ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Our current reliance on dirty, unreliable sources of energy such as coal, oil and nuclear power for electricity generation has left this country with a legacy of asthma attacks, oil spills, radioactive waste and global warming. This legacy also includes volatile price fluctuations, costing consumers dearly on electricity bills and threatening the reliability of our electricity system. Fortunately, America does not have to wait a generation for the safe, clean, affordable energy future it deserves.

Only 2% of our electricity comes from clean, renewable sources. However, renewable energy technology has advanced commercially to the point where it is now ready for wide-scale development. Huge untapped wind, solar, geothermal and biomass potential exists across the country. The technical potential of wind, clean biomass, and geothermal resources in the United States is four times greater than our current total electricity consumption. The wind that blows in just four states—North Dakota, South Dakota, Kansas and Nebraska—is enough to meet the electricity needs of the entire country. The sun’s energy that hits the surface of the Earth every minute is greater than the total amount of energy that the world’s human population consumes in a year. By applying America’s technological know-how, we could generate more electricity from these clean renewable sources and less from dirty energy sources.

Renewable energy also is the best economic choice. Increasing investment in renewable energy and energy efficiency programs will boost local economies and save consumers money, all while protecting the environment. Renewable energy sources also are “homegrown” energy sources that keep money spent on energy in the local economy. Several studies have shown that investment in renewable energy creates more jobs than business-as-usual and sparks economic development in local—particularly rural—economies by generating new sources of revenue for landowners, school districts and local government. In addition, diversifying the electricity mix to include renewable energy shields consumers from price spikes in the volatile fossil fuels market.

Because of the dramatically improved economics of renewable energy, state governments, municipalities, businesses, farmers, ranchers, and individuals across the country are embracing renewable energy as a way to boost the economy and save money while protecting the environment. Many states, most recently New Mexico, have implemented a renewable energy standard to mandate new electricity generation from renewable sources. Often the testing grounds for innovative policy, states will remain critical in increasing renewable energy generation; however, to ensure that all Americans can enjoy the benefits of clean, renewable energy, we also need national standards.

In order to encourage increased energy production from renewable sources, we should implement policies at the national level that include the following:

- A clean energy standard, known as a renewable portfolio standard (RPS), to increase the amount of electricity generated from renewable sources of energy to 20% of power generation nationally by 2020.

- A public benefits fund to provide funds for energy efficiency programs, investments in promising renewable energy technologies, and low-income assistance programs. A national fund would provide matching funds to the states to help enhance state programs.
• National and state net metering standards that allow consumers who generate their own electricity from renewable technologies (e.g. a small wind turbine, a rooftop solar panel) to reduce their electric bill by getting credit for any power generated.

• A five-year extension of the Production Tax Credit (PTC) to encourage new energy generation from renewable sources, including wind, solar, geothermal energy, and clean biomass—specifically excluding municipal solid waste incinerators. The Production Tax Credit is critical to making renewable energy price-competitive with conventional energy sources, such as oil, coal and nuclear, which are heavily subsidized by the federal government. The extension of the credit will enable the renewable energy industry to develop and improve its technology, drive costs down even more and provide Americans with clean electricity generation.

This report examines 35 states and their potential for electricity generation from renewable resources using state-of-the-art technology. We highlight success stories from Washington State to Maine that point to the enormous untapped potential for clean power generation from renewable resources and how businesses, counties, individuals and others are benefiting financially from renewable energy in action.
RENEWABLE ENERGY IS GOOD FOR THE ENVIRONMENT AND THE ECONOMY

Our current reliance on dirty, unreliable sources of energy such as coal, oil and nuclear power for electricity generation has left this country with a legacy of asthma attacks, oil spills, radioactive waste and global warming. This legacy also includes volatile price fluctuations, costing consumers dearly on electricity bills and threatening the reliability of our electricity system. Fortunately, America does not have to wait a generation for the safe, clean, affordable energy future it deserves. Renewable energy sources have advanced technologically and commercially to the point where they are now ready for wide-scale development. Moreover, huge untapped wind, solar, geothermal and biomass potential exists across the country. By applying America’s technological know-how, we could generate more electricity from these clean renewable sources and less from dirty energy sources. Renewable energy also is the best economic choice. Increasing investment in renewable energy and energy efficiency programs will boost the economy and save consumers money, all while protecting the environment.

Renewable Energy is a Vast, Virtually Untapped Resource
Currently, only 2% of our energy comes from clean, renewable resources. However, the technical potential of wind, clean biomass, and geothermal resources in the United States is four times greater than our current total electricity consumption. The wind that blows in just four states—North Dakota, South Dakota, Kansas and Nebraska—is enough to meet the electricity needs of the entire country. The amount of light energy that hits the surface of the Earth every minute is greater than the total amount of energy that the world’s human population consumes in a year.1 In fact, installing solar panels on the rooftops of 60% of the 10 largest retail box stores (WalMart, KMart, Safeway, Home Depot, Staples, Office Depot, etc) and 50% of the elementary schools would power the entire country.2 We still only harness a fraction of that power, but solar and wind have the potential to significantly relieve our energy woes.a

Renewable Energy Boosts the Economy and Creates Jobs
Energy efficiency and renewable sources of energy would greatly benefit our economy. Investing in energy efficiency and renewable energy sources creates substantially more jobs than similar investments in oil and gas production. A recent study conducted by the Tellus Institute for the World Wildlife Fund found that increased investment in renewable energy and energy efficiency would create 700,000 net new jobs by 2010 and 1.3 million jobs by 2020.3 Another study by the State of Wisconsin found that increased use of clean renewable energy sources would create three times more jobs than increased use of traditional sources of electricity.4 According to the European Wind Energy Association (EWEA), every megawatt of installed wind capacity creates about 15-19 jobs directly and indirectly.5 In addition, a June 2002 analysis found that building 5,900 MW of renewable energy capacity in California would lead to 28,000 year-long construction jobs and 3,000 permanent operations and maintenance jobs. Over thirty years of operation, these new plants would create 120,000 person-years of employment. This is four times as many person-years that would be created by building 5,900 MW of natural gas power plants.6

Clean renewable energy has become increasingly more cost competitive. The American Wind Energy Association estimates that the cost of electricity from utility-scale wind systems has dropped by more than 80% over the last 20 years.7 According to the Solar Energy Industries Association, the cost of solar energy has dropped by a similar factor. In fact, a study by the

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a Not all of America’s renewable potential will be developed due to economic, physical, and other limitations.
Generating Solutions 6

United States Energy Information Administration (EIA)—using very high estimates of renewable energy costs and low costs for natural gas—shows that increasing the amount of electricity generated from renewable energy to 20% by 2020 would cost roughly the same as business as usual through 2006, and less in the long run. The Union of Concerned Scientists also conducted an analysis of a 20% by 2020 renewable energy standard and found that consumers would save $4.5 billion between 2002 and 2020.

Renewable energy also boosts economic growth by redirecting dollars spent on energy into local economies. Currently, most states import energy from other places, so money spent on petroleum and coal, for example, flows from the local economy to other states or even other countries. Some economists estimate that 80% of every dollar spent on energy bills leaves the state economy. In contrast, energy efficiency and local renewable energy sources keep energy dollars within the state economy. Economists refer to the “economic multiplier” as a measure of how much economic activity could be generated in a community by different types of investments. Money spent on oil and gas has an economic multiplier of $1.48, but money spent on energy efficiency has an economic multiplier of $2.32. This means that for every dollar spent, energy efficiency generates $.84 more economic activity in local economies than buying oil and gas.

Renewable Energy Reduces Emissions of Soot, Smog and Greenhouse Gases

In addition to benefiting the economy, increasing our electricity generation from renewable sources will alleviate many of our most pressing environmental and public health problems, including acid rain, global warming, smog, asthma attacks and mercury contamination. The Tellus Institute, in its report written for the World Wildlife Fund, found that investment in renewable energy and energy efficiency programs would reduce pollution that causes global warming by 8.5% between 2000 and 2010 and by 28% between 2000 and 2020. A report by the Union of Concerned Scientists found that gradually increasing the percentage of energy generated from clean renewable sources to 20% by 2020 could reduce global warming emissions from power plants by 19% in 2020 compared to business as usual and also reduce smog-forming and soot emissions. Another report from the Union of Concerned Scientists showed that additional measures to promote renewable energy and energy efficiency could reduce global warming emissions from power plants by two-thirds and smog and soot emissions by 55% in 2020 compared to business as usual levels.

Renewable Energy Creates a More Secure Energy System

Farmers and ranchers would especially benefit from increased renewable energy use. Some developers pay landowners more than $2,000 per turbine per year for installing a wind turbine on their property. The land use impact is minimal as each turbine uses only about a quarter acre. In addition, farmers can plant crops and graze livestock right to the wind turbine. Generating just 5% of our nation’s electricity from wind energy alone by 2020 could provide $1.2 billion in new income for farmers and rural landowners by 2020 and 80,000 new jobs, according to the U.S. Department of Energy. Farmers could reap additional benefits by growing energy crops, converting crops and crop wastes into energy, or selling these crops and crop wastes to energy companies to produce power for homes and businesses. Tripling U.S. use of clean biomass energy from farm wastes and energy crops could provide as much as $20 billion in new income for farmers and rural communities. Farmers and ranchers also can use solar energy to cut electricity costs and power remote water pumps, lights, and electric fences. Solar power is often much less expensive than extending new transmission lines to remote locations. And, because they require no fuel and have no moving parts, they are more convenient to operate and maintain than diesel or gasoline generators.
In addition to economic and environmental benefits, increasing the amount of renewable energy used in the U.S. helps create a more resilient national energy system less vulnerable to disruption by human threats or natural disasters. Traditional energy sources rely on large centralized production and distribution systems. By creating more geographically dispersed energy sources, we decrease the risk that the failure or loss of one key plant will leave us in the dark.

Diversifying the energy mix to generate a greater percentage from clean renewable sources also ensures that we are less vulnerable to price spikes. The 2001 California energy crisis occurred in part because of a sharp rise in the cost of natural gas, which in turn led to spikes in wholesale electricity prices. During the 2002-2003 winter, natural gas prices surged to record highs across the country—in some places tripling.\textsuperscript{18} Home heating oil prices also jumped 50\% compared to last year.\textsuperscript{19} Renewable energy producers, in contrast, are not subject to commodity price spikes. With a diversified energy portfolio, consumers have alternative choices when prices rise rather than being held captive by the whims of a volatile fossil fuel market.
In order to understand the advantages of renewable energy, it is helpful first to understand how electricity is generated using conventional methods. Almost all power plants have a spinning generator. The generator rotates a conductor through a magnetic field, creating an electric charge that is transferred to a circuit. Force must be used to make the generator spin. Most conventional power plants use a steam turbine to generate this force. Pressurized steam turns the turbine, which then spins the generator. Burning fossil fuels to produce heat generates the steam in conventional plants. In nuclear power plants, the nuclear reaction generates the heat.

If this process only generated electricity, we would have fewer environmental problems. But the process of burning fossil fuels and creating nuclear reactions also creates by-products. Electric power plants generate waste heat, which is heat not converted into electricity. Often streams or other water bodies absorb this heat, raising the temperature of the water and disturbing the ecosystem. Nuclear reactions create radioactive waste that remains toxic for thousands of generations. Burning fossil fuels releases carbon dioxide, the primary greenhouse gas responsible for global warming. By building up in the atmosphere, carbon dioxide traps heat that would otherwise escape. As a result, the average temperature of the earth rises. In addition, burning fossil fuels creates sulfur dioxide, the cause of acid rain; nitrogen oxides, a contributor to smog; and particulate matter, or soot, that lodges deep in human lungs and causes respiratory disease and premature death.

Because of all the problems that accompany fossil fuel and nuclear use, researchers have been searching for alternative clean energy sources, such as harnessing the heat of the Earth, the energy of the sun, and the force of the wind. The technologies have been tested and are ready for widespread use. Here’s how they work.

**Solar Energy**

The sun releases an enormous amount of energy. The Earth receives a small amount of this energy as heat and light. The amount of the sun’s energy that hits the surface of the Earth every minute is greater than the total amount of energy that the world’s human population uses in a year.

There are two main methods of harnessing the sun’s energy. One way uses the light energy the sun generates, and the other uses the heat energy from the sun. Photovoltaic (or PV) systems convert solar radiation, or sunlight, into electricity by using the photoelectric effect. This occurs when a beam of light hits the negative end of a pair of charged plates, creating an electrical flow of energy. The flow, or current, occurs because particles hit by the light move from the negative plate to the positively charged plate. Photovoltaics can operate either remotely or as part of the utility grid. For people in rural areas, solar power is often less expensive than extending power lines. In addition, photovoltaics require no fuel and have no moving parts, making them more convenient to operate and maintain than conventional off-grid systems.

Solar thermal technologies utilize the sun’s heat energy. The heat is then used to power steam turbines to generate electricity or to heat water. These technologies include solar

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*Electricity is measured in watts. One kilowatt (kW) is equal to 1,000 watts. A megawatt (MW) is one million watts or 1,000 kilowatts. Most electricity bills display electricity use in kilowatt-hours (kWh). A kilowatt-hour means 1,000 watts or one kilowatt of electricity produced or consumed for one hour.*
concentrator power systems and flat plate solar collectors. Concentrated solar power plants focus the sun’s heat energy by using mirrors at different angles. The heat generated from this process is channeled into a conventional electricity generator. Each plant consists of two parts, one to convert and collect heat energy, and the other to transform the heat energy into electrical energy. Flat plate solar collectors do not produce electricity, but instead use heat at very high efficiencies to warm up buildings, homes, and water.23

The availability of light varies greatly depending on location. However, even on extremely cloudy days a solar powered system will produce energy—just not as much. During periods for which there is insufficient light to produce the power demanded, solar powered systems may require a supplemental power supply, such as a direct connection to an electricity grid, batteries, fuel cells or a small generator. The southwestern states have some of the greatest potential for the large-scale solar systems, but there is great potential for the growth in small-scale photovoltaic systems throughout the country.24

Although solar currently represents a small portion of installed renewable electricity capacity, it is expanding quickly and has potential for rapid development in the coming decade. Worldwide photovoltaics had a 28.9% growth rate from 1990 to 2000.25 If the U.S. photovoltaic capacity continues to grow at its current annual rate of 18%,26 it could play a large role in meeting our energy needs. In fact, installing solar panels on the rooftops of 60% of the 10 largest retail box stores (WalMart, KMart, Safeway, Home Depot, Staples, Office Depot, etc) and 50% of the elementary schools would power the entire country.27

Figure 1. Solar Potential in the United States. The following figures detail each state’s capacity for generating energy from concentrated solar systems and flat-plate collectors. These maps show that extremely sunny areas, such as the Southwest, receive enough sunlight that a concentrated solar system in Arizona could generate 63,364,000 kWh, enough to power more than 6,300 homes. Even in cloudy New England, a concentrated solar system in New Hampshire could generate 30,237,000 kWh, enough to power more than 3,000 homes.

Source: U.S. Department of Energy
Wind Energy
The American Wind Energy Association has predicted that 2003 will be a record year for the wind market in the U.S. Following an all-time high of 1,696 megawatts (MW) of new installations in 2001, AWEA is projecting that more than 2,000 MW of new wind capacity will be installed in the U.S. in 2003.28

Wind resources in just the windiest areas of this country, consisting of about 6% of the continental United States, could supply meet the electricity needs of the entire country.29 The wind that blows in just four states—North Dakota, South Dakota, Kansas, and Nebraska—is enough to meet the electricity needs of the entire country.30 Wind resource potential is measured by class of wind. Different classes can generate different amounts of power, with class 1 being the weakest and class 7 being the strongest.

Wind power systems consist of a wind turbine, a tower, wiring, and a way to collect and transmit the electricity. By using the wind to force the turbine to turn, the wind turbines generate mechanical power. The mechanical power is used to generate electricity.

Wind technology is versatile and adaptable. A small stand-alone wind turbine can provide enough power for a typical U.S. household, while groups of larger turbines combine to generate utility-scale electricity to power thousands of homes and businesses. These large arrays, called wind farms or wind plants, deliver power to an integrated grid. This setup is very reliable; at any time, several wind turbines at a wind plant may be shut down for maintenance, but most of the turbines will still be running.30

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28 The class 3, 4, 5 and 6 wind areas in Kansas, Nebraska, North Dakota and South Dakota yield 5,841,694 million kWhs of generation potential, according to NREL data. In 2000, the U.S. generated 3,799,944 million kWhs of electricity. Even if Class 3 wind potential is excluded, these four states have the potential of generating 3,217,386 million kWhs of electricity from wind power. Not all of this potential will be developed due to economic, physical, and other limitations.
Geothermal Energy
One scientific study estimates that the energy potential in one percent of the heat in the top ten kilometers of the Earth’s crust is 500 times more than the energy from all of the Earth’s oil and gas resources. Another study estimates the known, currently accessible geothermal resources at 23,000 megawatts (MW) for thirty years.31

There are two ways of generating geothermal energy. The hydrothermal process draws heat from geothermal geysers. Some geysers are naturally close to the surface, but others require drilling down into the Earth’s crust to reach areas that are hot enough to use for energy production. The heat sources can be found anywhere from a few hundred meters to 3,000 meters below the surface. The second process, known as the hot dry rock method, involves hydraulic fracturing, breaking rock apart and then creating an artificial geyser by pumping water through the break to use the heat naturally created by the rock.32 However, since the geothermal industry has yet to apply this technology, scientists have not completed any comprehensive studies on its environmental impact. Further research is necessary before any broad-scale application of the hot dry method occurs. All geothermal energy production needs to be carefully sited to ensure that the environment is not harmed.

Geothermal energy is used in two ways: to power large electric plants and to power small heat pumps. The large-scale geothermal resources needed to power the larger electric generating plants are concentrated in the Western states, although small-scale geothermal ground source heat pumps can be used nearly anywhere. This is because in most places, the topmost ten feet of the Earth’s surface has a temperature between 50 and 60 degrees Fahrenheit. Ground source heat pumps rely on this heat and water near the surface of the Earth rather than heat located deeper in the Earth’s crust.33

Geothermal heat pumps are 50-70% more efficient at heating and 20-40% more efficient at cooling than traditional electric heating and cooling systems. Because of this, using geothermal energy in heat pumps reduces pollution from fossil fuels and cuts energy costs. In fact, geothermal heat pumps usually pay for themselves within three years.34

Figure 3. Geothermal Energy Potential in the United States. Figure 3 shows that the Western states contain the most concentrated geothermal resources of the type necessary to power large-scale utilities, but all states can power small-scale heat pumps. Source: U.S. Department of Energy, http://www.eere.energy.gov/state_energy/.
"Biomass" is any living plant matter such as plants, grasses and agricultural crops. Although the types of biomass can vary from region to region, all states contain plentiful biomass. Currently, biomass generates more electricity than any other renewable source in the country. Utilities burn biomass to generate the heat needed to power turbines.35

Generation facilities can use biomass in its solid form to generate electricity or first convert it into a liquid fuel. One technology that converts biomass to a biogas is biogas digesters. Biogas digesters utilize bacteria to transform livestock manure and other organic matter into fertilizer and gases, mainly methane. The methane can then be used to generate electricity.36 As with fossil fuels, biomass is burned to generate electricity. Consequently, it is important that utilities only use the cleanest and most efficient forms of biomass. Municipal solid waste (garbage) incineration, for example, should not fall under the rubric of “clean” biomass. Waste incinerators are the second largest source of dioxin in this country. Dioxin, a known human carcinogen, is one of the most toxic chemicals known to science. Incinerators also account for nearly 20% of the nation’s emissions of mercury, a toxic metal that can damage the growing brains of children at low exposure levels.37 Instead, plant matter, such as crops grown specifically for energy purposes or agricultural trimmings, should be used as biomass sources.

Figure 4. Clean Biomass Potential in the United States. The darker sections in the map below highlight the regions with the most potential for generating energy from clean biomass. Source: U.S. Department of Energy, [http://www.eere.energy.gov/state_energy/](http://www.eere.energy.gov/state_energy/).

Landfill Gas
As household waste in landfills decomposes, it creates gases, such as methane, that escape into the atmosphere. When released directly into the air, methane contributes to global warming. To prevent explosions that could occur with an uncontrolled release of flammable gas, municipalities often control the emissions with flaring, burning the gas
in the open air. However, flaring wastes energy potential. Municipalities and utilities can use landfill gas to produce electricity, transforming the problem into an environmentally-preferable energy source. Landfills emit these gases whether or not utilities use them to generate electricity, so landfill gas-to-electricity facilities do not create any new emissions and can help to reduce landfill odors. In most cases, landfill gas used as a renewable fuel has a net benefit for the environment. While not a renewable resource, using landfill gas to generate electricity is environmentally preferable to flaring it without capturing its energy.\textsuperscript{38}

Any system converting landfill gas into electricity system has three basic components: the gas collection system, which gathers the gas being produced within the landfill; the gas processing and conversion system, which cleans the gas and converts it into electricity; and the interconnection equipment, which delivers the electricity from the project to the final user. Because landfill gas is present throughout the landfill, the operators place wells at various depths and locations. The type and depth of the landfill will determine the number and spacing of wells.\textsuperscript{39}

Thousands of closed landfills across the country offer a virtually untapped opportunity for landfill-to-electricity generation. For landfill facilities that already control landfill gas emissions, converting it to electricity instead of wasting the potential energy makes sense. However, as with any technology, decision-makers should monitor facilities for potential environmental side-effects of converting landfill gas to electricity, such as the potential for accidental release of toxic chemicals often present in landfills.

**Renewable Energy in Action at the State Level**

Because of the dramatically improved economics and reliability of alternative energy sources, states and municipalities across the country have launched renewable energy programs. Often the testing ground for new, innovative policies, states have proven that we can increase our reliance on renewable energy, save consumers money and protect the environment while creating jobs. Several state governments, municipalities, and utilities have implemented policies to encourage renewable energy growth.

In the following pages, we profile 35 states, detailing the energy mix they currently use to generate electricity and contrasting it with their potential for generating electricity from wind, solar, geothermal, clean biomass, and landfill gas. The tables on the following pages provide a state-by-state breakdown of renewable energy generation potential by source. In addition, we review several local case studies that illustrate how renewable energy and energy efficiency are saving consumers money, creating jobs and protecting the environment. States profiled include Arkansas, Arizona, California, Colorado, Connecticut, Florida, Illinois, Indiana, Iowa, Kansas, Louisiana, Maine, Maryland, Michigan, Minnesota, Missouri, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oregon, Pennsylvania, Rhode Island, South Carolina, South Dakota, Texas, Washington, West Virginia, and Wisconsin. We chose to profile these states for several reasons:

1. They represent a broad cross-section of the country, ranging from highly populous and industrialized states such as Texas to rural states with small populations such as Maine.
2- These states experience the ill effects of our dependence on fossil fuels in similar ways but to varying degrees.

3- These states have varying levels of potential to develop renewable energy, ranging from tremendous potential in North Dakota to more modest potential in South Carolina.

The state profiles demonstrate the vast potential for renewable energy in this country and provide good models and case studies for how renewable energy can work at the local level. Federal level policy needs to follow suit in order to translate these state and local models on a much larger scale across the entire nation.

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<td>4,871</td>
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<td>0</td>
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<td>1,763</td>
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<td>14,035</td>
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<td>0</td>
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<td>22,875</td>
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<td>0</td>
<td>0</td>
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<tr>
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<td>22,267</td>
<td>2,442</td>
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<td>Smoke 2</td>
<td>Smoke 3</td>
<td>Smoke 4</td>
<td>Smoke 5</td>
</tr>
<tr>
<td>--------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
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<td>1,663,389</td>
<td>0</td>
<td>2,431</td>
</tr>
<tr>
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<td>34,493</td>
<td>1,074</td>
<td>23,901</td>
<td>9,253</td>
<td>265</td>
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<td>1,532</td>
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<td>12,991</td>
<td>13,366</td>
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<td>5,591</td>
<td>9,764</td>
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<td>0</td>
</tr>
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<td>2,170</td>
<td>930,130</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3,783,004</strong></td>
<td><strong>15,217,115</strong></td>
<td><strong>742,135</strong></td>
<td><strong>14,244,247</strong></td>
<td><strong>190,951</strong></td>
<td><strong>39,782</strong></td>
</tr>
</tbody>
</table>

Compiled by the Union of Concerned Scientists. See methodology section for details on the assumptions of this analysis.
Table 2. 15 States with the Best Technical Potential from Wind, Clean Biomass, Geothermal Energy and Landfill Gas (millions of kWh)

<table>
<thead>
<tr>
<th>Rank</th>
<th>State</th>
<th>Total Renewable Energy Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kansas</td>
<td>1,706,664</td>
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<tr>
<td>2</td>
<td>Texas</td>
<td>1,696,046</td>
</tr>
<tr>
<td>3</td>
<td>North Dakota</td>
<td>1,601,468</td>
</tr>
<tr>
<td>4</td>
<td>Nebraska</td>
<td>1,378,218</td>
</tr>
<tr>
<td>5</td>
<td>South Dakota</td>
<td>1,269,733</td>
</tr>
<tr>
<td>6</td>
<td>Oklahoma</td>
<td>1,109,608</td>
</tr>
<tr>
<td>7</td>
<td>Montana</td>
<td>1,044,963</td>
</tr>
<tr>
<td>8</td>
<td>Minnesota</td>
<td>1,021,912</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rank</th>
<th>State</th>
<th>Total Renewable Energy Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Wyoming</td>
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</tr>
<tr>
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<td>Iowa</td>
<td>925,500</td>
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</tr>
<tr>
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<td>California</td>
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<tr>
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<td>Illinois</td>
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</tr>
<tr>
<td>15</td>
<td>New York</td>
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Table 3. 15 States with the Best Technical Potential from Wind (millions of kWh)

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<td>Texas</td>
<td>1,663,389</td>
</tr>
<tr>
<td>3</td>
<td>North Dakota</td>
<td>1,571,387</td>
</tr>
<tr>
<td>4</td>
<td>Nebraska</td>
<td>1,347,555</td>
</tr>
<tr>
<td>5</td>
<td>South Dakota</td>
<td>1,246,858</td>
</tr>
<tr>
<td>6</td>
<td>Oklahoma</td>
<td>1,091,020</td>
</tr>
<tr>
<td>7</td>
<td>Montana</td>
<td>1,034,866</td>
</tr>
<tr>
<td>8</td>
<td>Minnesota</td>
<td>991,332</td>
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<table>
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<th>Rank</th>
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<th>Wind Potential</th>
</tr>
</thead>
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<tr>
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<td>Iowa</td>
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</tr>
<tr>
<td>11</td>
<td>Colorado</td>
<td>524,303</td>
</tr>
<tr>
<td>12</td>
<td>New Mexico</td>
<td>297,012</td>
</tr>
<tr>
<td>13</td>
<td>Illinois</td>
<td>105,907</td>
</tr>
<tr>
<td>14</td>
<td>New York</td>
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</tr>
<tr>
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<td>Wisconsin</td>
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Table 4. 15 States with the Best Technical Potential from Clean Biomass (millions of kWh)

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<td>Minnesota</td>
<td>30,268</td>
</tr>
<tr>
<td>6</td>
<td>Texas</td>
<td>30,226</td>
</tr>
<tr>
<td>7</td>
<td>North Dakota</td>
<td>30,082</td>
</tr>
<tr>
<td>8</td>
<td>Missouri</td>
<td>28,076</td>
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<th>State</th>
<th>Biomass Potential</th>
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</thead>
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</tr>
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<td>Mississippi</td>
<td>26,528</td>
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<tr>
<td>12</td>
<td>Indiana</td>
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<td>13</td>
<td>Georgia</td>
<td>24,140</td>
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<tr>
<td>14</td>
<td>South Dakota</td>
<td>22,875</td>
</tr>
<tr>
<td>15</td>
<td>Tennessee</td>
<td>22,267</td>
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Table 5. 9 States with Technical Potential from Geothermal Energy (millions of kWh)

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<td>Oregon</td>
<td>18,571</td>
</tr>
<tr>
<td>4</td>
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<td>16,609</td>
</tr>
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<td>5</td>
<td>Utah</td>
<td>9,253</td>
</tr>
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<tr>
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<tr>
<td>9</td>
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Table 6. 15 States with the Best Technical Potential from Landfill Gas (millions of kWh)

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<tr>
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<td>2,431</td>
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<tr>
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<td>Ohio</td>
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<td>Colorado</td>
<td>1,476</td>
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<td>Virginia</td>
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<tr>
<td>12</td>
<td>Michigan</td>
<td>1,019</td>
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<tr>
<td>13</td>
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<tr>
<td>14</td>
<td>Washington</td>
<td>807</td>
</tr>
<tr>
<td>15</td>
<td>Wisconsin</td>
<td>779</td>
</tr>
</tbody>
</table>

All tables based on an analysis completed by the Union of Concerned Scientists. See methodology section for details on assumptions.

---

\(^d\) Only nine states have any significant potential for generating electricity from geothermal energy.
### Table 7. Pollution Avoided by Generating Electricity from Technical Wind Potential vs. Equivalent Generation from Average Energy Mix

<table>
<thead>
<tr>
<th>State</th>
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<th>SOx offsets (tons)</th>
<th>NOx offsets (tons)</th>
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<td>16,910</td>
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<tr>
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<td>180,208</td>
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<td>North Dakota</td>
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<td>South Carolina</td>
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<td>South Dakota</td>
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<td>Wisconsin</td>
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<tr>
<td>Wyoming</td>
<td>930,130</td>
<td>706,898,775</td>
<td>3,720,520</td>
<td>2,278,818</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>14,244,247</strong></td>
<td><strong>10,825,627,360</strong></td>
<td><strong>56,976,986</strong></td>
<td><strong>34,898,404</strong></td>
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</table>

* Assumes the technical wind potential is fully tapped and operating at full-capacity year round. Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, American Wind Energy Association fact sheet, www.awea.org/pubs/factsheets/EmissionKB.PDF.
Methodological Notes: State Data and Case Studies

1. Definition of “Dirty” Energy. Dirty energy sources include fossil fuels (petroleum, gas and coal), nuclear power and hydroelectric power.

2. State’s Electricity Mix for 2000. Unless otherwise noted, all data on each state’s energy mix came from the Energy Information Administration, www.eia.doe.gov. The definition of renewables in DOE data includes geothermal, wind, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which is not a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass.

3. Solar Energy. We do not include solar energy in the calculation of each state’s renewable energy potential, as the technical potential for solar is limited only by space and cost. In order to quantify each state’s solar potential, we would have to make assumptions about cost and rooftop and other space available now and in the future for photovoltaics.

4. State Renewable Energy Potential. The following describes the sources and key assumptions used to estimate state renewable energy potential data, compiled by Union of Concerned Scientists.

- Wind. UCS estimate based on a state breakout of data developed for Doherty, Julie P., “U.S. Wind Energy Potential: the Effect of the Proximity of Wind Resources to Transmission Lines,” Monthly Energy Review, Energy Information Administration, February 1995. Includes class 3 and higher windy land area within 20 miles of existing transmission lines, excluding all urban and environmentally sensitive areas, 50% of forest land, 30% of agricultural land, and 10% of range land.

- Biomass. UCS estimates based on data from Walsh, M.E, et. al. Biomass Feedstock Availability in the United States: 1999 State Level Analysis, Oak Ridge National Laboratory, (Updated 2000) online at: http://bioenergy.ornl.gov/pubs/econ_assess.html. Includes urban wood residues, mill residues, forest residues, agricultural residues, and energy crops (switchgrass) by state for $50 per dry ton and under. ORNL estimate of available forest residues excludes roadless areas, steep slopes, and more than half the remaining residues. According to UCS, these sources also exclude municipal solid waste, tires, and chemically-treated or contaminated wood, which could release toxic chemicals when burned.


Arizona is too dependent on dirty energy sources. In 2000, Arizona generated almost all of its electricity from fossil fuels and nuclear power and none from renewable sources, although the state has since enacted a renewable energy standard. The state relied on coal for 46% and nuclear for 34% of its electricity. Hydroelectric power, which emits less pollution than burning fossil fuels but causes its own set of environmental problems, accounted for 10% of the state’s electricity mix.

Arizona has significant capacity to generate electricity from renewable sources such as wind, clean biomass, geothermal energy and landfill gas. In fact, Arizona’s potential for generating electricity from these renewable sources is higher than the electricity currently generated from either hydroelectric power or oil and natural gas. Arizona’s total technical potential from wind, geothermal, clean biomass and landfill gas is 14.4 billion kilowatt hours (kWh)—enough to meet 16% of the state’s electricity needs or power more than 1.4 million homes.

1 Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Arizona’s Potential to Generate Electricity from Solar Energy

Arizona has some of the best solar resources in the country. While Arizona’s solar theoretical potential is enormous, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if Arizona installed solar photovoltaic systems on .5% of the state’s land area, it could generate 101,000 million kWh, or more than the state’s electricity generation in 2000. Said another way, according to the Department of Energy, if Arizona installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 1,216,000 kWh per year. This is enough to power 122.1 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, this system would produce about 63,364,000 kWh per year — enough to power 6,359 homes.

Renewable Energy Boosts the Economy...

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency programs could create 11,200 jobs in Arizona by 2010 and 19,900 jobs by 2020.42

Similarly, according to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):43

- $1.4 billion in new capital investment in Arizona;
- $117 million in new property tax revenue for local communities; and
- $7 million in lease payments to farmers and rural landowners from wind power.

While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Arizona’s technical wind potential, if fully tapped and operating at full capacity year round, would offset 5.2 million tons of global warming pollution (carbon dioxide), more than 27,000 tons of soot-forming pollution (sulfur dioxide) and almost 17,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.44

Generating Solutions: Case Studies

Imperial National Wildlife Refuge Goes Solar

The Imperial National Wildlife Refuge near Yuma, Arizona installed a 10-kW solar array in January 2003 to help power the visitor center and office complex at the refuge.

Refuge management says that is still quite early to determine the precise economic impact the installation will have on the refuge. Ken Edwards, refuge manager, estimates that it will offset approximately 25%-40% of the grid-supplied power for the refuge. The solar panels are connected to a computer that monitors the power output of the panels at any given time. By the end of the year, Edwards will be able to determine exactly...
how much power the panels generated and how much money and pollution the panels saved for Arizona residents.  

The panel installation employed about four people working for about 15 days. Refuge manager Ken Edwards plans to use the working solar installation as an educational tool for the more than 6,000 people who visit the refuge each year.

**Tucson Electric Power Activates 2.4-MW Solar Array**

In December 2002, Tucson Electric Power (TEP) expanded its Springerville Generating Station Solar System to become the one of the largest solar photovoltaic power systems in the Western Hemisphere, pumping out 2.4 MW at peak generating capacity. This is enough to power about 420 homes. By 2004, TEP plans to expand the system to 4 MW.

The giant solar array covers an area nearly half a mile in length and two football fields wide in a grassy field. That site was chosen because its cool climate and 6,500-foot elevation allow a large solar array to operate more reliably than it would in Tucson. TEP communications specialist Art McDonald says that the solar array is providing consumers with clean power at a competitive price.

TEP also provides incentives to encourage the use of grid-connected solar systems in homes and businesses in the Tucson area through its SunShare Program. This provides about 58 kW of TEP's solar capacity in Tucson.

**Arizona Public Service Co. Adds New Solar Capacity**

Since 1997, Arizona Public Service Company (APS) has provided an option to its customers to become a “Solar Partner.” Currently, APS has enrolled 3,600 homes and businesses who buy 15-kWh blocks of solar power at a premium of $2.64. In contrast to other “green pricing” programs, the green energy provided by APS to its solar partners is 100% solar-generated. Cassius McChesney, Solar Programs Manager at APS, says that the partners voluntarily choose to participate and pay the premium in support of solar technology and advancing research and design in the field. Due in part to this support, APS has developed a leadership position in solar energy technology and is developing technologies to bring down the price of solar energy.

The program has helped to fund new solar power plants across the state. APS seeks out sites in a variety of areas as a way of showing involved communities where their money is going. In some cases, APS has been quite innovative in choosing the placement of new solar plants. For example, in the city of Scottsdale, APS installed a 300-kW system on top of two acres of underground water storage tanks. In Glendale, APS took advantage of the sunny property near a water treatment facility and a bird sanctuary to install a photovoltaic system. A full list of APS solar plants is available at [http://www.aps.com/my_community/Solar/Solar_22.html](http://www.aps.com/my_community/Solar/Solar_22.html).
Arkansas’s Electricity Mix

Arkansas is too dependent on dirty energy sources. In 2000, Arkansas generated 95% of its electricity from fossil fuels, nuclear power and other dirty sources and 5% from renewable sources. The state relies on coal for 56% and nuclear for 26% of its electricity. Hydroelectric power, which emits less pollution than burning fossil fuels but causes its own set of environmental problems, accounted for 5% of the state’s electricity mix.

Arkansas’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (mill. kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Electricity Generation (2000)</td>
<td>43,975</td>
</tr>
<tr>
<td>Dirty Electricity Generation (2000)</td>
<td>41,731</td>
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<tr>
<td>Renewable Potential</td>
<td>42,434</td>
</tr>
<tr>
<td>Wind</td>
<td>22,257</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>39</td>
</tr>
<tr>
<td>Clean Biomass</td>
<td>20,138</td>
</tr>
</tbody>
</table>

Arkansas has significant capacity to generate electricity from renewable sources such as wind, clean biomass and landfill gas. In fact, Arkansas’s technical potential for generating electricity from these renewable sources could replace the state’s current generation.

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9 Data for the year 2000 was the most recent available. These percentages may have changed slightly.

h The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass. In addition, some wood-burning generators can be quite dirty; again, it was not possible to separate clean wood-burning facilities from the more polluting facilities. Therefore, this number may be high.
from dirty energy sources. Arkansas’s total technical potential from wind, geothermal, clean biomass and landfill gas is 42.4 billion kilowatt hours (kWh)—enough to meet 96% of the state’s electricity needs or power more than 4 million homes.

Arkansas’s Potential to Generate Electricity from Solar Energy
Arkansas has significant solar resources and could effectively use solar technologies. If Arkansas installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 970,000 kWh per year. This is enough to power 97.3 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, this system would produce about 35,807,000 kWh per year—enough to power 3,593.3 homes.54

Renewable Energy Boosts the Economy...
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 7,500 jobs in Arkansas by 2010 and 13,200 jobs by 2020.55

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Arkansas’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 16.9 million tons of global warming emissions (carbon dioxide), more than 89,000 tons of soot-forming pollution (sulfur dioxide) and more than 54,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.56

Generating Solutions: Case Studies

Powering Arkansas Homes with the Sun
The first official Arkansas photovoltaic (PV) net metering system was installed on a North Little Rock residence in February 2003. The home is located in a historical district and received a “Certificate of Appropriateness” from the city’s Historical Commission before installing the PV system. The homeowners are thrilled to have an opportunity to produce part of their electrical needs using solar energy.

Stellar Sun, a Little Rock renewable energy company that began business in 1976, supplied the equipment and system design. Stellar Sun installed a 1440-watt PV array consisting of 12 modules connected to the home’s electrical distribution box. The system is expected to provide the home with an average of 175 kWh of electricity per month.57

Stellar Sun also has assembled a team of state, municipal, educational, business and non-profit entities to construct a net-zero energy home demonstration project. Stellar Sun and its partners are using innovative construction techniques, passive design, Energy Star appliances and efficient mechanical equipment to reduce the home’s energy demand. The goal is for the 6-kW roof integrated PV system to provide all of the home’s electrical needs most months of the year. Stellar Sun is powering the home’s construction with a portable PV system (see below). The home is scheduled for completion in June 2003.58

Solar Energy on Wheels
Many residents of Arkansas’s rural areas, where utility outages tend to be more frequent and last longer, rely on a well for water. Without power, residents often cannot pump...
their water. The Arkansas Energy office teamed up with Stellar Sun to recycle some 15-year-old 60-watt PV modules and construct a portable water pumper and power system. The 2400-watt array, which rural residents suffering power outages can use for temporary electrical power or water pumping, is capable of traveling at freeway speeds. The system also consists of two pumps capable of moving more than 30,000 gallons of water per day, as well as a 3600-watt inverter and battery storage system.59

**Powering Schools with Solar Energy**

“Watts On Schools” is American Electric Power’s way of bringing solar power to schools in communities throughout Texas, Arkansas and Louisiana. Through Watts On Schools, AEP has installed nineteen solar energy systems at public elementary, middle, and high schools located within the service areas of three of its electric utility operating companies. Participating schools receive the energy produced by the systems for free, lowering the schools’ electric bills every month. In addition, participating schools receive solar energy educational materials and conduct solar energy events on an annual basis.

Fayetteville High School began generating power from its solar array on September 3, 1999 and has integrated the photovoltaic data acquisition system’s real time display into its physics and earth science courses. Similarly, the system at Trice Elementary School in Texarkana began generating power on July 27, 1999. Each school’s system has 16 solar modules with a generating capacity of 4 kW. This means that under full sun on a cool day, each system is capable of providing enough energy to light about 40 100-watt incandescent light bulbs. Over the course of a year, each system will feed about 6,000-8,000 kilowatt-hours of electricity into the school building.60

Each school saves about $520 a year on its electric bills by generating its own electricity from the solar array.61 In addition, by generating electricity from the sun rather than fossil fuels, each school’s system displaces 12,000 pounds of global warming (carbon dioxide) emissions, 29 pounds of soot-forming pollution (sulfur dioxide) and 24 pounds of smog-forming pollution (nitrogen oxides) each year.62
California has long been at the forefront of progressive environmental policy. In 2001, California generated 10.5%--a number that continues to grow--of its electricity from renewables sources, such as geothermal power, solar and wind. However, the state still depended on fossil fuels and nuclear power for 79% of its electricity needs. Natural gas, which often fluctuates dramatically in price, provided almost half of the state’s electricity needs in 2001.

California’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

California has tremendous technical capacity to generate electricity from renewable sources such as wind, clean biomass, geothermal energy and landfill gas. In fact, California has the best geothermal capacity in the country; it also ranks 1st for its potential to generate electricity from landfill gas. California has the technical potential to meet 81% of its current electricity needs with these four renewable sources alone. California’s total electricity generation from renewable sources is significantly lower than its potential, as shown in the following chart:

<table>
<thead>
<tr>
<th>Electricity Generation (2001)</th>
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<td>Renewable Potential</td>
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<tr>
<td>Wind</td>
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<tr>
<td>Geothermal</td>
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<td>Landfill Gas</td>
<td>8,714</td>
</tr>
<tr>
<td>Clean Biomass</td>
<td>17,057</td>
</tr>
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</table>

California’s Electricity Mix

*California Energy Commission, [http://www.energy.ca.gov/electricity/gross_system_power.html](http://www.energy.ca.gov/electricity/gross_system_power.html). Numbers may have changed slightly since 2001.

*The California Energy Commission estimates that 12% of the electricity sold to California consumers in 2001 came from renewable sources. See [http://www.energy.ca.gov/consumer/power_content_label.html](http://www.energy.ca.gov/consumer/power_content_label.html).

*“Technical” potential refers to what is possible given the state’s resources; however, cost and technology may limit the state’s ability to fully realize this potential.
generation potential from wind, geothermal, clean biomass and landfill gas is 216 billion kilowatt hours (kWh)—enough to power more than 21 million homes.

**California’s Potential to Generate Electricity from Solar Energy**

California has very good solar resources, and the entire state can effectively use solar technologies. The southern portion of the state has particularly good resources. While California’s solar theoretical potential is enormous, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if California installed solar photovoltaic systems on .5% of the state’s land area, it could generate 128,000 million kWh, or more than half of the state’s total electricity generation in 2000.63

**Renewable Energy Boosts the Economy...**

A June 2002 analysis found that building 5,900 MW of renewable energy capacity in California would lead to 28,000 year-long construction jobs and 3,000 permanent operations and maintenance jobs. Over thirty years of operation, these new plants would create 120,000 person-years of employment. This is four times as many person-years that would be created by building 5,900 MW of natural gas power plants.64

In addition to creating jobs, renewable energy development would boost California’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, a national standard requiring increased generation from renewable energy would produce:65

- $3.1 billion in new capital investment;
- $223 million in new property tax revenue for local economies; and
- $79 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, California’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset more than 65 million tons of global warming pollution (carbon dioxide), more than 343,000 tons of soot-forming pollution (sulfur dioxide) and more than 210,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.66

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Generating Solutions: Case Studies

California has long been the leader in developing its renewable energy potential. California currently has the most installed wind power in the country, with 1822.3 MW online and 948.94 MW in the planning process. The state has more than 60 wind projects operating in five major resource areas in northern, central and southern California.67 In

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1 Union of Concerned Scientists calculated the economic benefits from a national renewable energy standard requiring 10% renewable energy generation by 2020. Environment California supports a national standard of at least 20% renewable energy generation by 2020 and a California standard of 20% by 2017. Results are cumulative in 2000$ and reflect net present value using an 8% real discount rate.
addition, California’s geothermal power plants produce about 40% of the world’s
ageothermally-generated electricity.68

Powering California with Geothermal Energy
CalEnergy Corporation recently announced plans to build a new geothermal plant in
California’s Imperial Valley that would be the first such facility built in the state in more
than a decade and its largest to date. There are already ten geothermal plants in the
region that have a total of 340 MW of capacity.69 The new proposal is for a 185-MW
plant located six miles northwest of Calipatria. The project is currently undergoing the
permitting process, but the Energy Commission should make a decision by the end of
2003.70

Imperial County’s unemployment rate is historically the highest in the State of California,
between 22 and 25%.71 The 450-500 construction jobs that this project will provide at its
peak and the approximately 70 full time positions will be much needed additions to the
community’s economy.72 The current geothermal projects have 295 employees and a
payroll of more than $10 million. The current projects pay $11 million in property taxes,
and the new plant is expected to add $3 million to that. In addition, the existing plants
spend $100,000 a day in goods and services to support the current project. The existing
geothermal power plants in the area are about 80% of Calipatria’s tax base.73

Mojave Desert Solar Electric Generating Systems (SEGS)
California’s Mojave Desert is home to the world’s largest concentrating solar power
facility. The Solar Electric Generating Systems (SEGS) plants have a combined capacity
of 354 MW and enable Southern California Edison to meet the needs of some 500,000
people.74 The plants, built between 1984 and 1991, range in size from 14 MW to 80 MW
and are located on three sites.75 These nine plants have generated and sold more than
5 billion kilowatt-hours (kWh) of solar electricity to the Southern California Edison utility
during the last 14 years.76 Southern California Edison currently buys 335 MW of power
from seven of these plants.77

The solar plants have helped the economy since the first plant was built. Currently,
approximately 250 people are directly employed by the SEGS. Each of the two 80-MW
plants required about one million job hours to construct. Over their 30 year life, each of
the 80-MW plants are expected to contribute $11.6 million in taxes to the local
government, $65.8 million to the state government, and $228.9 million to the federal
government.78

In addition to the economic benefits, the solar systems save the energy equivalent of
more than two million barrels of oil every year by harnessing the power of the sun instead
of relying on traditional fossil fuel sources.79

Imperial Valley Bovine Waste to Energy Plant
Guépard Energy, Inc. (GEI) is developing four biowaste management facilities within the
Imperial Valley. GEI expects to complete the plants by the second quarter of 2004. The
four plants will have a combined capacity of 25 MW, enough electricity to power 12,000-
23,000 homes. The plants will generate the electricity by processing 200 tons of bovine
biowaste per day with biodigesters. This results in biogas and 120 tons per day of organic
fertilizer.80

In addition to being a source of electricity, the plants are a source of economic benefits
for the community. The plants are expected to create 150 construction jobs to build the
The plants will have many environmental benefits as well. Each plant will mitigate 25,000 tons of greenhouse gases annually. The processing of the waste will help the feedyards supplying the waste to comply with Clean Water Act requirements. The plants also will deliver steam to the feedyards, enabling the replacement of diesel boilers.

**Powering Los Angeles with Wind: Pine Tree Wind Project**

Wind Turbine Prometheus, LLC, a partnership between Zilkha Renewable Energy, LLC and Prometheus Energy Services, is developing a 120-MW facility on approximately 22,000 acres in California's Mojave Desert. The $162 million Pine Tree Wind Project, powered by 80 GE Wind Energy wind turbines, will be the first wind project for Los Angeles Department of Water and Power (LADWP), the nation's largest municipally owned utility. The project is scheduled to begin operation in July 2004.

The Pine Tree Wind Project, generating enough power to meet the annual energy needs of more than 36,000 households, will reduce the Los Angeles Department of Water and Power's dependence on fossil fuels, saving approximately $14 million a year in gas costs. The project is expected to create approximately 200 temporary construction jobs and ten permanent jobs for ongoing operation and maintenance throughout the life of the project. In addition, 8 to 12 landowners will receive lease payments for hosting wind turbines on their property.

The clean electricity generated by the Pine Tree Wind Power Project will offset 240,000 tons of global warming pollution (carbon dioxide); 1,200 tons of soot-forming pollution (sulfur dioxide); and 720 tons of smog-forming pollution (nitrogen oxides).

**Watsonville Homeowners Benefit from Solar Energy**

In 2001, Palo Alto-based homebuilder Clarum Homes built a new housing development, Cherry Blossom, consisting of 31 homes outfitted with photovoltaic solar panels as standard equipment. Each of the homes in the Cherry Blossom community, located in Watsonville, comes equipped with a 1-2 kW solar electric system, comprised of 12-24 BP Solar photovoltaic panels installed on the roofs of the homes. These systems have the capacity to produce 1,500-3,500 kWh of electricity per year.

The panels will provide 25-50% of the electricity requirements of an average California home, saving the homeowners an average of $30-$55 a month on their electricity bills. The systems also will help the homeowners get the best rate possible from PG&E on their bills, because rates go up depending on the number of kilowatt-hours consumed. By lowering the overall use, the homeowner can save by paying the lower rate for electricity use.

All of the homes are now occupied. The program was so successful that Clarum Homes has entered into contract with another solar company, Astropower, to build 277 more homes that include solar electric power.
COLORADO

Colorado’s Electricity Mix

Colorado is too dependent on dirty energy sources. In 2000, Colorado generated 97% of its electricity from coal and gas and a small percentage from renewable sources such as wind, solar and geothermal energy. The state relies on coal for 82% of its electricity, making Colorado one of the most coal-dependent states in the country. Hydroelectric power, which emits less pollution than burning fossil fuels but causes its own set of environmental problems, accounted for 3% of the state’s electricity mix.

Colorado’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>Potential (mill. kWh)</th>
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</thead>
<tbody>
<tr>
<td>Wind</td>
<td>524,303</td>
</tr>
<tr>
<td>Geothermal</td>
<td>16,609</td>
</tr>
<tr>
<td>Clean Biomass</td>
<td>5,122</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>1,476</td>
</tr>
<tr>
<td>Total Potential</td>
<td>547,510</td>
</tr>
<tr>
<td>Dirty Generation</td>
<td>43,661</td>
</tr>
</tbody>
</table>

Colorado has tremendous capacity to generate electricity from renewable sources. Colorado has the 4th best geothermal potential in the country; it also ranks 11th for its wind resources and 7th for its potential to generate electricity from landfill gas.

Overall, Colorado has the 11th best renewable energy potential in the country. In fact, Colorado has the technical capacity to exceed its electricity needs from renewables by more than 12-fold. Colorado’s total generation potential from wind, geothermal, clean biomass and landfill gas is 547.5 billion kilowatt hours (kWh)—enough to power more than 54 million homes.

Colorado’s Potential to Generate Electricity from Solar Energy

m Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Colorado has good solar resources throughout the state. While Colorado’s solar theoretical potential is significant, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if Colorado installed solar photovoltaic systems on .5% of the state’s land area, it could generate 83,000 million kWh, or almost double the state’s total electricity generation in 2000.90 Said another way, according to the Department of Energy, if Colorado installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 1,224,000 kWh per year. This is enough to power 122.8 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could produce about 61,554,000 kWh per year — enough to power 6,178 homes.91

Renewable Energy Boosts the Economy...
Several studies have estimated and calculated the benefits of renewable energy for Colorado’s economy.

► According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):92

- $2.4 billion in new capital investment in Colorado;
- $183 million in new property tax revenue for local communities; and
- $45 million in lease payments to farmers and rural landowners from wind power.

► An analysis by Environment Colorado showed that Colorado could reasonably develop enough wind power to meet half of new demand through the next decade and three-quarters of new demand in the following decade. Through 2020, the benefits of this scenario include:93

- 6,300 one-year jobs in wind farm manufacturing, installation, and supporting areas, with a payroll value of $210 million;
- 1,300 long-term, highly local jobs in wind farm operation, maintenance, and supporting areas, with an annual payroll value of $51 million;
- $230 million in additional property tax revenue for rural counties;
- Conservation of more than 25 billion gallons of water, with water rights worth more than $120 million at current Front Range prices; and
- $76 million in royalties paid to landowners.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Colorado’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 398 million tons of global warming pollution (carbon dioxide), more than two million tons of soot-forming pollution (sulfur dioxide) and almost 1.3 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.94

Generating Solutions: Case Studies

Fort Collins Commits to Renewable Energy and Energy Efficiency
On March 25, 2003, the Fort Collins City Council adopted an Electric Energy Supply Policy to guide the city and the Platte River Power Authority on issues surrounding system reliability, rates and the environment. As part of this policy, the city outlined numerous objectives, including
reductions in per capita energy consumption by 10% by 2012. During this time period (2002-2012), Fort Collins will save approximately 1.7 billion kilowatt-hours of electricity and avoid more than 1.8 million tons of global warming emissions (carbon dioxide). In addition, the council passed a renewable energy standard, stating that Fort Collins will “work with the Platte River Power Authority to increase the City’s percentage of renewable energy...to 2% by the end of 2004 and to 15% by the year 2017.” Fort Collins is the first municipality in Colorado to pass a resolution to increase electricity generation from renewable sources.95

Powering Southeastern Colorado’s Economy with Wind
In March 2001, after months of haggling over Xcel Energy’s plan to meet electricity demand through 2005 with a portfolio of new generation from natural gas, the Colorado Public Utilities Commission ordered Xcel Energy to add a proposed 162-MW wind project to its resource plan. The commission based its decision solely on the fact that the “acquisition of the Lamar facility will likely lower the cost of electricity for Colorado’s ratepayers,... [and] is justified on purely economic grounds, without weighing other benefits of wind generation.”96

In October 2002, the Colorado Public Utilities Commission approved a contract between Xcel Energy and GE Wind, clearing the way for Colorado’s newest wind energy development project 23 miles south of Lamar in Prowers County in southeastern Colorado. At 162 MW, it is five times larger than any other wind plant in the state and will produce enough electricity to power 75,000 homes each year. The facility’s 108 planned wind turbines are scheduled to come online in December 2003.97

The $160 million project is expected to spark the region’s economy. In addition to generating revenue for the county and state, the project will create temporary construction jobs and up to ten permanent jobs and pay three landowners for placing wind turbines on their property.98 The Lamar wind project also will have a multiplier effect, boosting the sales of goods and services in Prowers County. The ongoing maintenance and operation of the wind project could generate an additional $810,000 in sales of local goods and services each year.99

Leon Sparks, Superintendent of the Lamar Utilities Board, lauded the economic benefits of the project for southeastern Colorado, which has one of the lowest per capita incomes in the state. “In this time frame where Southeastern Colorado has been hit pretty hard with the drought conditions, we are needing something to give this part of the state a boost and I feel like this will give us a boost as far as economic conditions. ...Our area is just a bunch of hard-working people that basically have been busting the soil and, with the drought, agriculture has almost been impossible.”100

John Nielsen, Energy Project Director for The Land and Water Fund of the Rockies’, has said that the new wind project will save ratepayers nearly $7 million and will help protect consumers from the risk of rising natural gas prices.101

White Wave Making Waves with Wind
White Wave, the country’s largest soyfoods manufacturer, has acted to replace all of the traditional power it uses in manufacturing and operations with wind power. White Wave is the largest U.S. company to make this commitment.

In January 2003, White Wave initiated its wind energy support program by purchasing 20 million kWh of wind power credits. According to the EPA, White Wave’s purchase of wind power will save approximately 32 million pounds of global warming emissions (carbon dioxide) each year -- equivalent to taking 3,200 cars off the road.102
Connecticut is too dependent on dirty energy sources. In 2000, Connecticut generated 93% of its electricity from fossil fuels and nuclear power. Nuclear power, which generates radioactive waste that remains lethal for thousands of human generations, produces almost half of the state’s electricity. According to the Department of Energy, the state generated 6% of its electricity from renewables, although this number likely includes incineration of municipal solid waste.

Connecticut has significant potential to generate electricity from wind, clean biomass and landfill gas. In fact, by tapping into its potential from these sources, Connecticut almost could displace all electricity generation from its nuclear power plants. Connecticut’s total generation potential from wind, clean biomass and landfill gas is 11.5 billion kilowatt hours (kWh)—enough to meet 34% of the state’s electricity needs or power more than one million homes.

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**Connecticut’s Generation from Nuclear Power vs. Potential Generation from Renewables (million kWh)**

- Technical Potential from Wind, Biomass & Landfill Gas: 11,546

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**Connecticut Electricity Generation by Source: 2000**

- Nuclear: 49%
- Gas: 13%
- Renewables: 6%
- Petroleum: 19%
- Hydro: 1%

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**Connecticut’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas**

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (mill. kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>33,478</td>
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<tr>
<td>Dirty Generation</td>
<td>31,333</td>
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<tr>
<td>Renewable</td>
<td>11,546</td>
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<tr>
<td>Wind</td>
<td>10,005</td>
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<tr>
<td>Clean Biomass</td>
<td>1,366</td>
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<tr>
<td>Landfill Gas</td>
<td>175</td>
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</tbody>
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Data for the year 2000 was the most recent available. These percentages may have changed slightly.

The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass. In addition, some wood-burning generators can be quite dirty; again, it was not possible to separate clean wood-burning facilities from the more polluting facilities. Therefore, this number may be high.
Connecticut has average solar resources. If Connecticut installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 863,000 kWh per year. This is enough to power 86.6 average homes.\textsuperscript{103}

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 7,800 net jobs in Connecticut by 2010 and 14,100 net jobs by 2020.\textsuperscript{104}

...While Protecting the Environment
Based on the American Wind Energy Association's statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Connecticut's technical wind potential, if fully tapped and operating at full capacity year round, would offset 7.6 million tons of global warming emissions (carbon dioxide), more than 40,000 tons of soot-forming pollution (sulfur dioxide) and more than 24,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\textsuperscript{105}

### Generating Solutions: Case Studies

**Connecticut Expands its Solar Capacity**
On March 31, 2003, the Connecticut Clean Energy Fund announced the winners of its Photovoltaic (PV) Program Request for Proposals. The winners will develop solar PV projects that will result in 100 kW of new solar PV capacity. Two of the projects are located in Southwest Connecticut, where electric transmission is often congested. Projects selected include:\textsuperscript{106}

- The Fairfield Water Pollution Control & Compost Facility will integrate solar PV into a new compost processing facility at the existing water pollution control facility.
- The City of Hamden will install a solar-powered traffic light at an important intersection.
- The Stamford Katrina Mygatt Recycling Center will receive solar PV to power energy efficient lighting.
- The Hamden Government Center will install solar PV to charge the Center’s backup battery, provide emergency lighting as well as provide power to the electric grid.
- The Whitneyville Pumping Station in Hamden will receive solar PV to generate power during critical peak summer periods.
- The Salmon Brook Ecology Center will integrate a solar PV system with a self-sustaining aquaculture/hydroponics green facility.

**Fairfield University Goes Solar**
Fairfield University in Connecticut began using photovoltaic solar technology in April 2000, after receiving grants from the WM Keck Foundation and United Illuminating to install solar panels on
The University installed 650 solar roof shingles on four apartment units, generating a total of 12.5 kW. Dr. Evangelos Hadjimichael, Dean of the School of Engineering at Fairfield University, estimates that a single apartment unit obtains 50-60% of its electricity from solar power. Now that the project has been completed, the engineering school uses this real life lab to study efficiency and is constantly looking for ways to improve the system. The University is considering expanding the system in the future.\textsuperscript{107}

**Connecticut College Purchases Electricity Generated from Wind**

In January 2003, Connecticut College, located in New London, announced its purchase of 3.2 million kWh of renewable energy certificates generated by wind farms. Renewable energy certificates offer energy users a way to financially support the production of renewable energy without purchasing it directly from the company that generates it. Each certificate represents the environmental attributes associated with one kilowatt-hour of generation from a renewable source.\textsuperscript{108} The students agreed to assess themselves a $25 fee for the first year of the project to cover the additional costs of the electricity.\textsuperscript{109}

The certificates represent 22% of the college’s annual electricity consumption; this is the largest percentage of wind power purchased by any U.S. college or university. Connecticut College purchased 100% new wind renewable energy certificates from EAD Environmental LLC, a Green-e certified renewable certificate marketing firm based in New York City.\textsuperscript{110}

Connecticut College Renewable Energy Club and interested students began the campus’s push for increased use of renewable energy. In 2001, the club circulated a petition proposing that the college purchase energy from a “green” energy cooperative, with students covering the additional costs by voluntarily paying a special fee. The proposed energy cooperative went out of business a year later, leading students to seek out an alternative and find EAD Environmental’s certificates.\textsuperscript{111}
Florida is too dependent on dirty energy sources. In 2000, Florida generated 96% of its electricity from fossil fuels and nuclear and 4% from renewables. Coal, the dirtiest of fossil fuels, accounted for more than one-third of the state’s energy mix. Florida’s two nuclear power plants, which produce waste that remains lethal for thousands of years, also generate a significant percentage of the state’s electricity.

Florida has important capacity to generate electricity from clean biomass and landfill gas. In fact, Florida could generate more than 15.7 billion kilowatt-hours (kWh) from clean biomass and landfill gas alone—enough to power more than 1.5 million homes and offset half of the electricity generated from the state’s aging nuclear power plants.

Unfortunately, Florida does not have significant potential for developing wind power. In total, Florida has the technical potential to meet 8% of its electricity generation needs with clean biomass and landfill gas.

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**Florida’s Electricity Mix**

| Total Electricity Generation (2000) | 190,936 |
| Dirty Electricity Generation (2000) | 183,346 |
| Renewable Potential | 15,722 |

Florida’s Potential for Offsetting Nuclear Generation with Clean Biomass and Landfill Gas (million kWh)

- **Nuclear Generation (2000):** 32,291
- **Technical Potential from Biomass and Landfill Gas:** 15,722

*Data for the year 2000 was the most recent available. These percentages may have changed slightly.*

*The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass. In addition, some wood-burning generators can be quite dirty; again, it was not possible to separate clean wood-burning facilities from the more polluting facilities. Therefore, this number may be high.*
Florida’s Potential to Generate Electricity from Solar Energy
Florida has good solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Florida could produce around 1,035,000 kWh per year. This is enough to power 103.9 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could produce about 38,194,000 kWh per year — enough to power 3,832.8 homes.112

Renewable Energy Boosts the Economy
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency programs could create 37,000 jobs in Florida by 2010 and 66,800 jobs by 2020.113

Generating Solutions: Case Studies

The Florida Photovoltaic Rebate Program
The Photovoltaic Rebate Program is a collaborative effort by the Florida Energy Office, U.S. Department of Energy through Sandia National Laboratories, and the Florida Solar Energy Center. It provides rebates of $4 per nameplate-rated watt for the installation of grid-connected photovoltaic systems on homes, commercial buildings and public facilities. Homeowners can receive up to $16,000 in rebates; public and commercial facilities can receive up to $40,000.

By the end of 2002, the Florida Solar Energy Center had received 70 rebate applications and fielded 1,200 inquiries about the program. The Florida Solar Energy Center has helped to install at least 46 systems, with several more planned for 2003. JEA of Jacksonville installed 4-kW photovoltaic systems on every public high school and college in its service territory. The Orlando Utilities Commission also installed systems on schools.

These installations have added approximately 200 kW of solar electricity to the state’s energy capacity, reducing annual global warming emissions (carbon dioxide) by 650,000 pounds, soot-forming pollution (sulfur dioxide) by 3,500 pounds and smog-forming pollution (nitrogen oxides) by 1,700 pounds by offsetting electricity generated from conventional fossil fuel facilities.114

Department of Corrections Maximizes its Use of Solar Energy
The Florida Solar Energy Center assisted the Florida Department of Corrections (DOC) in evaluating the status of the solar water heating systems installed at various institutions operated by the Florida Department of Corrections. Many of these solar systems had been installed at the time of the facilities’ construction, often by contractors with little experience with solar technology. Realizing the energy savings that these systems could provide, the DOC wanted to make sure that they were operational and maximizing their potential. DOC contracted with the Florida Solar Energy Center to evaluate some of the systems and determine what needed to be done to achieve optimum performance.

For example, the Martin Correctional Institute hired the Florida Solar Energy Center to evaluate its solar water heating system, comprised of two large independent solar arrays. Initial inspection revealed that several components had deteriorated; however, the Florida Solar Energy Center determined that the system could be economically repaired. Solar Energy Systems of Ft. Pierce repaired the system; computer modeling of the system now projects a savings of approximately $5,000 per year based on anticipated hot water usage.115
Dry Tortugas National Park Goes Solar
The Florida Solar Energy Center is presently assisting the National Park Service with site evaluations and recommendations for renewable energy systems and energy efficiency measures at Dry Tortugas National Park. Located 75 miles west of Key West in the Florida Straights, this marine sanctuary encompasses more than 64,000 acres and includes small islands and coral reefs.116

The park decided to use a variety of technologies to reduce electricity and peak demand by two-thirds, including installing Energy Star appliances and more insulation on park residences. Park planners also installed photovoltaic panels and solar water heaters to meet some of their energy needs. The increased energy efficiency measures brought the refuge’s load down from 175 kWh/day to 50 kWh/day. The extensive energy efficiency measures saved the park enough money to cover the costs of a PV system with enough capacity to support the reduced electrical loads on the island.117

The environmental benefits of discontinuing the use of diesel generators on the island have been important. Diesel contributes about two pounds of carbon per kilowatt hour. Since the park had a minimum load of about 100 kWh a day, using these efficiency measures and energy alternatives offsets approximately 200 pounds of carbon a day from the park. Discontinuing the transportation of diesel to the island averts the potential for dangerous spills. The photovoltaic system was installed with a backup propane generator, but so far it has not been needed.

The park spent about $500,000 to upgrade its system. Specific dollar savings have not been estimated yet. But before the energy program went into place, the park used to pay almost $1 per kWh. At such a rate, the park expects a payback period of about 5-10 years.118

Local Government Fostering Innovation, Orange County, Florida
Orange County owns and operates the third-largest landfill in Florida, and in June 1998, the Orange County Solid Waste Department began harnessing the methane emitted from the landfill and sending it to the Orlando Utility Commission’s (OUC) Stanton Energy Center.

Orange County’s landfill gas energy system consists of 40,000 feet of collection pipe, a gas transmission pipeline, and a pump station. Landfill gas is collected from the 200 acres of waste that have been deposited at the Orange County landfill since the early 1990s. After collection, the gas is sent to the Stanton Energy Center where it is used to generate electricity. The waste at the landfill, in addition to the waste expected to be deposited over the next 20 years, will be the source of as much as 6,000 standard cubic feet of landfill gas per minute, or enough fuel for OUC to generate electricity for 13,000 homes.

Designed by the Orange County Solid Waste Department and several consultants, the system is owned and operated by DTE Biomass Energy, Inc. The project takes advantage of $4 million in federal funding and tax incentives, allowing OUC to replace fossil fuels with the cleaner burning, environmentally-preferable energy source.

This project benefits Orange County and its partners both financially and environmentally. Orange County stands to make $400,000 per year for rights to the landfill gas, in addition to the $5 million system purchase price. The Orange County landfill gas project will reduce methane emissions by almost 31,000 tons per year at capacity. The project has also reduced landfill odor complaints.

With the success of this project, Orange County is considering adding horizontal gas collection lines into future landfill cells as the landfill lifts are constructed to optimize gas collection. 119
Illinois’s Electricity Mix

Illinois is too dependent on dirty energy sources. In 2000, Illinois generated almost all of its electricity from fossil fuels and nuclear power and a mere 0.3% from renewable sources. The state relies on coal, the dirtiest of fossil fuels, for almost half of its electricity generation. Illinois also is one of the most nuclear-dependent states—third only to New Hampshire and South Carolina—generating more than half of its electricity from six nuclear power plants.

Illinois’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (million kWh)</th>
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<td>Wind</td>
<td>105,907</td>
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<tr>
<td>Clean Biomass</td>
<td>46,882</td>
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<tr>
<td>Landfill Gas</td>
<td>3,023</td>
</tr>
<tr>
<td>Total Potential</td>
<td>155,813</td>
</tr>
</tbody>
</table>

Illinois has considerable capacity to generate electricity from renewable sources. In fact, Illinois has the best clean biomass potential in the country and falls second only to California for its potential from landfill gas-to-energy.

Overall, Illinois ranks 14th in the country for renewable energy potential. Illinois could generate 106 billion kilowatt hours (kWh) from wind alone, more than the electricity it currently generates from coal, oil and gas combined. Illinois’s total generation potential from wind, clean biomass and landfill gas is 155.8 billion kWh, or 88% of the state’s total electricity generation in 2000. This is enough energy to power more than 15 million homes.

Illinois’s Potential to Generate Electricity from Solar Energy

Illinois has useful solar resources throughout most of the state. If Illinois installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 106 billion kWh of electricity, more than the electricity it currently generates from coal, oil and gas combined. Illinois’s total generation potential from solar energy is 106 billion kWh, or 88% of the state’s total electricity generation in 2000. This is enough energy to power more than 15 million homes.

*Data for the year 2000 was the most recent available. These percentages may have changed slightly.*
Generating Solutions: Case Studies

Powering McLean County’s Economy with Wind: Arrowsmith Wind Project
Zilkha Renewable Energy is finalizing plans to build a large wind farm in the Saybrook-Arrowsmith area in eastern McLean County. The wind farm will contain more than 260 turbines distributed over approximately 21,000 acres of land leased from more than 100 landowners. The Arrowsmith Wind Power Project will offer as much as 400 MW of generating capacity, enough to meet the annual energy needs of about 120,000 homes. The construction, likely to commence in 2004 and to span at least two phases, has a price tag of $400 million.124

The project also will spark the local economy, creating new jobs and generating substantial tax revenues for the county and local schools. Zilkha estimates that construction of the wind farm will create approximately 200-250 construction jobs over the 6-8 month construction period. When operational, the wind farm will require 20-25 full-time employees with middle- to high-level technical job skills. The wind farm also will significantly increase property tax revenues for McLean County, directly benefiting local schools, hospital districts, fire districts, and county government. Finally, lease payments to local landowners for hosting wind turbines on their property could total millions of dollars each year.125

927,000 kWh per year. This is enough to power 93.0 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could produce about 32,624,000 kWh per year — enough to power 3,273.9 homes.120

Renewable Energy Boosts the Economy...
Several studies have estimated how renewable energy and energy efficiency programs could boost the economy of Illinois.

► According to an analysis by the Regional Economics Applications Laboratory for the Environmental Law and Policy Center, a renewable energy standard requiring 22% renewable energy generation in the Midwest by 2020 would produce 13,470 net new jobs in Illinois and $1.5 billion in increased economic output, mostly from construction, manufacturing and service-related sectors.121

► According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):122

- $3.5 billion in new capital investment in Illinois;
- $170 million in new property tax revenue for local communities; and
- $8 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Illinois’s technical wind potential, if fully tapped and operating at full capacity year round, would offset more than 80 million tons of global warming emissions (carbon dioxide), almost 424,000 tons of soot-forming pollution (sulfur dioxide) and more than 259,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.123
The Arrowsmith wind farm also would have substantial environmental benefits, reducing air pollution generated from traditional sources, such as coal. Based on average EPA-reported 1998 emissions rates, a 400-MW wind farm would displace 2,600 tons of smog-forming pollution (nitrogen oxides); 7,100 tons of soot-forming pollution (sulfur dioxide); 832,000 tons of global warming emissions (carbon dioxide); and 45,000 pounds of mercury each year.  

**Powering Bureau County’s Economy with Wind: Crescent Ridge Windpower Project**

Crescent Ridge LLC, owned jointly by Illinois Wind Energy and Tomen Power Corporation, is in the final planning stages for the Crescent Ridge Windpower Project in the Indiantown and Milo Townships of Bureau County, Illinois. The Crescent Ridge Windpower Project will have the capacity to generate approximately 48 MW of electrical power from 32 turbines, enough to supply the electrical needs of approximately 20,000 average households. ComEd will purchase the entire output of the wind generating facility.

The Crescent Ridge project could provide a spark for the local economy. The wind farm would be the single largest property taxpayer in Bureau County based on 2001 tax receipts, providing $319,000 per year; $219,397 of this money would go to local school districts, which will help to reduce the shortfalls in their budgets. In addition, the county will receive approximately $225,000 in permit fees.

Thirteen local landowners will receive annual lease payments totaling approximately $200,000 to host the wind turbines, while they continue to farm the land. Crescent Ridge also has instructed its contractors to, wherever feasible, use local subcontractors and manpower and to purchase materials and services such as concrete, gravel, excavation and cable from local vendors. Crescent Ridge estimates that approximately 60 temporary construction jobs and 6-8 permanent jobs will be created by the project. Those workers coming into Bureau County to build and maintain the facility will be staying in local hotels, eating in local restaurants and spending money on local goods and services.

**Powering Lee County’s Economy with Wind: Mendota Hills Wind Farm**

In July 2002, Illinois Governor George H. Ryan announced a $2.75 million grant to Navitas Energy Inc. to develop a 50-MW wind farm in northern Illinois in rural Lee County. When completed, the wind farm will generate 133 million kilowatts of electricity, or enough to meet the annual needs of about 15,000 households. The project is pending final approval.

The potential economic and environmental benefits of the wind-to-energy project are impressive. The wind farm is expected to add $350,000-$400,000 to the local tax base each year and provide thousands of dollars in annual lease payments to area landowners. The project is expected to produce up to 30 construction jobs in Lee County for a period of 6-9 months and up to ten permanent skilled operations and maintenance jobs.

In addition to economic stimulus, the wind farm will reduce emissions of soot- and smog-forming pollutants and greenhouse gases by offsetting power generation from coal-fired power plants. When fully operational, the wind farm will eliminate the annual equivalent of 76,000 tons of global warming emissions (carbon dioxide); 800 tons of soot-forming pollution (sulfur dioxide); and 300 tons of carbon monoxide.

**Powering the Economy of Lee and DeKalb Counties with Wind: County Line Wind Project**

In January 2003, the Lee County Board approved the petition by FPL Energy Illinois Wind LLC, a subsidiary of Florida Power and Light, for a wind farm in Alto and Willow Creek townships. This
would be the first part of a project that would install up to 60 wind turbines in Lee and DeKalb counties capable of generating 90 MW of electricity. The estimated cost of the project is about $1 million per wind turbine. Construction is set to begin in January 2004 for the Lee County portion and February 2004 for the DeKalb County portion.\textsuperscript{134}

The County Line project will boost the local economy of Lee and DeKalb Counties. The project will pay approximately $10,000 per year per turbine in property taxes to the counties; about 70\% of the property taxes will go to the local school districts. Construction labor could peak as high as 200 people but likely will average between 75-100 employees. Full time operations and maintenance will require three to five full time staff. In addition, FPL Energy is leasing the land from private landowners for the wind turbines; each will receive $3,000-$5,000 per turbine per year in lease payments. The company has not signed binding agreements with the landowners, but 40-45 landowners likely will agree to host wind turbines on their property.\textsuperscript{135}

By generating electricity from wind, the County Line project also will offset emissions from traditional forms of generation, such as coal-fired power plants. When fully developed with 60 turbines, the County Line Wind Project will displace 180,000 tons of global warming emissions (carbon dioxide) each year.\textsuperscript{136}

**Chicago Public Schools Go Solar: Chicago Solar Partnership**

The Chicago Solar Partnership strives to promote solar energy as an alternative to more traditional forms of energy, with a particular focus on bringing solar technology to the Chicago Public Schools. The partnership includes ComEd, the primary electricity provider in Chicago; the City of Chicago Department of Environment; Spire Solar Chicago, a local PV manufacturer and installer; the International Brotherhood of Electrical Workers; and the Chicago Public Schools.

To date, the partnership has installed photovoltaic systems with more than 700 kW of generating capacity on the roofs of Chicago museums, schools, and city and other public buildings, such as the Art Institute of Chicago, the Field Museum of Natural History, and the Mexican Fine Arts Center Museum.\textsuperscript{137}

The partnership also has installed PV systems at several schools, including Frank W. Reilly Elementary School, Stephen A. Douglas School, Audubon Elementary School, and John Hay Elementary. In total, eight schools use 10-kW PV systems, with approximately 20 additional schools planned by the end of 2003. According to Spire Solar Chicago, each school now saves approximately 12,000 kWh per year.\textsuperscript{138} These electricity savings also save the school system money. Each 10-kW system saves the school system approximately $835 per year; since the first system became operational in 1999, the program has saved approximately $7,500 in generation costs.\textsuperscript{139}

The PV systems also offset power plant emissions of soot- and smog-forming pollutants and carbon dioxide, a greenhouse gas. As of March 10, 2003, the Frank W. Reilly Elementary School’s solar generation had offset a half-ton of carbon dioxide emissions since the beginning of the year. The Art Institute had offset almost three tons of carbon dioxide emissions. Students and interested others can monitor real-time power generation and pollution reduction at the Partnership website.\textsuperscript{140}
Indiana’s Electricity Mix
Indiana is too dependent on dirty energy sources. In 2000, Indiana generated more than 99% of its electricity from fossil fuels and only 0.1% from renewable sources. Indiana relies on coal, the dirtiest of fossil fuels, for almost 95% of its electricity generation—making Indiana one of the most coal-dependent states in the country.

Indiana’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas
Indiana has important capacity to generate electricity from wind, clean biomass and landfill gas. Indiana has the 12th best potential in the country from clean biomass and ranks 10th for its potential from landfill gas-to-energy. In fact, Indiana could generate more than 36.6 billion kilowatt-hours (kWh) from wind, clean biomass and landfill gas—enough to power 3.6 million homes and offset almost a third of the state’s generation from dirty coal-fired power plants.

Indiana’s Potential to Generate Electricity from Solar Energy
Indiana has useful solar resources, particularly in the southern portion of the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Indiana

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
could produce around 886,000 kWh per year. This is enough to power 88.9 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 31,828,000 kWh per year — enough to power 3,194.0 homes.\textsuperscript{141}

**Renewable Energy Boosts the Economy...**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 20,900 jobs in Indiana by 2010 and 36,000 jobs by 2020.\textsuperscript{142}

In addition to creating jobs, renewable energy development would benefit Indiana’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20\% renewable energy generation by 2020 would produce (cumulative through 2020):\textsuperscript{143}

- Nearly $800 million in new capital investment in Indiana;
- $23 million in new property tax revenue for local communities; and
- $3 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Indiana’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset almost 6.9 million tons of global warming emissions (carbon dioxide), more than 36,000 tons of soot-forming pollution (sulfur dioxide) and more than 22,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\textsuperscript{144}

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### Generating Solutions: Case Studies

**Growing Energy on Indiana’s Farms**

Professors Hugh Brown and James Eflin of Ball State University’s Department of Natural Resources and Environmental Management completed a study in November 2002 showing that Indiana has tremendous potential for cultivation of switchgrass as an alternative energy crop. According to the researchers’ geographic information system (GIS) estimates, Indiana could almost replace electricity generated by coal combustion if all agricultural lands were converted to grow switchgrass. As the professors note, not all agricultural land in Indiana is suitable or available for energy production. However, the report concludes that biomass energy has the potential to contribute substantially to Indiana’s overall energy needs. Interestingly, the researchers found that idle land, marginal land (land less suitable for row-cropping or reclaimed surface mining lands) and degraded land represent the most attractive options for initial introduction of bioenergy crop production in Indiana.\textsuperscript{145}

**Testing the Winds in Indiana**

Orion Energy of Oakland, California plans to build a meteorological tower near Scircleville, about 30 miles north of Indianapolis in Clinton County. Orion will use the tower to determine whether enough wind blows in the area to power its electrical generators. Company spokesman J. Turner Hunt said that the tower will stand for two years at the most. Testing and construction of windmills will take at least another year, if Orion decides to go forward with construction.\textsuperscript{146}

If the wind data proves promising and the company’s project feasibility guidelines are satisfied,
Orion selected the testing site because the surrounding land generally slopes downward for about 50 miles in every direction. The company will lease the land, now used for farming, while conducting the tests.\textsuperscript{148}

\textbf{Powering Business with Landfill Gas, Fort Wayne, Indiana}

The General Motors Fort Wayne Assembly Truck Plant has implemented a landfill gas-to-energy project, where methane gas produced from a local landfill is used to displace a portion of the natural gas used at the facility. The facility captures methane gas that is created by decomposing trash and delivers it to the Fort Wayne plant for burning through a network of collection pipes. This is the second General Motors plant to utilize landfill gas as an energy source.

The GM facility receives approximately 16\% of its energy needs via the methane gas from the Serv-All Landfill. The powerhouse obtains as much as 70\% of the energy it needs to fire the boilers from the landfill gas facility, rather than natural gas, according to Dave Shenefield, site utilities manager for the Fort Wayne assembly plant. GM's cost savings at the plant as a result are anticipated to be more than \$500,000 annually.\textsuperscript{149}
Iowa’s Electricity Mix

Iowa is too dependent on dirty energy sources. In 2000, Iowa generated 97% of its electricity from fossil fuels and nuclear power and only 1% from renewable sources, such as wind. Coal, the dirtiest of fossil fuels, accounted for 85% of the state’s electricity mix, making Iowa one of the most coal-dependent states in the country. The state also relied on the aging Duane Arnold nuclear power plant for 11% of its electricity.

Iowa’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

Iowa has tremendous capacity to generate electricity from renewable sources. In fact, Iowa ranks 10th in the country for the most renewable energy potential; Iowa has the 10th best wind resources, and its potential from clean biomass is second only to Illinois. By fully tapping into its technical potential for wind power alone, Iowa could generate 21 times the electricity it currently generates from dirty energy sources. Assuming average generating capacity of 33%, Iowa’s wind potential still exceeds its current generation from all sources by seven times. Iowa’s total generation potential from wind, clean biomass and landfill gas is 925.5 billion kilowatt hours (kWh)—enough to power 93 million homes.

Iowa’s Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Iowa has good, useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Iowa could produce around 944,000 kWh per year. This is enough to power 94.7 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could produce about 34,215,000 kWh per year — enough to power 3,433.5 homes.150

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 8,300 jobs in Iowa by 2010 and 14,700 jobs by 2020.151

In addition to creating jobs, renewable energy development would benefit Iowa’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):152

- $2.2 billion in new capital investment in Iowa;
- $126 million in new property tax revenue for local communities; and
- $30 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Iowa’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 668 million tons of global warming emissions (carbon dioxide), 3.5 million tons of soot-forming pollution (sulfur dioxide) and more than 2.1 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.153

According to the Iowa Department of Natural Resources, if 1000 acres of Iowa land were covered with solar panels, the energy produced would:154

- equal the energy use of 111,000 homes;
- displace the consumption of 438,480 tons of coal per year;
- keep $10.9 million in the local economy rather than exported to pay for fossil fuels;
- avoid 1,200,000 tons of global warming emissions (carbon dioxide) per year;
- avoid 2,900 tons of smog-forming pollution (nitrogen oxides) per year;
- avoid 33,000 tons of soot-forming pollution (sulfur dioxide) and carbon monoxide annually.

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**Generating Solutions: Case Studies**

Iowa has more than 400 wind turbines with total nameplate capacity of more than 423 MW. This is enough power to generate electricity for more than 130,000 homes per year and offset more than 1.3 million tons of global warming emissions (carbon dioxide) annually. Iowa is home to four major wind farms, with a fifth currently in development.155 On March 26, 2003, MidAmerican Energy announced its plans to build 310 megawatts of wind energy generation facilities in Iowa, the largest land-based wind project in the world.156

**Powering Worth County’s Economy with Wind: Top of Iowa Wind Farm**
The Top of Iowa Wind Farm, an 80-MW facility with 89 turbines, is located on approximately 5,500 acres of cropland in western Worth County, Iowa. Completed in November 2001, Top of Iowa was a joint venture with Midwest Renewable Energy Corporation; Entergy now has majority ownership. Zilkha Renewable Energy provided all the capital required to build the project and
sells all of the electricity under a power purchase agreement with Alliant Energy of Madison, Wisconsin. The Top of Iowa Wind Farm produces enough electricity to supply about 24,000 homes annually.\textsuperscript{157}

The wind farm has sparked the economy in Worth County. The construction site created approximately 200 temporary jobs and expended 51 man-years of labor; the site requires eight full-time staff for ongoing operation and maintenance. In addition, the wind farm entered into easement agreements for 49 parcels of land; the landowners receive more than $250,000 in lease payments. The Top of Iowa Wind Farm also will pay more than $9 million in property tax to Worth County over the project’s expected 25-year lifetime.\textsuperscript{158}

In addition to the economic benefits, each turbine offsets pollution that would otherwise be created by fossil-fueled power generation. Each year, the Top of Iowa Wind Farm displaces 370 million pounds of pollution linked to acid rain, smog and global warming.\textsuperscript{159}

Midwest Renewable Energy Corporation is now in the final stages of developing the wind farm’s second phase, the 110 MW Top of Iowa Wind Farm Phase II wind energy project. The developers have permitted the site and are ready to construct, pending a contract with a power purchaser; they plan to commence commercial operation in 2004. When complete, the Phase II wind farm will consist of approximately 67 wind turbines located on more than 7,300 acres of cropland in Worth County. When operational, the Phase II wind farm is anticipated to deliver approximately 300 GWh of renewable energy per year, enough power for about 30,000 homes.\textsuperscript{160}

The second phase of the Top of Iowa wind farm will inject additional economic activity into the Worth County economy. The project will create approximately 100 temporary construction jobs and six permanent jobs for ongoing maintenance and operation. The developers have leased land from 67 landowners, offering approximately $4,000 per turbine per year. The second phase alone will generate approximately $600,000 a year in tax revenue for the county and state.\textsuperscript{161}

**Powering Clear Lake’s Economy with Wind: Cerro Gordo Wind Farm**

The Cerro Gordo Wind Farm, equidistant to Des Moines and Minneapolis, is situated about two miles south of Clear Lake, Iowa and spans across approximately 10 square miles of farm land. With turbines and roads located predominantly between fields along property lines, the regular harvesting of corn and beans continues with minimum change. The $42 million wind farm generates sufficient power to supply 20,000 Iowa homes with electricity for more than 20 years. FPL Energy and enXco co-developed the project; Alliant Energy purchases the power generated by the wind farm.\textsuperscript{162}

The Cerro Gordo project provided a spark for the local economy. Construction created 70 temporary construction jobs for about seven months; ongoing operation and maintenance requires five permanent employees. A total of 13 landowners participate in the wind farm project and collect lease revenue for placing turbines on their property. In addition, the Cerro Gordo Wind Farm has become part of the local tourism economy. The motor coaches coming through town stop at the Surf Ballroom, Music Man Square and now the wind farm.\textsuperscript{163}

**Growing Energy on Iowa’s Farms**

Chariton Valley Resource Conservation & Development (RC&D) coordinates Iowa’s first major switchgrass demonstration project. Switchgrass is a perennial warm-season grass native to Iowa that has significant potential as an alternative energy crop. Chariton Valley RC&D is coordinating the cultivation of approximately 4,000 acres of switchgrass. The goal of the project is to eventually use the switchgrass as a fuel to replace a portion of the coal burned at Alliant
Prairie Lands Bio-Products, Inc., a group of 50 switchgrass producers formed through the project, is leading efforts to develop products and markets derived from the plant, such as paper, fiberboard, mulch, and logs.\footnote{164}

In October 2002, U.S. Senator Tom Harkin announced new funding for the Chariton Valley RC&D switchgrass project. Upon announcing this funding, Senator Harkin said that switchgrass "is yet another way to develop our rural economy. It's a viable fuel source that's environmentally sound and provides income for Iowa farmers."\footnote{165}

The $2 million dollar grant was awarded by the Department of Energy to install new equipment for testing at the Ottumwa Generating Station. It will allow for the co-firing of 12.5 tons of biomass per hour. Funds also will go to construct a switchgrass storage facility and to conduct ergonomic, environmental and marketing activities to support the use and production of biomass. By mixing switchgrass with existing coal at power plants, the energy crop can help generate 35 MW of electrical power — enough to light approximately 40,000 homes.\footnote{166}

**Forest City School District Generates Power with Wind**

In January 1999, the Forest City School District installed a wind turbine as a physics class project. The turbine, designed to meet approximately 85% of the campus’s electrical needs, started producing in January of 1999.

The wind turbine is a boost to the school district in Forest City, a small town located in north central Iowa with a population of about 5,000. The power from the turbine is sent into the grid owned by the City of Forest City and Dairyland Power. The school system receives full credit for all power produced against its electrical bill. In its first four years, the turbine has produced 3.7 million kWh of electricity with an approximate dollar value of $224,600, including $56,066 in energy production credits from the federal government.\footnote{167}

In addition, the school’s wind turbine has displaced pollution that would have otherwise been produced from fossil-fueled power generation. Since the turbine began operating, it has offset 2,972 tons of global warming emissions (carbon dioxide) and 13.5 tons of soot-forming pollution (sulfur dioxide).\footnote{168}
Kansas is too dependent on dirty energy sources. In 2000, Kansas generated almost all of its electricity from fossil fuels and nuclear power. Coal, the dirtiest of fossil fuels, accounted for nearly three-fourths of the state’s electricity mix. In addition, Kansas relied on nuclear power for one-fifth of its electricity needs; nuclear power produces waste that remains lethal for thousands of years.

Kansas has tremendous potential to generate electricity from renewable resources. In fact, Kansas has the best technical potential from renewables in the country. The state ranks 1st for its wind potential and 4th for its generating potential from clean biomass. Using wind power alone, Kansas could generate 37 times the electricity it currently generates from all energy sources. Kansas’s total generation potential from wind, clean biomass and landfill gas is more than 1,706 billion kilowatt hours (kWh)—enough to power 170 million homes.

*Data for the year 2000 was the most recent available. These percentages may have changed slightly.*
Renewable Energy Boosts the Economy...
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 7,100 jobs in Kansas by 2010 and 12,500 jobs by 2020.170

In addition to creating jobs, renewable energy development would benefit Kansas’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):171

- $3.2 billion in new capital investment in Kansas
- $149 million in new property tax revenue for local communities; and
- $47 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Kansas’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset more than 1.2 billion tons of global warming emissions (carbon dioxide), more than 6.7 million tons of soot-forming pollution (sulfur dioxide) and more than 4.1 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.172

Generating Solutions: Case Studies

Powering Gray County’s Economy with Wind: Gray County Wind Farm
The Gray County Wind Farm, completed in December 2001, is the largest wind farm in Kansas, sporting 170 turbines with generating capacity of 110 megawatts—enough electricity to power 33,000 homes. The wind farm spans a 12,000-acre site near the small farming community of Montezuma, with only six acres directly used for tower sites and roads. The wind farm is owned by FPL Energy.173

The Gray County Wind Farm has had an energizing effect on the local economy. Early construction of the wind farm created about 150 construction jobs and injected additional money into the local economy as the developers rented trucks, cranes and other equipment.174 Restaurants, gas stations and hardware stores in the area reported increased business from construction workers building the Gray County Wind Farm and sightseers lured off the highway to watch the wind turbines.175 More than 20 farmers and other landowners agreeing to house a wind turbine on their property are receiving about $2,000 per year per tower.176

Before the wind project came to town, Debbie Wehkamp’s farm equipment supply business was closing its doors for good. The wind farm could not have come at a better time for her. Now, she works as the administrative assistant for Gray County Wind Energy. Because the wind farm has sparked new activity in town, she says, “I don’t think there is anyone in town who is not completely thrilled to have the wind farm here.”177

The Gray County project has benefited Kansas’s environment and public health as well. Compared to the average Kansas electricity mix, the Gray County Wind Farm reduces emissions...
of carbon dioxide by approximately 297,000 tons, smog-forming pollution (nitrogen oxides) by 696 tons and soot-forming pollution (sulfur dioxide) by 957 tons.\textsuperscript{178}

**Powering Wichita County's Economy with Wind: Sunflower Electric Wind Farm**

In February 2003, Sunflower Electric Power Corporation and Renewable Energy Systems (RES), an international wind farm developer, announced plans to construct the Sunflower Electric Wind Farm in Wichita County, near Leoti, Kansas. RES North America and Sunflower expect to break ground in April or May 2003 and plan to complete the first phase of the project by December 2003. When completed, the wind farm, comprised of between 17 and 20 wind turbines laid out in rows on a 7,000 acre project site, will have the capacity to generate 30 MW of power. The site, located in eastern Wichita County, has the capacity to expand to 100 MW.\textsuperscript{179}

The wind farm is likely to be a boon to the local economy. Sharla Krenzel, director of the Wichita County Economic Development Corporation, expressed her excitement about the economic impact this project will bring to Wichita County. The project, once expanded to 100 MW, is expected to create up 150 temporary construction jobs and as many as 10 permanent jobs and generate approximately $100 million in capital investment.\textsuperscript{180} In addition, the wind project developers have entered into lease agreements with 14 local landowners, offering them monthly payments in exchange for placing wind turbines on their property. The wind farm also will generate additional revenue for the county treasury. Wichita County has entered into a Payment in Lieu of Taxes (PILOT) agreement with the company, in which the company has agreed to pay $2,500 per megawatt of capacity built per year for 10 years.\textsuperscript{181}

**Powering Butler County's Economy with Wind: Elk River Windfarm**

In March 2003, Butler County planning commissioners approved a proposal for an 8,000-acre wind farm about three miles south of Beaumont, Kansas. Elk River Windfarm, a Kansas limited liability corporation wholly owned by Greenlight Energy, is developing the project. Jeff Schlichting, president of Elk River Windfarm, said that construction would begin late this year and be completed in the third quarter of 2004, pending resolution of any final challenges. The project would include 67 wind turbines on 8,000 acres of land and generate 100 MW of power, enough capacity to power about 40,000 homes a year.\textsuperscript{182}

In addition to displacing 300,000 tons of global warming emissions (carbon dioxide), soot-forming pollution (sulfur dioxide), smog-forming pollution (nitrogen oxides), mercury and other emissions each year, the Elk River Windfarm project could serve as a tremendous economic stimulus for Butler County. Schlichting said that whenever possible, Elk River Windfarm will use local resources to construct and operate the project. He anticipates that the initial groundbreaking will create approximately 125 jobs over the 9-month construction period, adding that there would be approximately seven permanent jobs once the project was completed.\textsuperscript{183}

In addition to creating new jobs, Schlichting said that his company plans to make lease payments to the farmers willing to site wind turbines on their land. Elk River Windfarm also has committed to making an annual community contribution of $175,000 in each of the first 10 years of the project’s operations, assuming a final project capacity of 100 MW. Schlichting said that his company would divide this sum amongst the school districts, Butler County government and Butler County Community College.\textsuperscript{184}

**Powering Kansas's Municipalities with Wind**

In March 2003, Kansas Wind Power announced that it is working with five municipalities to finance and construct small wind projects in each city. Kansas Wind Power’s project facilitates
economies of scale, such as bulk turbine purchases, financing terms and construction efficiencies, which would not be possible for an individual municipality wind project. Kansas Wind Power has obtained commitments for the first 30 MW of power from five cities and is in the process of obtaining similar agreements with other neighboring counties for the same project.

The Larned council unanimously authorized City Manager Don Gaeddert and City Attorney Jerry Larson to work out a letter of intent for a 10-megawatt wind farm. Gaeddert said the wind farm would include seven or eight large wind turbines, each standing on 263-foot-tall towers.
**Louisiana’s Electricity Mix**

Louisiana is too dependent on dirty energy sources. In 2000, Louisiana generated 95% of its electricity from fossil fuels and nuclear power and 4% from renewable sources. The state depends on coal, the dirtiest of fossil fuels, for more than a quarter of its electricity needs. Natural gas, which is subject to frequent price fluctuations, provided almost half of the state’s electricity in 2000.

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### Louisiana’s Potential to Generate Electricity from Clean Biomass and Landfill Gas

<table>
<thead>
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<th>Source</th>
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<td>Clean Biomass</td>
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</tr>
<tr>
<td>Landfill Gas</td>
<td>390</td>
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</tbody>
</table>

Louisiana has good capacity to generate electricity from clean biomass and landfill gas. In fact, Louisiana has the technical potential to displace its nuclear power generation using just these two renewable resources; alternatively, clean biomass and landfill gas could displace three-fourths of the coal-generated electricity in the state. Louisiana’s total generation potential from clean biomass and landfill gas is 17.9 billion kilowatt hours (kWh)—enough to meet 20% of the state’s electricity demands.

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**Note:**

- Data for the year 2000 was the most recent available. These percentages may have changed slightly.
- The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. However, the purpose of presenting the state’s energy mix is to show the importance of clean energy sources. In Louisiana, some wood-burning generators can be quite dirty; therefore, this number may be high.
needs or power 1.8 million homes. Unfortunately, Louisiana does not have any significant capacity for wind power generation.

**Louisiana’s Potential to Generate Electricity from Solar Energy**

Louisiana has good, useful solar resources throughout the state. If the state installed a PV array with a collector area equal to the size of a football field, Louisiana could produce around 945,000 kWh per year. This is enough to power 94.9 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 33,419,000 kWh per year — enough to power 3,353.6 homes.\(^{186}\)

**Renewable Energy Boosts the Economy**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 19,200 jobs in Louisiana by 2010 and 32,900 jobs by 2020.\(^{187}\)

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### Generating Solutions: Case Studies

**Powering the Waddill Wildlife Refuge with the Sun**

In August 1999, the Louisiana Department of Natural Resources installed a photovoltaic system at an educational pavilion constructed by the Department of Wildlife and Fisheries at the Waddill Wildlife Refuge. The pavilion is used to conduct hunter safety courses for residents obtaining a hunting license in Louisiana. The system, consisting of two pole-top mounted arrays with eight 77-watt panels on each array, has a generating capacity of 1.2 kW. The building is completely off-grid; the photovoltaic system powers the pavilion’s interior and exterior lighting, ventilation, and lighting at the skeet range.\(^{188}\)

**North DeSoto Middle School Goes Solar**

“Watts On Schools” is American Electric Power’s way of bringing solar power to schools in communities throughout Texas, Arkansas and Louisiana. Through Watts On Schools, AEP has installed nineteen solar energy systems at public elementary, middle, and high schools located within the service areas of three of its electric utility operating companies. Participating schools receive the energy produced by the systems for free, lowering the schools’ electric bills every month. In addition, participating schools receive solar energy educational materials and conduct solar energy events on an annual basis.

North DeSoto Middle School in Stonewall, Louisiana began generating its own solar power from a photovoltaic solar system on March 24, 2000. The school’s system has 16 solar modules with a generating capacity of 4 kW. Over the course of a year, the system will feed about 6,000-8,000 kilowatt-hours of electricity into the school building.\(^{189}\)

North DeSoto Middle School saves about $537 a year on its electric bills by generating its own electricity from the solar array.\(^{190}\) In addition, by generating electricity from the sun rather than fossil fuels, the school offsets 12,000 pounds of global warming emissions (carbon dioxide), 29 pounds of soot-forming pollution (sulfur dioxide) and 24 pounds of smog-forming pollution (nitrogen oxides) each year.\(^{191}\)
Maine’s Electricity Mix

Maine derives 42% of its energy from fossil fuels and 29% from hydroelectric power, which is less polluting than fossil fuels but causes its own set of environmental problems that could be avoided with increased generation from renewable energy sources. According to the Department of Energy, Maine generated 29% of its electricity from renewable sources, however, a large percentage of this likely came from dirty incinerators and polluting wood-burning facilities.

Maine’s Potential to Generate Electricity from Wind and Clean Biomass

Maine has good capacity to generate electricity from wind and clean biomass. In fact, Maine could generate 36% more electricity from wind and clean biomass than it currently does from dirty energy sources and more than triple the amount of electricity generated from renewable sources in 2000. Maine’s total potential for electricity generation from these renewable sources is 12.7 billion kilowatt hours (kWh)—enough to meet 98% of the state’s electricity needs or power 1.2 million homes.

Maine’s Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly. The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass. In addition, some wood-burning generators can be quite dirty; again, it was not possible to separate clean wood-burning facilities from the more polluting facilities. Therefore, the number may be high.
Maine has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Maine could produce around 921,000 kWh per year. This is enough to power 92.4 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 31,032,000 kWh per year — enough to power 3,114.1 homes.  

Renewable Energy Boosts the Economy...  
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 3,700 jobs in Maine by 2010 and 6,600 jobs by 2020.  

...While Protecting the Environment  
Based on the American Wind Energy Association's statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Maine’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 7.1 million tons of global warming emissions (carbon dioxide), more than 37,000 tons of soot-forming pollution (sulfur dioxide) and almost 23,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.  

Generating Solutions: Case Studies  

**Powering Redington Township's Economy with Wind: Redington Mountain Wind Project**  
Endless Energy Corporation is developing Maine’s first wind farm along 220 acres of the Redington Pond Range and Black Nubble mountains in Redington Township, approximately four miles west of Sugarloaf Mountain ski area and eight miles south of Stratton, Maine. The 29 wind turbines will have a 52-MW capacity, generating about 200 million kilowatt hours a year, enough to power 33,000 Maine homes. The company hopes to begin construction in the spring of 2004 and commence commercial operation by the end of the year.  

The Redington wind project also will provide a spark for the local economy. Endless Energy estimates that wind project will create 30 temporary jobs during the construction phase and up to ten permanent positions for ongoing operation and maintenance. In addition, the company says that the project will generate an additional $400,000-$600,000 in tax revenue for the state and county each year.  

In addition to these economic benefits, the Redington project will prevent more than 630,000 pounds of pollution per day compared to existing fossil fuel produced electricity in New England.  

**Maine Audubon Society Constructs a Green Building**  
Maine Audubon Society runs the Gilsland Farm Environmental Center and Sanctuary, located in Falmouth. When the staff had outgrown the headquarters building in 1995, special thought went into how to construct the new building. The building had to blend in with the surrounding landscape and structures, use construction materials that minimized negative impact on the environment, and at the same time serve the needs of the staff and public who use it. Using geothermal energy as well as solar energy to power its office was one way of meeting this goal.  

There are three geothermal heat pumps that draw water from a 600 foot well. These pumps extract heat from the 45-50°F groundwater and transfer it to a closed loop of water circulating through tubing in the floor. Heated up to 130°F, the circulating water warms the surrounding concrete, which radiates heat for the building. The system, although more expensive to install...
than traditional heating systems, is expected to pay for itself over its 20-year lifetime by using much less electricity than traditional systems. The payback will be faster if it is used for air-conditioning as well as heating, as the geothermal heat pump can cool a building at 35% less cost than conventional air conditioning. Maintenance costs are also substantially lower for both residential installations of geothermal heat pumps than traditional fossil fuel powered heating.

Maine’s Solar House
The two-story custom home of William and Deborah Lord on Maine’s Cape Porpoise coastline is a model of energy efficiency and the use of renewable energy. The house has 16 photovoltaic (PV) solar modules installed on the roof with a total capacity of 4.2 kW. The panels take up 384 square feet of roof space. In 2002, the PV array generated 3.188 MWh of electricity, enough to offset almost all of the family’s electrical consumption. Between January and March 2003, the panels generated 1,014 kWh, an almost record amount.

The solar panels added to the initial expense of building the home but have since offset energy costs. For example, the PV system generated more power than the Lords used in 1998, allowing the family to save money on its electric bill through the state’s net metering program. In 1998, the Lords only paid the fee to connect to the grid, $8 a month.

Using the solar PV systems to generate electricity instead of buying it from the electric company also has had many environmental benefits. In 2002, the power generated from the PV displaced more than 25,000 pounds of smog-forming pollution (nitrogen oxide), 9,500 pounds of soot-forming pollution (sulfur dioxide) and more than eight million pounds of global warming emissions (carbon dioxide).
Maryland’s Electricity Mix

Maryland is too dependent on dirty energy sources. In 2000, Maryland generated 95% of its electricity from fossil fuels and nuclear power and less than 1% from renewable sources. The state depended on coal, the dirtiest of fossil fuels, for more than half of its electricity needs, and nuclear power, which generates waste that remains lethal for thousands of years, for more than a quarter.

Maryland’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas

Maryland has important technical potential to generate electricity from wind, clean biomass and landfill gas. In fact, Maryland’s technical potential from renewables could almost offset two-thirds of its electricity generation from nuclear power or one-third of the state’s generation from coal.

Maryland’s total technical potential for electricity generation from these renewable sources is more than 9 billion kilowatt hours (kWh)—enough to meet 18% of the state’s electricity needs or power more than 900,000 homes.

Maryland’s Potential to Generate Electricity from Solar Energy

Maryland has good, useful solar resources throughout most of the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Maryland could

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Z Data for the year 2000 was the most recent available. These percentages may have changed slightly.
produce around 890,000 kWh per year. This is enough to power 89.3 average homes. Similarly, if
the state installed just one concentrated solar system covering approximately 200 acres, it could
generate about 31,032,000 kWh per year — enough to power 3,114.1 homes.206

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy
efficiency could create 12,500 jobs in Maryland by 2010 and 22,000 jobs by 2020.207

...**While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative
emissions of wind power (which are zero) and the average U.S. fuel mix, Maryland’s technical
wind potential, if fully tapped and operating at full-capacity year round, would offset almost 4.3
million tons of global warming emissions (carbon dioxide), more than 22,000 tons of soot-forming
pollution (sulfur dioxide) and almost 14,000 tons of smog-forming pollution (nitrogen oxides)
compared to equivalent generation from the average U.S. power plant.208

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### Generating Solutions: Case Studies

**Powering Garrett County’s Economy with Wind: Clipper Windpower Criterion Project**
On March 26, 2003, Clipper Windpower received approval from the Maryland Public Service
Commission to begin building the Clipper Windpower Criterion Project in Garrett County,
Maryland. When complete, the Criterion Project will include up to 67 turbines distributed along
Backbone Mountain. The Criterion Project will be one of the largest wind energy facilities in the
eastern United States, generating up to 100.5 megawatts of power, enough to serve the annual
energy needs of 35,000 average households in the Mid-Atlantic region. Construction on the first
phase—70.5 MW—likely will begin in early summer 2003 and be completed in late December
2003.209

Criterion will provide numerous economic benefits for the citizens of Garrett County. It will create
approximately 175 temporary construction jobs and 6-8 permanent operating positions. It will
generate an estimated $3.75 million in construction phase work and purchases for local
companies, an estimated $4,900 per year in income tax revenue from personal income taxes,
and up to $800,000 per year in personal property tax revenue.210 Clipper has signed leases with
a dozen Garrett farmers and other landowners, agreeing to pay roughly $2,000 to $4,000 a year
to site wind turbines on their properties.211

In addition to boosting Garrett County’s economy, the project will generate revenue for the
state treasury as well. Construction of the project will generate $243,000 in state income tax
revenue, $55,000 from sales tax from construction purchases, and $47,000 in sales tax on
expenditures by workers. Operation of the project will generate $9,000 annually in state income
tax revenue, $2,400 in sales tax on expenditures by workers and $9,000 in corporate income tax
revenue.212

The project also will offset pollution from dirty power sources, such as coal-fired power plants.
Estimates are that the Criterion Project will displace more than 368,000,000 pounds of global
warming emissions (carbon dioxide), 2,600,000 pounds of soot-forming pollution (sulfur dioxide),
and 860,000 pounds of smog-forming pollution (nitrogen oxides) each year.213

**Powering Garrett and Allegheny Counties with Wind: Big Savage Mountain Wind Project**
U.S. WindForce's Big Savage Mountain project will be located near Lonaconing on an active strip mining operation and will straddle the Garrett and Allegany county line, with 10 turbines located in each county. This 40-MW project, now permitted\textsuperscript{214} and scheduled for completion in December 2003 or early 2004, will be one of the first utility scale wind projects in the state. When it is fully operational, the 25-turbine wind farm is expected to provide electricity for up to 12,000 average-sized homes.\textsuperscript{215}

The project will be a boon to the local area's economy. The construction expenditures are expected to generate $500,000 in federal, state and local taxes. The project will add approximately $1 million dollars to the personal and real property tax base per megawatt of nameplate capacity, or $40 million. In addition, the project is expected to create 150 to 200 construction jobs, generate $250,000 in full-time employee wages and benefits annually, and provide $3 million to construction companies. Local landowners will collect approximately $125,000 annually in lease payments from the project.\textsuperscript{216}

**Using the Earth to Power Choptank Elementary School**

In 1997, Choptank Elementary School in Dorchester County became the first school in Maryland to use geothermal energy for its heating and cooling. Today, the school uses geothermal energy for all of its heating and cooling needs. Chris Hauge, the school district's facilities planner and chief engineer, said that the geothermal system at Choptank exceeded savings projections and paid for itself after just five years.

The geothermal system also provides a higher level of comfort for those in the buildings than traditional heating and cooling systems, according to Hauge. Many traditional systems cannot heat one part of a building and cool another at the same time and often derive power from gas, costing a lot of money. Hauge said that the geothermal system has the ability to heat and cool at once, providing a comfortable atmosphere that leads to more learning. “When teachers and students are comfortable in the classrooms, educational achievement goes up,” Hauge said.

Choptank's geothermal project has been so successful that the school district will use geothermal energy to meet all heating and cooling needs of a new 93,000 square-foot middle school that is under construction. The new middle school is being built right next to Choptank, and the two will combine to make the first geothermal powered multi-school campus in Maryland.\textsuperscript{217}

According to Wedgeco Engineering, the firm that installed the Choptank system, Choptank is consuming 40% less energy than average schools in the state.\textsuperscript{218}

**Fueling NASA Goddard with Landfill Gas**

Landfill gas is fueling boilers at NASA Goddard Space Flight Center (GSFC) in Maryland. In fact, NASA is making history as the first federal agency to burn landfill gas on federal property. The gas is piped about five miles to NASA GSFC from the Prince George’s County Sandy Hill Landfill. Two of the five boilers at GSFC were modified to burn landfill gas and use natural gas and fuel oil as backup.

NASA expects to save taxpayers at least $3.5 million in fuel costs over the next ten years while increasing energy security by relying on a locally available, environmentally-preferable fuel source. In addition, this landfill gas project will reduce greenhouse gas emissions by more than 1.6 million metric tons of carbon dioxide equivalents over ten years. These greenhouse gas benefits are roughly equivalent to removing the emissions of more than 35,000 cars during every year of the project’s lifetime.\textsuperscript{219}
Michigan is too dependent on dirty energy sources. In 2000, Michigan generated 97% of its energy from fossil fuels and nuclear power and only 2% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for two-thirds of Michigan’s energy mix, making it one of the most coal-dependent states in the country. The state relied on its aging fleet of nuclear power plants for nearly one-fifth of its electricity needs.

Michigan has significant technical potential to generate electricity from wind, clean biomass and landfill gas. In fact, Michigan’s technical potential from renewables could almost offset all of the state’s current generation from dirty sources such as coal, oil and gas, and nuclear power. Michigan’s total technical potential for electricity generation from renewable sources is more than 92 billion kilowatt hours (kWh)—enough to meet 88% of the state’s electricity needs or power more than nine million homes.

Michigan has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Michigan could produce around 836,000 kWh per year. This is enough to power 83.9 average homes.

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**Michigan’s Electricity Mix**

Michigan is too dependent on dirty energy sources. In 2000, Michigan generated 97% of its energy from fossil fuels and nuclear power and only 2% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for two-thirds of Michigan’s energy mix, making it one of the most coal-dependent states in the country. The state relied on its aging fleet of nuclear power plants for nearly one-fifth of its electricity needs.

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**Michigan’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas**

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Michigan has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Michigan could produce around 836,000 kWh per year. This is enough to power 83.9 average homes.

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**Michigan’s Potential to Generate Electricity from Solar Energy**

Michigan has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Michigan could produce around 836,000 kWh per year. This is enough to power 83.9 average homes.
Renewable Energy Boosts the Economy...

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 29,800 jobs in Michigan by 2010 and 51,000 jobs by 2020.\(^{221}\)

In addition to creating jobs, renewable energy development will spark the economy. According to an analysis by the Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):\(^{222}\)

- $750 million in new capital investment in Michigan;
- $37 million in new property tax revenue for local communities; and
- $10 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Michigan’s technical wind potential, if fully tapped and operating at full capacity year round, would offset almost 56 million tons of global warming emissions (carbon dioxide), more than 294,000 tons of soot-forming pollution (sulfur dioxide) and more than 180,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\(^{223}\)

Generating Solutions: Case Studies

Powering Mackinaw City with Wind

In July of 2000, the residents of Mackinaw City began researching the feasibility of constructing wind turbine generators in the community. In 2000, the residents joined with Bay Windpower to install the turbines, signing a lease and power purchase agreement to provide the municipally-owned buildings with power at a set rate and provide the city with income from a lease arrangement for the land.

Bay Windpower’s two wind turbines went online on December 3, 2001. In their first four days of operation, they produced enough energy to power nine homes for a year. The turbines produce an estimated 4 million kWh annually.\(^{224}\)

Bay Windpower estimates that the Mackinaw project offsets the combustion of 4 million pounds of coal, 7.2 million pounds of global warming emissions (carbon dioxide), 43,000 pounds of soot-forming pollution (sulfur dioxide), and almost 21,000 pounds of smog-forming pollution (nitrogen oxides) each year, when compared to the emissions generated from Michigan’s current energy mix. This reduces the same amount of carbon dioxide as eliminating 4.8 million miles driven in an SUV (approximately 10,714 round trips between Lansing to Mackinaw City).\(^{225}\)

The company has plans to construct three more turbines in Mackinaw City in 2003 and another in St. Ignace. The company also is working preliminarily with property owners and local governments in many areas of northern Lower Michigan and the Upper Peninsula.\(^{226}\)

Powering Traverse City with Wind

In June 1996, Traverse City Light & Power dedicated the first utility scale wind turbine generator in Michigan. The turbine, installed on a private farm a few miles west of Traverse City, produces...
about one million kWh of electricity a year, enough to meet the needs of 160 average Traverse City homes. The capital cost of approximately $650,000 was partially funded by a $50,000 grant from the State of Michigan and the U.S. Department of Energy's State Energy Program. The company paid the landowner hosting the wind turbine $14,000 for the first year and agreed to pay an additional $1,500 a year for 25 years.

St. Elizabeth Catholic Church Goes Solar
St. Elizabeth Catholic Church in Wyandotte, Michigan received a $4,990 Community Energy Project Grant in October 2001 from the state of Michigan to demonstrate a solar hot water system. St. Elizabeth had already installed a 400-watt wind generator; the church also generates about 640 watts from a photovoltaic system.

Father Charles Morris estimates that 15% of the rectory's electricity and two-thirds of the hot water is generated from solar sources. The church just received another grant and plans to add another 600 watts of solar capacity.

Powering Michigan's Parks with Renewable Energy
In late 1996, the Sleeping Bear Dunes National Lakeshore installed an 11-kW photovoltaic system that provides power for the staff residences and shop on North Manitou Island. The PV array provides essentially all the power required during the prime season, May through August. Lee Jameson, facility manager at the Sleeping Bear Dunes National Lakeshore, says that this PV system has saved the park money on diesel fuel and has eliminated other side effects of diesel power generation, including noise and air pollution and hauling diesel fuel across the lake.

Jameson says that the Sleeping Bear Dunes National Lakeshore plans to install a photovoltaic system on South Manitou Island as well, starting construction on the building for the inverter this year.

Powering Riverview with Landfill Gas
In 1987, Riverview Energy Systems (RES), a partnership between Detroit Edison and Landfill Energy Systems, developed a landfill gas-to-energy project on the 212-acre Riverview Land Preserve Landfill in Wayne County. According to the terms of the project, Biomass Energy Systems, a subsidiary of Detroit Edison, collects the landfill gas and sells it to RES. RES then uses the landfill gas to create electricity with two gas turbines. Detroit Edison purchases the electricity under a 25-year power purchase agreement. It generates enough power to meet the energy needs of more than 3,700 homes. This landfill gas recovery project is the largest combustion turbine project run on landfill gas in the state of Michigan.

"All of the parties involved in the project have gained something, but none more so than the City of Riverview. We gained both economically and environmentally," says Don Schroat, Landfill Director for the City of Riverview.

Since the installation of the landfill gas recovery and electricity generation facilities, property values surrounding the landfill have increased, and new upscale homes are being developed nearby. Safety has improved so much at the closed landfill that the area from which gas is collected, dubbed "Mount Trashmore," has been used as a wintertime skiing and recreation area, and future land-use plans include the development of a golf practice facility and a tube sledding course.

This project has achieved great benefits for the environment as well. The project has resulted in greenhouse gas reductions equivalent to removing 36,000 cars from the road.
Minnesota is too dependent on dirty energy sources. In 2000, Minnesota generated 96% of its electricity from dirty energy sources, relying on coal, the dirtiest of all fossil fuels, for nearly two-thirds of its power. The state also relied on nuclear power, which creates waste that remains lethal for thousands of years, for a quarter of its electricity generation.

### Minnesota’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas

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Minnesota has tremendous potential to generate electricity from wind, clean biomass and landfill gas. In fact, Minnesota ranks 8th in the country for renewable energy potential, with the 5th best clean biomass potential and 8th best wind resources. Minnesota has the technical potential to generate 19 times the electricity from wind as it does currently from all energy sources combined. Minnesota’s total technical potential for electricity generation from these renewable sources is more than 1,021 billion kilowatt hours (kWh)—enough to power more than 102 million homes.

### Minnesota’s Potential to Generate Electricity from Solar Energy

Minnesota has useful solar resources throughout the state, especially in the western regions. If the state installed a photovoltaic array with a collector area equal to the size of a football field, the

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**Abbreviation**

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
state could produce around 925,000 kWh per year. This is enough to power 92.9 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 31,828,000 kWh per year—a sufficient amount to power 3,194.0 homes.\textsuperscript{232}

**Renewable Energy Boosts the Economy**

Several studies have estimated how renewable energy and energy efficiency programs could boost the economy of Minnesota.

- According to an analysis by the Regional Economics Applications Laboratory for the Environmental Law and Policy Center, a renewable energy standard requiring 22\% renewable energy generation in the Midwest by 2020 would produce 6,415 net new jobs in Minnesota and $674 million in increased economic output, mostly from construction, manufacturing and service-related sectors.\textsuperscript{233}

- According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20\% renewable energy generation by 2020 would produce (cumulative through 2020):\textsuperscript{234}
  
  - $2.4 billion in new capital investment in Minnesota;
  - $144 million in new property tax revenue for local communities; and
  - $39 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Minnesota’s technical wind potential, if fully tapped and operating at full-capacity year-round, would offset more than 753 million tons of global warming emissions (carbon dioxide), almost four million tons of soot-forming pollution (sulfur dioxide) and more than 2.4 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\textsuperscript{235}

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**Generating Solutions: Case Studies**

**Powering the Economy of Lincoln County with Wind: Lake Benton I Wind Project**

Lake Benton I is the second wind project in Lincoln County, the first being Buffalo Ridge, just southwest of the town of Lake Benton. The Lake Benton I wind project is comprised of 143 wind turbines spread across more than 19,000 acres of land; it has the capacity to generate 107 MW of electricity. GE Wind Energy owns and operates Lake Benton I, which began production in 1998; Xcel Energy purchases the power produced.

Construction of the Lake Benton I project created 150 temporary construction jobs. A recent report by Northwest Economic Associates found that ongoing operation and maintenance of Lake Benton I, by increasing expendable income, supports 31 jobs in Lincoln County and more than $909,000 in personal income. In addition, the Lake Benton I wind development paid $71,800 in county property taxes in 1999, $611,200 in 2000, and $621,000 in 2001. The Lincoln County school district and county offices received $275,000 of this revenue in 2000 and 2001; the local townships received about $61,000 each year from the wind project.\textsuperscript{236}

Landowners have benefited as well. The developer purchased easements on 17,100 acres of land for 128 of the turbines for almost $10 million. Landowners hosting the remaining 15 turbines receive annual royalty payments of at least $1,500 per turbine per year.\textsuperscript{237}
Powering Pipestone County’s Economy with Wind: Moraine Wind Project
In southwestern Minnesota, PacifiCorp Power Marketing, Inc. (PPM) plans to build the Moraine Wind Power Project in Pipestone County using 34 wind turbines from GE Wind Energy to produce approximately 51 MW of electricity. Xcel Energy will buy all of the power from the wind facility, which could begin commercial operation in fall 2003. Peak construction will occur this summer, creating about 100 construction jobs.

The Moraine project has rebuilt a farming community. In 1996, the town of Chandler in Pipestone County near the planned Moraine wind farm was completely leveled by a tornado. The Moraine project, now the biggest industry in the area, has done much to rebuild the community. The community, known as a local hot spot for fishing and other outdoor recreation, has received an unexpected response from tourists interested in visiting the wind farm.

Powering Southeast Minnesota with Wind
In March 2003, Southern Minnesota Municipal Power Agency (SMMPA) installed two 950-kilowatt wind turbines on a soybean field south of Fairmont in southeast Minnesota. The wind turbines will generate about 2.5 million kWh each at a 33% capacity factor. This is enough power for approximately 700 homes.

The wind power is generated at a slight premium to consumers at 1-1.5 cents per kWh. However, Dan Hayes, a manager at SMMPA, notes that the community may experience other types of savings, as the turbines will produce enough power to offset approximately 15 train car loads of coal a year. At 100 tons of coal per car, this is about 1,500 tons of coal a year that will not be releasing pollutants into the air.

Hayes also estimates that the project has benefited the economy by supporting existing jobs in the area. As much as possible, the company purchased supplies for the project from local or domestic vendors. The farmer hosting the turbines receives about $2,500 in royalties for each turbine per year. In all, the company spent $2.1 million dollars on the project.

Wayzata School District Wind Turbine Project
In the suburbs of Minneapolis, school officials are planning to put the power of wind to work to help meet the energy needs for Wayzata High School. Officials have proposed putting one 1.5-MW wind turbine on the campus of the high school in northwest Plymouth. Currently, a wind monitoring station is collecting data about the wind speeds near the soccer field of the high school in preparation for the installation of the turbine. The school will need a grant and the promise of a state production payment for the wind generation to make the project financially viable. The community has responded in an almost overwhelmingly positive manner, and school officials hope to see the turbine installed within the next year.
Missouri is too dependent on dirty energy sources. In 2000, Missouri generated more than 99% of its electricity from dirty energy sources. In fact, the state relied on coal, the dirtiest of fossil fuels, for 82% of its electricity generation. Missouri also generated 13% of its electricity from the aging Callaway nuclear power plant, which produces waste that remains lethal for thousands of human generations.

Missouri's Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas

Missouri ranks 8th in the country for its potential from clean biomass. Missouri has the technical potential to more than replace all of its current electricity generation from dirty energy sources with renewable sources; Missouri’s wind potential alone could meet the state’s current electricity needs. Missouri’s total technical potential for electricity generation from these renewable sources is more than 110 billion kilowatt hours (kWh)—enough to power more than 11 million homes.

Missouri's Potential to Generate Electricity from Solar Energy

Missouri has good and useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, the state could generate 28,076 million kWh of electricity from clean, renewable solar power.

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Missouri's Electricity Mix

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Missouri has significant potential to generate electricity from renewable sources such as wind, clean biomass and landfill gas. Missouri's wind potential alone could meet the state’s current electricity needs. Missouri's total technical potential for electricity generation from these renewable sources is more than 110 billion kilowatt hours (kWh)—enough to power more than 11 million homes.

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Missouri’s Electricity Generation by Source (2000):

- Coal: 82%
- Nuclear: 13%
- Petroleum: 3%
- Gas: 4%
- Renewables: 0.1%
- Hydro: 0.5%
produce around 957,000 kWh per year. This is enough to power 96.1 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 35,011,000 kWh per year — enough to power 3,513.4 homes.247

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 15,100 jobs in Missouri by 2010 and 26,600 jobs by 2020.248

In addition to creating jobs, renewable energy development would benefit Missouri’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):249

- $1.6 billion in new capital investment in Missouri;
- $62 million in new property tax revenue for local communities; and
- $4 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Missouri’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset almost 62 million tons of global warming emissions (carbon dioxide), more than 325,000 tons of soot-forming pollution (sulfur dioxide) and almost 200,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.250

### Generating Solutions: Case Studies

#### Powering Education with Landfill Gas Energy, Maryland Heights, Missouri
In Maryland Heights, Missouri, students in the ecology club at Pattonville High School proposed using methane from the nearby Fred Weber Landfill to heat their school. Fred Weber, Inc. donated the methane as a gift to the community and spent about $200,000 to get the project started. The school paid $175,000 to bury a 3,600-foot pipeline from the landfill to the school’s basement boilers. Saving $40,000 a year, the school expects to pay off its investment in five years and use the methane for at least another ten.

Pattonville High School officials have heated their building using landfill gas since 1997. However, the idea that led to the partnership with Fred Weber was born three years earlier during a dinner-table discussion at Marc Ramsey’s home. Ramsey, a civil engineer, is Fred Weber’s vice president of landfill operations. He said his daughter, a high school student at the time, asked if it would be possible to pipe landfill gas to her school. Fred Weber was already utilizing landfill gas in its asphalt and concrete operations as well as to heat a commercial greenhouse, but the landfill produced far more gas than the company could use. As a result, the landfill was flaring, essentially wasting, the excess. Ramsey began talks with school administrators to interest them in the possibility of a partnership, and he initiated the feasibility study that brought about the project.251

#### Powering Business with Landfill Gas, St. Louis, Missouri
After three and one-half years in development, the Onyx Oak Ridge Landfill now supplies landfill gas as a direct-fuel to the DaimlerChrysler St. Louis Assembly plant boilers. Landfill gas from the Oak Ridge Landfill is sent via a 4.5-mile pipeline to the DaimlerChrysler Assembly Plant. The
Kansas City Discovery Center Goes Solar

The Discovery Center, a conservation learning center that emphasizes learning by doing, is located on the ten acre Urban Conservation Campus in Kauffman Legacy Park just east of the Country Club Plaza. This facility is a joint project of the Missouri Department of Conservation and the Missouri Department of Natural Resources.

The Discovery Center installed four building integrated photovoltaic systems at the time of the Center’s construction to demonstrate the variety, dependability and safety of PV as a part of basic architectural planning. The generating capacity of the four systems totals 7.2 kilowatts.

The solar electric systems on the Discovery Center save about $835 per year in electric bills at current electric rates. In addition to saving money, the Discovery Center systems offset 25,700 pounds of global warming emissions (carbon dioxide); 110 pounds of smog-forming pollution (nitrogen oxides); and 240 pounds of soot-forming pollution (sulfur dioxide) per year.
Montana’s Electricity Mix

Montana is too dependent on dirty energy sources and hydroelectric power. In 2000, Montana generated 58% of its electricity from fossil fuels and less than one percent from renewable sources. Although hydroelectric power, which accounted for 42% of the state’s total energy mix, is less polluting than fossil fuels, it causes its own set of environmental problems that could be avoided by turning to renewable energy.

Montana has tremendous technical potential for generating electricity from renewable sources. In fact, Montana ranks 7th in the country for renewable energy potential, with the 7th best wind resources. Montana’s wind potential alone could generate 36 times the electricity currently produced from all sources. Montana’s total technical potential for electricity generation from these renewable sources is almost 1,045 billion kilowatt hours (kWh)—enough to power more than 104 million homes.

Montana’s Potential to Generate Electricity from Solar Energy

Montana has good, useful solar resources, especially in the southern portion of the state. While Montana’s solar theoretical potential is enormous, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the

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Data for the year 2000 was the most recent available. These percentages may have changed slightly.
West, if Montana installed solar photovoltaic systems on .5% of the state’s land area, it could generate 101,000 million kWh, or more than triple the state’s total electricity generation in 2000. Said another way, according to the Department of Energy, if the state installed a photovoltaic array with a collector area equal to the size of a football field, the state could produce around 976,000 kWh per year. This is enough to power 97.9 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 38,194,000 kWh per year — enough to power 3,832.8 homes.

### Renewable Energy Boosts the Economy...

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 2,300 jobs in Montana by 2010 and 4,000 jobs by 2020.

In addition to creating jobs, renewable energy development would benefit the economy of the Pacific Northwest. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would (cumulative through 2020):

- Spark more than $7 billion of new investment in renewable energy generation in the Northwest;
- Generate almost $100 million in lease payments for the region’s farmers, ranchers and rural landowners from wind power;
- Produce more than $400 million in new property tax revenue for local communities in the region;
- Reduce average natural gas prices by an estimated 3% in 2010 and 10% in 2020 in Washington and Oregon and by 4% in 2010 and 14% in 2020 in Montana and Idaho compared to business as usual;
- Save the region’s energy consumers at least $3.1 billion; and
- Reduce a typical household’s monthly electricity bill by $1.94.

### While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Montana’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 786 million tons of global warming emissions (carbon dioxide), more than 4.1 million tons of soot-forming pollution (sulfur dioxide) and more than 2.5 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

### Generating Solutions: Case Studies

#### Ranching with Solar Energy

Farmers and ranchers across Montana are using solar power to save time and money. Solar-powered livestock watering systems provide cost-effective, off-grid electricity to run water pumps far from the utility grid. These systems also reduce livestock pressure on stream banks, mitigating nutrient loading, damage to streamside vegetation, erosion and pollution.

- Jim and Adele Ballard graze 250 cattle on their ranch in the Musselshell River valley near Lavina, Montana. When the small windmill used to pump water to the stock tanks broke, the Ballards had to haul water to their cattle for 45 days during the heat of the summer. The Ballards installed a solar-powered pumping system on the advice of their neighbors.
Every summer, Jim Tomlinson pastures cows in timber and grassland several miles from the town of Gold Creek, Montana. In June 2000, Tomlinson installed a solar-powered pumping system to replace the gasoline-powered pumping system that required rigid upkeep. The solar pumping system is reliable and nearly maintenance free, keeping Tomlinson’s tanks full all summer and freeing up his schedule during the busy times of irrigating and haying. It also allows him to pump water during times of drought and extreme fire danger, times when he would not be allowed to run the gasoline-powered pump.

**Spa Hot Springs Motel**

Innovative entrepreneurs in Montana are taking advantage of the state’s wind, solar, and geothermal renewable energy potential. Spa Hot Springs Motel in White Sulphur Springs uses these three renewable sources of energy to help meet its electricity needs. For the past 15 years, Gene Gudmundson, owner of the spa and the motel, has taken advantage of the wealth of renewable energy available to him. The 21-room motel and the other buildings on the Spa’s property are heated with a radiant geothermal system. Hot water from the springs is “borrowed” from the source and sent through pipes embedded in the floors of the buildings and even in the concrete patio surrounding the spa’s hot pools. When the hot water has circulated through the pipe circuit, it is directed back to the creek bed where it would have naturally flowed.

Gudmundson estimates that he is able to meet roughly half of the spa’s energy needs from the geothermal heat, wind turbine, and two solar panel banks. The wind turbine and two solar panel banks offset approximately 10-15% of the motel’s electricity usage. This amounts to significant savings for Spa Hot Springs, whose electricity bill can soar to $1,000 a month in peak seasons.

According to Gudmundson, the systems in place at the spa have inspired at least three other residences to install solar and wind projects on their property. Because the spa is located in a central part of town, it receives a lot of attention from passersby, attracting groups who want tours of the facility and increasing general community awareness of renewable energy technology for Montana.

**Sun4Schools**

The Sun4Schools program provides photovoltaic systems for Montana schools. The program, launched in 2000, is funded by Northwestern Energy Universal Systems Benefit Fund and administered by the National Center for Appropriate Technology. Currently, 27 schools are involved in the project, and five schools are being recruited for involvement in the coming year.

Each school applies for a grant to receive a 2-kW solar electric system. On average, the panels provide 3,000 kWh a year for each school, although this varies between schools across the state. Monitoring systems at each school collect data on energy output as well as demand and feed it to an Internet site so that students can compare figures from the schools.

Lisa Mahony, a teacher at Bridger Alternative School in Boseman, MT, one of the schools participating in the Sun4Schools program, says her students have benefited from the solar installation in many ways. Her students helped to write the grant for the panels, and she uses the panels to teach physics, chemistry, and principles of electricity. Classroom discussions about solar energy in Montana led to discussions of other renewable energy sources in Montana and even prompted the students to construct several Savonius windmills.

Each school that participates in the project is required to have an “Energy Fair” for the five years following installation of the panels to educate the community about the solar installation.
year, Bridger Alternative School’s fair attracted a small but strong turnout of people interested in solar energy; as a result, several families in the community are now looking into obtaining grants for their own homes for solar and wind. Mahony, who is now in the process of planning the school’s second energy fair, has been approached by others in the sustainability community who would like to expand the event and showcase bikes, organic food, and other sustainable energy applications at the fair.267
Nebraska’s Electricity Mix

Nebraska is too dependent on dirty energy sources. Nebraska generated all of its electricity in 2000 from fossil fuels, nuclear power, and hydroelectric power and none from renewable energy, despite its vast potential. In fact, Nebraska generated nearly two-thirds of its electricity in 2000 from coal, the dirtiest fossil fuel, and nearly one-third from nuclear power, which produces waste that remains lethal for thousands of years.

Nebraska has tremendous potential to generate electricity from renewable energy sources. Nebraska ranks 4th in the country for renewable energy potential, with the 3rd best clean biomass resources and 4th best wind resources. Its technical potential from clean biomass could displace all current electricity generation from dirty energy sources; similarly, Nebraska could generate 46 times the current electricity output by tapping into its technical potential for wind alone. Nebraska’s total technical potential for electricity generation from these renewable sources is more than 1,378 billion kilowatt hours (kWh)—enough to power more than 137 million homes.

Nebraska’s Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Nebraska has good, useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Nebraska could produce around 1,032,000 kWh per year. This is enough to power 103.6 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could generate about 43,187,000 kWh per year — enough to power 4,334 homes.

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 4,700 jobs in Nebraska by 2010 and 8,500 jobs by 2020.

In addition to creating jobs, renewable energy development would benefit Nebraska’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):

- $1.4 billion in new capital investment in Nebraska;
- $83 million in new property tax revenue for local communities; and
- $23 million in lease payments to farmers and rural landowners from wind power.

Union of Concerned Scientists also specifically analyzed the potential economic benefits of expanding wind power in Nebraska, finding that the total net benefit to the state economy of developing wind power instead of coal and natural gas is nearly $15 million per year over a 20-year period.

UCS found that building, operating, and maintaining wind facilities would create new jobs and spark local economic activity. Developing 800 megawatts of wind capacity would, on net, create more jobs and earnings than developing natural gas and coal facilities to produce an equivalent amount of electricity. The analysis showed that wind projects generate roughly 2.4 times more jobs during construction and 1.5 times more jobs from ongoing operation and maintenance than do coal and natural gas plants. In addition, UCS found that Nebraska’s farmers and landowners would receive $2.2 million in lease payments by 2012 (assuming $2,000 per year per turbine). Wind projects also could generate $5.2 million in property tax revenue for local Nebraska economies by 2012.

According to UCS, these benefits are most likely to accrue to the poorest counties. Median income levels in Nebraska’s ten windiest counties are, on average, 21% below the state average.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Nebraska’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset more than one billion tons of global warming emissions (carbon dioxide), almost 5.4 million tons of soot-forming pollution (sulfur dioxide) and more than 3.3 million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

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**Generating Solutions: Case Studies**

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"Union of Concerned Scientists based its analysis on a policy goal of generating 10 percent of Nebraska’s electricity from wind power by the year 2012."
Powering Kimball with Wind
In August 2002, Tennessee Valley Infrastructure Group completed construction of the Kimball, Nebraska wind farm project, the state’s first commercial-scale wind farm initiative. The Kimball power project, operated by Municipal Energy Agency of Nebraska, brings green power to nearly 4000 homes and businesses in the region. The wind farm has a generating capacity of 10.5 MW of power from seven wind turbines. The state held the formal groundbreaking ceremony in May 2002 at Kay and Val Deane Snyder’s farm two miles northwest of Kimball. The Snyders provided land on their farm to Municipal Energy Agency of Nebraska to construct the wind turbines under a long-term lease.

Eleven Nebraska communities have signed agreements to purchase wind-generated electricity from the Municipal Energy Agency of Nebraska wind project at Kimball. If demand continues to increase, Municipal Energy Agency of Nebraska can expand the wind farm up to a total of 20 turbines with a capacity output of 30 megawatts — enough for 10,000 homes.

In September 2002, the U.S. Environmental Protection Agency selected the Kimball wind project as one of nine winners of the 2002 Pollution Prevention Award. The Kimball project offsets approximately 22,000 tons of global warming emissions (carbon dioxide), 119 tons of soot-forming pollution (sulfur dioxide) and 36 tons of smog-forming pollution (nitrogen oxides) each year.

Powering Springview with Wind: Springview Distributed Wind Energy Project
Installed in September 1998, the twin turbines in Springview, Nebraska have a 1.5-MW capacity. During the first three years of the project’s operation, the two 750-kilowatt units produced almost 14,000 MWh of electricity—enough power to serve 534 average homes daily. NPPD leases the land for the site from one landowner, paying him approximately $500 per year.

Nebraska Public Power District (NPPD) project manager Mike Hasenkamp explained that NPPD’s customers have been supportive of the wind project. “We serve predominantly an agricultural base of customers, so we do have a lot of farmers and ranchers and so a lot of these people are familiar with the old windmills. I think...they see wind as being a resource that we can use within our state, without having to go outside the state for the source of energy.”

The wind turbines benefit Nebraska’s environment and public health as well. Assuming an annual generation of 5,000 MWh for the Springview site, the wind turbines offset 3,873 tons of global warming emissions (carbon dioxide), 7.25 tons of smog-forming pollution (nitrogen oxides), and 6.3 tons of soot-forming pollution (sulfur dioxide) each year, compared to what emissions would be if the same amount of power was generated by conventional generation sources in the Nebraska system.

Green Power from Landfill Gas, Omaha, Nebraska
The Omaha Public Power District (OPPD) has teamed with Waste Management, Inc. to bring energy to its customers through the utilization of landfill gas. Headquartered in Omaha, Nebraska, OPPD is one of the largest publicly owned electric utilities in the U.S., serving more than 280,000 customers in 13 southeast Nebraska counties.

In the spring of 2002, OPPD built a landfill gas-to-energy facility at the Douglas County Recycling and Disposal Facility, which consists of four generating units and provides a capacity of 3.2 MW. Called the Elk City Station, it has been generating electricity since April 2002 and is the first of its kind in Nebraska.
The project will initially generate enough electricity for 2,000 homes on an annual basis. At maximum landfill gas generation, the project will support a capacity of 30 MW, which will generate enough electricity for 23,000 homes. In addition, this project will reduce methane emissions by approximately 6,750 tons annually and will displace approximately 19,000 tons of coal per year used in the generation of electricity at OPPD’s North Omaha Station.282
Nevada’s Electricity Mix

Nevada is too dependent on dirty energy sources. In 2000, Nevada generated 89% of its electricity from fossil fuels and 4% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for more than half of Nevada’s energy mix—making it one of the most coal-dependent states in the country. Natural gas, which often fluctuates dramatically in price, accounted for 36% of the state’s total.

Nevada’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

Nevada has significant technical potential to generate electricity from wind, geothermal energy, clean biomass and landfill gas. Nevada’s technical potential from geothermal energy ranks second only to California. Nevada’s potential from these renewable resources could produce 27% more electricity than currently generated by the state of Nevada. Nevada’s total technical potential for electricity generation from these renewable sources is more than 45 billion kilowatt hours (kWh)—enough to power more than four million homes.

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99 Data for the year 2000 was the most recent available. These percentages may have changed slightly; the state enacted a renewable portfolio standard in 2001.

98 The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass.
Nevada’s Potential to Generate Electricity from Solar Energy
Nevada has very good solar resources, with the best resources in the southern part of the state. While Nevada’s solar theoretical potential is enormous, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if Nevada installed solar photovoltaic systems on .5% of the state’s land area, it could generate 93,000 million kWh, or almost triple the state’s total electricity generation in 2000.283 Said another way, according to the Department of Energy, if the state installed a photovoltaic array with a collector area equal to the size of a football field, Nevada could produce around 1,217,000 kWh per year. This is enough to power 122.1 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could generate about 67,379,000 kWh per year — enough to power 6,762 homes.284

Renewable Energy Boosts the Economy...
Several studies have estimated the beneficial impacts of renewable energy on Nevada’s economy.

► According to a study commissioned by the Nevada Renewable Energy and Energy Conservation Task Force and written by the Center for Business and Economic Research at the University of Nevada-Las Vegas, Nevada could realize nearly $665 million in annual gross state product (GSP) and support 5,500 jobs a year by simply meeting the state’s renewable portfolio standard.285

► According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):286

• $2.8 billion in new capital investment in Nevada;
• $213 million in new property tax revenue for local communities; and
• $18 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Nevada’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 18 million tons of global warming emissions (carbon dioxide), almost 95,000 tons of soot-forming pollution (sulfur dioxide) and more than 58,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.287

Generating Solutions: Case Studies

Nevada’s Renewable Energy Standard Jumpstarts Renewable Energy Development
Nevada’s renewable energy standard, enacted in 2001, has sparked new renewable energy development across the state. In November 2002, Nevada Power Company signed six contracts that will add approximately 200 megawatts of renewable generating capacity to the utility’s power supply. More than half of the new generating capacity will come from wind power, but the remainder will come from geothermal power. On March 6, 2003, Nevada state officials hailed the Public Utilities Commission’s history-making approval of these contracts, the first under Nevada’s renewable energy law.288 The contracts include agreements with the following companies to build new renewable energy facilities:
• Desert Queen Wind Limited Partnership, a project of Cielo Wind Power, to build an 80-MW wind generation facility in Clark County near Goodsprings. Cielo’s Desert Queen Wind Ranch will be one of Nevada’s first commercial-scale wind power projects. The project will generate enough power to provide the average annual electricity needs for up to 50,000 homes. The project, located entirely on Bureau of Land Management lands, will be completed by the end of 2004.289

• Advanced Thermal Systems to build a binary geothermal plant in Washoe County. ATS announced in late September 2002 that it will build a new 40-MW geothermal plant in the previously developed Steamboat geothermal power park, located nine miles south of Reno. The Steamboat IV Kalina Cycle geothermal plant will use a new technology that can cut construction costs by 20% while increasing power-plant efficiency by 20%. The plant is scheduled to start operation in early 2005.290

• Earth Power Resources, Inc. to build Hot Sulphur Springs, a 25-MW binary geothermal plant in Elko County.

• Subsidiaries of Ormat Nevada, Inc. to build Desert Peak 2 and Desert Peak 3, two flash-steam and binary geothermal plants with 38-MW combined capacity, in Churchill County.291

• Ely Wind Company LLC, a subsidiary of subsidiary of Global Renewable Energy Partners, to build a 50-MW wind generation facility in White Pine County on the closed BHP Robinson Mine.292

During construction, these projects are expected to employ between 480 and 650 people. Once operational, the power plants will employ between 63 and 70 people for ongoing maintenance and operations. In addition, the renewable energy facilities are expected to pay between $55-58 million in fees and various federal and state taxes, providing a new revenue base for the state economy.293

Pyramid Lake Paiute Tribe Adopts Geothermal Energy
In late October 2002, Pyramid Lake Paiute Tribe and Advanced Thermal Systems announced the signing of a letter of intent to enter into a joint venture to develop the tribe’s geothermal resources. Studies are currently underway to determine the presence and amount of geothermal resources. Advanced Thermal Systems made an initial submission of 28 MW for the facility; this would be enough power for approximately 28,000 homes.294 Shuman Moore, president of Advanced Thermal Systems, says that plans for this plant may include using the warm water for aquaculture and hydroponics. When the water is extracted from the earth, it is about 300 degrees; it is typically returned at about 170 degrees. A typical problem with hydroponics is obtaining and heating the water. In this instance, the water from the geothermal plant could be used for these projects. Such an application could spur economic development for the tribe by creating new business opportunities. The feasibility of such a project is under review.295

Nevada to Build State’s First Solar Thermal Power Plant
Duke Solar Energy has plans to build the first new solar thermal power plant on American soil in ten years in Eldorado Valley, near Boulder City, Nevada. Sierra Pacific Resources’ two Nevada-based utility subsidiaries, Nevada Power and Sierra Pacific Power Company, have signed long-term contracts with Duke Solar Energy to supply 50 MW of electricity generated by the solar thermal plant.296

The new solar thermal plant will employ a new design, developed from lessons learned from California’s solar thermal plants, known as SEGs. The SEGs plants use approximately 20% fossil
fuels during overcast weather and at night. With the new plant, only a 2% mix of fossil fuels will keep the system warm throughout the night, and it will be the first solar thermal plant of its size not to generate any electricity from fossil fuels. The plant will serve up to 50,000 customers.297

Nevada to Power New College Campus with Geothermal Energy
The University of Nevada at Reno entered into a 30-year agreement with Advanced Thermal Systems (ATS) of Reno to use advanced geothermal technology to power the university’s new Redfield campus. Scheduled to open in 2004, the Redfield campus is a cooperative venture involving the university and nearby Truckee Meadows Community College, Reno, and Western Nevada Community College, Carson City.

ATS has agreed to build and operate an 11-MW Kalina Cycle geothermal power plant adjacent to the Redfield campus. The plant will provide the campus with electricity and enough hot water to support both residential needs and university research in areas such as hydroponics and aquaculture. Initially, the plant will meet the campus’s load of 500 kilowatts, but plans are in place to ramp up the plant’s generation to meet the needs of a growing campus.298
New Hampshire’s Electricity Mix

New Hampshire is too dependent on dirty energy sources. In 2000, New Hampshire generated 83% of its electricity from fossil fuels and nuclear power. Nuclear power, which produces the most hazardous waste known to science, accounted for more than half of the state’s electricity mix—making New Hampshire one of the most nuclear-dependent states in the country. According to the Department of Energy, New Hampshire generated 8% of its electricity from renewables, most of it likely from polluting wood-burning facilities or incinerators.

New Hampshire’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas

New Hampshire has important potential for electricity generation from renewable energy sources, including wind, clean biomass and landfill gas. Using these renewable sources, New Hampshire could offset more than three-fourths of the state’s current generation from dirty energy sources. New Hampshire’s total technical potential for electricity generation from wind, clean biomass and landfill gas is more than 10.8 billion kilowatt hours (kWh)—enough to meet 72% of the state’s electricity needs or power more than one million homes.

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**Note:**

- Data for the year 2000 was the most recent available. These percentages may have changed slightly.
- The definition of renewables in DOE data includes geothermal, wood, wind, photovoltaic, solar energy and biomass. Note that DOE’s definition of biomass includes municipal solid waste, which U.S. PIRG and the State PIRGs do not consider a clean, renewable resource. However, for the purpose of presenting the state’s energy mix, it was not possible to separate municipal solid waste from clean biomass. In addition, some wood-burning generators can be quite dirty; again, it was not possible to separate clean wood-burning facilities from the more polluting facilities. Therefore, this number may be high.
New Hampshire’s Potential to Generate Electricity from Solar Energy

New Hampshire has useful solar resources throughout much of the state. If the state installed a PV array with a collector area equal to the size of a football field, New Hampshire could produce around 892,000 kWh per year. This is enough to power 89.5 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 30,237,000 kWh per year — enough to power 3,034.3 homes.299

Renewable Energy Boosts the Economy...

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 2,800 jobs in New Hampshire by 2010 and 5,000 jobs by 2020.300

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, New Hampshire’s technical wind potential, if fully tapped and operating at full-capacity year-round, would offset more than 5.7 million tons of global warming emissions (carbon dioxide), more than 30,000 tons of soot-forming pollution (sulfur dioxide) and more than 18,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.301

Generating Solutions: Case Studies

Using the Earth to Heat and Cool Bow Memorial School

The Bow school board in Bow, New Hampshire voted almost unanimously in March 2003 to use geothermal technology as a way to repair part of Bow Memorial School’s ancient heating and cooling system (HVAC) without asking taxpayers for more funding. The school plans to install the geothermal system this summer.

John Heneage, a representative of architecture and engineering firm Dufresne-Henry, Inc., presented the cost estimates and project parameters to the school board. Using compression units and copper piping similar to that used in refrigerators or air conditioners, the system heats and cools classrooms by pumping heat out of the ground or into it. “It doesn’t create heat, it just moves it,” said Heneage. “That’s where the decrease in cost comes in.”302

Installing heat pumping units in the school’s older wing would be more cost-efficient than the current system. Heneage estimates that the school will save about 15-25% on operating costs, compared with the old HVAC system. Each classroom will have its own geothermal heat pump, allowing each classroom to be heated, cooled and ventilated independently. Teachers will be able to adjust room operating temperatures when the classrooms are occupied; on evenings and weekends, a computer control system and occupancy sensors will detect when a classroom is empty and adjust the temperature to reduce energy costs. In this way, the geothermal heat pump system will allow the school to utilize each classroom for special activities, such as summer school and evening programs, without heating/cooling the entire school.303

Heneage estimates that the geothermal HVAC renovation will cost about $335,000. Bow Memorial School plans to cover these costs with a grant from the local utility for $35,000 and a bond from the local school district (up to $300,000). The Bow School District is in the process of applying for grants from various private, state and federal agencies to cover more of the costs.304 Peter Chamberlin, Business Administrator for the Bow School District, expressed frustration that the federal government is not doing more financially to encourage the Bow
Heneage describes this project as a “ground-breaking” one for the state.306

Renewable Energy Along the Appalachian Trail

The Appalachian Mountain Club (AMC) operates eight cabins in New Hampshire along the scenic Appalachian Trail. The scenic location of the huts along the trail is a great draw for outdoor enthusiasts, but the remoteness of the location makes powering the huts a challenge. The AMC has chosen to meet this challenge by using solar photovoltaic panels at all eight huts to power the lighting and refrigerators. In addition, there are small wind turbines at three of the huts to provide additional power. The AMC sees the huts as a way to demonstrate how reliable and useful renewable energy can be.307
New Jersey’s Electricity Mix

New Jersey is too dependent on dirty energy sources. In 2000, New Jersey generated 98% of its electricity from fossil fuels and nuclear power. In fact, it relied upon nuclear power for half of its electricity, making it one of the most nuclear-dependent states in the country. Nuclear power creates waste that remains lethal for thousands of years. In addition, the state generated almost a third of its electricity from natural gas, which often fluctuates significantly in price.

New Jersey’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

<table>
<thead>
<tr>
<th></th>
<th>mm. kWh</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Total Dirty Generation (2000)</td>
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<tr>
<td>Renewable Potential</td>
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<table>
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<tr>
<th>Source</th>
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<tbody>
<tr>
<td>Wind</td>
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<tr>
<td>Clean Biomass</td>
<td>1,473</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>1,374</td>
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</table>

New Jersey has important potential to generate electricity from wind, clean biomass and landfill gas. Using these renewable sources, New Jersey could offset nearly one-third of the state’s current electricity generation from dirty energy sources such as coal, nuclear power and oil and gas. New Jersey’s total technical potential for electricity generation from these renewable sources is more than 18 billion kilowatt hours (kWh)—enough to meet 31% of the state’s electricity needs or power almost two million homes.

New Jersey’s Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
New Jersey has useful solar resources, with southern New Jersey having the best resources. If the state installed a photovoltaic array with a collector area equal to the size of a football field, New Jersey could produce around 905,000 kWh per year. This is enough to power 90.8 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 30,237,000 kWh per year — enough to power 3,034.3 homes.

**Renewable Energy Boosts the Economy...**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 20,200 jobs in New Jersey by 2010 and 36,200 jobs by 2020.

In addition to creating jobs, renewable energy development would benefit New Jersey’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, increased generation\(^\mathrm{\text{i}}\) from renewable energy would produce:

- $360 million in new capital investment;
- $27 million in new property tax revenue for local communities;
- $2 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, New Jersey’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 11.6 million tons of global warming emissions (carbon dioxide), more than 61,000 tons of soot-forming pollution (sulfur dioxide) and almost 38,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

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**Generating Solutions: Case Studies**

**Powering Atlantic County with Wind: The Jersey-Atlantic Wind Project**

Community Energy is finalizing plans to build a $9 million wind project in Atlantic City. The site would use five wind turbines to generate 7.5 MW of electricity, or enough to power about 4,000 average-size homes. The proposed site is owned by the Atlantic County Utilities Authority, near its wastewater treatment plant off of Route 30. The project is in late stage development with completion anticipated in the fourth quarter of 2003.

The project’s construction will create between five and ten temporary construction jobs and additional permanent jobs for ongoing maintenance and operation. In addition, Community Energy will provide lease payments to the Atlantic County Utilities Authority for hosting the turbines on its property.

The project will provide numerous environmental benefits for the county and state. The project will offset 6,500 pounds of toxic emissions, 356,000 pounds of soot-forming pollution (sulfur dioxide), 119,000 pounds of smog-forming pollution (nitrogen oxides), and 44,630,000 pounds of global warming emissions (carbon dioxide) each year, when compared to equivalent generation from the B.L. England Generating Station at Beesleys Point, Cape May, New Jersey.

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\(^{\text{i}}\) Results are cumulative in 2000$ and reflect net present value using an 8% real discount rate. Union of Concerned Scientists calculated the economic benefits from a national renewable energy standard requiring 10% renewable energy generation by 2020. The State PIRGs support a standard of at least 20% renewable energy generation by 2020.
Howell Township Schools Go Solar

The Prisco Group, a New Jersey-based architecture firm committed to sustainable design, is in the final stages of building two new high-performance schools in the Howell Township school district. As part of this environmental design, the new Howell Elementary School and Howell Middle School will each have a 50-kW photovoltaic system mounted on its rooftop.\(^\text{315}\)

Cassandra Kling of Evergreen Services Corporation prepared an environmental and economic impact study for the Howell Board of Education. Kling’s study showed that the school district would have to invest a little more than $325,000 in the photovoltaic systems, after factoring in a $400,000 grant from the New Jersey Clean Energy Program. However, Kling found that the school district would see a 300% payback on its investment over the 25 year life of the project, including almost $496,000 saved on electricity costs and $202,000 on direct offset of peak power. In fact, the solar technology would pay for itself in less than ten years.\(^\text{316}\)

The Evergreen Services Corporation study also detailed the environmental benefits of Howell Board of Education’s decision to install photovoltaic systems on its new school buildings. Over the life of the systems, they will offset 49,795 pounds of smog-forming pollution (nitrogen oxides), 79,672 pounds of soot-forming pollution (sulfur dioxide), and 5,975 tons of global warming emissions (carbon dioxide).\(^\text{317}\)

In addition, these photovoltaic systems come with an Internet-based “real-time” data logger that offers numerous educational opportunities. Students will be able to check the performance of the system and compare it to the weather patterns, time of day, environmental impact, societal benefit and electrical savings.

Cordis Corporation Goes Solar in New Jersey

In December 2002, Cordis Corporation, a Johnson & Johnson company, installed a 72-kilowatt solar system from PowerLight at the company’s site in Warren, New Jersey. The new solar system makes use of the roof of a building to generate on-site electricity and help reduce the company’s annual consumption of electricity. The solar electric system, comprised of 1,680 solar electric tiles, covers more than 15,800 square feet of the Cordis facility’s roof and generates enough electricity to power more than 90 homes. The energy project was partially funded by New Jersey’s Clean Energy Program and the Virginia Alliance for Solar Electricity.\(^\text{318}\)

When running at peak output, the system can provide 8-10% of the facility’s electricity. Cordis anticipates that the system will save the company $7,000-$8,000 a year on electricity costs alone. In addition, the system, comprised of two-inch thick solar panels that serve as natural insulation, will provide additional savings on heating, ventilating and air-conditioning costs. All told, the system will pay for itself in five or six years.\(^\text{319}\)

Bj’s Wholesale Club Goes Solar in New Jersey

In May 2002, Green Mountain Energy Company, Sun Power Electric and Bj’s Wholesale Club teamed up with the New Jersey Board of Public Utilities to install New Jersey’s first large solar electric system atop the Bj’s Wholesale Club in Deptford, New Jersey. The New Jersey Clean Energy Program provided funding for 60% of the upfront capital and installation costs. The solar array, comprised of 1,330 solar panels, takes up more than 12,000 square feet of the store’s roof. The system has a nameplate capacity of 62 kW with the potential to generate 81,350 kWh each year. Over its lifetime, this solar installation will offset 6,600 pounds of smog-forming pollution (nitrogen oxides); 9,060 pounds of soot-forming pollution (sulfur dioxide); and 3,567,300 pounds of global warming emissions (carbon dioxide).\(^\text{320}\)
New Mexico’s Electricity Mix

New Mexico is too dependent on dirty energy sources. In 2000, New Mexico generated 99% of its electricity from fossil fuels and none from renewable sources such as wind and solar. Coal, the dirtiest of fossil fuels, accounted for 85% of New Mexico’s electricity mix, making it one of the most coal-dependent states in the country despite its vast renewable resource potential.

New Mexico’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

New Mexico has tremendous potential to generate electricity from renewable sources. New Mexico’s technical potential from wind alone could generate almost nine times the current electricity output in the state. New Mexico’s total technical potential for electricity generation from these renewable sources is more than 303 billion kilowatt hours (kWh)—enough to power more than 30 million homes.

New Mexico’s Potential to Generate Electricity from Solar Energy

New Mexico has excellent solar resources. While New Mexico’s solar theoretical potential is enormous, solar currently represents a small portion of installed renewable electricity capacity;

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**mm** Data for the year 2000 was the most recent available. These percentages may have changed slightly.
however, it is expanding quickly and has potential for rapid development in the coming
decade. According the Renewable Energy Atlas of the West, if New Mexico installed solar photovoltaic systems on .5% of the state’s land area, it could generate 104,000 million kWh, or more than triple the state’s total electricity generation in 2000. Said another way, according to the Department of Energy, if the state installed a photovoltaic array with a collector area equal to the size of a football field, New Mexico could produce around 1,222,000 kWh per year. This is enough to power 122.6 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could generate about 60,648,000 kWh per year — enough to power 6,087 homes.

Renewable Energy Boosts the Economy...
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 4,200 jobs in New Mexico by 2010 and 7,100 jobs by 2020.

In addition to creating jobs, renewable energy development would benefit New Mexico’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):

- $1.6 billion in new capital investment in New Mexico;
- $124 million in new property tax revenue for local communities; and
- $25 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, New Mexico’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset almost 226 million tons of global warming emissions (carbon dioxide), more than 1.1 million tons of soot-forming pollution (sulfur dioxide) and almost 728,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

Generating Solutions: Case Studies

Powering the Economies of DeBaca and Quay Counties: New Mexico Wind Energy Center
In October 2002, Public Service of New Mexico (PNM) and FPL Energy announced plans to develop New Mexico’s first large wind power plant near the small towns of House and Fort Sumner by late 2003. FPL Energy will own and operate the facility; PNM will purchase all of its output. Once complete, FPL Energy's New Mexico Wind Energy Center will be capable of producing 204 megawatts of electricity from 136 turbines, enough to power 94,000 average-sized New Mexico homes. Initial construction began in March 2003; the New Mexico Wind Energy Center will be fully operational sometime during the third quarter of this year.

Over the next 25 years, the New Mexico Wind Energy Center will bring more than $40 million to the rural economies of DeBaca and Quay counties. Construction is expected to involve 120 to 150 workers; once complete, the facility will permanently employ about a dozen workers for ongoing operation and maintenance.

FPL currently plans to use 1.5-MW wind turbines for this project. When compared to the emissions average of the U.S. utility mix, each turbine will displace 15 tons of soot-forming pollution (sulfur dioxide), nine tons of smog-forming pollution (nitrogen oxides) and 3,000 tons of global warming
emissions (carbon dioxide) each year. Annually, the New Mexico Wind Energy Center will
displace more than 2,000 tons of soot-forming pollution (sulfur dioxide); more than 1,200 tons of
smog-forming pollution (nitrogen oxides); and 408,000 tons of carbon dioxide. 328

“Schools with Sol”
In March 2003, New Mexico’s Energy, Minerals and Natural Resources Department announced
its plans to initiate a new energy efficiency and renewable energy project called “Schools with
Sol.” The project is designed to encourage the installation of solar energy systems in public
schools. The program is one part of the governor’s Conservation Agenda and will act as a
teaching tool for the students and communities as well as help reduce energy consumption by
the public school system. The Energy, Minerals and Natural Resources Department’s Energy
Conservation and Management Division will manage the project; funding will come from
available federal U.S. Department of Energy funds and donations from New Mexico businesses
and other organizations. 329

At each school, the state will install photovoltaic (PV) or solar heating systems to provide heat for
domestic hot water needs at schools, such as showers, dishwashing, and swimming pools. The
first system will be installed at Rio Grande High School in Albuquerque. 330

The solar systems to be installed at participating schools will serve as a valuable educational tool
for students, providing current information on solar technology. Chris Wentz, Director of Energy
Conservation and Management Division, says that students “should have the opportunity to get
closer to working solar systems, to see that these are proven, reliable technologies that are
environmentally friendly. We also want to demonstrate PV and solar heating concepts to the
local communities where the schools are located.” 331
New York Electricity Mix

New York is too dependent on dirty energy sources. In 2000, New York generated 80% of its electricity from nuclear, coal, petroleum and natural gas. New York obtained nearly one-quarter of its electricity from its aging nuclear power plants, which produce waste that remains lethal for thousands of years. More than half of the state’s electricity came from fossil fuels, which pose numerous environmental and public health problems.

New York’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (million kWh)</th>
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</thead>
<tbody>
<tr>
<td>Total Electricity Generation (2000)</td>
<td>138,039</td>
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<tr>
<td>Generation from Fossil Fuels and Nuclear Power (2000)</td>
<td>110,580</td>
</tr>
<tr>
<td>Renewable Potential</td>
<td>115,563</td>
</tr>
</tbody>
</table>

- **Wind**: 100,158
- **Clean Biomass**: 12,560
- **Landfill Gas**: 2,845

New York has significant renewable energy potential. Its technical potential from wind alone could generate enough electricity to displace 90% of the state’s current generation from fossil fuels and nuclear power. New York’s total technical potential for electricity generation from wind is more than 100 billion kilowatt hours (kWh)—enough to meet 73% of the state’s electricity needs or power more than 10 million homes.

New York’s Potential to Generate Electricity from Solar Energy

New York has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, New York could produce around 881,000 kWh per year. This is enough to power 88.4 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 28,645,000 kWh per year—enough to power 2,874.6 homes.

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*Data for the year 2000 was the most recent available. These percentages may have changed slightly.*
Renewable Energy Boosts the Economy...

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 38,000 jobs in New York by 2010 and 68,200 jobs by 2020.333

In addition to creating jobs, renewable energy development would benefit New York’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, increased generation from renewable energy would produce:334

- $390 million in new capital investment;
- $17 million in new property tax revenue for local communities;
- $6 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, New York’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 76 million tons of global warming emissions (carbon dioxide), more than 400,000 tons of soot-forming pollution (sulfur dioxide) and more than 245,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.335

Generating Solutions: Case Studies

Government officials, renewable energy businesses and consumers have demonstrated increased interest in generating power from renewable energy in New York State. The state government has used economic incentives and purchasing requirements to facilitate growth. Every year more wind and solar projects are unveiled across the state. Ratepayers are buying more renewable power for their homes and businesses.

Requiring Renewables

New York has become the latest state to consider requiring a percentage of power come from renewable generation, known as a renewable portfolio standard (RPS). In Governor Pataki’s 2003 State of the State address, he directed the state Public Service Commission to require 25% of the electricity sold in New York to come from renewables, such as solar and wind, in the next ten years. The Public Service Commission has started that rulemaking process.

Powering Fenner's Economy with Wind: Canastota Windpower

The Fenner wind project, completed in November 2001 and owned by Canastota Windpower, is located on rural farmland in the town of Fenner, spanning 2,000 acres of land about 25 miles east of Syracuse in Madison County. The wind farm is comprised of 20 wind turbines with a generating capacity of 30 MW, enough to serve about 10,000 average American homes, assuming 33% capacity.336 At the time of its construction, the Fenner wind project was the largest wind farm east of the Mississippi River.

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333 Results are cumulative in 2000$ and reflect net present value using an 8% real discount rate. Union of Concerned Scientists calculated the economic benefits from a national renewable energy standard requiring 10% renewable energy generation by 2020. The State PIRGs support a standard of at least 20% renewable energy generation by 2020.
Canastota Windpower, a subsidiary of CHI Energy, pays Fenner about $150,000 a year in a payment in lieu of taxes. The company also is providing lease payments to the 14 local landowners and farmers who have leased their land for the wind turbines. In addition, the Fenner project created 78 temporary construction jobs during the construction phase; three full-time staff now oversee ongoing operation and maintenance of the facility.337

The wind turbines have become a tourist draw for people around the state and even in other parts of the country; the Madison County Tourism office has fielded hundreds of calls about the wind turbines since they came online, according to Larry Goodsight, executive director of Madison County Tourism.338 Donna Griffin, who lives in the middle of the wind farm, has sold more than 2,000 T-shirts and about 500 caps adorned with a drawing of the wind turbines. “We’ve always sold fence posts and firewood and farm products,” said Griffin, who runs a dairy farm with her husband, Scott. “We never thought we’d be selling tourist items.”339

Compared to the average electric generation in New York, the project will offset approximately 135 million pounds of air pollution each year. This is the carbon dioxide equivalent of taking 7,600 cars off the road.340

**Powering Madison’s Economy with Wind: Madison Wind Project**

The Madison County wind project, completed in October 2000 and owned by PG&E National Energy Group, is located on rural farmland in the town of Madison, about 45 miles southeast of Syracuse. The project, comprised of seven turbines, has a generating capacity of 11.5 MW, or enough to power more than 11,000 homes at full capacity.341

Although the Madison project is exempt from paying taxes, it has entered into a voluntary agreement with the local school district and the town of Madison to pay each $30,000 a year. In addition, two local farmers receive lease payments for hosting turbines on their property.342 The industry average is $2,000 per turbine per year.

The Madison wind project benefits the environment as well as the economy. During an average year of generation, the Madison project offsets 65 tons of soot-forming pollution (sulfur dioxide), 19 tons of smog-forming pollution (nitrogen oxides) and more than 12,000 tons of global warming emissions (carbon dioxide), as compared to equivalent generation from the average fossil-fueled facility.343

**Greenpoint Manufacturing and Design Center Solar Array**

In October 2002, Clean Air Communities, New York State Energy Research & Development Authority (NYSERDA), Con Edison, Greenpoint Manufacturing and Design Center (GMDC) and PowerLight Corporation unveiled New York City’s largest commercial rooftop solar power system. The 115-kilowatt, $900,000 solar power system, located on the roof of two GMDC buildings in the Greenpoint neighborhood of Brooklyn, covers 11,500 square feet of roof area. When fully powered, the solar system will generate the equivalent energy to light 100 homes. To the extent the system displaces fossil fuel electricity, it will eliminate 1,456 tons of global warming emissions (carbon dioxide) over its 25-year lifetime—a reduction equivalent to planting 16 acres of trees.344
North Carolina

North Carolina’s Electricity Mix
North Carolina is too dependent on dirty energy sources for its electricity. In 2000, North Carolina generated almost two-thirds of its electricity from coal, the dirtiest of fossil fuels, and nearly one-third from nuclear power, which produces waste that remains lethal for thousands of years.

North Carolina’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

North Carolina has important potential to generate electricity from renewable sources rather than nuclear and coal. In fact, by utilizing its technical potential from wind, clean biomass and landfill gas, North Carolina could offset 59% of its current generation from nuclear power or nearly one-third of its generation from coal-fired power plants. North Carolina’s total technical potential for electricity generation from these renewable sources is more than 23 billion kilowatt hours (kWh)—enough to meet 19% of the state’s electricity needs or power more than two million homes.

North Carolina’s Potential to Generate Electricity from Solar Energy
North Carolina has good, useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, North Carolina could produce around 961,000 kWh per year. This is enough to power 96.4 average homes. Similarly, if...

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 34,215,000 kWh per year — enough to power 3,433.5 homes.\(^3\)\(^4\)\(^5\)

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 22,400 jobs in North Carolina by 2010 and 38,900 jobs by 2020.\(^3\)\(^4\)\(^6\)

In addition to creating jobs, renewable energy development would benefit North Carolina’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, increased generation\(^3\)\(^4\)\(^7\) from renewable energy would produce:

- $72 million in new capital investment;
- $6 million in new property tax revenue for local communities;
- $2 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, North Carolina’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 4.5 million tons of global warming emissions (carbon dioxide), almost 24,000 tons of soot-forming pollution (sulfur dioxide) and more than 14,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\(^3\)\(^4\)\(^8\)

### Generating Solutions: Case Studies

**Catawba College Constructs a Sustainably-Designed Building**
Last year, Catawba College received a $4 million grant to fund a “green” building to house its Center for the Environment and the environmental science and studies programs. The building will be located adjacent to the campus science building and on the edge of the college’s 189-acre ecological preserve.

Scheduled to open in the fall, the building uses shredded newspaper for insulation and crushed sunflower seed hulls for conference room tabletops. The 20,000-square-foot structure has walls of glass to take advantage of the sun’s heating powers. Photovoltaic cells capture more sunlight to produce electricity. Water passing through underground wells absorbs heat and coolness from the earth.

The $5.7-million building costs somewhat more than a conventional structure, but operating costs will be much lower, thanks to energy-saving features. Energy efficiency was a primary goal in the building’s design. The heating and air-conditioning system and light fixtures have occupancy sensors that automatically turn off the systems in a space if no one is present. Photocells also control the artificial light; as natural light comes in, the artificial light goes down.\(^3\)\(^4\)\(^9\)

**Powering Innovation with Landfill Gas Energy, Burnsville, North Carolina**
In 1999, Blue Ridge Resource Conservation and Development Council, HandMade in America, and Mayland Community College joined together to form EnergyXchange, Inc., with the mission...
of demonstrating the responsible use of landfill gas as an energy source for small enterprise in
craft and horticulture while meeting local energy needs. EnergyXchange operates the
EnergyXchange Renewable Energy Center. The Center, located at the foot of the Black
Mountain Range in Western North Carolina, is a “campus” of high energy demand facilities
adjacent to the Yancey-Mitchell landfill, fueled by the landfill methane gas being generated by
decomposing garbage in the 6-acre landfill. The EnergyXchange site includes two craft studios
(one for pottery and one for glass blowing), three greenhouses, three cold frames, a public
gallery, and a visitor center.350
To date, EnergyXchange has installed two landfill gas systems to capture methane from the
Yancey-Mitchell landfill. These systems will reduce emissions of methane, a potent greenhouse
gas, by 7,500 tons over 10 years.

The success of the initial project has led to the development of a second project in Avery
County, NC. Still under construction, this project will use landfill gas to fuel a large greenhouse, a
Regional Forestry & Horticultural Center, a microturbine demonstration, and heat for a hangar at
a nearby airport.351

Generating Power from Landfill Gas, Raleigh, North Carolina
Ajinomoto, a pharmaceutical company, in connection with Natural Power, Inc. and the City of
Raleigh, North Carolina, has prevented pollution equivalent to removing more than 23,000 cars
from the road. How? By using landfill gas derived steam at its Raleigh facility.

Since 1989, Natural Power has collected landfill gas from Wilder’s Grove landfill and piped it 3/4
mile to Ajinomoto. There, landfill gas is fed to a boiler owned by Natural Power. This boiler, which
can operate on landfill gas or natural gas, produces steam that heats the Ajinomoto facility and
warms pharmaceutical cultures. In 1997, Natural Power added a second landfill gas-fueled
boiler to the site, in response to Ajinomoto’s plans for a facility expansion. Ajinomoto uses landfill
gas for all of its boiler fuel needs and has eliminated its use of fuel oil altogether. With the second
boiler on line, the project meets more than 95% of Ajinomoto’s steam needs.

Natural Power funded the capital costs for the project, including pipeline and boiler installation.
Natural Power’s revenue comes from its sale of steam to Ajinomoto. In turn, Natural Power pays
approximately 15% of the project’s gross revenue to the landfill owner, the City of Raleigh, as
royalties on the landfill gas rights and about 40% to the pipeline system owner, Raleigh Landfill
Gas Corporation, to purchase the landfill gas, making this project a revenue generator for a
variety of participants.

For Ajinomoto, a noteworthy benefit of the landfill gas-to-energy partnership is the assurance of
a reliable fuel source at significant cost savings (about $250,000 in 1998) over traditional fuels.
Says Gary Faw, Manager of the Utilities Department at Ajinomoto, the project meant that “we
could win and they could win.”

The public also benefits from improved air quality and reduced greenhouse gas emissions.
Current reductions from this project are equivalent to eliminating nearly 162,000 tons of global
warming emissions each year.352

NCSU Solar House
Dedicated and opened to the public in 1981, the Solar House at North Carolina State University is
one of the most visible and visited solar buildings in the United States. Over the last two decades,
more than 250,000 people from around the world have toured the facility.
Beyond the educational value of the Solar House, the building, together with an adjacent research annex, is a living laboratory for solar research on solar thermal systems, residential passive solar options, building-integrated photovoltaic/thermal systems and other applications. By monitoring, metering and compiling data, researchers have determined how well the Solar House works, under what weather conditions, and what it costs to operate. The total heating bill per winter for the Solar House averages less than $70.35.
North Dakota's Electricity Mix

North Dakota is too dependent on dirty energy sources. In 2000, North Dakota generated 93% of its electricity from fossil fuels and less than 1% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for 93% of North Dakota's energy mix—making it one of the most coal-dependent states in the nation. Hydroelectric power, which is less polluting than fossil fuels but causes its own set of environmental problems, accounted for 7% of the state's total.

North Dakota's Potential to Generate Electricity from Wind and Clean Biomass

North Dakota has tremendous potential to generate electricity from wind and clean biomass. In fact, the state ranks 3rd in the country for the best renewable energy potential, following Kansas and Texas. North Dakota has the 3rd best wind resources and 7th best potential from clean biomass. The state’s technical potential from biomass alone is almost sufficient to displace all electricity currently generated from dirty energy sources. North Dakota’s wind potential is more than 50 times the current level of generation from all energy sources. North Dakota’s total technical potential for electricity generation from these renewable sources is more than 1,601 billion kilowatt hours (kWh)—enough to power more than 160 million homes.

North Dakota's Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly.

Ranking based on analysis by Union of Concerned Scientists; see methodology for details about assumptions. Other analyses have shown North Dakota to have even better wind resources than profiled here.
North Dakota has good, useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, North Dakota could produce around 971,000 kWh per year. This is enough to power 97.4 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 35,807,000 kWh per year — enough to power 3,593.3 homes.  

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 1,900 jobs in North Dakota by 2010 and 3,300 jobs by 2020. In addition to creating jobs, renewable energy development would benefit North Dakota’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):

* $1.4 billion in new capital investment in North Dakota;
* $86 million in new property tax revenue for local communities; and
* $25 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, North Dakota’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 1.2 billion tons of global warming emissions (carbon dioxide), almost 6.3 million tons of sulfur dioxide and more than 3.8 million tons of nitrogen oxides compared to equivalent generation from the average U.S. power plant.

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**Generating Solutions: Case Studies**

**Powering the Economies of Edgeley and Kulm with Wind**
In September 2002, Basin Electric Power Cooperative and FPL Energy LLC reached an agreement to build a large wind energy project near Edgeley, North Dakota, about 30 miles south of Jamestown. Construction should begin in the summer, with operation commencing in September 2003. When completed, the Edgeley project will have a generating capacity of at least 40 MW from 27 wind turbines.

Dennis Anderson of Coteau Hills Wind Energy LLC, a company formed about three years ago to promote the use of wind energy in North Dakota and in particular the Edgeley, Kulm, Ellendale area, says the Edgeley wind project will be a boon for the local economy of this small community. The wind farm will generate about $270,000 per year in additional revenue, of which $183,000 will go to schools in Kulm. During the construction phase, scheduled to begin in the summer of 2003, the project will create up to 100 jobs for a period of six months—not an insignificant amount in a town of 700 people. In addition, after the facility is operational, the wind project will permanently staff four to five full-time positions for highly trained technicians. Ten landowners will receive lease payments from the developers, averaging $2,000-$5,000 per turbine per year.

In April 2003, FPL Energy announced it was adding 14 turbines to the Edgeley/Kulm wind farm. Otter Tail Power Co. of Fergus Falls, Minnesota announced that it would buy all 21 megawatts of electricity produced from the 14 additional turbines, set for construction in June 2003.

**Powering Dickey County with Wind**
Montana-Dakota Utilities Co. has entered into an agreement with Dakota I Power Partners of Fredonia, North Dakota to develop a 20-megawatt wind energy farm in Dickey County. Dakota I, jointly owned by UPC Wind Partners and Global Winds Harvest, will construct 13 towers, each supporting a 1.5-megawatt wind energy turbine. Interconnection studies are underway, and project construction is expected in 2003. Wayne Fox, president of Montana-Dakota, said that this project “will provide construction jobs as well as permanent employment and new revenue sources for the local economy while, at the same time, furthering our commitment to be a supplier of reliable, reasonably priced electrical energy.” In addition, the wind farm will reduce emissions of harmful air pollutants. Each year, the 13 wind turbines will offset 195 tons of sulfur dioxide, 117 tons of nitrogen oxides, and 39,000 tons of global warming carbon dioxide that otherwise would have been produced from fossil-fueled electricity generation.
Ohio’s Electricity Mix
Ohio is too dependent on dirty energy sources. In 2000, Ohio generated more than 99% of its electricity from fossil fuels and its aging nuclear power plants and less than 1% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for more than 87% of Ohio’s energy mix—making it one of the most coal-dependent states in the country.

Ohio’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

Ohio has important potential to generate electricity from wind, clean biomass and landfill gas rather than coal. Ohio’s potential from clean biomass is 9th best in the country, and it ranks 5th for potential from landfill gas-to-energy. By tapping into these renewable resources, Ohio could offset more than one-quarter of all electricity currently generated from Ohio’s aging and dirty coal-fired power plants or all of its generation from nuclear power. Ohio’s total technical potential for electricity generation from these renewable sources is almost 35 billion kilowatt hours (kWh)—enough to meet 23% of the state’s electricity needs or power more than three million homes.

Ohio’s Potential to Generate Electricity from Solar Energy

\* Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Ohio has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Ohio could produce around 850,000 kWh per year. This is enough to power 85.3 average homes. Renewable Energy Boosts the Economy...

Several studies have estimated how renewable energy and energy efficiency programs could boost the economy of Ohio.

► According to an analysis by the Regional Economics Applications Laboratory for the Environmental Law and Policy Center, a renewable energy standard requiring 22% renewable energy generation in the Midwest by 2020 would produce 13,090 net new jobs in Ohio and more than $1 billion in increased economic output, mostly from construction, manufacturing and service-related sectors.

► According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):

- $940 million in new capital investment in Ohio;
- $33 million in new property tax revenue for local communities; and
- $5 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Ohio’s technical wind potential, if fully tapped and operating at full capacity year round, would offset 4.5 million tons of global warming emissions (carbon dioxide), almost 24,000 tons of soot-forming pollution (sulfur dioxide) and more than 14,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

Generating Solutions: Case Studies

Bowling Green Municipal Utility Wind Project

Following a wind resource assessment lasting from August 1999 through November 2000, the Bowling Green Municipal Utility has begun looking into installing a utility-scale wind generating system. According to Bowling Green Utilities Director Daryl Stockburger, Columbus-based American Municipal Power-Ohio is accepting bids for the project on behalf of participating municipal electric system members, including the City of Bowling Green.

The wind project would be located on land owned by Wood County adjacent to the Wood County landfill. Pending final cost analysis and participation by municipal utilities, the wind project will include one to four 1.5-MW wind turbines. The City of Bowling Green anticipates that it will own a share of the project ranging from 1 to 3.6 MW.

Solar and Wind Energy at Lake Farmpark

Lake Farmpark, located in Kirtland, 25 miles east of Cleveland, is a family oriented science and cultural center devoted to agriculture, farming, and country life that has installed solar and wind energy technology.

In May 2002, Green Mountain Energy Company installed a 25-kilowatt solar array at Lake Farmpark. The Green Mountain solar array, which consists of 260 individual solar panels, is
mounted at ground level so that the 185,000 people who visit the park each year—including 50,000 school children—easily can see the solar panels and learn about solar-generated electricity. The 25-kilowatt solar array will prevent nearly 35 tons of global warming emissions (carbon dioxide) each year. Green Mountain says that is equivalent to not driving almost 80,000 miles or not making the 145-mile trip from Cleveland to Columbus 550 times.\textsuperscript{371}

In January 2003, Green Energy Ohio, First Energy Solutions, and Lake Fampark installed a 25 kW wind turbine to power Lake Fampark's Plant Science Center. The park expects to save a significant amount on its monthly electricity bills.\textsuperscript{372} With support from the Ohio Department of Development Office of Energy Efficiency, plans are now underway at Lake Fampark to create a renewable energy educational center that will include monitoring equipment to measure the turbine’s efficiency and feed output to real-time displays.\textsuperscript{373}

**Landfill Gas Goes High-Tech, Columbus, Ohio**

In 1992, Lucent Technologies partnered with Network Energy of Lake County, Inc. to harness landfill gas to fuel its boiler. The proximity of the Lake County landfill - only 1.5 miles from the Lucent facility - as well as the 2.5 million tons of waste at the landfill provided enough reasons to start a large-scale landfill gas recovery project. Lucent became interested in the project because it offered significant potential fuel savings with little risk or investment. Today, Lucent uses the gas to fuel boiler operations that generate steam for space heating and hot water at its 2.2-million-square-foot facility. The boiler supplements the landfill gas with natural gas as needed, in the unlikely case that the landfill gas supply is interrupted. This back-up system ensures that Lucent will have a constant supply of boiler fuel.

Lucent, the surrounding community, and the global environment benefit from cleaner air and a reduced need for fossil fuels. In fact, this project reduces greenhouse gas emissions equivalent to nearly 162,000 tons of global warming emissions (carbon dioxide) each year - equivalent to the reductions achieved by taking more than 23,000 cars off the road each year.\textsuperscript{374}

**Bringing Landfill Gas to Market with Pooling Arrangements, Ohio**

In order to take advantage of landfill gas-to-energy opportunities at several small landfills, American Municipal Power-Ohio, Inc. (AMP-Ohio) decided to try pooling landfill gas collected at four landfills with relatively small gas production to match pooled electricity loads from several municipalities. Combining the landfill gas into a single source of energy has proven to be successful as well as cost-effective.

In 1998, AMP-Ohio partnered with Browning Ferris Gas Service, Inc. and Energy Developments, Ltd. (EDI) to market the power generated from the four Ohio landfills. AMP-Ohio initiated contracts with small independent power producers, who allowed the project to qualify for accelerated depreciation and federal tax credits. This action, in turn, would provide the developers with a reasonable level of return on their investment, thereby making the project more attractive to investors.

To date, AMP-Ohio has successfully marketed to its customers all of the power generated from these sources, which is currently 28 MW. AMP-Ohio envisions that other projects will successfully replicate this model elsewhere in the United States.\textsuperscript{375}
Oregon is too dependent on dirty energy sources and hydroelectric power. In 2000, Oregon generated 24% of its electricity from fossil fuels and only 1% from renewable sources such as wind and solar. Although hydroelectric power, which accounted for 75% of the state’s total energy mix, is less polluting than fossil fuels, it causes its own set of environmental problems that could be avoided by turning to renewable energy.

### Oregon’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

<table>
<thead>
<tr>
<th>Source</th>
<th>Potential (million kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Electricity</td>
<td>51,414</td>
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<tr>
<td>Dirty Electricity</td>
<td>50,847</td>
</tr>
<tr>
<td>Renewable Potential</td>
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<tr>
<td>Wind</td>
<td>50,697</td>
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<tr>
<td>Geothermal</td>
<td>18,571</td>
</tr>
<tr>
<td>Clean Biomass</td>
<td>14,966</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>383</td>
</tr>
</tbody>
</table>

Oregon has significant renewable energy potential. Oregon’s geothermal potential is third only to California and Nevada. In fact, by tapping into its potential from wind, geothermal, clean biomass and landfill gas, Oregon could more than meet its current electricity needs. Oregon’s total technical potential for electricity generation from these renewable sources is almost 85 billion kilowatt hours (kWh)—enough to power more than eight million homes.

### Oregon’s Potential to Generate Electricity from Solar Energy

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Oregon has useful solar resources in most of the state, with the best resources falling in the eastern portion of the state. While Oregon’s solar theoretical potential is significant, solar currently represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if Oregon installed solar photovoltaic systems on .5% of the state’s land area, it could generate 68,000 million kWh, or more than the state’s total electricity generation in 2000. Said another way, according to the Department of Energy, if the state installed a photovoltaic array with a collector area equal to the size of a football field, Oregon could produce around 983,000 kWh per year. This is enough to power 98.7 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could generate about 42,340,000 kWh per year — enough to power 4,249 homes.

**Renewable Energy Boosts the Economy...**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 8,600 jobs in Oregon by 2010 and 15,600 jobs by 2020.

In addition to creating jobs, renewable energy development would benefit the economy of the Pacific Northwest. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would (cumulative through 2020):

- Attract more than $7 billion of new investment in renewable energy generation in the Northwest;
- Generate almost $100 million in lease payments for the region’s farmers, ranchers and rural landowners from wind power;
- Produce more than $400 million in new property tax revenue for local communities in the region;
- Reduce average natural gas prices by an estimated 3% in 2010 and 10% in 2020 in Washington and Oregon and by 4% in 2010 and 14% in 2020 in Montana and Idaho compared to business as usual;
- Save the region’s energy consumers at least $3.1 billion; and
- Reduce a typical household’s monthly electricity bill by $1.94.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Oregon’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 38.5 million tons of global warming emissions (carbon dioxide), almost 203,000 tons of soot-forming pollution (sulfur dioxide) and more than 124,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.

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**Generating Solutions: Case Studies**

**Powering the Economies of Washington and Oregon: Stateline Wind Energy Center**

In December 2002, FPL Energy completed a 37-megawatt expansion of the Stateline Wind Energy Center located on Vansycle Ridge, a crest of land straddling the Washington-Oregon
border, near Touchet, WA and approximately 20 miles north of Pendleton, OR. The facility now has a 300 MW capacity, generating enough wholesale electricity to power some 70,000 households.381

The Stateline Wind Energy Center has provided a boost for the local economy. Construction provided an average of 150 (and as many as 300 at peak) jobs over its 12-month construction period. Local residents comprised 82% of the workforce, and the Stateline facility purchased goods and services from 107 vendors in Washington and Oregon. In addition, the Stateline Wind Energy Center generates approximately $1.5 million in tax revenue each year and provides generous lease payments to eight landowners. It also has become a tourist destination. In 2002, the Stateline facility gave 100 tours to 2,527 visitors and made 12 educational presentations to 860 attendees.382

The Stateline facility also offsets pollution by generating electricity from wind rather than fossil fuel combustion. A 300 MW wind power project (such as Stateline) operating at 33% capacity avoids at least 379,000 tons of global warming emissions (carbon dioxide), 35 tons of smog-forming pollution (nitrogen oxides) and two tons of soot-forming pollution (sulfur dioxide) annually, as compared with a natural gas-fired power plant.383

**Powering the Umatilla County Economy with Wind: Vansycle Ridge Wind Farm**

The Vansycle Ridge Wind Farm, located on land used for wheat farming and livestock grazing five miles north of Helix in Umatilla County, was Oregon’s first commercial wind facility, beginning operation in November 1998. The Vansycle Ridge Wind Farm uses 38 wind turbines, which produce a maximum output of 25 MW of electricity. On average, the project delivers enough power for more than 5,000 average Northwest homes.384 FPL Energy owns the project and sells the electricity generated to Portland General Electric.

A recent report by Northwest Economic Associates found that the Vansycle Ridge Wind Farm helped to boost the local economies of Umatilla and Morrow Counties in Oregon. Northwest Economic Associates estimates that the construction of the wind farm supported more than $105,000 in personal income in Umatilla and Morrow Counties; the operation and ongoing maintenance of the wind projects have supported about $103,000 in personal income annually.

The Vansycle Ridge wind project also generated tax revenue for Umatilla County. The wind facility paid $243,580 in taxes in 1999, $241,580 in 2000, and $229,680 in taxes in 2001. Schools in Umatilla County receive more than half of this tax revenue; the county and townships receive about 20% of the revenue. Others benefiting from this increased tax base include fire departments, libraries, parks and other county and municipal agencies.385

The Northwest Economic Associates study also found that the landowners leasing their land to the wind project receive at least $76,000 a year in lease payments; only nine acres of farm and rangeland are lost to agricultural production, limiting the opportunity cost to these landowners to about $356.386

**Powering the Gilliam County Economy with Wind: Condon Wind Energy Project**

The Condon Wind Energy Project, a 50 MW project comprised of 83 wind turbines, is located near the town of Condon in Gilliam County, south of the Columbia River Gorge. SeaWest WindPower, Inc. constructed the wind farm in two phases, which went online in December 2001 and December 2002; the Bonneville Power Administration agreed to purchase and market the entire output of the project over a 20-year period.387
The wind farm provides additional income and revenue for a rural part of Oregon. Located on private farmland, the project will provide more than $100,000 in annual lease income to farmers in the first ten years of operation and approximately $200,000 in the second ten years, while leaving the vast majority of their land available for wheat and barley production.  

In addition, money spent on the Condon project’s construction injected an estimated $445,000-$570,000 into the local economy and $3.7-$4.5 million into the region. The Condon project pays more than $500,000 a year in property taxes and spends $170,000-$240,000 a year for operation and maintenance of the facility.

Powering the Sherman County Economy with Wind: Klondike Wind Power Project
The 24-MW Klondike Wind Power Project, comprised of 16 turbines located approximately seven miles east of the City of Wasco in Sherman County, began operation in December 2001.

The Klondike Wind Power Project has boosted the economy of Sherman County. The construction phase of the Klondike facility created 40 temporary jobs, and the ongoing operation and maintenance requires three full-time staff. The project paid $316,000 in taxes in its first year of operation, generating additional revenue for schools and other public facilities and services. Three land owners receive lease payments for hosting the wind turbines on their property; the specific amount of the lease payment is a confidential figure, but lease payments are generally 3-6% of gross revenues on a per turbine basis. In addition, the Klondike wind farm has sparked local tourism and boosted the sales of local restaurants and stores. Support personnel called in on occasion often stay in The Dalles, Rufus or Biggs, Oregon.

PPM Energy purchased the Klondike facility from Northwestern Wind Power in January 2003.

Powering Lane County with Landfill Gas: Short Mountain Landfill Gas Project
The 3.2-MW Short Mountain Landfill Gas Project, near Eugene, Oregon, takes worthless landfill methane gas and turns it into valuable electricity. Emerald People’s Utility District (PUD) extracts methane from the Short Mountain Landfill and then burns it to generate electricity.

The Short Mountain Project’s first phase became operational on February 18, 1992; the second phase expansion became operational on November 1, 1993. The project generates about 18 million kilowatt hours (kWh) annually, enough electricity to power about 1,200 homes.

The Short Mountain project has brought many economic benefits to the local community and Emerald People’s Utility District. Lane County receives a royalty of at least $20,000 per year; more importantly, Lane County avoids having to build, operate and maintain a $700,000 methane collection system. The project also contributed more than $15,623 in property taxes in 2002, which was split amongst the county and some school districts. During the facility’s construction, Emerald PUD used three people full time for about six months, plus various specialty contractors. The facility now staffs two full-time, highly skilled people at high family-wage jobs; one makes about $50,000 per year plus benefits and the other about $54,000 per year plus benefits.
Pennsylvania’s Electricity Mix

Pennsylvania is too dependent on dirty energy sources. In 2000, Pennsylvania generated more than 98% of its electricity from fossil fuels and nuclear power and 1% from renewable sources such as wind. Coal, the dirtiest of fossil fuels, accounted for more than half of Pennsylvania’s electricity mix. Pennsylvania also relied on nuclear power, which generates waste that remains lethal for thousands of years, for more than a third of its electricity needs.

Pennsylvania’s Potential to Generate Electricity from Wind, Clean Biomass, and Landfill Gas

Pennsylvania has significant potential to offset some of its electricity generation from dirty sources with wind, clean biomass and landfill gas. By tapping into these renewable resources, Pennsylvania could displace all of its nuclear generation or two-thirds of the generation from Pennsylvania’s aging fleet of dirty coal-fired power plants. Pennsylvania’s total technical potential for electricity generation from these renewable sources is almost 81 billion kilowatt hours (kWh)—enough to meet 39% of the state’s electricity needs or power more than eight million homes.

Pennsylvania’s Potential to Generate Electricity from Solar Energy

Pennsylvania has useful solar resources across the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Pennsylvania could produce around

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Data for the year 2000 was the most recent available. These percentages may have changed slightly.
874,000 kWh per year. This is enough to power 87.7 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 29,441,000 kWh per year — enough to power 2,954.4 homes.\(^{393}\)

**Renewable Energy Boosts the Economy...**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 31,600 jobs in Pennsylvania by 2010 and 55,500 jobs by 2020.\(^{394}\)

In addition to creating jobs, renewable energy development would benefit Pennsylvania’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, increased generation\(^{w}\) from renewable energy would produce:\(^{395}\)

- $705 million in new capital investment;
- $34 million in new property tax revenue for local communities;
- $10 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Pennsylvania’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset more than 51 million tons of global warming emissions (carbon dioxide), more than 271,000 tons of soot-forming pollution (sulfur dioxide) and more than 166,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\(^{396}\)

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**Generating Solutions: Case Studies**

**Powering Fayette and Somerset Counties with Wind: Mill Run and Somerset Wind Projects**

Two joint projects between Zilkha Renewable Energy and Atlantic Renewable Energy Corporation are generating economic activity as well as electricity for Fayette and Somerset Counties.

The Mill Run Wind Power Project is a 15-MW project located along the Allegheny Mountains in eastern Fayette County straddling Stewart and Springfield Townships, Pennsylvania. Zilkha Renewable Energy and Atlantic Renewable Energy Corporation partnered to build Mill Run, which was completed in November 2001. Mill Run is comprised of 10 wind turbines with an estimated annual energy output sufficient to supply the yearly energy consumption of 5,700 homes of average size.\(^{397}\) In March 2001, Exelon Power Team announced a 20-year agreement with Mill Run Power, LLC to purchase the output of the wind project.

The Somerset Wind Power Project began construction in June 2001 and commenced commercial operation in October 2001. Located on an abandoned strip mine along the Allegheny Mountains in Somerset County, Pennsylvania, the 9-MW project includes six turbines, producing about 25,000 megawatt-hours of electricity or enough electricity annually to supply

\(^{w}\) Results are cumulative in 2000$ and reflect net present value using an 8% real discount rate. Union of Concerned Scientists calculated the economic benefits from a national renewable energy standard requiring 10% renewable energy generation by 2020. PennEnvironment supports a national standard of at least 20% renewable electricity generation by 2020.
Exelon Power Team markets the output from the Somerset wind farm exclusively to Community Energy Inc., of Wayne, Pennsylvania.

Both projects have provided Fayette and Somerset Counties with a small economic boost. According to Community Energy, Fayette County receives approximately $20,000 a year in additional revenue from the wind project; Somerset County receives approximately $12,000. During construction, the Somerset and Mill Run projects together produced about 50 temporary construction jobs and four on-going operation and maintenance jobs. Landowners hosting turbines at each site receive at least $2,000 per turbine per year.

Based on the fuel mix of the mid-Atlantic regional electric grid, the Somerset and Mill Run projects combined offset approximately 75 million pounds of global warming emissions (carbon dioxide), 568,000 pounds of soot-forming pollution (sulfur dioxide), and 177,000 pounds of smog-forming pollution (nitrogen oxides) each year.

**Powering Luzerne County with Wind: Bear Creek Wind Project**

Global Winds Harvest has plans to develop the 19-25 MW wind farm on Bald Mountain in Bear Creek Township in Luzerne County. This wind farm will be visible from the Pennsylvania Turnpike. Construction is slated to begin in the summer of 2003; the facility could become operational by the fall. The Bear Creek wind project, comprised of 10-20 turbines, could generate enough electricity to power up to 10,000 homes.

The Bear Creek project will spark the local economy by generating additional tax revenue and creating jobs. Global Winds Harvest estimates that the project will create approximately 47 temporary construction jobs and five permanent jobs to man operation and ongoing maintenance. The wind project also will provide lease payments to landowners agreeing to place wind turbines on their property.

The Bear Creek wind project also will benefit the environment by offsetting harmful emissions from fossil fuel combustion. By generating electricity from wind rather than coal or other fossil fuels, the Bear Creek wind project will avoid 440 tons of emission that would cause acid rain and 44,000 tons of global warming emissions (carbon dioxide).

**Powering Somerset County with Wind: Meyersdale Wind Power Project**

The Meyersdale Wind Power Project, jointly owned by Atlantic Renewable Energy and Zilkha Renewable Energy LLC, is a $30 million, 20-turbine wind farm proposed for construction in Somerset County in the Casselman River Valley. The geography of the Meyersdale site makes it one of the most energetic wind sites in Pennsylvania. The Meyersdale project, which will have a 30-MW capacity, is slated to come on line during the late summer of 2003. The Meyersdale project likely will create 20 temporary construction jobs and 3-4 permanent jobs for ongoing operation and maintenance of the facility.
Rhode Island is too dependent on dirty energy sources for its electricity. In 2000, Rhode Island generated almost all of its electricity from natural gas, which fluctuates frequently in price and emits carbon dioxide when burned. Rhode Island is more dependent on natural gas for its electricity than any other state.

Rhode Island has important potential to generate electricity from renewables. By tapping into its potential for wind, clean biomass and landfill gas, Rhode Island could offset almost one-quarter of its current generation from natural gas. Rhode Island’s total technical potential for electricity generation from these renewable sources is almost 1.3 billion kilowatt hours (kWh)—enough to meet 22% of the state’s electricity needs or power more than 100,000 homes.

Rhode Island’s Potential to Generate Electricity from Solar Energy

*Data for the year 2000 was the most recent available. These percentages may have changed slightly. In addition, this mix represents the electricity generated in Rhode Island; however, all of the electricity gets pumped into the New England grid and then sent back out to Rhode Island consumers. Therefore, electricity consumers in Rhode Island are consuming a slightly different energy mix than what is generated within the state’s borders.*
Rhode Island has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Rhode Island could produce around 900,000 kWh per year. This is enough to power 90.4 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate 28,645,000 kWh per year — enough to power 2,874.6 homes.406

**Renewable Energy Boosts the Economy...**

According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 2,100 jobs in Rhode Island by 2010 and 3,900 jobs by 2020.407

...While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Rhode Island’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 633,000 tons of global warming emissions (carbon dioxide), more than 3,300 tons of soot-forming pollution (sulfur dioxide) and more than 2,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.408

### Generating Solutions: Case Studies

**Lighting Up South Providence**

About three years ago, the South Providence Development Corporation decided to buy and renovate an abandoned and deteriorating building within a neglected urban industrial area on Gordon Avenue in South Providence. South Providence Development Corporation now is spearheading the full renovation of this building for use as a business incubator with an environmental focus. The building’s design incorporates many environmentally-friendly features, including a 10 kW solar unit on the roof; the roof itself is designed to capture, store, and reuse rain water. In addition, the building includes all new energy efficient windows, and all exterior walls have been insulated.409

Both during and after construction, the project will generate quality jobs of varied skill levels, many of which will be accessible to low-income workers. According to the South Providence Development Corporation, the Gordon Avenue project’s true value lies in its potential to promote similar types of redevelopment of abandoned buildings in distressed urban areas like South Providence.410 The facility is expected to be ready for tenants by mid-2003.

The South Providence Development Corporation is a non-profit organization designed as a partnership between the residents of South Providence, Rhode Island Hospital, St. Joseph Health Center, Women & Infants' Hospital, Fleet Bank, Gilbane Building Company and other partners.

**Block Island Goes Solar**

Electricity has always been a problem on Block Island, but now things are getting better thanks to solar power. The grid on the island experiences constant outages, especially during periods of extreme weather. Block Island School’s students and staff were tired of losing information on their computers and decreasing their productivity every time the power went out, so they installed a 5-kW solar panel system on the roof. One-quarter of the project was funded by grants from the U.S. Department of Energy and the Rhode Island State Energy Office.

The photovoltaic system supplies power to all the computers in the school and acts as a backup generator during times when the power from the grid goes out. The solar panels also keep the
school's servers up and running without interruption. According to Chris Warfel, who administers the Block Island Renewable Energy Grant, power disruptions at Block Island School have gone from 12 per year before the system was installed to zero since February 2002 when the panels came online.

The solar panels bring Block Island School savings as well as convenience. In addition to the $2,200 that the school saves on electricity costs every year, the solar system has increased productivity and reliability. Warfel said that this has enabled the school to recoup all of its initial costs for the project within one year. The project also has created environmental benefits. Block Island School has reduced global warming (carbon dioxide) emissions by 18,000 pounds annually.

Warfel said he wants to spread the word that “solar electricity has shown it is a great niche and it can compete with traditional sources of electricity.”

Brown University “Brown is Green” Program
At Brown University in Providence, operating costs for the University are down because energy efficiency programs are up. The “Brown is Green” program, a “cooperative effort between all departments, staff, students and faculty,” has led the campus toward a much more efficient use of energy since it started in 1990. According to Kurt Teichert, the Environmental Coordinator of Brown is Green, conservation and energy efficiency took hold at Brown because campus officials did not want to continue spending large amounts of money on the campus's energy use.

Brown is Green took on the responsibility of making the university more energy efficient, focusing first on improvements to existing buildings. Many of Brown’s buildings have since been renovated to increase energy efficiency. For example, a 1994 retrofit of lighting systems in Brown’s Geological and Chemical Sciences Building now saves the university more than $15,000 per year and prevents more than 85,000 pounds of global warming emissions (carbon dioxide) annually. In addition, a series of other energy efficiency upgrades in that building and many others at Brown save the university tens of thousands of dollars more. Improvements have included everything from lighting upgrades to motor efficiency.

Teichert says that many of the efficiency projects have occurred as a direct result of the local utility's energy efficiency incentives. Brown wanted “to take maximum advantage of the utility’s demand side management programs,” and some of the energy efficiency program’s costs have been offset by the utility’s incentives. The Brown is Green program now focuses much of its attention toward energy efficiency in new campus buildings. Teichert estimates that the energy efficiency programs reduce energy consumption by about one-third in buildings that have been completely retrofitted or built to high energy efficiency standards.

Brown is Green also educates students about how to reduce their energy consumption by using energy efficient appliances. In addition, the program is studying new ways of saving money and the environment by reducing energy consumption, including energy efficient vending machines.
South Carolina is too dependent on dirty energy sources for its electricity. In 2000, South Carolina relied on nuclear power for more than half of its electricity needs, making it one of the most nuclear-dependent states in the country. South Carolina also relied on coal, the dirtiest of fossil fuels, for 42% of its electricity generation.

South Carolina has good potential to offset some of its generation from dirty energy sources with wind, clean biomass and landfill gas. By tapping into these renewable resources, South Carolina could displace 38% of its current generation from the state’s dirty coal-fired power plants. South Carolina’s total technical potential for electricity generation from these renewable sources is almost 15 billion kilowatt hours (kWh)—enough to meet 16% of the state’s electricity needs or power more than one million homes.

South Carolina’s Potential to Generate Electricity from Solar Energy
South Carolina has good, useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, South Carolina could produce around 973,000 kWh per year. This is enough to power 97.7 average homes.

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 35,011,000 kWh per year—enough to power 3,513.4 homes.413

Renewable Energy Boosts the Economy...
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 11,500 jobs in South Carolina by 2010 and 20,000 jobs by 2020.414

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, South Carolina’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset almost 507,000 tons of global warming emissions (carbon dioxide), more than 2,600 tons of soot-forming pollution (sulfur dioxide) and more than 1,600 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.415

Generating Solutions: Case Studies
In light of an increasingly volatile natural gas market, South Carolina is one of many states across the country that is beginning to realize the potential of landfill gas as a way to meet energy needs. Recently, the South Carolina Energy Office signed on as a state ally to EPA’s Landfill Methane Outreach Program. In a survey conducted by SCS Engineers for EPA’s Landfill Methane Outreach Program, 30 landfills in South Carolina were identified for potential landfill gas-to-energy projects. The total potential of these projects is 81 MW equivalent, enough energy to power 60,000 homes for a year. The pollution offset would be the equivalent of removing 1.4 million cars from the road for one year and planting one million acres of trees.416

Horry County Landfill
The Horry County Landfill Gas conversion project, a two-unit, 2.2 megawatt facility, went into commercial operation in October 2001. It is a joint project of Santee Cooper, the Horry County Solid Waste Authority, Horry Electric Cooperative and Central Electric Power Cooperative.417 When the plant reaches full capacity, it will be able to provide power in 100-kWh blocks to about 9,300 residential customers.418

EPA estimates that the energy harnessed from the landfill is equivalent to 329,000-764,000 barrels of oil and 700-16,000 rail cars of coal. The project also offsets carbon emissions equivalent to removing 30,000-71,800 cars from South Carolina’s highways.419

Palmetto Landfill Gas helps Power BMW Plant
Methane from Palmetto Landfill, the largest landfill in South Carolina, is being used to help power a nearby BMW plant in Greer. The turbines at the plant have been retrofitted to use the methane collected from the Palmetto Landfill and can generate up to 4.8 MW of power. This is enough to heat 10,000 homes and supply 1/5 of the plant’s energy needs.420 The gas from the landfill is transported to the plant through a 10.5 mile pipeline.421

BMW has agreed to buy gas from the landfill for 20 years. A spokesperson from the plant says that the turbines now powered by the methane have been idle because of the high cost of natural gas.422 The project was appealing to BMW as it provided a way for it to reduce its fossil
fuel consumption, harmful gas emissions, and exposure to the sharp price increase in natural gas.\textsuperscript{423} The project will reduce global warming emissions from the landfill equivalent to removing 61,000 automobiles from South Carolina’s highways each year.\textsuperscript{424}

**Solar Water Pumps for Cattle Ranches**

Drought conditions across the country hit livestock farmers hard as water wells dry up; often they are faced with the choice of drilling a new well or leaving their animals to go thirsty. South Carolina is no exception and, as water supplies dwindle, cattle farmers must drill new wells.

Unfortunately, the cost of running utility lines to remote places can be prohibitive for both the farmer and the utility company. Luckily, solar power can harness the same sunlight that makes the cows thirsty to pump water to the surface for them to drink, cost effectively. SC Solar recently installed a solar water pump at a ranch in Chesterfield, SC. The pump supplies water for 50-60 head of cattle at a cheaper price than the local utility can provide. The Chesterfield farmer saved about $1000 by hiring SC Solar to install four 75-watt solar panels and a solar pump instead of running utility lines to the well site.\textsuperscript{425} In addition, the farmer will realize about $13 savings each month on his utility bill because the energy he uses for the well is his own.\textsuperscript{426}

Projects like this one keep small businesses like SC Solar running and provide solutions to rural problems.
South Dakota is too dependent on dirty energy sources for its electricity. In 2000, South Dakota derived more than one-third of its electricity from coal, the dirtiest of fossil fuels. Although hydroelectric power, which accounted for 58% of the state’s total energy mix, is less polluting than fossil fuels, it causes its own set of environmental problems that could be avoided by turning to renewable energy.

South Dakota has exceptional potential to generate electricity from wind and clean biomass. In fact, South Dakota ranks 5th in the country for the best renewable energy potential, with the 5th best wind resources. By tapping into its wind potential alone, South Dakota could generate 131 times the electricity it currently generates from all sources. South Dakota’s total technical potential for electricity generation from these renewable sources is almost 1,270 billion kilowatt hours (kWh)—enough to power about 127 million homes.

South Dakota has good solar resources throughout the state, especially in the western half of the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, South Dakota could produce around 1,016,000 kWh per year. This is enough to power 101.9 average homes. Similarly, if the state installed just one concentrated solar system.

Data for the year 2000 was the most recent available. These percentages may have changed slightly.
covering approximately 150 acres, it could generate 42,340,000 kWh per year — enough to power 4,249 homes.427

Renewable Energy Boosts the Economy...
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 2,000 jobs in South Dakota by 2010 and 3,500 jobs by 2020.428 In addition to creating jobs, renewable energy development would benefit South Dakota’s economy. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):429

• $544 million in new capital investment in South Dakota;
• $34 million in new property tax revenue for local communities; and
• $11 million in lease payments to farmers and rural landowners from wind power.

...While Protecting the Environment
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, South Dakota’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset 947 million tons of global warming emissions (carbon dioxide), almost five million tons of soot-forming pollution (sulfur dioxide) and more than three million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.430

Generating Solutions: Case Studies

Powering Hyde County’s Economy with Wind: Highmore Wind Project
In September 2002, Basin Electric Power Cooperative and FPL Energy LLC reached an agreement to build an 80-megawatt wind energy project, with 40 megawatts in each of the Dakotas. The South Dakota facility will be located near Highmore in Hyde County.431 Jeff Nelson, general manager of East River Electric, said the Highmore project would supply enough electricity for 12,000-13,000 homes.432

The wind farm, scheduled for completion in December 2003, will include 27 wind turbines, each costing about $1.5 million, on a ridge southwest of Highmore. Basin would purchase the electricity generated for distribution by member cooperatives throughout the area. FPL has preliminary lease options with eight Hyde County landowners.433

Mike Newton, mayor of Highmore, said the project will be a tremendous stimulus for Highmore and Hyde County. At a meeting of the Hyde County Board of Commissioners, Steve Ponder of FPL Energy stated that the Highmore project would create 150 construction jobs for four to six months and three to four permanent jobs, using local labor and equipment as much as possible. Additional economic benefits would include annual landowner payments, a potential for tourism and a multiplier effect for the businesses within the city of Highmore.434

The Highmore project also will contribute tax revenue to the county and state. It will give the state $2 million in a one-time payment for sales/use and excise taxes. In addition, the project will pay local property taxes annually, estimated to be about $250,000 for the first year.435
Powering Chamberlain with Wind: The Prairie Mountain Wind Project


The two wind turbines have provided a small economic boost for the rural community. One landowner hosting the turbines receives thousands of dollars a month in lease payments. In addition, the Chamberlain project generates about $20,000 annually in property taxes for the county and state.436

The two wind turbines generated enough electricity to serve 461 average homes during 2002. According to George Colombe, substation & dispatch manager with East River Electric Power Cooperative, the wind project avoided the burning of 4,646 tons of coal in its first year of operation.437

Using the Sun to Provide Water for Livestock

In parts of rural South Dakota, groundwater can be scarce. When rancher Oliver Romey’s stock dams went dry in 1990, he had to search for a new source of water on his land—and he found it 1.5 miles from the power line. Extending the line to power his pump would have cost $18,000. So, like other hard-working ranchers, Romey hauled water to his cattle in tank trucks each day. After two seasons of hauling water, he read about solar-powered pumping provided by the Northwest Rural Public Power District.

The Northwest Rural Public Power District offers customers the choice of running new power lines or installing a photovoltaic (PV) system. Now, Romey’s PV system pumps water through 5.6 miles of pipeline to four stock tanks that supply more than 150 head of cattle. And with the new pipeline, he can graze cattle on two fields that he could not use before.438
Texas is too dependent on dirty energy sources. In 2000, Texas generated 99% of its electricity from fossil fuels and nuclear power and only 1% from renewable sources, although this number likely has increased since 2000 due to the recently enacted renewable portfolio standard. Texas relied on coal, the dirtiest of fossil fuels, for more than a third of its electricity needs, and natural gas, which tends to fluctuate wildly in price, for more than half.

Texas has tremendous potential to generate electricity from clean energy sources. In fact, Texas has the second best technical potential from renewables in the country, second only to Kansas. Texas ranks 2nd in the country for wind potential, 6th for potential from clean biomass and 4th for landfill gas-to-energy potential. By tapping into its potential for wind, clean biomass and landfill gas, Texas could more than quadruple its current electricity generation from all energy sources. Texas’s total technical potential for electricity generation from these renewable sources is more than 1,696 billion kilowatt hours (kWh)—enough to power more than 169 million homes.

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**Texas’s Potential to Generate Electricity from Wind, Clean Biomass and Landfill Gas**

<table>
<thead>
<tr>
<th>Source</th>
<th>Technical Potential (mill. kWh)</th>
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<tbody>
<tr>
<td>Total Electricity Generation (2000)</td>
<td>379,757</td>
</tr>
<tr>
<td>Total Dirty Generation (2000)</td>
<td>377,496</td>
</tr>
<tr>
<td>Renewable Potential</td>
<td>1,696,046</td>
</tr>
</tbody>
</table>

- **Wind**: 1,663,389
- **Clean Biomass**: 30,226
- **Landfill Gas**: 2,431

Data for the year 2000 was the most recent available. These percentages may have changed slightly; the state enacted a renewable portfolio standard in 1999 that went into effect at the beginning of 2002.
Texas has very good solar resources. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Texas could produce around 1,210,000 kWh per year. This is enough to power 121.5 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 150 acres, it could generate about 60,648,000 kWh per year — enough to power 6,087 homes.439

**Renewable Energy Boosts the Economy...**
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 71,500 jobs in Texas by 2010 and 123,400 jobs by 2020.440

In addition to creating jobs, renewable energy development would benefit Texas’s economy, according to an analysis by Union of Concerned Scientists. Through 2020, increased generation from renewable energy would produce:

- $2.1 billion in new capital investment;
- $185 million in new property tax revenue for local communities;
- $86 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**
Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Texas’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset almost 1.3 billion tons of global warming emissions (carbon dioxide), more than 6.6 million tons of soot-forming pollution (sulfur dioxide) and more than four million tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.442

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### Generating Solutions: Case Studies

#### Wind: Powering Texas's Economy
According to an analysis by the SEED Coalition and the Texas office of Public Citizen completed in September 2002,443 Texas’s first 1,100 megawatts of wind power had a profound impact on local economies across the state. The completed wind facilities created 2,500 quality jobs and paid these employees $75 million in salary. In 2002 alone, farmers and landowners hosting wind turbines on their property received $2.5 million in royalty income. In addition, these wind projects have contributed enormous amounts of property tax revenue for Texas counties—revenue that goes to public schools across the state. In 2002 alone, they paid more than $11.6 million in property taxes to school districts.

<table>
<thead>
<tr>
<th>County</th>
<th>Installed Wind (MW)</th>
<th>Tax Due in 2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pecos</td>
<td>412.7</td>
<td>$4,809,472</td>
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<tr>
<td>Upton</td>
<td>292.3</td>
<td>$2,750,400</td>
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<tr>
<td>Crockett</td>
<td>61</td>
<td>$631,750</td>
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<tr>
<td>Taylor</td>
<td>100.5</td>
<td>$1,131,324</td>
</tr>
<tr>
<td>Nolan</td>
<td>49.5</td>
<td>$594,080</td>
</tr>
<tr>
<td>Carson</td>
<td>80</td>
<td>$856,750</td>
</tr>
<tr>
<td>Culberson</td>
<td>65</td>
<td>$470,028</td>
</tr>
<tr>
<td>Howard</td>
<td>34.3</td>
<td>$370,656</td>
</tr>
</tbody>
</table>

bbb Results are cumulative in 2000$ and reflect net present value using an 8% real discount rate. Union of Concerned Scientists calculated the economic benefits from a national renewable energy standard requiring 10% renewable energy generation by 2020. The State PIRGs support a standard of at least 20% renewable energy generation by 2020.
Jeff Davis 6 $64,800
Hudspeth 1.3 $14,256

Source: SEED/Public Citizen

**Powering Culberson County’s Economy with Wind: Delaware Mountain Wind Farm**

Delaware Mountain Wind Farm, owned and operated by FPL Energy, is located on private ranch land in Culberson County in west Texas. The wind ranch uses 40 turbines to generate 100 million kWh of electricity annually, which is sold to the Lower Colorado River Authority and Reliant Energy.

Much of the labor used to construct the facility consisted of non-resident workers who temporarily resided in the area and purchased goods and services from local stores, restaurants and hotels. However, a recent report by Northwest Economic Associates found that construction of the Delaware Mountain Wind Farm, by increasing expendable income, supported 26 jobs, mostly in the trade and service sector. The study estimates that the construction also supported $361,000 in personal income in Culberson County. Similarly, 11 jobs and $346,000 in personal income in Culberson County remain supported by the ongoing operation and maintenance of the wind ranch.444

In addition, Culberson County accepted a set yearly payment in lieu of taxes, receiving $104,000 each year for the county and $39,000 for the hospital district. In 2000, the wind ranch paid $239,000 in taxes that went to schools.445

**Powering Carson County’s Economy with Wind: The Llano Estacado Wind Ranch at White Deer**

The Llano Estacado Wind Ranch at White Deer, located in Carson County, Texas, is comprised of 80 wind turbines capable of generating 80 MW of electricity—enough to power 28,000 households each year. The wind ranch, developed by Cielo Wind Power LLC and owned by Shell WindEnergy, began operation in December 2001. Southwestern Public Service Company purchases the output from the wind ranch.446

The Llano Estacado Wind Ranch at White Deer has boosted the local economy. In addition to increasing the property tax base in Carson County, the facility’s construction created 40 temporary jobs and eight permanent jobs for ongoing maintenance and operation. Shell WindEnergy also pays 13 landowners 4% of the gross annual revenue generated from each turbine hosted on their property.447

The Llano Estacado project also benefits Texas’s environment. The wind project displaces 128,000 tons of global warming emissions (carbon dioxide), 720 tons of soot-forming pollution (sulfur dioxide), and 320 tons of smog-forming pollution (nitrogen oxides) each year.448

**University of Texas-Houston Goes Solar**

In 1998, the University of Texas-Houston Health Science Center installed four solar panels with 21 kW of generating capacity on the roof of its garage as a demonstration project. However, this demonstration project has evolved into a reliable source of power for the facility. In 2000, the Health Science Center added another 24 kW of solar capacity on the roof and a 7-kW mounted solar photovoltaic system on an awning. The new additions increased the annual generation from 39,000 kWh to 80,000 kWh. The mounted panels on the awning also provide shade for some of the south-facing windows, reducing the use of air conditioning on that floor of the building. In 2002, the university added another 15-kW system adjacent to the installed PV. According to the university, this is the largest building-mounted PV system in Texas.449 Since the
first panels came online in 1998, the university's photovoltaic system has generated 190,000 kWh, saving the university $11,400 on electricity costs.450

These facilities have had great environmental benefits as well. Through June 2002, the facilities had offset emissions of 105 tons of global warming emissions (carbon dioxide), 506 pounds of smog-forming pollution (nitrogen oxides) and 827 pounds of soot-forming pollution (sulfur dioxide), when compared to equivalent generation from traditional energy sources.451

The University is now finalizing plans to install a larger 75-100 kW system on the School of Nursing and Student Community Center building by the end of 2003. This will be one of the largest building integrated PV systems in the southwestern U.S.452
Washington is too dependent on dirty energy sources and hydroelectric power. In 2000, Washington generated 25% of its energy from fossil fuels and nuclear power and only 1% from renewable sources. Although hydroelectric power, which accounted for 74% of the state’s total electricity mix, is less polluting than fossil fuels, it causes its own set of environmental problems that could be avoided by turning to renewable energy.

Washington’s Potential to Generate Electricity from Wind, Clean Biomass, Geothermal Energy, and Landfill Gas

<table>
<thead>
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<tbody>
<tr>
<td>Wind</td>
<td>50,569</td>
<td>107,269</td>
</tr>
<tr>
<td>Geothermal</td>
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<td></td>
</tr>
<tr>
<td>Clean Biomass</td>
<td>14,966</td>
<td></td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>807</td>
<td></td>
</tr>
</tbody>
</table>

Washington has good potential to generate electricity from renewable energy sources. By tapping into its potential for wind, geothermal energy, clean biomass and landfill gas, Washington could offset almost two-thirds of its current generation from dirty energy sources such as hydropower, coal and other fossil fuels. Washington’s total technical potential for electricity generation from these renewable sources is almost 69 billion kilowatt hours (kWh)—enough to meet 63% of the state’s electricity needs or power about seven million homes.

Washington’s Potential to Generate Electricity from Solar Energy

Washington’s solar resources vary across the state, with the most useful resources in the eastern 2/3 of the state. While Washington’s solar theoretical potential is significant, solar currently

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Data for the year 2000 was the most recent available. These percentages may have changed slightly.
represents a small portion of installed renewable electricity capacity; however, it is expanding quickly and has potential for rapid development in the coming decade. According to the Renewable Energy Atlas of the West, if Washington installed solar photovoltaic systems on 0.5% of the state’s land area, it could generate 42,000 million kWh, or more than a third of the state’s electricity generation in 2000. Said another way, according to the Department of Energy, if the state installed a photovoltaic array with a collector area equal to the size of a football field, Washington could produce around 911,000 kWh per year. This is enough to power 91.4 average homes. Similarly, if the state installed just one concentrated solar system covering approximately 200 acres, it could generate about 37,398,000 kWh per year — enough to power 3,752.9 homes.

Renewable EnergyBoosts the Economy...
Renewable energy development would benefit the economy of the Pacific Northwest. According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would (cumulative through 2020):

- Produce more than $7 billion of new investment in renewable energy generation in the Northwest;
- Generate almost $100 million in lease payments for the region’s farmers, ranchers and rural landowners from wind power;
- Produce more than $400 million in new property tax revenue for local communities in the region;
- Reduce average natural gas prices by an estimated 3% in 2010 and 10% in 2020 in Washington and Oregon and by 4% in 2010 and 14% in 2020 in Montana and Idaho compared to business as usual;
- Save the region’s energy consumers at least $3.1 billion; and
- Reduce a typical household’s monthly electricity bill by $1.94.

The Union of Concerned Scientists also evaluated the potential economic impact of a state-level renewable portfolio standard that would mandate that utilities increase electricity generation from renewable energy sources—such as wind, solar and geothermal power—to 15% by 2023. According to this analysis, economic benefits in Washington from the renewable energy standard would include (cumulative through 2013):

- More than $7 million in annual land lease payments for Washington farmers, ranchers, and rural landowners from wind development alone;
- Nearly $10 million per year in property taxes that would be used to support local services, such as the county government, local schools, parks, libraries and fire departments;
- More than 900 permanent jobs in the state, many in rural communities, providing $39 million in new wages and stimulating more than $74 million in economic activity;
- An average of more than 650 additional construction-related jobs in Washington each year, providing more than $30 million in new wages and stimulating more than $100 million in economic activity annually through 2023.

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*ddd* Assumes that more than half of the wind turbine components (turbine, blades and tower) will be manufactured within Washington state and about half of the financing will be provided by in-state institutions.

*eee* “Jobs” refers to full-time equivalent employment for a full year; “earnings” refers to wage and salary compensation paid to workers. Economic activity refers to the value of production in the state or local economy, and includes direct, indirect, and induced economic output.
While Protecting the Environment

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Washington’s technical wind potential, if fully tapped and operating at full-capacity year round, would offset more than 38 million tons of global warming emissions (carbon dioxide), more than 202,000 tons of soot-forming pollution (sulfur dioxide) and almost 124,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.457

Generating Solutions: Case Studies

Powering the Economies of Washington and Oregon: Stateline Wind Energy Center

In December 2002, FPL Energy completed a 37-megawatt expansion of the Stateline Wind Energy Center located on Vansycle Ridge, a crest of land straddling the Washington-Oregon border, near Touchet, WA and approximately 20 miles north of Pendleton, OR. The facility now has a 300 MW capacity, generating enough wholesale electricity to power some 70,000 households.458

The Stateline Wind Energy Center has provided a boost for the local economy. Construction provided an average of 150 (and as many as 300 at peak) jobs over its 12-month construction period. Local residents comprised 82% of the workforce, and the Stateline facility purchased goods and services from 107 vendors in Washington and Oregon. In addition, the Stateline Wind Energy Center generates approximately $1.5 million in tax revenue each year and provides generous lease payments to eight landowners. It also has become a tourist destination. In 2002, the Stateline facility gave 100 tours to 2,527 visitors and made 12 educational presentations to 860 attendees.459

The Stateline facility also offsets pollution by generating electricity from wind rather than fossil fuel combustion. A 300 MW wind power project, such as Stateline, operating at 33% capacity, avoids at least 379,000 tons of global warming emissions (carbon dioxide), 35 tons of smog-forming pollution (nitrogen oxides) and two tons of soot-forming pollution (sulfur dioxide) annually, as compared with a natural gas-fired power plant.460

Powering Benton County’s Economy with Wind: Nine Canyon Wind Project

The 2,000-acre Nine Canyon Wind Project consists of 37 turbines located eight miles southeast of Kennewick on dry land wheat farms owned by the Blair family and the Bateman family. The wind farm, developed by Energy Northwest, has 48 megawatts of generating capacity, making it the largest publicly owned wind generating station in the United States at the time of construction. Commercial operation began in late September 2002.461

The Nine Canyon Wind Project has boosted the economy of Benton County. Construction of the Nine Canyon project created approximately 150 temporary construction jobs for the seven month construction period, with the majority of them being local hires through the union halls. The developers hired many local companies to provide goods and services such as concrete, machinery, and electrical infrastructure. The project also created four permanent positions, which are staffed by three local hires and one from outside the area.462

The Nine Canyon project is exempt from property taxes, but it pays a $17,500 generation tax to Benton County each year. The project also pays an annual wildlife mitigation fee of $75 per
turbine ($2,775 total) to the Washington Department of Fish and Wildlife for the benefit of Benton County. In addition, three landowners hosting wind turbines on their property receive $4,865 per turbine per year.463

**Powering Kittitas County’s Economy with Wind**

EcoNorthwest released a study in October 2002 detailing the economic impacts of two proposed wind projects in Kittitas County, detailed below. ECOnorthwest estimates that the Zilkha and enXco wind projects will increase income to the county by almost $12.5 million during the construction phase and by almost $4.3 million annually due to project operations and maintenance. Kittitas County also will see a jump in county tax revenue. ECOnorthwest estimates that the construction of the two wind farms will increase property tax revenues collected in Kittitas County by $2.8 million annually—an 11% increase over current property tax revenues. Tax revenues accruing directly to the Kittitas County government will be approximately $693,000 each year.464

Kittitas Valley Wind Power Project

Zilkha Renewable Energy is in the permitting process for the Kittitas Valley Wind Power Project, which would be comprised of at least 120 wind turbines on the wind-swept ridges near Ellensburg, Washington, approximately 70 miles east of Tacoma. The wind project will have a capacity of 180 megawatts (MW), enough to meet the annual energy requirements of about 45,000 Northwest homes.465

The local Kittitas County economy will benefit significantly from the more than $100 million investment this wind power project represents. The wind project will create 250 temporary construction jobs and 15 permanent jobs once the turbines begin operation. The 15 landowners leasing their land to the company will receive annual payments of $3,000-$6,000 per turbine. Finally, the wind project will generate $1.2 million in tax revenue for the county in the first year, which will go to local schools, hospitals, roads, fire departments, and other government funded programs. The Kittitas Valley Wind Power Project will be one of the largest taxpayers in the entire county.466

In addition to economic benefits, the wind project will offset pollution from traditional power plants. Zilkha’s wind project would annually eliminate approximately 22 tons of sulfur dioxide and nitrogen oxides, the cause of smog and acid rain, and 227,650 tons of carbon dioxide, which would otherwise be emitted by other electricity sources.467

In January 2003, Zilkha Renewable Energy submitted an application for site certification for the Kittitas Valley Wind Farm to the Washington State Energy Facility Site Evaluation Council. If permitted, construction is expected to begin in early 2004; it will take approximately 12 months.468

Desert Claim Wind Power Project

In January 2003, Desert Claim Wind Power LLC, a wholly owned subsidiary of enXco Inc., submitted an application to Kittitas County for permits to build and operate a 180-megawatt wind farm in the Reecer Creek area, approximately eight miles north of Ellensburg. The Desert Claim project would consist of 120 wind turbines located across 5,200 acres owned by eight private landowners.469

Desert Claim submitted its permit application to Kittitas County Community Development Services in January 2003. In its application, Desert Claim says that the construction of the wind project would require 80-100 temporary construction jobs; after completion, the project would
employ approximately 10 full-time staff, including field technicians and a project operations manager.470

**White Bluffs Solar Station**

White Bluffs Solar Station, dedicated in May 2002, is a joint effort of Energy Northwest, Bonneville Environmental Foundation, Bonneville Power Administration, and Newport Northwest LLC. Owned and operated by Energy Northwest, the solar photovoltaic generating station is located on the site of the terminated WNP 1 nuclear power plant on the Hanford Nuclear Reservation, 10 miles north of Richland in Washington. The project uses existing nuclear plant infrastructure (foundations, interconnect equipment) that remained when the plant was terminated.471

The facility, comprised of 242 solar panels, has the capacity to produce up to 39 kilowatts of electricity, enough to power about eight average households for one year. Bonneville Power Administration buys all of the power produced at White Bluffs Solar Station. 472
West Virginia's Electricity Mix

West Virginia is too dependent on dirty energy sources for its electricity. West Virginia is one of the most coal-dependent states in the country, relying on coal-fired power plants to meet 98% of its electricity needs. Coal pollutes West Virginia's environment from extraction to combustion, destroying West Virginia's rolling hills and mountaintops and emitting smog- and soot-forming pollutants into the state's air.

West Virginia’s Potential to Generate Electricity from Wind and Clean Biomass

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<td>Wind</td>
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<td>Clean Biomass</td>
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Given the harmful impacts of coal on West Virginia’s environment, the state’s potential for generating electricity from alternatives is significant. By tapping into its potential for wind and clean biomass, West Virginia could offset almost one-fifth of its current generation from coal. West Virginia’s total technical potential for electricity generation from these renewable sources is more than 15 billion kilowatt hours (kWh)—enough to meet 17% of the state’s electricity needs or power more than one million homes.

West Virginia’s Potential to Generate Electricity from Solar Energy

West Virginia has useful solar resources throughout much of the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, West Virginia could produce around 843,000 kWh per year. This is enough to power 84.6 average homes.473

Renewable Energy Boosts the Economy...

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Data for the year 2000 was the most recent available. These percentages may have changed slightly.
According to a report by the Tellus Institute, investment in renewable energy and energy efficiency could create 3,800 jobs in West Virginia by 2010 and 6,000 jobs by 2020.\footnote{474}

**While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, West Virginia’s technical wind potential, if fully tapped and operating at full capacity year round, would offset 7.4 million tons of global warming emissions (carbon dioxide), more than 39,000 tons of soot-forming pollution (sulfur dioxide) and almost 24,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.\footnote{475}

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**Generating Solutions: Case Studies**

**Powering Mountain Economies with Wind: Mountaineer Wind Energy Center**

FPL Energy began commercial operation in late December 2002 at its 66-megawatt Mountaineer Wind Energy Center in Tucker and Preston Counties in northern West Virginia. FPL Energy bought the project rights from Atlantic Renewable Energy Corporation, which had previously pursued it under the name of the Backbone Mountain Wind Project. The wind power facility is comprised of 44 wind turbines, generating enough electricity to power 50,000 homes, distributed on 4,400 acres along Backbone Mountain near the town of Thomas.\footnote{476} Exelon Corporation signed a 20-year agreement to purchase the output of the 66-MW facility and will jointly market the output of the facility with Community Energy, Inc. of Wayne, Pennsylvania.

The Mountaineer project has sparked West Virginia’s otherwise coal-dependent economy. The six-month construction of the Mountaineer Wind Energy Center employed up to 250 construction workers; the site now employs approximately six operations and maintenance workers full-time. The Mountaineer wind project also will generate property tax and energy tax revenue for the county and state; the exact amounts are not yet known. Three landowners benefit from lease payments for hosting wind turbines on their property. Although the payment amounts are confidential, lease payments at wind farms across the country generally range between $2,000 and $4,000 per turbine per year.\footnote{477}

In addition to these economic benefits, the Mountaineer Wind Energy Center displaces approximately 132,000 tons of global warming emissions (carbon dioxide) each year.\footnote{478}
Wisconsin is too dependent on dirty energy sources. In 2000, Wisconsin generated 95% of its electricity from fossil fuels and nuclear power and only 2% from renewable sources. Coal, the dirtiest of fossil fuels, accounted for nearly three-fourths of the state’s electricity mix—making it one of the most coal-dependent states in the country. Wisconsin met almost one-fifth of its electricity needs with nuclear power, which generates waste that remains lethal for thousands of years.

Wisconsin has significant potential to meet its electricity needs with renewable energy. By tapping into its potential for wind, clean biomass and landfill gas, Wisconsin almost could double its current electricity generation from dirty energy sources. Wisconsin’s total technical potential for electricity generation from these renewable sources is almost 113 billion kilowatt hours (kWh)—enough to power more than 11 million homes.

Wisconsin’s Potential to Generate Electricity from Solar Energy
Wisconsin has useful solar resources throughout the state. If the state installed a photovoltaic array with a collector area equal to the size of a football field, Wisconsin could produce around 888,000 kWh per year. This is enough to power 89.1 average homes. Similarly, if the state installed...
just one concentrated solar system covering approximately 200 acres, it could generate about 30,237,000 kWh per year — enough to power 3,034.3 homes.479

**Renewable Energy Boosts the Economy...**

Several studies have estimated how renewable energy and energy efficiency programs could boost the economy of Wisconsin.

► According to an analysis by the Regional Economics Applications Laboratory for the Environmental Law and Policy Center, a renewable energy standard requiring 22% renewable energy generation in the Midwest by 2020 would produce 6,350 net new jobs in Wisconsin and $610 million in increased economic output, mostly from construction, manufacturing and service-related sectors.480

► According to an analysis by Union of Concerned Scientists, a national renewable energy standard requiring 20% renewable energy generation by 2020 would produce (cumulative through 2020):481

- $1.6 billion in new capital investment in Wisconsin;
- $81 million in new property tax revenue for local communities; and
- $10 million in lease payments to farmers and rural landowners from wind power.

**...While Protecting the Environment**

Based on the American Wind Energy Association’s statistics quantifying the comparative emissions of wind power (which are zero) and the average U.S. fuel mix, Wisconsin’s technical wind potential, if fully tapped and operating at full capacity year round, would offset almost 69 million tons of global warming pollution (carbon dioxide), more than 361,000 tons of soot-forming pollution (sulfur dioxide) and more than 221,000 tons of smog-forming pollution (nitrogen oxides) compared to equivalent generation from the average U.S. power plant.482

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**Generating Solutions: Case Studies**

**Kewaunee County Wind Farm, Wisconsin Public Service Corp.**

Wisconsin Public Service Corporation completed a 14-wind turbine wind farm in 1999 in the Kewaunee County town of Lincoln, adding 9 MW of wind energy to the electrical system. When operating at full power, the wind turbines have the capacity to power 3,600 typical homes.483

Public Service is leasing the land from private landowners. The Town of Lincoln and Kewaunee County benefit from the wind farm, receiving an annual payback based on the state’s existing “Shared Revenue” tax formula (the wind turbines are exempt from property tax). Based on initial project cost estimates of about $10 million, the town received about $23,000 and the county $45,000 for the first year. This annual payback will decrease every year as the equipment depreciates over 30 years. The total net revenue over 30 years is $200,000 for the town and $375,000 for the county.484

Eli Fenendael milks 300 cows and is one of four landowners who leased the five acres of land for the wind farm. The leases provide annual payments ranging from $3,000 to $7,000 per tower.485

**We Energies Wind Turbines, Fond du Lac, Wisconsin**

We Energies, the principal utility subsidiary of Wisconsin Energy Corporation, operates two low-speed wind turbines in the town of Byron on the Douglas and Cynthia Decker farm; the turbines...
began operation on June 14, 1999. Each turbine can generate up to 660 kilowatts of electricity, enough electricity to supply about 300 homes — 600 homes total. This clean generation offsets almost 2,000 tons of global warming emissions (carbon dioxide) annually, the equivalent of 260 people driving SUVs for a year.486

In December 2002, We Energies invited wind-power developers to submit proposals for delivering up to 200 MW of generating capacity from wind, with the self-imposed goal of using renewable energy for 5% of its retail sales by 2011. The request for proposal required that suppliers build and start operating their wind-power plants by December 31, 2004.487

**Madison Gas & Electric Wind Farm**

MGE owns and operates a 17-turbine, 11-MW wind farm in the townships of Lincoln and Red River in northwest Kewaunee County. The wind farm produces enough electricity to power 3,300 homes. Seven landowners host the turbines.488

MGE’s wind farm economically benefits the small Kewaunee County community. The company pays landowners $25,000 to $30,000 per year to lease a small amount of farmland for the turbines. In addition, through the state’s “shared revenue” plan (the turbines are exempt from property tax), the company agreed pay Kewaunee County a total of $1.5 million and the host townships a total of $725,000 over 30 years.489

The wind farm produces numerous environmental benefits as well. MGE's wind farm generates enough electricity every year to offset 18,630 tons of global warming (carbon dioxide) emissions, 106 tons of soot-forming pollution (sulfur dioxide) and 61 tons of smog-forming pollution (nitrogen oxides). Overall, the MGE wind farm avoids burning the equivalent of 13,110 tons of coal, enough to fill a train 1.25 miles long, each year. 490

**Madison Gas & Electric: Solar Power**

MGE owns and operates five photovoltaic (PV) systems across the state. The company’s PV systems on the Dane County Arena, Dane County Henry Vilas Zoo, Dane County Henry Vilas Zoo, Lussier Family Heritage Center, Society of Friends Meeting House, and UW Madison Arboretum McKay Center have a generating capacity of approximately 20 kW. As of March 10, 2003, the photovoltaic system atop the Lussier Family Heritage Center alone had saved approximately 523 pounds of global warming (carbon dioxide) emissions so far this year.491

In addition, MGE maintains a PV system on each of the 10 high schools in its electric service territory through the Solar in Schools program. Participating schools include Abundant Life Christian School, Madison West High School, Edgewood High School, Malcolm Shabazz High School, James Madison Memorial High School, Middleton High School, La Follette High School, Middleton Alternative High School, Madison East High School and Monona Grove High School. As of March 10, 2003, the PV systems installed in these schools had offset more than 6,200 pounds of global warming (carbon dioxide) pollution so far this year.492

**Building Integrated Photovoltaics Project**

Wisconsin Public Service Corporation partnered with the State of Wisconsin and University of Wisconsin-Green Bay to integrate photovoltaics into a planned 120,000 square foot classroom building on the college campus. Construction of the building, named Mary Ann Cofrin Hall, was completed in September 2001.

In addition to the educational benefits of having the building integrated photovoltaic system on a college campus, the University will receive approximately 27,500 kWh per year of generation, saving the State of Wisconsin an estimated $1,700 in annual electricity costs.493
The photovoltaic system also provides significant air quality benefits, offsetting pollution generated from fossil-fueled power plants. The company and University estimate that, each year, the PV system offsets approximately 74,000 pounds of global warming emissions (carbon dioxide); 340 pounds of soot-forming pollution (sulfur dioxide); and 400 pounds of smog-forming pollution (nitrogen oxides), or the equivalent of the emissions produced by driving 1,100 SUVs from New York to Los Angeles.\textsuperscript{494}

**Converting Animal Waste to Energy**

In July 2002, Environmental Power Corporation announced that it had signed letters of intent with six farms in the Green Bay area of Wisconsin to build an anaerobic digester system on each site. The systems provide a method of producing environmentally-preferable energy generated by methane gas extracted from animal (primarily cow) wastes. Systems at five of the six farms are expected to be operational by late summer of 2003. These systems will help farmers manage animal waste at their facilities while generating electricity.\textsuperscript{495}

Environmental Power recently obtained the North American license for an efficient anaerobic digestion technology through its acquisition of Microgy Cogeneration Systems, Inc., now a company subsidiary. The company will use the technology to produce approximately 10 MW of peak power at electric generating facilities to be constructed on the farms and operated by Environmental Power.\textsuperscript{496}
CONCLUSION AND RECOMMENDATIONS

We need to change the current pattern of dirty energy dependence that has damaged public health, polluted the environment, and compromised the U.S. economy. Instead, we need a proactive policy that rejects more drilling and more spilling and advances cleaner, more sustainable energy solutions. We can move towards a clean energy future by requiring significant energy production from renewable energy sources and increasing energy efficiency.

States must continue their local efforts to generate more electricity from renewable sources, but we also need national standards to ensure that all Americans can enjoy the benefits of clean, renewable electricity. In order to encourage increased energy production from renewable sources, we need to implement policies at the state and national level that include the following:

**Clean Energy Standard**

If we truly want to encourage clean renewable energy, we should create state and national “renewable portfolio standards” (RPS) to increase the amount of electricity from renewable sources of energy. A renewable portfolio standard diversifies the portfolio, or mix, of our energy supplies. Arizona, California, Connecticut, Iowa, Maine, Massachusetts, Nevada, New Jersey, New Mexico, Pennsylvania, Texas, and Wisconsin have passed state renewable energy standards to encourage development of clean energy technologies. Hawaii, Illinois and Minnesota have set strong goals for the percentage of electricity that would come from renewable energy. At the national level, decision-makers should set the standard at 20% of power generation by 2020. A national renewable standard of 20% of electricity generation by 2020 could save consumers an additional $4.5 billion by 2020 compared to business as usual.

**Public Benefits Fund**

Utility companies used to be responsible for generating, transmitting, and selling energy to consumers. Since they were responsible for making sure the system could handle the amount of electricity sent, the companies encouraged energy efficiency and some off-the-grid production, including solar panels. Because of electricity restructuring, the utility companies have shed most responsibility for transmitting electricity, focusing instead on generating and selling the electricity. As a result, utilities no longer have the same incentives to encourage programs that ensure the electricity grid remains reliable. A public benefits fund would offset these declines by charging consumers a small amount, usually one tenth of one cent per kilowatt-hour, and using the money in the states for:

- energy efficiency programs;
- investments in promising renewable energy technologies;
- low-income assistance programs; and
- clean energy research and development.

States that already have some form of systems benefit fund in place include: California, Connecticut, Delaware, Illinois, Maine, Massachusetts, Minnesota, Montana, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, and Wisconsin. Unfortunately, because of state budget problems, some of these funds are being raided to pay for programs that are not related to energy efficiency or renewable energy. This is a problem because the funds help jump start promising technologies that could save the state money immediately and in the future. According to the American Council for an Energy-Efficient Economy, spending on energy efficiency and renewable energy programs has dropped almost 50% while energy use has climbed. A federal level public benefits fund could save 50 quadrillion British thermal units of electricity by 2020. This is equivalent to the output of 500 average sized power plants.
**Net Metering**

A net metering standard would allow consumers who generate their own electricity from renewable technologies (e.g. a small wind turbine, a rooftop solar panel) to reduce their electric bill by getting credit for any excess power generated. Thirty-three states and the District of Columbia already have varying net metering standards in place, including Arizona, Arkansas, California, Connecticut, Delaware, Georgia, Hawaii, Idaho, Indiana, Iowa, Maine, Maryland, Massachusetts, Minnesota, Montana, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode Island, Texas, Utah, Vermont, Virginia, Washington, Wisconsin, and Wyoming. Net metering programs vary widely by state. In Colorado, Florida and Illinois, some utilities have implemented net metering programs independent of state action. A national standard would ensure that this benefit is applied consistently across the country.

**Production Tax Credits**

The Production Tax Credit (PTC) allows builders of renewable energy sources to get a tax credit for investment in renewable energy. The current structure of energy production tax incentives skews the economic benefits of energy towards dirty fossil fuels and nuclear power. The production tax credit is an important factor in making the cost of renewable energy more competitive by offsetting the relatively high front-end capital costs of renewable energy, thus allowing renewable energy to compete on a more level playing field with fossil fuels and nuclear power. A national credit should last for at least five years and include wind, solar, geothermal energy, and clean biomass within the credit’s parameters—specifically excluding municipal solid waste incinerators. The PTC should not include hydroelectric power or so-called “clean coal” programs.

These measures would reduce pollution, save money, create jobs, and reduce our vulnerability to energy supply disruptions. Given all the benefits of pursuing a clean energy path, there is no reason to drill in our last wild places, darken our skies with pollution and threaten public health and the environment by continuing to rely on dirty fuel sources.
END NOTES

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23 Information on how solar energy works was collected from the Department of Energy’s Energy Efficiency and Renewable Energy Network (EREN), located at http://www.eren.doe.gov/state_energy/technologies.cfm.
24 Information on how solar energy works was collected from the Department of Energy’s Energy Efficiency and Renewable Energy Network (EREN), located at http://www.eren.doe.gov/state_energy/technologies.cfm.
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