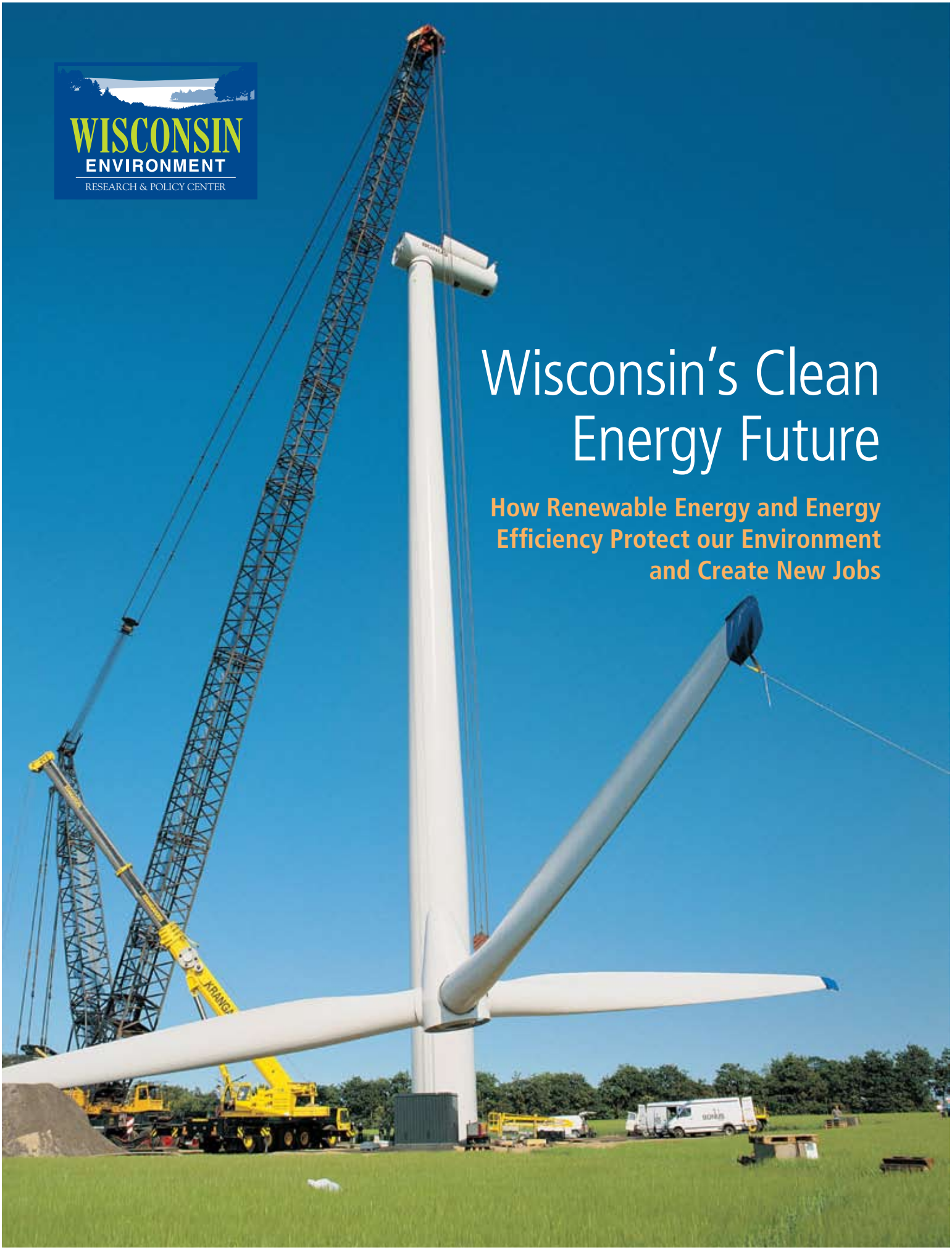

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Wisconsin's Clean Energy Future

How Renewable Energy and Energy Efficiency Protect our Environment and Create New Jobs

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How Renewable Energy and Energy Efficiency Protect our Environment and Create New Jobs

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Executive Summary

Wisconsin has begun a transition away from fossil fuels and toward a clean energy future. The state is developing local wind, biomass and solar energy resources, while using energy more wisely. These efforts are reducing our contribution to global warming, protecting our air and water quality, and improving public health.

At the same time, Wisconsin's push toward clean energy is spurring economic growth. For example, the wind energy industry invested $400 million in Wisconsin in 2007, and consumers are now saving $85 million a year through energy efficiency.

Wisconsin's Blue Sky Green Field Wind Farm began generating electricity in 2008. Credit: Zeke Rice

Wisconsin has the potential to accomplish a great deal more. Deepening Wisconsin's commitment to clean energy can be an important tool to protect our environment while helping to revitalize the state's economy. Investing in clean energy can create new jobs, reduce Wisconsin's expensive addiction to out-of-state fossil fuel resources, and put the state on sound footing for the future.

Wisconsin is making progress toward a clean energy economy.

- Wisconsin now generates the equivalent of more than 5 percent of its annual electricity consumption from renewable resources. At this rate of growth, the state should achieve its target of 10 percent of electricity sales produced from renewable energy sources in advance of the 2015 deadline.

- With the completion of four new wind farms in Fond du Lac and Dodge counties in 2008, Wisconsin increased its capacity to generate electricity from wind power by more than seven-

fold. Local wind farms now produce enough electricity to meet the needs of 130,000 typical Wisconsin homes—or all the residences in the Appleton-Oshkosh-Neenah metropolitan area.

- In 2008 Xcel Energy and DTE Energy announced plans to convert two Wisconsin power plants from coal to renewable biomass fuel, doubling the state's biomass energy capacity. Xcel's new facility will become the largest biomass power plant in the Midwest.

- More than 400 homes and commercial buildings in Wisconsin have been outfitted with solar photovoltaic panels, and installations are increasing at a rate of 80 percent per year.

- As of 2008, Wisconsin's energy efficiency programs are saving enough energy to meet the annual needs of more than 160,000 households—or nearly all the residences in the Madison metropolitan area.

Clean energy prevents pollution, protecting public health and Wisconsin's environment.

- Wisconsin is generating nearly 4 billion kilowatt-hours (kWh) per year of renewable electricity and saving more than 1.4 billion kWh per year through energy efficiency.

- By displacing fossil fuels, this clean energy annually prevents more than 4 million metric tons of global warming carbon dioxide pollution, more than 10 million pounds of smog-forming nitrogen oxide emissions, more than 15 million pounds of soot-forming sulfur dioxide emissions, and at least 80 pounds of highly toxic mercury pollution.

- In terms of global warming pollution, the impact of clean energy in Wisconsin is equivalent to making more than one out of every 10 cars and trucks in the state pollution-free (800,000 vehicles).

At the same time, investments in clean energy benefit Wisconsin's economy.

- The wind energy industry invested $400 million in Wisconsin in 2007. More than 75 Wisconsin companies participate in the regional wind energy industry.

- Through 2008, wind farms built in Wisconsin created an estimated 1,300 local jobs during construction and now support more than 190 long-term jobs.

- Increasing regional demand for renewable energy is prompting companies to open new factories in Wisconsin, such as Energy Composite Corporation's planned wind turbine blade factory in Wisconsin Rapids—a facility that will employ 400 workers.

- From 2002 to 2007, Wisconsin's energy efficiency programs created more than 1,400 local jobs, generated $181 million in sales for local businesses, and increased disposable income for Wisconsin residents by $85 million. By 2012, these impacts will more than double.

Renewable energy also benefits Wisconsin's rural economies.

- Wind energy in Wisconsin is providing about $1.2 million per year in additional income to farmers and other landowners.

- In addition, Wisconsin wind farms are currently increasing local government

tax revenues by about $850,000 per year. According to the National Renewable Energy Laboratory, wind farms can provide more than double the tax revenue than either coal- or gas-fired plants, per unit of energy output.

Wisconsin has barely scratched the surface of its clean energy resources—the state has the potential to achieve much more.

- Wisconsin has enough wind, solar and biomass energy resources to produce power equivalent to the entire state's electricity needs. Total potential for wind power alone has been estimated at 53 billion kWh per year, equivalent to 75 percent of the state's current electricity consumption.

- At the same time, Wisconsin has massive potential for more efficient energy use. For example, the use of efficient motors and precise controls in commercial building systems and manufacturing processes could reduce statewide electricity consumption by as much as 15 to 25 percent.

- Wisconsin's clean energy resources are local, while its fossil fuels are imported from out-of state. Deepening Wisconsin's commitment to clean energy will help keep more of the state's money circulating in the local economy, providing a boost.

Increasing Wisconsin's commitment to clean energy can help put the state on sound footing for the future.

- Wisconsin should increase its renewable energy standard to ensure that at least 25 percent of the state's electricity consumption comes from renewable sources of energy by 2025, matching Minnesota and Illinois.

- Wisconsin should also increase its efforts toward energy efficiency, aiming to reduce electricity consumption by 2 percent and natural gas consumption by 1 percent or more per year, at investor-owned, municipal and cooperative utilities.

Energy Composite Corporation plans to manufacture wind turbine blades at a new facility in Wisconsin Rapids, like that pictured here, employing 400 workers. Credit: NEG Micon

Introduction

Wisconsin's economy needs an infusion of new energy. From December 2008 to February 2009, more than 50,000 Wisconsinites lost their jobs.[1] Nationally, the unemployment rate has climbed to its worst level in 25 years.[2]

Recovering from this recession will be a long-term task. However, Wisconsin has the resources right here at home to lay the foundation for a prosperous future.

The key is energy.

Wisconsin has no local reserves of oil or natural gas. Nor does the state host any coal or uranium mines.[3] As a result, Wisconsin exports more than $16 billion each year to other states and countries to pay for energy imports.[4] This energy drain is equivalent to nearly 7 percent of gross state product, or more than $2,800 per person—and a huge boon for coal-rich states like Wyoming.[5]

At the same time, Wisconsin's historical dependence on fossil fuels has created serious public health and environmental risks. Burning coal and oil has contaminated Wisconsin's rivers and lakes with mercury pollution and dirtied the state's air with dangerous soot and smog. It has also created massive amounts of global warming pollution, which pose a serious threat to the state's future.

Fortunately, Wisconsin's leaders have recognized that the solution lies with local clean energy resources, including using energy more efficiently and generating more energy from clean, renewable sources like wind, biomass and sunlight. The state has established an effective ratepayer funded energy efficiency program and a requirement for utilities to obtain one tenth of their electricity supplies from renewable energy sources by 2015. And in November 2008, the Wisconsin Public Service Commission rejected a proposal by Alliant Energy to build a new coal-fired power plant in Cassville.[6]

As demonstrated in this report, these programs and actions are beginning to make a real difference. By pursuing a new energy future, Wisconsin is freeing its citizens from dependence on fossil fuels, reducing our exposure to dangerous health threats, and beginning to do its part to reduce global warming. At the same time, Wisconsin is giving its economy a needed boost by keeping more energy dollars in-state, creating jobs, and building new industries.

Credit: Gabriel Schouten de Jel

While the state has come a long way, much more could be done. Wisconsin Governor Jim Doyle has called for a goal of generating 25 percent of the state's electricity and 25 percent of the state's transportation fuel from renewable fuels by 2025.[7]

Deepening Wisconsin's commitment to clean energy will help the state build and diversify its economy in the 21st century. Utilizing efficiency and renewable resources would prompt the growth of a new manufacturing industry to supply the state with clean energy technologies. It would also help set up the state to capitalize on rapidly growing regional and global demand for efficient products and renewable energy components. Finally, increasing deployment of clean energy will increase the economic benefits of an economy-wide limit on global warming pollution—such as the Waxman-Markey bill pending in the 2009 Congress—and make it easier to achieve its goals.[8]

Making a deeper commitment to energy efficiency and renewable energy will signal that Wisconsin is ready to modernize its economy and take control of its energy destiny. Implementing an expanded clean energy plan will create thousands of good-paying jobs, millions of dollars of economic growth, and significant reductions in pollution—while beginning to limit the costs, risks and liabilities of global warming.[9]

The nation that leads the world in creating new energy sources will be the nation that leads the 21st-century global economy. … [T]he bulk of our efforts must focus on unleashing a new, clean-energy economy that will begin to reduce our dependence on foreign oil, will cut our carbon pollution by about 80 percent by 2050, and create millions of new jobs right here in America….

— President Barack Obama,
speaking at the Trinity Structural Towers Manufacturing Plant
in Newton, Iowa, April 22, 2009[10]

Wisconsin Is Making Progress Toward a Clean Energy Economy

Wisconsin has begun to transition away from fossil fuels and toward a clean energy future. The state is developing local wind, biomass and solar energy resources, while using energy more wisely.

The rapid rise in clean energy is the result of a series of federal and state policies designed to promote cleaner sources of electricity, as well as volatile fossil fuel prices, increased concern about global warming, and technological improvements that have reduced the cost of renewable energy over the last three decades.

Wisconsin's Renewable Energy Capacity is Growing Rapidly

Renewable energy is rapidly growing in importance as part of Wisconsin's electricity supply. Renewable resources now account for about 6 percent of Wisconsin's annual electricity generation—equivalent to more than 5 percent of the electricity consumed in Wisconsin each year.[11] (See Figure 1.) In particular, wind energy capacity is expanding quickly—now accounting for about one-third of Wisconsin's renewable electricity supply. (See Figure 2.)

Among the most important factors encouraging the development of renewable energy, in 2005 Wisconsin legislators enacted a renewable electricity standard. This policy requires utilities to obtain 10 percent of the electricity supplied to consumers from renewable resources by 2015.[12] The state is well on its way to achieving the 10 percent target years in advance of the deadline.[13]

Wind

Wind power is making a growing and valuable contribution to Wisconsin's electricity system. By capturing the energy in the wind through high-tech wind turbines, wind power can provide substantial amounts of electricity from an inexhaustible resource—and the fuel is free.

In 2008, wind energy companies completed the construction of four new wind farms in Fond du Lac and Dodge counties. We Energies erected 88 wind turbines at

the Blue Sky and Green Field wind farms. Wisconsin Power & Light placed 41 turbines at the Cedar Ridge Wind Farm. And Invenergy put up 86 turbines at the Forward Wind Energy Center.[16] Altogether, these facilities increased Wisconsin's capacity to generate electricity from the wind by 342 megawatts (MW)—or more than seven-fold.[17] (See Figure 3).

Currently active Wisconsin wind farms are capable of generating more than 1.1 billion kilowatt-hours (kWh) of electricity per year.[18] This amount of electricity is enough to meet the needs of 130,000 typical Wisconsin homes—or all the homes in the Appleton-Oshkosh-Neenah metropolitan area.[19]

In the near future, Wisconsin could nearly triple its wind generation capacity. The 54 MW Butler Ridge Wind Farm in Dodge County is now under construction and anticipated to come online during 2009.[21] Additionally, wind developers are pursuing other wind energy projects across the state with a potential capacity on the order of 700 MW.[22]

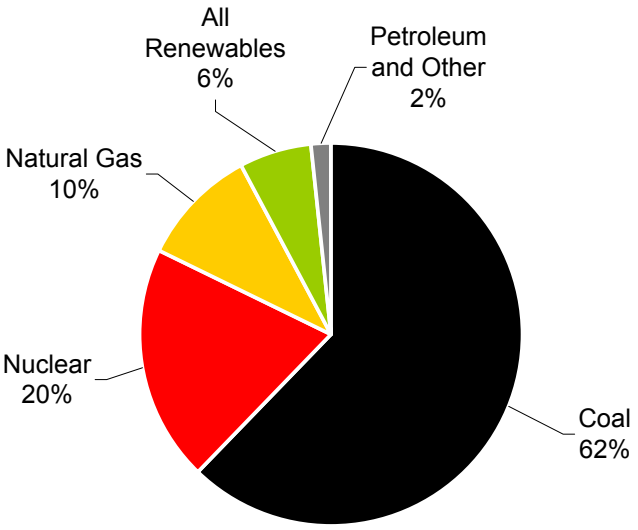
Nationwide, wind power is rapidly becoming an important part of the electric system. In 2008, wind turbines accounted for more than 40 percent of all electric generating capacity added to the grid, a greater share of new capacity than any other type of generation except perhaps natural gas-fired power plants.[23]

The past decades have seen dramatic advances in the technology of wind turbines, enabling wind turbines to generate more power at lower cost. The cost of wind power projects has been cut by about two thirds over the past two and a half decades, and technological advances have made it possible to build turbines that are more efficient at generating electricity from the wind.[24]

Biomass

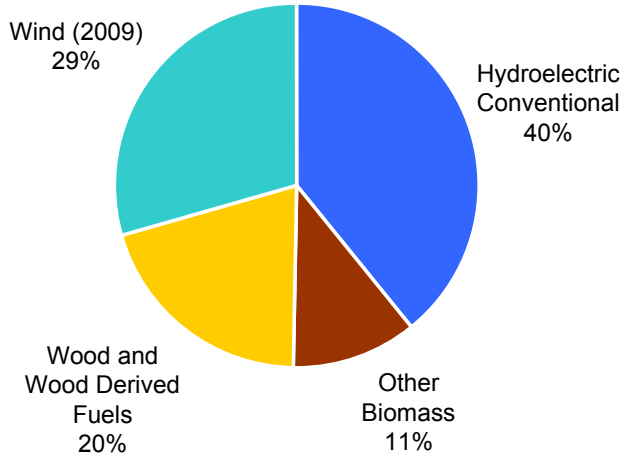
Wisconsin is increasingly turning to plant-based energy sources (or biomass) as an additional fuel for electricity generation.

Figure 1: Wisconsin's Electricity Generation Mix, 2009 (Estimated)[14]



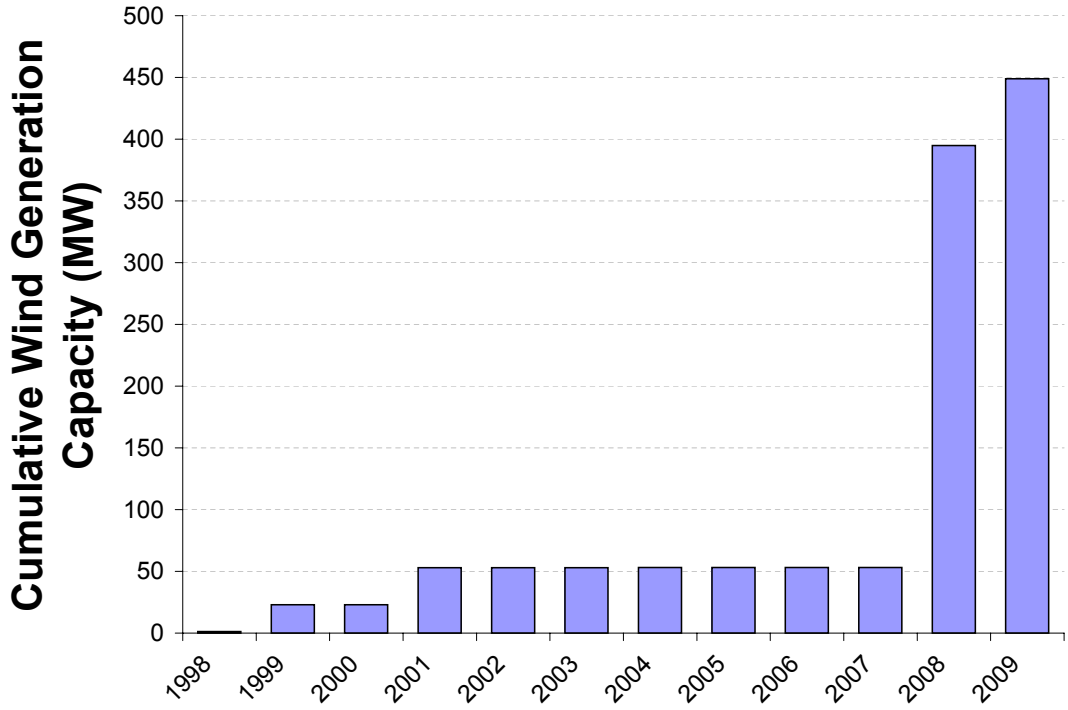
With the installation of four new wind energy facilities in 2008, Wisconsin now derives about 6 percent of its electricity supply from renewable energy sources, including wind, biomass, conventional hydro and solar power.

Figure 2: Estimated Renewable Energy Generation in Wisconsin, 2009[15]



Today, Wisconsin obtains most of its renewable energy from conventional hydroelectric power sources. However, wind and biomass are rapidly growing in importance. For example, in 2008, Wisconsin increased its wind energy capacity more than seven-fold.

Figure 3: Wind Energy Generation Capacity in Wisconsin, 1998-2009[20]



Biomass power plants often burn plant material obtained from the local region, including waste wood from forestry, or cornstalks or switchgrass from farming. Biomass power plants can also operate using methane gas captured from landfills or livestock operations. With proper safeguards, biomass can be depended upon as a renewable resource, without contributing to global warming.

In 2007, Wisconsin generated 1.2 billion kWh from biomass resources—largely waste wood.[25] That level of generation is equivalent to Wisconsin's wind energy sector, producing enough electricity to power about 130,000 typical Wisconsin homes—or all the homes in the Appleton-Oshkosh-Neenah metropolitan area.[26]

Wisconsin's biomass energy sector is expanding. In September 2008, Xcel Energy announced plans to convert the last remaining coal-fired boiler at its Bay Front Power Plant in Ashland to 100 percent biomass fuel. (Two of the three boilers already burn biomass—primarily waste wood from area forestry operations.) When complete, the new facility will become the largest biomass power plant in the Midwest.[27] The 68 MW power plant will be capable of generating enough electricity to power 40,000 homes.[28]

In August 2008, We Energies agreed to build a 50 MW power plant fueled exclusively with biomass, as part of a lawsuit settlement.[29] And in May 2008, DTE Energy bought the 50 MW coal-fired E.J. Stoneman power plant in Cassville and announced a plan to convert it to burn 100 percent wood waste by 2009.[30]

When these three new projects are completed, they will be capable of providing another 1.1 billion kWh per year (assuming they operate at 80 percent of full capacity).[31] Added to existing biomass capacity, altogether Wisconsin biomass will supply more than 3 percent of the state's annual electricity needs.[32]

In addition, Governor Doyle has

"We must move away from our dependence on coal. This new project will help build the biomass market in Wisconsin, keep the money we spend on energy in the local economy and create green jobs in the area."

—Governor Jim Doyle,
announcing the construction of a new biomass-fired boiler at the Charter Street Heating Plant at the University of Wisconsin-Madison, February 6, 2009 [35]

launched an initiative to switch to biomass fuel at state-owned heat and power facilities in Madison. For example, in February 2009, Governor Doyle directed the Charter Street Heating Plant on the University of Wisconsin-Madison campus to switch from coal to natural gas, while building a new boiler capable of burning 100 percent biomass.[33] When complete in 2012, the new biomass boiler will generate up to 50 percent of the plant's output.[34]

Solar

The sun's energy can directly provide electricity for home or business use in Wisconsin through the use of solar photovoltaic (PV) panels. The simplicity of photovoltaic panels makes them easy to install on rooftops throughout urban areas; they are the only electric generators without moving parts, and like wind they have no fuel supply to obtain. Moreover, as a distributed resource, solar panels minimize the need to invest in new power lines.

Solar power has also experienced dramatic growth in recent years, albeit on a much smaller scale than wind power. More than 400 homes and commercial buildings in Wisconsin have been outfitted with solar photovoltaic panels since 2002, and installations are increasing at a rate of 80 percent per year.[36] During 2008, the solar industry installed more than 1,600 kW of solar photovoltaic systems, including several large commercial projects on rooftops of Kohl's retail stores.[37] So far in 2009, Johnson Controls, an automotive, building efficiency and power company, completed installation of a 250 kW solar array at its Glendale headquarters, now the largest single solar installation in the state.[38]

Solar power generally remains more expensive than wind power, but the price of photovoltaic panels is dropping dramatically as more manufacturing capacity comes online and demand decreases due to the economic crisis. Prices have fallen by more than 80 percent since 1980.[39] Some analysts see the cost of solar cells dropping by another 50 percent or more by 2015, setting the stage for solar panels to become fully cost-competitive with other forms of electricity generation.[40]

Additionally, utilities and consumers are coming to recognize the unique benefits of solar photovoltaic systems to

The Aldo Leopold Legacy Center in Fairfield, Wisconsin, features a solar photovoltaic system that produces more power than the facility uses over the course of a year. Homes and businesses across Wisconsin are increasingly turning to solar systems like this for a local source of renewable energy. Credit: Kyocera Solar

the environment and to the electric grid. Because solar panels tend to generate power when it is most needed—during hot summer days when demand for electricity typically peaks—they can alleviate strain on the grid and the high cost of delivering "peaking" power.[41]

Wisconsin is Mining Opportunities to Increase Energy Efficiency

At the same time that Wisconsin develops renewable energy resources, the state is turning to energy efficiency as the cheapest and fastest way to reduce its dependence on fossil fuels.

Through energy efficiency measures, residents are installing compact fluorescent lightbulbs that waste less energy than traditional incandescent bulbs. Industrial facilities and farmers are installing highly efficient motors to drive machinery. And businesses are improving heating and air conditioning systems. These measures deliver the same or better lighting, comfort and production while consuming less energy.

Despite the fact that many energy efficiency measures make sense without financial incentives, market barriers (including lack of consumer awareness, the up-front cost of efficient technologies, and split incentives between builders and buyers) often block their widespread adoption. To help overcome these market barriers, Wisconsin requires electricity and gas utilities to finance *Focus on Energy*, a program designed to reduce energy consumption by promoting efficiency and renewable energy.

Wisconsin's Focus on Energy program is now saving 1.4 billion kWh per year—enough energy to meet the annual needs of more than 160,000 households. Credit: Paul Adam Smith

Focus on Energy

In 1999, the Wisconsin Legislature required energy utilities to pay a portion of their revenues into a public benefits fund for energy efficiency, renewable energy and low income household assistance programs.[42]

Currently, electric and natural gas utilities are required to spend 1.2 percent of their annual revenues on programs to promote energy efficiency and renewable energy—either on their own, or using the statewide Focus on Energy program.[43] Focus on Energy offers technical and financial assistance to residential and commercial energy customers seeking to reduce energy use or develop small-scale renewable energy installations.

In fiscal year 2008, Focus on Energy worked with 130,000 participants to save more than 300 million kWh of electricity (about 0.4 percent of annual consumption) and 10 million therms of natural gas (about 0.3 percent of annual consumption), saving participants more than $36 million per year on energy costs.[44]

In terms of per-capita spending on energy efficiency (excluding load management), Wisconsin ranked 17th out of all U.S. states in 2007, and first in terms of per-capita spending on natural gas efficiency.[45]

Measures installed through Focus on Energy, from 2001 through mid-2008, are now saving 1.4 billion kWh of electricity per year.[46] That amount of electricity is enough to meet the annual needs of more than 160,000 households—equivalent to nearly all the residences in the Madison metropolitan area.[47]

Clean Energy Prevents Pollution, Protecting Public Health and Wisconsin's Environment

Investing in clean energy reduces global warming pollution and helps to create a cleaner, healthier future for Wisconsin. Clean energy cuts emissions of carbon dioxide, the leading cause of global warming, as well as speeds progress in reducing soot, smog and mercury pollution, which damage public health. At the same time, clean energy helps to conserve Wisconsin's supplies of fresh water, reducing the amount of water that would otherwise be consumed in steam-driven power plants.

Reduced Pollution

As of early 2009, Wisconsin is generating approximately 3.8 billion kilowatt-hours (kWh) per year of renewable electricity, and saving more than 1.4 billion kWh per year through energy efficiency. If this electricity were to be generated in traditional power plants, it would create global warming and smog-forming pollution, while contributing mercury contamination to the state's waterways. However, clean energy displaces the need to burn fossil fuels, reducing emissions of these pollutants.

Reduced Global Warming Pollution

On average, each megawatt-hour of electricity generated in Wisconsin produces 1,726 pounds of carbon dioxide, the leading pollutant driving global warming.[48] In contrast, renewable electricity sources, because they do not rely upon fossil fuels, emit little global warming pollution.[49]

Wisconsin's renewable electricity generation and energy efficiency efforts currently prevent about 4 million metric tons per year of carbon dioxide emissions from entering the atmosphere.[50] This impact is roughly equivalent to making more than one out of every 10 cars and trucks in the state pollution free (800,000 vehicles).[51]

These emission cuts are just the first steps for Wisconsin to do its fair share to mitigate the worst effects of global warming. According to climate scientists, the world as a whole must reduce carbon dioxide pollution 50 percent or more by 2050. The United States must shoulder a larger burden, as one of the leading emitters of global warming pollution—cutting pollution by at least 80 percent by mid-century.[52]

The Threat of Global Warming

Global warming threatens to change much of what we know and love about natural Wisconsin. Indeed, Wisconsin's climate is already changing. Average temperatures increased by 0.7° F during the 20th century, extreme rainfall events have become more common, the duration of ice cover on Wisconsin lakes has declined, and springtime events—such as the blooming of plants and the return of migratory birds—are happening earlier in the year.[53]

Wisconsin is a significant contributor to global warming. Emissions of carbon dioxide—the leading global warming pollutant—increased by 25 percent in the state between 1990 and 2004. Were Wisconsin its own country, it would rank 38th in the world for carbon dioxide emissions, ahead of such nations as Romania, Austria, Sweden and Israel.[54]

Should emissions of global warming pollutants continue to increase, global average temperatures could increase by another 2° to 11.5° F by the year 2100 (depending on the pace of the emissions increase).[55] Warming on such a scale would have serious consequences for Wisconsin and the world. Global warming could:[56]

- Leave the Great Lakes smaller, shallower and less able to sustain healthy populations of fish and aquatic life;
- Reduce or eliminate the Wisconsin habitat of several key tree species—such as the balsam fir, paper birch, white spruce, jack pine and red pine—threatening the state's pulp and paper and softwood lumber industries;
- Increase the risk of forest fires and pest infestation in Wisconsin forests;
- Reduce or eliminate recreational opportunities, including snowmobiling, ice fishing, hunting and bird watching;
- Elevate the risk of drought as a result of higher summer temperatures that increase evaporation of moisture from the soil, and increase the erosion of farm soil, due to heavy rainfall.

Worldwide, global warming threatens to radically transform the environment in which we live, reshaping coastlines and creating hundreds of millions of refugees fleeing flooding or drought.

Reduced Soot and Smog

Clean energy sources—particularly wind and solar power and energy efficiency—can help clean Wisconsin's air and improve public health. Clean energy, by displacing dirtier power sources, can help prevent emissions of pollutants that form soot and smog, two serious public health threats.

For every megawatt-hour of electricity generated, the average Wisconsin power plant emits 7.4 pounds of soot-forming sulfur dioxide and 2.8 pounds of smog-forming nitrogen oxides.[57] Partially because of this pollution, 10 counties along Lake Michigan, from Door County to Kenosha County, violate federal air quality standards.[58]

As of early 2009, Wisconsin's renewable electricity generation and energy efficiency efforts prevent more than 10 million pounds of smog-forming nitrogen oxide emissions and more than 15 million pounds of soot-forming sulfur dioxide emissions per year.[59]

Reduced Mercury Deposition

Mercury emissions from coal-fired power plants and other industrial sources are making the fish in Wisconsin's lakes, rivers and streams unsafe to eat. Burning coal releases mercury into the air that eventually contaminates rivers and lakes, where bacteria convert it to a highly toxic form that bioaccumulates in fish.[66]

Mercury is a neurotoxin that is particularly damaging to the developing brain. In early 2004, EPA scientists estimated that one in six women of childbearing age in the U.S. has levels of mercury in her blood that are sufficiently high to put her baby at risk of learning disabilities, developmental delays and problems with fine motor coordination, among other health impacts.[67]

In 2005, Wisconsin's coal-fired power plants emitted 2,300 pounds of mercury.[68] As a result, Wisconsin has issued safe fish consumption guidelines for every lake in the state, and for 192 miles of rivers.[69] In 2008, special mercury advisories applied to

The Threat of Air Pollution

The combustion of fossil fuels forms soot and smog, two serious threats to public health in Wisconsin's air.

Sulfur dioxide emissions from coal-fired power plants form fine soot particles in the atmosphere. When inhaled, these particles become lodged deep in the lungs where they cause a variety of health problems, including asthma, bronchitis, lung cancer and heart attacks.[60] Soot pollution from power plants is responsible for significant harm to public health in Wisconsin.[61]

Fossil-fueled power plants also emit nitrogen dioxide, one of the primary ingredients in smog. Smog makes lung tissues more sensitive to allergens and less able to ward off infections.[62] It scars airway tissues.[63] Children exposed to smog develop lungs with less flexibility and capacity than normal. During high smog days, otherwise healthy people who exercise can't breathe normally.[64] Over time, smog exposure can lead to asthma, bronchitis, emphysema and other respiratory problems.[65]

Health problems imposed by soot and smog have serious economic consequences for Wisconsin. Beyond the loss of priceless years of healthy life, an unhealthy workforce is less productive.

95 bodies of water primarily in northern, central, and eastern Wisconsin.[70]

By displacing coal-fired power, clean energy helps to prevent mercury contamination. Wisconsin's clean energy efforts currently prevent—at minimum—80 pounds of mercury emissions per year.[71]

Reduced Water Usage

Renewable energy has the additional benefit of conserving water.

Traditional power plants depend heavily on a constant supply of water to produce steam and provide cooling.[72] Wisconsin's thermoelectric power plants withdraw more than 2 trillion gallons of fresh water every year.[73] Some cooling water is released to the atmosphere, irreversibly consumed and thus becomes unavailable for other uses.

In contrast, clean energy technologies use very little water (with the exception of biomass technologies that generate steam to move a turbine). For example, water use for a wind farm is limited to that required to periodically wash dust off of the turbine blades. Table 1 shows the consumptive water use of different types of energy systems.[74]

If the energy produced or conserved by Wisconsin's clean energy resources (excluding biomass), were instead generated by fossil-fueled power plants consuming 300 gallons of water per MWh produced, the state would consume more than 1.2 billion gallons of additional fresh water per year. That much water would be enough to meet the domestic needs of nearly half the city of Green Bay.[75]

Table 1: Consumptive Water Requirements of Energy Generation Technologies

Energy Technology	Water Consumption (gallons per MWh)
Coal-fired simple cycle power plant, once-through cooling	290 to 320
Coal-fired simple cycle power plant, re-circulating cooling system	690
Natural gas combined cycle power plant, once-through cooling	100
Natural gas combined cycle power plant, re-circulating cooling system	180
Nuclear power	820
Solar PV, residential	Negligible
Solar PV, central utility	25
Solar Thermal, Luz System	1,100
Solar Thermal, Stirling Engine	Negligible
Wind	Negligible
Biomass, once-through cooling	350
Geothermal (water is typically drawn from high-mineral content areas deep underground and is not suitable for other uses)	0 to 1,000

Note: This table presents water consumption requirements as opposed to water withdrawal requirements. Once-through cooling systems require more water withdrawals, but return more of the withdrawals to a water body than a re-circulating system.

Investments in Clean Energy Benefit Wisconsin's Economy

Wisconsin's progress toward clean energy also benefits the state economy. Renewable energy helps to replace energy expenditures for fuel or materials produced out of state with labor and materials produced at home. This keeps more of Wisconsin's energy dollars in the local economy, providing a boost. Additionally, money saved by consumers through efficiency programs can then be spent for other goods and services, stimulating the local economy. As a result, clean energy creates jobs, expands economic activity in rural areas of the state, and boosts overall economic productivity.

Clean Energy Creates Skilled, High-Paying Jobs

Investment in renewable energy and energy efficiency directly creates quality jobs in manufacturing, construction and building trades, operation and maintenance, and finance.

For example, the wind energy industry invested $400 million in Wisconsin in 2007.[76] Wisconsin workers helped to manufacture parts used in building wind turbines, helped to install the turbines on-site, and now work to maintain the turbines and run the business of power generation. In turn, the money wind businesses and their workers spend in the local economy helps to support other businesses. According to economic modeling work by the U.S. Department of Energy, wind farms installed in Wisconsin as of January 2009 created an estimated 1,300 local year-long jobs during construction, and now support more than 190 long-term jobs.[77]

Manufacturing

Wisconsin's well-developed industrial base makes it an ideal site for manufacturing energy efficient products and components for renewable energy systems.

Manufacturing Energy-Efficient Products

Energy efficiency programs require technologies that use less energy, and companies employ people to design and manufacture those technologies. Opportunities for more energy efficient products encompass nearly the entire spectrum of manufacturing. Companies could pro-

Energy Composite Corporation plans to manufacture wind turbine blades at a new facility in Wisconsin Rapids, like that pictured here, employing 400 workers. Credit: NEG Micon

"Look to the New North (the eighteen counties of northeast Wisconsin) to provide the manufacturing elements necessary for the growing wind energy industry. No other region in the Midwest offers the unique combination of advantages available here, including superior supplier potential built upon a one hundred year old manufacturing tradition, an expanding economy, access to some of the nation's best wind resources, strong existing markets and excellent workforce and transportation assets."

— The New North, Inc., a consortium of business, economic development, chambers of commerce, workforce development, civic, non-profit, and education leaders in 18 counties of Northeast Wisconsin, May 2008.[81]

duce energy efficient lighting systems, dishwashers, power supplies, windows, industrial motors, electronic controls and countless other energy-using products. By increasing demand for these types of products, energy efficiency programs can directly create manufacturing jobs.

For example, Racine, Wisconsin is home to Ruud Lighting, a company that manufactures a range of lighting technology, including low-maintenance and high-efficiency LED fixtures. The company employs more than 500 people.[78] Ruud benefits from demand for energy-efficient fluorescent and LED light fixtures—stimulated by state energy efficiency policies and utility incentives.[79] One of the company's latest innovations is an LED streetlight system including controls that a city can use to dim lights during low-traffic hours, reducing energy and maintenance costs by up to 80 percent.[80]

Manufacturing Wind Turbines

Renewable energy systems require highly skilled manufacturing workers who design and build components of wind turbines, solar panels and other technologies.

Much of the work involved in creating a wind farm goes into manufacturing components, which include rotor blades, structural towers, hubs, transmissions, generators and assorted electronic controls. According to a survey of wind energy companies by the Renewable Energy Policy Project in 2001, manufacturing 10 MW of wind turbines requires a year of labor from 32 full-time workers.[82]

Wisconsin is in good position to see employment growth from wind turbine manufacturing. More than 75 local companies participate in the wind turbine supply chain. The wind industry is one of 9 primary business clusters marketed by the business recruitment and promotion organization *Forward Wisconsin*, alongside other staples such as paper products and the dairy industry.[83]

"The future of wind energy is very bright and there is lots of upside potential for the industry to expand and provide new jobs for the United States."

— Mike Skahan, Human Resources Director for Tower Tech Systems, a wind turbine tower manufacturer in Manitowoc, as quoted by the Herald News Tribune on April 15, 2009.[88]

The New North, Inc., a coalition of civic, education and business leaders in 18 counties of Northeast Wisconsin, sees Wisconsin playing a strong role in wind turbine component manufacturing. The organization notes that the New North region has the second-highest concentration of manufacturing jobs in the United States, and that Wisconsin as a whole is home to more than 500 businesses, together capable of producing "all component products required of wind energy industries."[84]

Already, local companies are benefiting from the regional wind energy expansion. For example, Tower Tech Systems of Manitowoc employs 210 people constructing tall steel towers for wind turbines.[85] The company occupies a factory where workers built submarines for the U.S. Navy during World War II, followed by steel cranes and other heavy equipment.[86] Paul Smith, vice president of the company, told the *Herald News Tribune* that part of the company's strategy was locating manufacturing close to the sites where wind turbines will be installed, minimizing the expense of transporting the heavy tower sections.[87]

Additionally, in April 2009—amidst news of layoffs and job cuts at local factories

in other industries—the Energy Composites Corp. announced plans to construct a new wind turbine blade manufacturing plant in Wisconsin Rapids.[89] The new plant will employ at least 400 people, many likely transitioning from lost jobs in the paper industry.[90] Connie Loden, president of the Heart of Wisconsin Business & Economic Alliance, told the *Wisconsin Rapids Tribune*: "It's going to have a positive impact across the entire business community, and on a municipal level," adding to the city's tax revenues and providing wages that can be spent at local businesses.[91]

Manufacturing Solar Energy Systems

Similarly, much of the work behind solar energy involves manufacturing. Building a photovoltaic panel requires creating cells from silicon and glass, installing wires and other electrical components, and assembling them into a unit. According to a 2002 analysis by University of California-Berkeley Professor Daniel Kammen, manufacturing a megawatt of solar photovoltaic panels requires approximately six full-time employees working for a year.[92]

Wisconsin is home to a variety of solar energy companies. Cardinal Solar Technologies, for example, broke ground on a new facility in Mazomanie in June 2008. The facility will manufacture specialized glass covering for solar photovoltaic panels, employing more than 40 people in its first phase. If all goes well, the facility could eventually employ 200 to 300 workers.[93]

Spurring Local Renewable Energy Manufacturing

By increasing local demand for renewable energy and energy efficient products, Wisconsin could create and enhance the opportunity for new companies to locate facilities in Wisconsin while bolstering the state's existing clean energy businesses. The state has a well-developed industrial base, access to rail and highway infrastructure, and access to ports on the Great Lakes—assets that could attract manufacturers interested in tapping into the regional and even global clean energy market. For example, the Spanish wind turbine manufacturing company Gamesa located its U.S. headquarters in Pennsylvania in part because of the state's commitment to renewable energy, as well as its strategic location.[94]

The Renewable Energy Policy Project (REPP) estimates that national efforts to build large amounts of solar and wind energy facilities would bring a $2.6 billion investment to Wisconsin and create more than 7,000 manufacturing jobs.[95] REPP identified more than 700 Wisconsin businesses with the capacity to manufacture components for large-scale solar or wind energy systems.[96]

Building Trades, Construction and Installation

Installation of energy efficiency measures and renewable energy facilities typically involves local construction firms and general contractors, boosting local economies.

Energy efficiency programs increase the demand for builders, general contractors and energy service companies to install and maintain energy efficiency measures. For example, architecture and design firms help plan energy efficient structures. Consulting firms help businesses meet building codes. Energy service companies provide a wide range of energy related services, from identifying efficiency opportunities to facilities management. Engineering firms create technical solutions. Contractors provide installation and service for heating, ventilation, air conditioning, and refrigeration systems. All of these activities support jobs.

Wisconsin is home to many of these companies. In particular, the building efficiency services division of Johnson Controls—a company with a large nationwide presence—is headquartered in Milwaukee. Johnson Controls is Wisconsin's largest

Large wind farms can need up to 300 workers on site during construction. Credit: BONUS Energy A.S.

publicly traded company.[97] Energy efficiency service providers stand to gain significantly from the $8 billion in energy efficiency spending included as part of the February 2009 federal stimulus package.

Similarly, wind farm installation also requires local workers. Large wind farms can need up to 300 workers on site during construction. These workers assemble turbines, erect towers, pour concrete, build roads, and lay cable.[98] Steel to reinforce foundations, gravel and road base, concrete, and supplies for wiring, as well as excavation, transport services and fuel, housing, and food for workers can all benefit local businesses during wind farm construction.

The construction of the Blue Sky—Green Field wind energy center in Fond du Lac County created an estimated 200 year-long jobs.[99] Most of those jobs went to local Wisconsin firms, such as Appleton-based Carew Concrete and Supply Co., which supplied the concrete for the turbine foundations.[100]

Operation and Maintenance

The operation and maintenance needs of a wind farm or a biomass facility create permanent, high-quality local jobs ranging from servicing turbines to accounting.

Wind farms need staff to operate and regularly service the turbines throughout their roughly 30-year lifetimes. A survey of large wind farms in Texas found that every 100 MW of capacity requires six full-time employees to operate, monitor, and service the turbines.[101]

Similarly, biomass facilities need biomass fuel. The Bay Front Power Plant in northern Wisconsin, with two wood-fired boilers, has a $20 million annual economic impact on the six-county region around Ashland.[102]

Spillover Effects

Each dollar spent on renewable energy—or saved through energy efficiency—creates impacts that ripple outward through the local economy, extending far beyond the direct creation of jobs at energy facilities.

For example, workers at a manufacturing plant need raw materials and equipment. Their work in assembling turbines supports jobs in equipment manufacturing and component supply. Contractors at a construction site need concrete and heavy equipment, and their work supports additional jobs supplying these needs. In addition to these indirect jobs, workers spend much of their wages in the local economy, purchasing goods and services like groceries and housing and supporting additional workers.

The same is true for every dollar saved through energy efficiency or reduced energy prices. Savings achieved through clean energy can then be spent on other goods and services, creating jobs and stimulating the local economy. For example, the Focus on Energy program estimates that from 2002 to 2007, state energy efficiency programs created more than 1,400 local jobs, generated $181 million in sales for

local businesses, and increased disposable income for Wisconsin residents by $85 million. By 2012, these impacts will more than double.[103]

Other forecasts concur that clean energy is an effective tool to stimulate the economy:

- In 2009, the University of Massachusetts, Amherst and the Center for American Progress estimated that a large-scale investment in clean energy technologies including energy efficiency, plus wind, solar, biofuel, and geothermal power, could create 37,000 jobs in Wisconsin.[104]

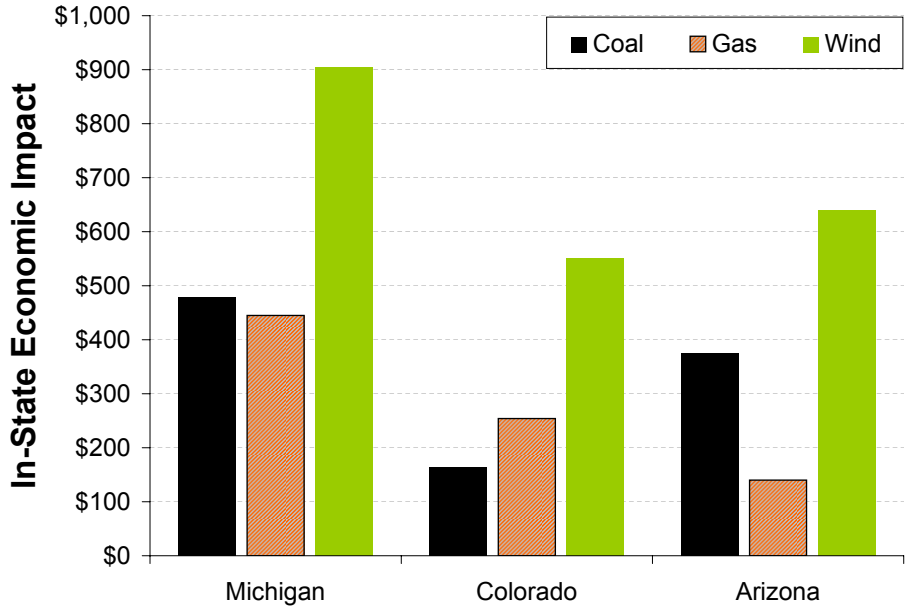
- In January 2005, the American Council for an Energy Efficient Economy estimated that a five-year regional

Renewable Energy Facilities Have Larger Direct Economic Impact than Coal or Gas-Fired Power Plants

The National Renewable Energy Lab has found that wind farms have greater direct and local economic impact than natural gas or coal-fired power plants capable of producing an equivalent amount of electricity. In the three test-case states of Michigan, Colorado and Arizona, wind has 150 percent to 300 percent of the direct economic impact of an equivalent fossil-fueled plant.[109] (See Figure 4.) In Wisconsin, the Union of Concerned Scientists estimates that the state's renewable

(Continued next page)

Figure 4: Direct Economic Impact of Wind, Gas and Coal Power Plants in Michigan, Colorado and Arizona (on an Energy-Equivalent Basis)[112]



energy efficiency program focused on reducing natural gas consumption could create more than 7,000 jobs in Wisconsin by 2020, while increasing total wages paid to employees by $160 million.[105]

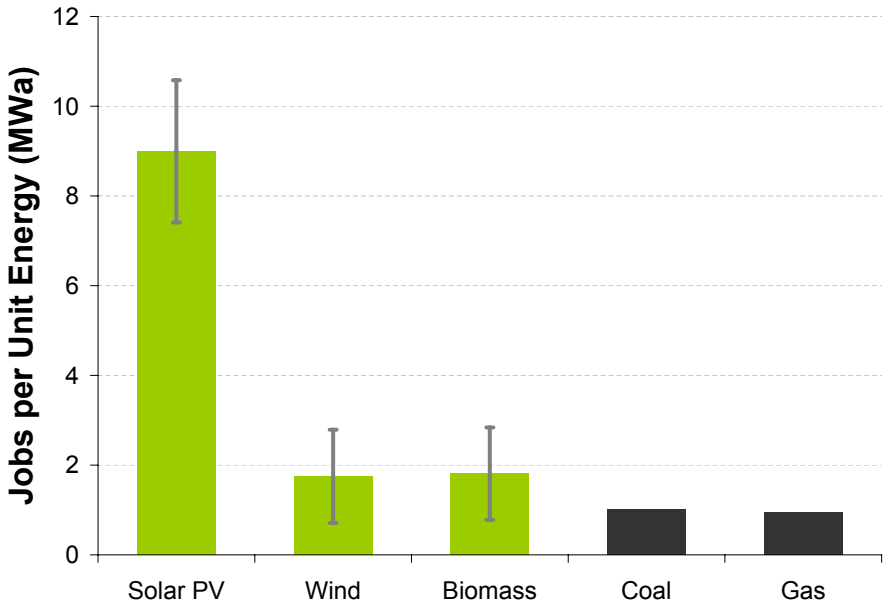
- In 2001, researchers at the University of Illinois calculated that an energy efficiency package aimed at reducing regional electricity consumption 28 percent by 2020 would create 7,400 jobs and increase Wisconsin's economic output by $2.7 billion.[106]

Efficiency programs can create productivity benefits as well, especially in the industrial sector. Investments that increase industrial energy efficiency can improve product quality, lower capital and

electricity standard (10 percent by 2015) will create 2,100 jobs and increase wages by $80 million—more than twice the expected impact from building more natural gas or coal power plants.[110]

Similarly, a variety of studies confirms that renewable energy generates more total jobs per unit energy produced than fossil-fuel technologies.[111] (See Figure 5, which presents the total number of direct jobs created per unit of energy for selected renewable and fossil technologies, including manufacturing, installation, fuel extraction, and operation and maintenance.) Compared to coal- and gas-fired power, solar energy creates on the order of 9 times as many jobs, and wind and biomass create on the order of 75 percent more jobs.

Figure 5: Jobs per Unit of Energy from Renewable and Fossil Technologies, U.S.[113]



operating costs, and increase employee productivity.[107] By increasing reliability and preventing power outages, efficiency programs can also create value for the economy. One recent study estimated the cost of power outages to U.S. businesses alone at between $104 billion and $164 billion per year.[108]

Clean Energy Enhances Rural Economies

Local Jobs

Renewable energy installation can create jobs in rural parts of the state. Wind farms in particular are often located in places where local economies depend on farming or resource extraction. Local jobs include construction and facility installation, operation and maintenance of the facility after it is constructed, and jobs induced by the additional money the workers spend on locally obtained goods and services.

Landowner Royalties

Rural landowners who lease their property for a wind facility can enjoy an additional source of income. Unlike the income from a typical harvest or livestock sale, payments from wind energy are steady and year-round. The Union of Concerned Scientists estimates that a farmer or rancher with good wind resources could increase the economic productivity of his or her land by 30-100 percent.[114]

Lease terms vary, but they typically represent 2.5 percent of gross revenue from electricity sales.[115] Assuming a contract price for electricity generated from wind power of 3.5 ¢/kWh, a single 1.5 MW turbine with a 30 percent capacity factor would bring the landowner $3,500 each year. In the case of land owned by a local government, leasing income could be funneled into local schools and services.

The U.S. Department of Energy estimates that wind energy in Wisconsin is currently providing about $1.2 million per year in additional income to farmers and other landowners.[116] By 2020, the Union of Concerned Scientists estimates that Wisconsin's 10 percent renewable electricity standard will yield $22 million in payments to rural landowners who host wind farms.[117]

Local Tax Income

Renewable energy equipment will raise the property tax base of a county, creating a new revenue source for education and other local government services. The U.S. Department of Energy estimates that Wisconsin wind farms are currently increasing local government tax revenues by about $850,000 per year.[118] By 2020, the Union of Concerned Scientists estimates that Wisconsin's 15 percent renewable electricity standard will increase property tax revenues for local communities by a total of $31 million.[119]

Wind power has several advantages over coal- and gas-fired power plants when it comes to contributing to the economic health of local governments. First, Wisconsin's wind energy and biomass resources are distributed across a wide area of the state. Traditional power plants, in contrast, are concentrated on smaller areas of land and can only benefit a handful of communities.

Coal-fired power plants also pay a proportionally smaller share in property taxes than renewable energy, because they require less land and less capital investment per unit of energy produced (with a greater share of cost going toward ongoing fuel expenses).[120]

Energy Crop Production

Using tree trimmings for energy, or specifically growing a crop for energy on a plot of land, can also help advance the

Clean Energy Can Increase the Potential Economic Benefit of a Cap on Global Warming Pollution

In its latest Strategic Energy Assessment, the Public Service Commission of Wisconsin prominently concludes that "mandatory constraints on greenhouse gas emissions appear to be inevitable."[132] The Governor's Task Force on Global Warming has recommended that Wisconsin aim to reduce emissions of global warming pollution by 22 percent below 2005 levels by 2025, and 75 percent below 2005 levels by 2050.[133] Legislation pending in the 2009 U.S. Congress sets similar targets.

Achieving these emission reduction targets will require action in all areas of Wisconsin's economy. But implementing energy efficiency measures and expanding renewable energy production in Wisconsin now can make it easier for the state to achieve large emission reductions later on and maximize the benefits of a transition away from fossil fuels. The Union of Concerned Scientists examined the economic impact of a national cap on global warming pollution, finding that consumers would save $0.6 trillion through 2030 compared to continuing our current, fossil-fuel dependent path.[134] However, supplementing such a policy with a comprehensive effort to increase energy efficiency and renewable electricity generation would more than double anticipated consumer savings, reaching $1.6 trillion.[135]

economies of rural parts of Wisconsin. For example, the Oak Ridge National Laboratory estimates that planting and harvesting 188 million dry tons of switchgrass, an energy crop, would increase total U.S. farm income by $6 billion.[121]

The Bay Front power plant in Ashland, WI is one of Wisconsin's largest biomass facilities. The owner of the plant, Xcel Energy, estimates that the plant has a $20 million impact on a six-county region around the plant, through its purchases of waste wood and fuel delivery services. [122]

Clean Energy Saves Consumers Money

Clean energy saves consumers money on their electricity and gas bills, particularly in the long run. Moreover, clean energy reduces overall energy system costs—saving everyone money, even people who don't directly install efficiency measures or solar panels. As a result, people have extra money to spend, which can stimulate Wisconsin's economy and create jobs.

Much of the savings stem directly from energy efficiency programs, which help consumers use less energy—directly translating into smaller energy bills. For example, a homeowner will find that savings on electricity and replacement bulbs more than justify investing in compact fluorescent light bulbs (CFLs). Purchasing five CFLs requires an extra investment of $15 over the cost of incandescent bulbs. However, over the life of the CFL bulbs, a homeowner will save more than 2,700 kWh of electricity and pay $385 less on energy bills. The bulbs effectively pay for themselves in less than four months, and save the consumer $370 over their useful lifetime.[123]

If every household in Wisconsin replaced five incandescent bulbs with CFLs,

Clean energy saves consumers money on their electricity and gas bills. Credit: Jake Levin

residential electricity use would drop by more than 2 percent and bulbs would need replacement less frequently, saving consumers more than $90 million per year. Over the life of the bulbs, Wisconsin homeowners would save more than $800 million.[124]

Additionally, energy efficiency and renewable energy can insulate consumers from expensive and volatile fossil fuels, like natural gas—helping to stabilize energy prices.

For example, the inclusion of wind in Xcel's generation portfolio in Colorado provides a hedge against natural gas price spikes that have driven up electricity and heating prices in recent years. Whenever wind is available, the highest-cost natural gas generators producing power at the time are turned down, or turned off. Since wind has no fuel cost, once wind turbines are installed, consumers can know exactly how much wind will cost for the life of the turbines.

Xcel Energy determined that in 2005, the cost stability of wind energy on its system saved its customers a net of $9.75 million.[125] According to the Interwest Energy Alliance, Coloradans will save more than $250 million over the next two decades because of the wind farms on Xcel's network as of summer 2006.[126]

Clean energy also provides a hedge against spikes in the price of coal. For example, the price of Illinois Basin coal more than doubled from August 2007 to August 2008, and many other kinds of coal have reached historically high prices in the last year.[127]

Second, both energy efficiency and renewable energy reduce the demand for natural gas and ease the upward pressure

on natural gas prices. As a result, people and industries that depend on natural gas will have slightly smaller bills than without natural gas conservation efforts. These savings can then be reinvested in other parts of the economy, rather than spent on high-priced fuel imported from out of state. This additional spending creates jobs throughout the economy.

Recent studies estimate that for every 1 percent reduction in national natural gas demand, natural gas prices fall by 0.8 percent to 2 percent below forecast levels.[128] Modeling the impacts of a hypothetical national renewable energy standard and energy efficiency effort in effect starting in 2003, the Lawrence Berkeley National Laboratory found natural gas bill savings with an estimated net present value as high as $73 billion through 2020.[129] According to a 2005 analysis by the American Council for an Energy Efficient Economy, decreasing natural gas consumption by 1 percent per year for five years in eight Midwestern states would decrease wholesale natural gas prices by as much as 13 percent.[130] As a result, Wisconsin consumers would save more than $900 million on energy by 2020.[131]

Clean Energy Can Boost Economic Output

Investments in renewable energy, dollar for dollar, produce a greater net benefit for Wisconsin's economy than traditional technologies.

Renewable energy policies improve economic output because they increase the amount of money kept within the local economy. For example, in 2001 researchers at the University of Illinois's Regional Economics Application Laboratory determined that a regional plan to boost energy efficiency, renewable energy and combined heat and power would increase Wisconsin's gross state product by $2.7 billion by 2020.[136]

Wisconsin Has the Potential to Achieve Much More

While Wisconsin's use of clean energy resources has grown dramatically in recent years, we have barely begun to scratch the surface of the state's potential. Wisconsin has enough wind, solar and biomass energy resources to produce power equivalent to the entire state's electricity needs. And at the same time, Wisconsin has massive potential for more efficient energy use.

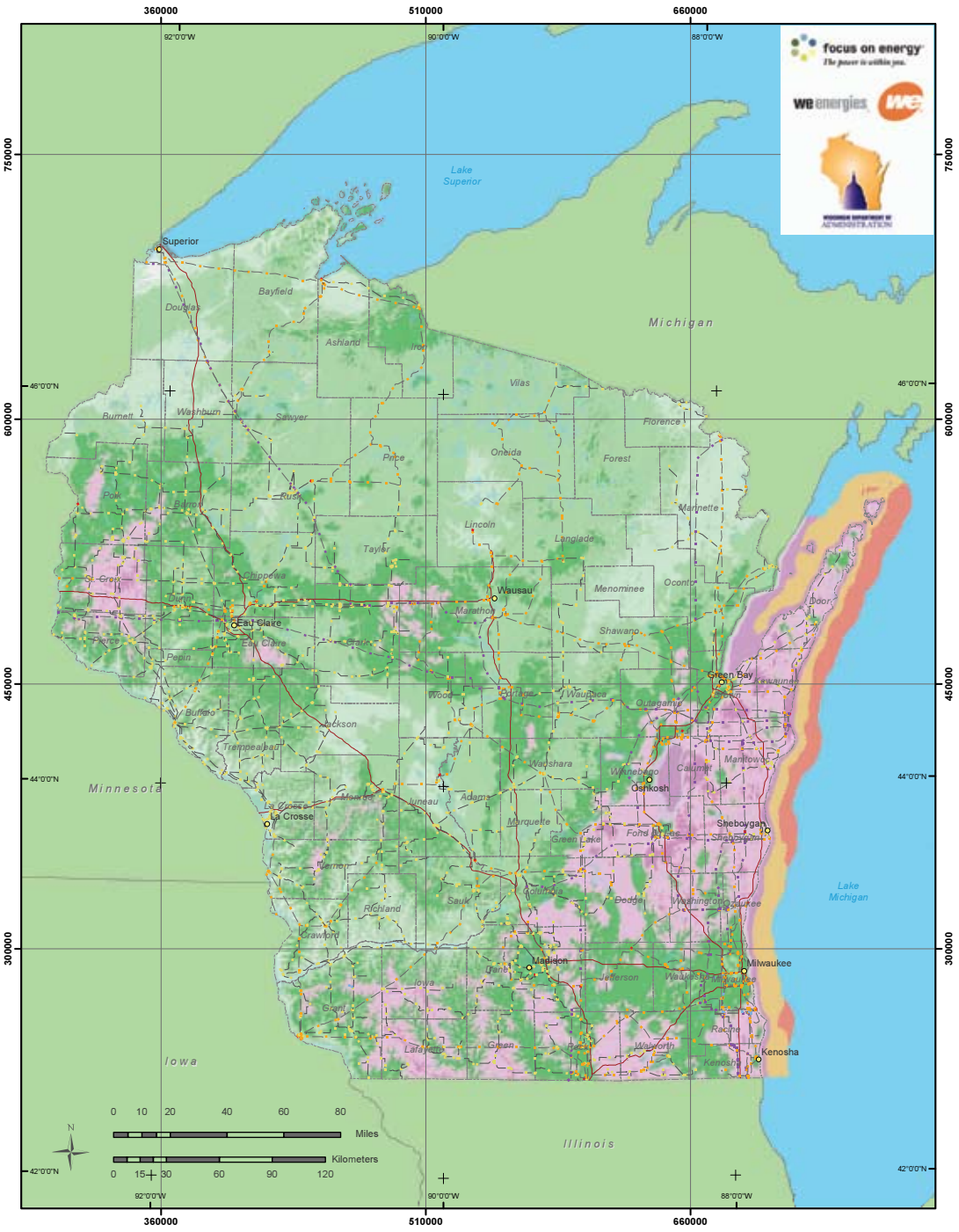
Renewable Resources Could Meet the State's Electricity Needs

Wind

While wind power has grown tremendously in the past decade, there is ample room for further growth. Wind power produces about 2 percent of Wisconsin's electricity. In comparison, as of the end of 2007, wind power's share of total electricity consumption was approximately 7 percent in Germany, 12 percent in Spain and more than 20 percent in Denmark.[137] Iowa, Minnesota, Colorado and Oregon also get more than 5 percent of their electricity from wind, while Texas generates enough wind energy to power more than 1 million homes.[138]

Wisconsin has vast amounts of untapped wind energy potential. The state's total wind energy potential has been estimated at 53 billion kWh per year, equivalent to 75 percent of the state's current electricity consumption.[139]

Even though the wind doesn't necessarily blow all the time, wind power can make a valuable contribution to Wisconsin's overall electricity grid. Nations such as Denmark have shown that it is possible to obtain 20 percent of their electricity supplies from wind (and much more at certain times and places). In early 2006, a group of the nation's largest utility companies found that at wind penetration levels of up to 20 percent, "system stability in response to a major plant or line outage can actually be improved by the addition of wind generation"; the cost of integrating wind energy into a typical utility system is affordable; and wind energy does not require backup generation.[140] And a recent study under-



Wind Resource of Wisconsin

Mean Annual Wind Speed at 100 Meters

Features

- City
- Interstate Highway
- County Boundary
- Water Body

Transmission Line Category

- Under 100 kV
- 100 kV-161 kV
- 230 kV-287 kV
- 345 kV
- 500 kV
- 735 kV +
- Step-Up
- DC Line

Mean Speed at 100 m

mph	m/s
< 12.3	< 5.5
12.3 - 13.4	5.5 - 6.0
13.4 - 14.5	6.0 - 6.5
14.5 - 15.7	6.5 - 7.0
15.7 - 16.8	7.0 - 7.5
16.8 - 17.9	7.5 - 8.0
17.9 - 19.0	8.0 - 8.5
19.0 - 20.1	8.5 - 9.0
20.1 - 21.3	9.0 - 9.5
> 21.3	> 9.5

AWS Truewind

Projection: NAD 1983 HARN Transverse Mercator
Spatial Resolution of Wind Resource Data: 200m
This map was created by AWS Truewind using the MesoMap system and historical weather data. Although it is believed to represent an accurate overall picture of the wind energy resource, estimates at any location should be confirmed by measurement.

The transmission line information was obtained by AWS Truewind from the Global Energy Decisions Velocity Suite. AWS does not warrant the accuracy of the transmission line information.
Source date: December 2006

WI_SPD_PWR_6Feb07.mxd MFB 2/6/07

taken in Minnesota found that utilities can obtain up to one-quarter of their electricity from wind without harming grid reliability, and with only minor costs for absorbing the intermittent power.[141] Some wind industry analysts have even suggested that it is possible to have up to 40 percent wind power as part of a smoothly functioning electricity grid.[142]

Biomass

Although biomass energy use is rapidly expanding in Wisconsin, the state has the potential for much more growth. Wisconsin has almost 15 million tons of available biomass, which could be used to replace 15 million tons of imported coal—equivalent to 56 percent of Wisconsin's total coal use.[143]

Wisconsin farms could contribute to the state's energy security through non-food crop wastes, or by capturing animal wastes as a fuel source. The Union of Concerned Scientists estimates that energy crops could ultimately provide up to 14 percent of U.S. electricity or 13 percent of motor fuel, while at the same time bolstering the health of rural economies.[144]

Solar

Wisconsin has significant solar energy potential. A solar PV system in Wisconsin

Measuring Efficiency Potential

There are three different ways to measure energy efficiency potential.

- Technical Potential is the sum of all technically possible energy saving measures, regardless of cost. Theoretically, technical potential should approach 100 percent, since there are always more measures that could be considered when money is no object—but most studies consider only a fraction of all energy saving measures to hone in on those most likely to be implemented.

- Economic Potential represents the total energy savings that could be achieved using all available energy efficiency measures that meet a cost-effectiveness test. Economic potential can vary greatly, depending on how one defines "cost-effective." More measures become cost-effective the higher the cost of energy becomes. More measures also become cost-effective with a wider consideration of the benefits of energy efficiency (at the narrowest level, a utility can benefit from avoided investments in infrastructure, and at the widest level, society benefits from reduced fuel costs and reduced environmental and public health impact of energy use).

- Achievable Potential represents the total energy savings that an analyst believes are practical and achievable with a certain policy measure. Achievable potential estimates are narrower than economic potential, and are subject to additional assumptions about the effectiveness of efforts to increase the market penetration of a set of efficient technologies.

can produce approximately 80 percent of the energy of the same system located in Florida.[145] If solar panels (with an average area of 300 square feet per system) were installed on 1 million Wisconsin rooftops, they could produce 5,000 GWh per year, more than 20 percent of the electricity used in Wisconsin homes in 2006.[146]

Much Greater Energy Efficiency Savings Are Possible

Wisconsin can do more to improve energy efficiency. The state is reducing electricity consumption by less than half a percent per year, compared to achievable potentials higher than 1 percent per year.

Opportunities to improve efficiency are everywhere. For example, if every household in the Midwest installed 5 efficient compact fluorescent light bulbs in place of conventional bulbs, household lighting energy use would fall by by one-quarter.[147] Overall, this action would save more than 500 gigawatt-hours (GWh) of electricity each year in Wisconsin, enough electricity to power more than 50,000 homes.[148]

Similarly, many motors driving fans, pumps and industrial equipment only run at one speed—wasting energy whenever the load on the motor is less than 100 percent. These systems are like "driving a car with the accelerator pushed to the floor while controlling the vehicle's speed with the brake."[149] Upgrading motors (and the equipment they drive) to more efficient technology can save significant amounts of energy. The use of high-efficiency motors and better controls in the industrial, electricity generation and commercial sectors could reduce *total* U.S. electricity demand by as much as 15 to 25 percent.[150]

In 2005, the Energy Center of Wisconsin evaluated the achievable potential for electric energy efficiency in Wisconsin for the Governor's Task Force on Energy Efficiency and Renewable Energy.[151] The study limited its definition of "cost effective" measures to those that could save energy at costs less than the cost of electricity generation, excluding the cost of electricity transmission and distribution. The study also did not include any estimates of the external costs of fossil fuel use, such as the health impacts of air pollution, or any estimates of future cost increases that will affect fossil fuels as a result of new laws limiting the emission of global warming pollution. Including these additional costs would expand the amount of achievable efficiency potential. During 2009, the Public Service Commission of Wisconsin plans to release an updated energy efficiency potential study with a wider scope, including consideration of the future cost of emitting global warming pollution.[152]

The study found that over five years, an expanded efficiency program could:

- Reduce electric energy consumption by 0.5 to 0.7 percent annually; and
- Reduce natural gas consumption by 0.2 to 0.4 percent annually.[153]

At this level of savings, energy efficiency would defer the need for one electric power plant, save enough power to run 200,000 homes, and save enough natural gas for roughly 50,000 homes.[154]

The study found that the greatest achievable efficiency reservoirs included increased adoption of compact fluorescent bulbs in homes, lighting retrofits in commercial buildings, and improvements to compressed air and pump systems in industrial and commercial buildings.[155]

If the program were run for 10 years rather than five, the program would be more effective. At the 10-year horizon, the study found that an achievable efficiency program would:

- Reduce projected electricity consumption by 6 to 9 percent (7.6 percent); or 0.76 percent per year; and

- Reduce projected natural gas consumption by 3 to 5.2 percent (4.1 percent), or by 0.4 percent per year.[156]

The study concluded, looking at avoided costs of generation alone, that Wisconsin could sustain economically justified energy efficiency spending levels as much as three times higher than in fiscal year 2006, up to $121 million per year.[157]

Additional studies of efficiency potential in other parts of the United States suggest that even greater savings are possible:

- In 2005, the American Council for an Energy-Efficient Economy (ACEEE) performed an analysis of how energy efficiency measures could help address the natural gas crisis in the Midwest. ACEEE estimated that a "modestly aggressive but pragmatically achievable" energy efficiency campaign could reduce electricity and natural gas consumption by about 5 percent over five years.[158]

- In 2004, the American Council for an Energy-Efficient Economy (ACEEE) reviewed a set of leading studies of efficiency potential nationwide, finding substantial potential for energy savings. ACEEE found that the median U.S. state could technically reduce electricity consumption by 33 percent and gas consumption by 40 percent.[159] Looking at measures that were both cost-effective and achievable, ACEEE found that the typical state could achieve electric energy savings of 24 percent below forecast levels within 20 years (at a rate of 1.2 percent per year) and gas savings of 9 percent (at a rate of 0.5 percent per year).[160]

- In 2004, Synapse Energy Economics estimated that nationwide, there are enough cost-effective energy efficiency resources to reduce electricity consumption by as much as 35 percent by 2020.[161]

- In 2002, the Southwest Energy Efficiency Project estimated that six states from Arizona to Wyoming could reduce projected electricity demand by 33 percent by the year 2020 (or close to 100,000 GWh/year).[162]

Increasing Wisconsin's Policy Commitments to Clean Energy

By deepening its commitment to energy efficiency and renewable energy, Wisconsin can improve its environment and protect public health—all while boosting its economy.

While Wisconsin has no fossil fuel or uranium reserves, the state is blessed with ample local clean energy resources. By capturing more of these resources, Wisconsin can keep more of its dollars local, providing new energy for the state's economy. Developing clean energy resources can also prepare Wisconsin for new laws limiting the emission of global warming pollution from fossil fuels, increasing potential economic benefits and making emission reduction targets easier to achieve.

Credit: NREL

The state should take action to increase the development and deployment of Wisconsin's ample clean energy resources, helping to put the state on sound footing for the future.

Wisconsin should increase its renewable energy standard to ensure that at least 25 percent of the state's electricity consumption comes from renewable sources of energy by 2025, matching Minnesota and Illinois.

- Wisconsin should act on the recommendations of the Governor's Task Force on Global Warming and increase the state's renewable electricity standard.[163] Specifically, the state should move the current requirement that utilities obtain 10 percent of their electricity sales from renewable resources by 2015 ahead two years, to 2013. Additionally, the state should set new renewable energy requirements of 20 percent by 2020 and 25 percent by 2025.

- A renewable electricity standard of this magnitude would match requirements set by the neighboring states of Minnesota and Illinois.[164]

Wisconsin should also increase its efforts toward energy efficiency, aiming to reduce annual electricity consumption by 2 percent and natural gas consumption by 1 percent or more per year, at investor-owned and municipal and cooperative utilities.

The Governor's Task Force on Global Warming concluded that energy efficiency is "the most effective, least-costly early action that can be taken to reduce … emissions [of global warming pollution]."[165] The Task Force recommended that "capturing all available cost-effective energy savings should be Wisconsin's first resource priority to achieve ... [global warming pollution] emissions reductions as well as achieve energy savings that can mitigate future energy costs and energy infrastructure needs."[166]

- Currently, the state sets aside 1.2 percent of utilities' revenue and attempts to save as much energy as possible. Instead, the state should set a specific target for annual energy savings, and fund the program appropriately to meet the target.

- Wisconsin should set an annual energy savings target of 2 percent of electric consumption per year, and 1 percent of natural gas consumption per year. The state of Illinois has established a similar program, increasing electric energy savings to 2 percent of consumption per year by 2015.

- Increasing the scale of Wisconsin's energy efficiency programs will likely increase their ability to deliver large amounts of savings for very low cost. Studying energy efficiency programs in the Northeast, researchers at Synapse Energy Economics concluded that as the scale and scope of energy efficiency programs increase, they tend to become even more cost effective.[167]

Notes

1 U.S. Bureau of Labor Statistics, *Wisconsin Economy at a Glance*, 13 March 2009; available at www.bls.gov/eag/eag.wi.htm.

2 Joel Dresang, "U.S. Jobless Rate Reaches 25-Year High," *Milwaukee Journal Sentinel*, 7 March 2009.

3 U.S. Department of Energy, Energy Information Administration, *State Energy Profiles—Wisconsin*, 5 March 2009.

4 Including all primary energy consumption, minus biomass, data for 2006. U.S. Department of Energy, Energy Information Administration, *State Energy Data System*: *Consumption*, *Prices and Expenditures*, 28 November 2008. Wisconsin spends more than $21 billion in total on energy each year. Nearly $9 billion is for coal, natural gas, uranium and electricity imports. The rest is for transportation fuels.

5 Gross State Product: U.S. Department of Commerce, Bureau of Economic Analysis, *Gross Domestic Product by State*, *2007*, 5 June 2008; Wisconsin population is about 5.7 million, per Wisconsin Department of Health Services, *Wisconsin Population Estimates*, revised 24 October 2008.

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