the section on general efficiency programs.

Other Improvements to Building Efficiency

New Jersey can improve the energy efficiency of public sector buildings through retrofitting existing buildings and establishing high efficiency standards for new buildings.

The state should seek to retrofit at least half of all state buildings for improved energy efficiency within 10 years. One model for energy efficiency upgrades to existing facilities comes from New Hampshire's Building Energy Conservation Initiative (BECI), under which retrofitting 1.2 million square feet of office space saved 26 billion BTU of energy each year. The program is funded with a loan from the state to the agency occupying the building. The loan is repaid with energy savings over the next 10 years. Potential improvements include lighting upgrades, heating and cooling system replacement, more efficient water heating, automatic controls on heat and lights, better insulation and other changes.[53]

New state buildings should be built to high standards, such as the Advanced Building Benchmark standards discussed above. New Jersey has already committed to building new schools to the U.S. Green Building Institute's Leadership in Energy and Environmental Design (LEED) standards, which produce energy savings similar to those of the Advanced Building Benchmark and offer other environmental benefits.[54] While LEED-certified buildings cost an average of 2 percent more to construct, they yield 20-year financial benefits of about 10 times the construction premium.[55] The state can demonstrate the benefits of strong energy codes by requiring that all state-owned buildings be constructed to high standards.

Appliance Efficiency Standards

Energy saved in 2020: 1,442 GWh of electricity, or 1.4 percent of projected consumption; 3.8 billion cubic feet of natural gas, or 0.7 percent of projected consumption

Household appliances and those used by businesses are a major source of energy consumption. Since the first state appliance efficiency standards were adopted in the mid-1970s (followed by federal standards beginning in the late 1980s), the energy efficiency of many common appliances has been dramatically improved. For example, residential refrigerators complying with the latest national standards consume less than one-third the electricity annually of refrigerators manufactured in the early 1970s.[56]

The federal appliance standards program has led to great improvements in the efficiency of many appliances and, because a number of states including New Jersey adopted strong appliance standards, the federal standards recently have been expanded to include more than a dozen new appliances.

The new federal standards for these items will take effect beginning in 2006 and later and are expected to save New Jersey 110 thousand MWh of electricity and 435 million cubic feet of natural gas in the first year.[57] In addition, New Jersey residents and businesses will save $1.3 billion by 2030, even after paying slightly more for efficient products.[58]

States are pre-empted from adopting their own efficiency standards for products covered by federal standards, but there are two opportunities for states to take action. First, states may adopt efficiency standards for products not specifically covered by the federal program. In addition, states have the opportunity to apply for a waiver of federal pre-emption to apply stronger standards to products currently covered by federal standards.

Additional energy and cost savings are

available for the state by adopting efficiency standards for more appliances (see Table 2), which would reduce energy use by 314,000 MWh and 411 million cubic feet in the first year. After paying for slightly more expensive energy-efficient equipment, the cost savings from reduced energy purchases would save New Jersey nearly $2 billion between the time of adoption and 2030.[59]

By 2020, the new state standards could reduce New Jersey's annual electricity consumption by 1.4 million MWh (1.4 percent of projected consumption in 2020) and annual natural gas use by 3.8 billion cubic feet (0.7 percent of projected consumption).

In addition, the furnace standard could apply to oil furnaces in addition to natural gas furnaces. Stronger standards could reduce oil consumption by 5.8 million gallons annually and save consumers $14.3 million a year.[60] Savings related to oil are valuable to consumers because winter heating oil prices have risen so sharply. Further, some of the new standards affect water consumption and may help reduce domestic and commercial water use.

Expanded Energy Efficiency Programs

Energy saved in 2020: 36 billion cubic feet of natural gas, or 6.9 percent of projected consumption

Stronger residential and commercial building codes and improved appliance efficiency standards, while important, are limited in their scope, leaving many existing buildings and sources of energy use untouched. Energy efficiency programs can increase the efficiency of electricity and natural gas use in a broad range of residential and commercial applications.

Table 2. Savings from Products Covered by Additional State Efficiency Standards[61]

Appliance	Annual Energy Savings in 2020 (thousand MWh)	Annual Energy Savings in 2020 (million cubic ft.)	Cumulative net savings by 2030 (2004 $ million)
Bottle-type water dispensers	7.9		$7.2
Commercial boilers		174.2	$20.4
Commercial hot food holding cabinets	11.2		$8.9
Compact audio products	50.5		$17.5
DVD players and recorders	7.3		$6.6
Liquid-immersed distribution transformers	239.1		$270.2
Medium-voltage dry-type transformers	14.7		$17.5
Metal halide lamp fixtures	268.6		$301.1
Pool heaters		333.9	$24.2
Hot tubs	7.9		$4.4
Residential furnaces & boilers	337.0	3,325.6	$785.7
Single-voltage external AC to DC power supplies	142.9		$125.2
State-regulated incandescent reflector lamps	172.4		$175.6
Walk-in refrigerators and freezers	182.6		$144.2
Total	**1,482.1**	**3,833.7**	**$1,908.7**

Existing Energy Efficiency Programs

Traditionally, states have required electric utilities to make investments in efficiency programs through the rate-setting process. When New Jersey deregulated its electricity market, it wanted to continue investing in energy efficiency and so established a surcharge, known as a systems benefit charge (SBC), paid by all consumers on their electric bills.[63] The concept behind an SBC is that all consumers share in the benefits of energy efficiency improvements.

Conservation and Energy Efficiency Can Provide An Immediate and Major Drop in Consumption

Increased spending on energy efficiency and conservation programs can quickly reduce demand for power. During California's 2000-2001 energy crisis, the state greatly increased funding for energy efficiency and conservation and achieved a rapid drop in electricity use. A similar investment in New Jersey now would help ease the impact of high natural gas and oil costs on heating bills.

California experienced periodic rolling blackouts and more than 70 days of electric system emergencies when power supplies were barely enough to meet demand in late summer 2000 and early 2001.[62] In the winter of 2001, the California Energy Commission anticipated a 5,000 MW power shortage during the coming summer. In response to the actual and projected power shortfalls, California greatly expanded its energy efficiency and conservation programs. The state's goals included cutting power use by state government, including universities and prisons, by 5 percent within one week's time and cutting peak demand from cities and counties.

The state increased funding for energy efficiency programs to $1.3 billion in 2001, a 250 percent increase compared to 2000, and initiated a broad public information campaign to encourage efficiency and conservation. Public agencies and private utilities participated. The California Public Utilities Commission and the California Energy Commission offered appliance rebates, commercial lighting retrofits and low-income assistance; promoted traffic signal replacement, efficiency in public buildings, real-time meters, and demand-response mechanisms in buildings; and provided loans to local governments. The state also conducted an expedited update of its building energy codes and appliance standards. Investor-owned utilities, whose programs were funded by a systems benefit charge, expanded their existing efficiency programs and were required to give customers a 20 percent rebate on their electric bills if they reduced consumption by 20 percent during the summer of 2001.

The programs cost-effectively reduced California's peak power demand during the summer of 2001 by 5,500 MW and prevented any rolling blackouts. California achieved a 10 percent reduction in peak demand in summer 2001, with the greatest savings of 14 percent happening in June. For all of 2001, electricity use was 6.7 percent lower than in 2000. These electricity savings cost approximately $0.03 per kWh, less than half of what the state would have spent had it attempted to build new power plants and produce additional power.

Some of the benefits are explicitly economic, such as a reduced need for expensive new generating facilities or transmission lines. Other benefits include environmental improvements, such as reduced air pollution and global warming pollution that ultimately have economic impacts because air pollution and global warming impose societal costs that are not typically included in the nominal price of energy.

Because significant efficiency opportunities exist in the use of natural gas, New Jersey has established an SBC for natural gas also.

Both electricity and natural gas efficiency programs are overseen by the Board of Public Utilities' Office of Clean Energy, which has been gradually assuming responsibility for efficiency programs in place of utility-operated programs. This means that consumers throughout the state receive the same incentives and assistance regardless of which utility company provides their electricity and natural gas, and that the state has the flexibility to target efficiency efforts to the sectors or regions with the greatest potential.

The Clean Energy Program offers financial incentives, technical assistance and education to individuals, businesses, schools, and governments to improve their energy efficiency. Some of the existing programs include:

- Financial incentives to purchase energy efficient residential heating and cooling systems.
- Education to encourage consumers to purchase efficient appliances and lighting fixtures.
- Purchase and installation incentives for combined heat and power (CHP), in which heat and electricity are produced from the same steam.
- Low-interest loans to implement energy efficient practices in homes and businesses.
- Financial incentives and technical assistance for public and private buildings to enhance the efficiency of lighting, heating, cooling, appliances and motors.[64]

Table 3. New Jersey's Planned Energy Efficiency Spending[68]

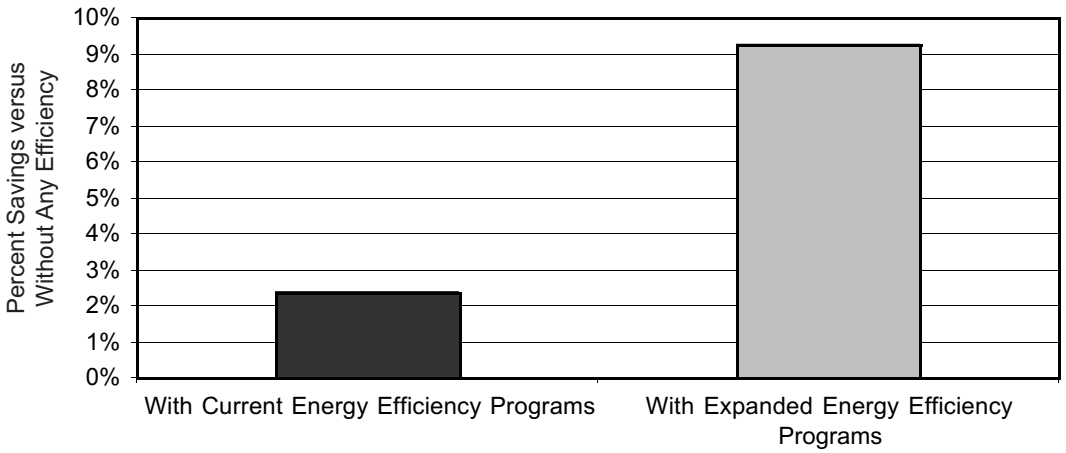
Year	Energy Efficiency Spending (millions)	Electricity Savings Goal (MWh)	Natural Gas Savings Goal (million cubic feet)
2005	$103	341,770	474.6
2006	$113	409,454	568.6
2007	$123	486,958	676.2
2008	$133	575,568	799.3

Current and Anticipated Energy Efficiency Savings

Spending in 2004 on energy efficiency programs saved 440,000 MWh of electricity and 696 million cubic feet of natural gas, or one-half of one percent of New Jersey's 2004 electricity use and one-tenth of one percent of 2004 natural gas use.[65] Investments made in 2004 will yield lifetime savings of 6.1 million MWh and 12.8 billion cubic feet of natural gas.[66] According to a report for Rutgers University, the annual funding levels of $85 million annually from 2001 to 2003 produced a net benefit to society of $1.8 billion.[67]

New Jersey plans to spend slightly more than $100 million on energy efficiency programs in 2005 and the following three years (see Table 3). The state has shown commitment to this effort, maintaining funding even in years when the state budget has been tight and planning increased funding over time, reaching $133 million by 2008. This funding for energy efficiency and renewable energy programs is provided by both natural gas and electric customers.

Figure 6. Potential Reduction in Natural Gas Consumption in 2020 Under Different Efficiency Program Scenarios Compared to No Efficiency Programs[72]



From the 2008 energy efficiency program spending level, the state anticipates electricity savings of 575,600 MWh, 0.7 percent of projected demand in 2008, or enough to meet the electricity needs of more than 69,000 homes for a year.[69] Natural gas savings from efficiency measures in 2008 are expected to total 800 million cubic feet, 0.2 percent of projected demand in 2008 or the amount of natural gas used by nearly 12,000 homes in a year.[70]

Anticipated Natural Gas Savings Fall Short of Potential

New Jersey's anticipated natural gas savings fall far short of the potential savings and benefits that energy efficiency programs can deliver.

According to a study by KEMA, conducted for Rutgers University Center for Energy, Economic and Environmental Policy, energy efficiency programs have the potential to reduce New Jersey's natural gas demand by 47.8 billion cubic feet in 2020.[71] However, the state's current funding for natural gas energy efficiency programs will capture only one quarter of this potential. Assuming that from 2008 to 2020, New Jersey maintains energy efficiency funding at 2008 levels and achieves its targeted savings, natural gas efficiency savings in 2020 would be approximately 12.1 billion cubic feet. That would leave 35.7 billion cubic feet of efficiency savings untouched, or the equivalent of 7 percent of projected consumption in 2020. (See Figure 6.)

Benefits of Greater Energy Efficiency Program Funding

Increasing funding for energy efficiency would be a wise investment for New Jersey because increased spending on energy efficiency costs individual consumers relatively little up front and produces significant long-term social benefits.

Currently, the average household pays $9 annually on their electric bill and $7 through natural gas-related charges to support energy efficiency and renewable energy programs.[73] To support scheduled modest increases in energy efficiency programs, the Board of Public Utilities intends to require residential consumers to pay $9 more on their electricity bills and $7 more on their natural gas bills annually in 2008 (with increases for commercial and industrial consumers also). As a result, the state ex-

pects to save 800 million cubic feet of natural gas in 2008, a 40 percent increase compared to 2005 efficiency savings. This will also allow a reduction in total costs for consumers who increase their efficiency and produce a net benefit to society.[74]

Potential for Expanding Efficiency Program Services

New Jersey could achieve greater savings by expanding the reach of existing programs. Incentives could be created for additional appliances, such as those for which efficiency standards were recently adopted, encouraging the replacement of old and inefficient equipment with new, efficient versions. An incentive for efficient windows might also be appropriate. Commercial and industrial programs could benefit from better guidance for efficient schools, training for the correct installation of updated heating and cooling systems, and outreach to smaller customers.

Conclusion

New Jersey has tremendous energy efficiency potential. Improved residential and commercial building codes, stronger appliance standards, and greater investment in energy efficiency programs to supplement existing energy efficiency measures could help the state to reduce electricity consumption by 15,400 GWh, or 16 percent of projected consumption in 2020. Natural gas use could drop by 76 billion cubic feet, or 15 percent of consumption projected for 2020.

Lower consumption of energy will reduce environmental impacts such as air pollution and global warming, reduce consumers' exposure to sudden increases in fuel prices, and likely create a net economic benefit for the state.

The first three policies the state should pursue to cost-effectively reduce energy use include:

- Stronger building codes for both residential and commercial buildings. This will reduce energy consumption in new homes and businesses.

- Appliance efficiency standards for common items, cutting energy use in new equipment.

- Greater funding for energy efficiency programs targeted at natural gas, helping to retrofit existing buildings and replace appliances for greater efficiency.

These policies could be supplemented with additional programs, such as an energy efficiency portfolio standard, requiring utilities to acquire a certain percentage of their power through energy efficiency.

The benefits of energy efficiency investments are available immediately and increase over time. New Jersey should act now to achieve the greatest savings.

Methodology

Baseline Energy Use

We created two projections of future energy use: one that does not include any energy efficiency programs and another that assumes New Jersey will continue its current energy efficiency efforts to 2020.

Projected electricity and natural gas use in New Jersey in the absence of any energy efficiency measures were calculated using data and projections from the U.S. Department of Energy, Energy Information Administration (EIA). Current electricity use data came from EIA, *Current and Historical Monthly Retail Sales, Revenues, and Average Revenues per Kilowatt Hour by State and by Sector (Form EIA-826)*, downloaded from www.eia.doe.gov/cneaf/electricity/page/data.html, 22 July 2005. Current natural gas use data came from EIA, *New Jersey Natural Gas Summary*, 29 June 2005, available at http://tonto.eia.doe.gov/dnav/ng/ng_sum_lsum_dcu_SNJ_a.htm. Projected consumption is based on EIA's projected rates of growth for the Mid-Atlantic region. The projected electricity growth rate is from EIA, *Annual Energy Outlook 2005 (AEO 2005) Supplemental Tables, Table 62: Electric Power Projections for Electricity Market Module Region, Mid-Atlantic Area Council*, February 2005. Natural gas projections came from EIA, *AEO 2005, Supplemental Table 2 Energy Consumption by Sector and Source, Middle Atlantic*, February 2005. The regional growth rate was applied to a New Jersey baseline.

EIA's projections of future energy use—as published in the *Annual Energy Outlook 2005 (AEO)*—are intended to reflect all federal, state and local legislation adopted as of October 31, 2004. This means that general energy efficiency programs adopted by New Jersey in December 2004 and new appliance standards adopted at the federal government in summer 2005 were not included.

The second projection that includes New Jersey's recently adopted efficiency measures was created by subtracting anticipated efficiency savings from the baseline described above. See the section below on "Energy Efficiency Programs" for how we projected savings from the state's current efficiency programs.

Efficiency Measures

Building Codes

The projected impact of residential energy codes was derived by estimating the percentage of residential energy use that would take place in new homes under EIA projections and applying estimated percentage reductions in energy use that would take place under updated codes. Revised codes were not assumed to affect energy use in existing homes.

The proportion of projected residential energy use from new homes was derived by subtracting estimated energy use from homes in existence prior to 2002 from total residential energy use for each year based on *AEO 2005* growth rates. Consumption of energy by surviving pre-code homes was calculated by assuming that energy consumption per home remains stable over the study period and that 0.33 percent of homes are retired each year, per EIA, *Assumptions to AEO 2005*.

Energy savings from updating New Jersey's residential building code to Energy Star standards are assumed to be 19 percent for electricity and 6 percent for natural gas below projected levels for 2002-2020, based on projected kWh and therm savings from Energy Star homes built or permitted in 2003, per New Jersey Board of Public Utilities, Office of Clean Energy, *2003 Annual Report: A Year of Continued Growth, A Year of Significant Change*. Percentage reduction from current usage levels was calculated based on per household electricity use from New Jersey Board of Public Utilities, *Frequently Asked Questions: Energy Issues, Prepared for consideration by the Blue Ribbon Panel on Offshore Wind*, 14 April 2005. Current natural gas use per home was calculated based on an assumption of 2.68 people per home and per capita residential natural gas use of 26 million Btu from U.S. Census Bureau, *New Jersey Quickfacts*, revised 1 February 2005 and U.S. Department of Energy, Energy Efficiency and Renewable Energy, *New Jersey Energy Statistics*, downloaded from www.eere.energy.gov/states/state_specific_statistics.cfm/state=NJ, 24 August 2005.

For commercial building codes, Mid-Atlantic-specific commercial building retirement percentages were estimated by determining the approximate median age of commercial floorspace in the Mid-Atlantic based on data from EIA, *2003 Commercial Building Energy Consumption Survey* (CBECS), estimating a weighted average "gamma" factor (which approximates the degree to which buildings are likely to retire at the median age), and inputting the results into the equation, $Surviving\ Proportion = 1/(1+(Building\ Age/Median\ Lifetime)^{Gamma}$ as described in EIA, *National Energy Modeling System Commercial Demand Module Documentation Report*, 2005.

Baseline 2001 commercial energy use was then multiplied by the percentage of surviving commercial buildings to estimate the energy use from new buildings. The adoption of the latest ASHRAE commercial energy code was estimated to result in a 10 percent reduction from current New Jersey codes from 2007 to 2020. Use of Advanced Building Benchmark standards was assumed to reduce energy use by 25 percent compared to projected commercial energy consumption. No attempt was made to estimate the impact of commercial code revisions on energy use due to renovations of existing commercial space.

All new buildings are assumed to fully comply with codes.

Appliance Standards

Estimates of energy savings from additional appliance efficiency standards were based on Steve Nadel, Andrew deLaski and Maggie Eldrige, American Council for an Energy-Efficient Economy and Appliance Standards Awareness Project, analysis for upcoming report to be released February 2006.

Energy Efficiency Programs

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These saving were compared with estimates of achievable electricity and natural gas energy efficiency from KEMA, Inc., *New Jersey Energy Efficiency and Distributed Generation market Assessment*, *Final Report to Rutgers University*, *Center for Energy Economic and Environmental Policy*, August 2004.

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Notes

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62 Information in this section comes from Martin Kushler and Edward Vine, American Council for an Energy-Efficiency Economy, *Examining California's Energy Efficiency Policy Response to the 2000/2001 Electricity Crisis: Practical Lessons Learned Regarding Policies, Administration, and Implementation*, 2003.

63 Approximately 3 percent of New Jersey power customers do not pay the fee because they are served by municipal and cooperative utilities. From: State of New Jersey, Board of Public Utilities, *In the Matter of Comprehensive Energy Efficiency and Renewable Energy Resource Analysis for 2005-2008, Docket Number EX04040276*, 22 December 2004, 23.

64 New Jersey's Clean Energy Program, downloaded from www.njcleanenergy.com, 18 August 2005.

65 See note 35.

66 See note 45.

67 State of New Jersey, Board of Public Utilities, *In the Matter of Comprehensive Energy Efficiency and Renewable Energy Resource Analysis for 2005-2008, Docket Number EX04040276*, 22 December 2004, 19.

68 Ibid.

69 Assuming the average home consumes 8,386 kWh of electricity annually, per source: New Jersey Board of Public Utilities, *Frequently Asked Questions: Energy Issues, Prepared for Consideration by the Blue Ribbon Panel on Offshore Wind*, 14 April 2005.

70 Assuming 2.68 people per home and per capita residential natural use of 26 million Btu. 2.68: U.S. Census Bureau, *New Jersey Quickfacts*, revised 1 February 2005. 26 million Btu: U.S. Department of Energy, Energy Efficiency and Renewable Energy, *New Jersey Energy Statistics*, downloaded from www.eere.energy.gov/states/state_specific_statistics.cfm/state=NJ, 24 August 2005.

71 See note 31.

72 See methodology for calculation of baseline. Current energy efficiency programs from State of New Jersey, Board of Public Utilities, *In the Matter of Comprehensive Energy Efficiency and Renewable Energy Resource Analysis for 2005-2008, Docket Number EX04040276*, 22 December 2004, assuming 2008 level continues to 2020. Expanded efficiency programs assuming state reaches potential identified in KEMA, Inc., *New Jersey Energy Efficiency and Distributed Generation market Assessment, Final Report to Rutgers University, Center for Energy Economic and Environmental Policy*, August 2004, Table 3-1.

73 See note 67.

74 Ibid.

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