Union of Concerned Scientists

Raising the Bar in Wisconsin

FACT SHEET

Increasing the State's Renewable Electricity Standard Is Achievable and Affordable

The Wisconsin legislature is considering the Clean Energy Jobs Act (AB 649/SB 450), a comprehensive bill to increase energy efficiency and renewable energy based on recommendations from Governor Jim Doyle's Task Force on Global Warming. The bill includes a requirement for Wisconsin utilities to increase the use of wind, bioenergy, and other renewable energy sources from approximately 5 percent of the state's electricity use in 2009 to 25 percent by 2025. Utilities must obtain 40 percent of this required renewable power from in-state facilities. Wisconsin is currently ahead of schedule in meeting its existing renewable electricity standard (also known as a renewable portfolio standard) of 10 percent by 2015. As of February 2010, renewable electricity standards have been adopted by 29 states, with 17 states having requirements of 20 percent or higher. Neighboring states Illinois and Minnesota have renewable electricity standards of 25 percent by 2025.

Using an updated model the Union of Concerned Scientists (UCS) originally developed for the University of Wisconsin and the Wisconsin energy office, and a separate model to calculate jobs impacts,[1] we examined the costs and benefits of increasing Wisconsin's renewable electricity standard to 25 percent by 2025 under three different scenarios:

- the **No Hydro Imports case** assumes electricity from new, large-scale (greater than 60 megawatts) hydropower projects in Canada and other states do not contribute to the standard;
- the **Hydro Imports case** assumes electricity from new, large-scale hydro projects are imported into the state and contribute to the standard; and
- the **No Renewable Energy Imports case** assumes all new (post-2009) generation used to meet the standard comes from in-state renewable energy projects

Consistent with other studies by UCS and the State of Wisconsin, we find that the Badger State has the resources to meet the 25 percent standard, while helping to protect consumers from rising electricity bills, create jobs, and cut global warming emissions. A more detailed description of the methodology can be found at the end of this document.

Benefits of increasing Wisconsin's renewable electricity standard to 25 percent by 2025:*

Renewable energy development
• 2,430 megawatts of new in-state capacity—mostly wind and biopower—equal to two-thirds of the new capacity needed to meet the standard

Lower electricity bills
• $59 million reduction in electricity bills—equivalent to reducing the average Wisconsin household bill by 60 cents per month

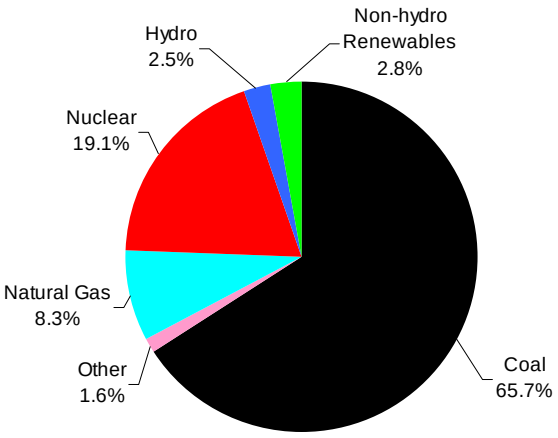
Carbon reductions
• Carbon emissions reductions equal to taking 2.1 million cars off the road

Economic development
• $2.4 billion in new capital investment
• $630 million to farmers and rural areas from bioenergy production
• $36 million in new local tax revenues

Job creation
• 2,650 new jobs from renewable energy—5 times the number of jobs that would be created by producing the same amount of electricity with coal and natural gas

* Under the no hydro imports case

Wisconsin Electricity Mix, 2008



Note: "Other" includes oil, municipal solid waste, tires, propane, and other fossil fuel-derived manufactured and waste gases. Data source: Energy Information Administration. 2010. *State Electricity Profiles*.

No Hydro Imports Case

We believe the No Hydro Imports case is the most likely scenario for a 25 percent by 2025 renewable electricity standard in Wisconsin. Under this case, the state would reap significant economic and environmental benefits:

Energy diversity. Wisconsin is heavily reliant on coal and nuclear power to generate its electricity (see the chart on the previous page). All of this fossil and nuclear fuel is imported into the state, exporting dollars and jobs in the process. For example, in 2007 alone Wisconsin utilities spent more than $740 million to import 23.7 million tons of coal from other states and even one foreign country (Colombia) to burn in power plants.[2] Wisconsin has also historically imported about 15 percent of the electricity used in the state.

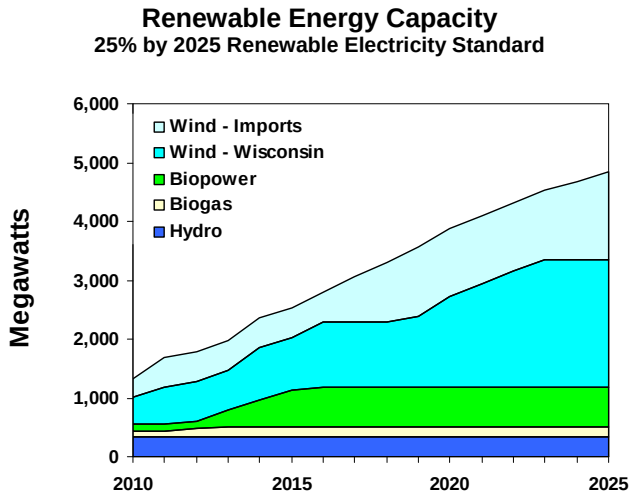
Wisconsin's Renewable Energy Potential

Resource	Capacity (MW)	Generation (Billion kWh)	% of 2008 Electricity Use
Wind	103,750	300.1	428%
Solar	19,000	25.0	36%
Biomass	2,750	18.3	28%
Biogas	365	2.6	4%
Hydro	520	1.8	3%
Total	**126,385**	**348.8**	**497%**

Source: See Endnotes 3–7.

Wisconsin has the technical potential to generate nearly five times its current electricity needs from renewable energy. The resources with the greatest potential in Wisconsin are wind, solar, and biomass. In February 2010, the National Renewable Energy Laboratory (NREL) released an updated national wind resource assessment that shows much greater wind speeds and potential in Wisconsin at 80 meter and 100 meter tower heights compared with previous assessments at 50 meters. (Most wind turbines are now installed on taller towers to capture these higher wind speeds and increase electricity production.) Wisconsin's Cedar Ridge and Blue Sky Green Fields wind farms were installed in 2009 with 80-meter towers. The Shirley wind farm, which will be built near Green Bay in 2010, will use 100-meter towers. NREL's study found that Wisconsin has the technical potential to generate more than four times its 2008 electricity use with wind power (see the table at right), using 80-meter towers at sites with sufficient wind speeds to support commercial wind development.[3]

Wisconsin also has the potential to produce more than a quarter of its electricity needs from biomass energy sources including residues from the state's forestry and agricultural industries and from energy crops, such as switchgrass, grown on marginal and idle farm land.[4] While the state's biogas potential from landfills,[5] anaerobic digesters on dairy farms, and wastewater treatment plants is more limited, many low-cost opportunities exist for farmers and local communities to develop projects that can contribute to the standard.[6] While Wisconsin has already tapped most of its low-cost hydropower potential, some new opportunities exist to increase production at existing projects or to install turbines at existing dams that currently do not generate power.[7] Installing solar photovoltaic panels on Wisconsin homes and businesses has the potential to provide more than one-third of the state's electricity.[8] Solar photovoltaic generation is currently more expensive than other renewable energy technologies; however, costs are falling rapidly due to the rapid growth and mass production resulting from supportive state and national policies.

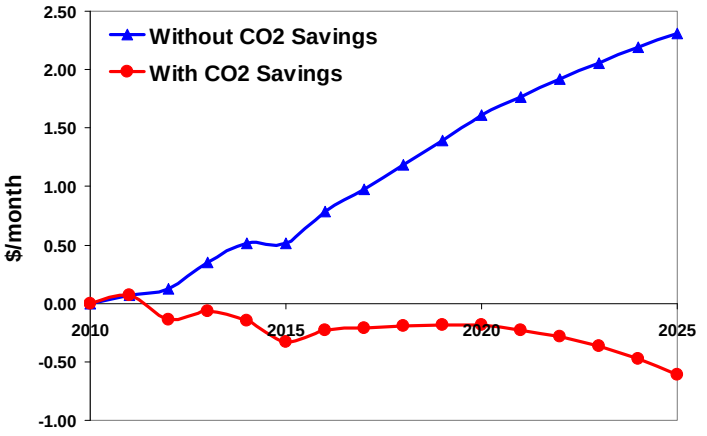


While not all of Wisconsin's renewable resources will be developed due to economic, physical, and other limitations, only a small fraction (3–5 percent) of this potential would be needed to meet the 25 percent renewable electricity standard. Under the standard, we found that renewable electricity generated and purchased by Wisconsin utilities would increase by more than five times current levels by 2025. More than 3,700 megawatts (MW) of new renewable energy capacity would be developed by 2025 to meet the standard—enough to supply the entire electricity needs of over 1.7 million average Wisconsin households and significantly reduce the use of imported coal and natural gas (see the chart at left). Two-

thirds of this new capacity (2,430 MW) would be installed in Wisconsin and would come primarily from wind and biopower (including cofiring in existing coal plants and dedicated biopower plants).

Lower electricity bills. Increasing Wisconsin's reliance on renewable energy would result in more stable energy bills for consumers. It would help protect Wisconsin consumers from future increases in coal, natural gas, and electricity prices[9] by reducing demand for fossil fuels, and because it reduces carbon dioxide (CO_2) and air pollution, it would reduce the cost of complying with future federal limits on carbon emissions and with other environmental regulations. In addition, renewable energy technologies have more stable and predictable long-term costs than coal and natural gas power plants. Policies that encourage renewable energy development will also help drive down the cost and increase the performance of renewable energy technologies over time.

Change in Average Household Monthly Electric Bill in Wisconsin under a 25% Renewable Electricity Standard



Increasing renewable electricity generation to meet a 25 percent standard would result in a modest increase in monthly electricity bills. However, because renewable energy displaces electricity generated from fossil fuel power plants, it reduces the costs of complying with future federal limits on CO_2 emissions. If the costs of federal CO_2 limits are included, average monthly electric bills will be lower. Note: Assumes average usage of 700 kilowatt-hours per month.

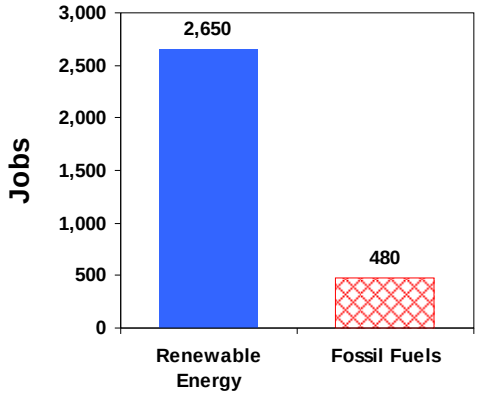
Under the 25 percent renewable electricity standard, reductions in the cost of complying with future federal CO_2 limits would more than offset the modest increases in consumer electricity bills that are projected to occur from meeting Wisconsin's renewable standard (see chart at right). Without federal CO_2 limits, the 25 percent standard would result in a modest increase in consumer electricity bills of $52 million in 2015, increasing to $225 million in 2025. For an average Wisconsin household using 700 kilowatt-hours (kWh) per month, monthly electricity bills would be 50 cents higher in 2015 and $2.30 higher in 2025. When the value of reducing CO_2 emissions is included, however, the 25 percent standard would lower consumer electricity bills in Wisconsin by $34 million in 2015 (33 cents per month per household) and $59 million in 2025 (60 cents per month per household), compared with a scenario without the standard. Cumulatively, electricity bills would be $140 million lower by 2025 with the 25 percent standard.

New renewable electricity generation developed under a 25 percent standard after 2009 would reduce emissions from coal and natural gas power plants by more than 13 million metric tons by 2025, a 30 percent reduction compared with 2007 levels.

These cost estimates conservatively assume that CO_2 allowance prices will be at the low end of the range projected in recent analyses by the Energy Information Administration and the Environmental Protection Agency (see the Methodology section for more information). In addition, we conservatively assume that federal renewable energy tax credits are not extended, we do not include any reductions in natural gas prices from reducing natural gas use in power plants, and we do not include savings from investing in energy efficiency measures that would occur under other provisions of Wisconsin's Clean Energy Jobs Act.[10] If CO_2 allowance prices are higher, the federal tax credits for renewable energy are extended, or natural gas and energy efficiency savings are included, consumer electricity bills in Wisconsin would be even lower under the 25 percent standard.

Carbon reductions. By displacing generation from power plants that burn coal and natural gas, the new renewable electricity generation developed under a 25 percent standard after 2009 would reduce power plant CO_2 emissions by more than 13 million metric tons by 2025. This

Jobs Created by Renewable Energy vs. Fossil Fuels in Wisconsin (2025)*



* Under a 25% by 2025 renewable electricity standard.

represents a 30 percent reduction compared with 2007 levels and is equivalent to taking 2.1 million cars off the road. This is a significant reduction as power plants were responsible for 41 percent of Wisconsin's total energy-related CO_2 emissions in 2007.[11] The 25 percent standard would also reduce mercury emissions and other toxic pollutants that adversely affect the state's air and water quality and cause or exacerbate public health problems such as asthma, learning disorders, and even premature death.

New jobs and economic development. Increased renewable energy development would create high-paying jobs and other economic benefits for Wisconsin. By 2025, the 25 percent standard would create 2,650 new long-term jobs in manufacturing, construction, operations, maintenance, agriculture, forestry, and other industries—five times the number of jobs that would be created by generating an equivalent amount of electricity from coal and natural gas (see the chart above). Renewable energy development from the 25 percent standard would also provide Wisconsin with an additional $137 million in gross state product and $91 million in personal income in 2025.[12]

Many of these jobs and economic benefits would be created in rural areas where most of the renewable energy facilities would be located. By 2025, the 25 percent standard would also provide Wisconsin's economy with:

- $2.4 billion in new capital investment;
- $630 million to farmers and rural areas from bioenergy production;
- $36 million in new property tax revenues for local communities; and
- $16 million in wind power lease payments to rural landowners.[13]

A 25 percent by 2025 renewable electricity standard would create 2,650 new jobs in Wisconsin—five times the number of jobs created to generate the same amount of electricity from fossil fuels.

The new jobs and economic development benefits projected in this study are consistent with other recent analyses of the Clean Energy Jobs Act as well as with previous UCS studies on the impacts that state and national renewable electricity standards would have on Wisconsin. Our study is the only one to analyze the impacts specific to increasing the state's renewable electricity standard; other studies that analyzed the suite of energy efficiency and renewable energy provisions in the Clean Energy Jobs Act indicate even greater economic benefits. For example, a study by several state agencies found that the Clean Energy Jobs Act would create more than 15,000 new jobs by 2025—including more than 12,000 new jobs from the energy efficiency and renewable energy policies in the electricity sector[14]—while also reducing consumers' electricity costs (assuming future federal limits on carbon emissions).

Hydro Imports Case

In the Hydro Imports case, we assume that 500 MW of new Canadian hydroelectric capacity would come online in 2018 based on a recent agreement between Manitoba Hydro and Wisconsin Public Service. Manitoba Hydro is also proposing to build a new dedicated transmission line to deliver the power into Wisconsin. Because of the significant uncertainty of whether this project can be built in this time frame, and whether it will be cost-competitive with other renewable energy projects to meet Wisconsin's standard, we did not include it in our most likely case. While we were not able to obtain specific cost estimates for this project, we assumed a capital cost of $3,500 per kilowatt (kW) for the generation and transmission line based on the low end of a range of costs from other projects proposed by Manitoba Hydro.[15]

This case results in fewer new jobs and economic development benefits for Wisconsin because the increase in hydro imports displaces 750 MW of new wind power development that otherwise would have been built in the state compared with the No Hydro Imports case. (The wind and hydro capacity figures differ because they have different capacity factors.) We also found that under the Hydro Imports case, it would cost $59 million more (cumulatively by 2025) to meet the 25 percent standard compared with the No Hydro Imports case because the Manitoba Hydro project and the associated transmission line appear to be more expensive than developing wind projects in Wisconsin at the capital costs assumed above. However, consumers would still realize a cumulative net reduction in electricity bills of $81 million when the carbon emission reduction benefits are included.

Comparison of Benefits in Wisconsin under a 25 Percent Renewable Electricity Standard (2025)

	No Hydro Imports Case	Hydro Imports Case	No Renewable Energy Imports Case
New in-state renewable energy capacity	2,430 MW	1,680 MW	3,390 MW
Consumer electricity bill reduction	$140 million	$81 million	$117 million
New capital investment	$2.4 billion	$1.8 billion	$3.2 billion
Biomass energy revenues	$630 million	$630 million	$833 million
Property tax revenues	$36 million	$30 million	$43 million
Wind power land lease payments	$16 million	$12 million	$19 million
Gross state product (net increase)	$137 million	$112 million	$208 million
Personal income (net increase)	$91 million	$72 million	$133 million
Jobs (net increase)	2,170	1,870	3,120

Note: All dollar values are presented in cumulative net present value 2007 dollars, using a 7 percent real discount rate.

No Renewable Energy Imports Case

In the No Renewable Energy Imports case, we assume the generation from new renewable energy facilities developed outside of Wisconsin after 2011 is used to meet other state and federal requirements and that sufficient transmission capacity is not available to import more renewable electricity into Wisconsin before 2025. We do not assume that imports are ineligible for the Wisconsin standard, however, as this may violate the U.S. Commerce Clause and the North American Free Trade Agreement. This case results in 950 MW of additional wind and biopower development in Wisconsin that would replace 980 MW of imported wind power compared with the No Hydro Imports case. This additional renewable energy development in Wisconsin would result in a significant increase in jobs and economic developments for the state.

We also found that under the No Renewable Energy Imports case, it would cost $23 million more (cumulatively by 2025) to meet the 25 percent standard compared with the No Hydro Imports case; however, consumers would still see a cumulative net reduction in electricity bills of $117 million when the carbon emission reduction benefits are included. While this scenario may be less likely than the other two scenarios, it demonstrates that it is feasible and affordable to meet a 25 percent by 2025 renewable energy standard in Wisconsin using state-based resources exclusively, in the event that renewable energy imports are not available in the future.

A Cleaner, Safer Energy Future

As our analysis shows, a 25 percent renewable electricity standard would make Wisconsin's electricity supply more reliable and secure. It would use local energy sources to create high-skilled jobs, improve the state's rural economies, and help protect consumers from future increases in energy prices and future limits on global warming emissions. Increasing Wisconsin's renewable electricity standard is a smart, common-sense step away from the unstable, dirty fossil fuel supply on which the state currently depends, and toward a clean energy future.

Methodology

We used an updated version of a model we developed in 2003 for the University of Wisconsin and the Wisconsin energy office to quantify the increase in renewable energy development, change in consumer electricity bills, and carbon emission reductions from increasing the state's renewable electricity standard (see Endnote 1 for more information). This model was also used to quantify the direct change in capital, operation and maintenance, and fuel expenditures for renewable energy technologies and displaced coal and natural gas plants. These data were then used in the IMPLAN input-output model,[16] as well as in a variation of the National Renewable Energy Laboratory's Jobs and Economic Development Impact model,[17] to calculate direct, indirect, and induced jobs, personal income, and gross state product.

We made the following assumptions for modeling the key provisions in the Clean Energy Jobs Act:

- As specified, Wisconsin utilities are required to obtain 10 percent of their total electricity sales from renewable energy sources by 2013, 20 percent by 2020, and 25 percent by 2025. While it is not required under the bill, we assumed the targets would ramp up linearly between these years.
- At least 30 percent of the total renewable electricity utilities need to meet the standard by 2020 must come from renewable energy facilities located in Wisconsin, and at least 40 percent by 2025.
- We assume that the energy efficiency targets in the bill are met. These targets reduce electricity use by 0.75 percent in 2009, increasing to 2 percent per year by 2015. We also assume that existing utility and state efficiency programs are achieving savings of 0.7 percent per year based on data collected by the Public Service Commission of Wisconsin. Adjusting the proposed targets to account for existing programs, we project a slight reduction (0.3 percent per year) in Wisconsin's total electricity sales over time. However, we do not include the savings on consumer electricity bills, or the jobs that would be created in Wisconsin from achieving these efficiency targets, in this analysis.
- The bill would allow certain non-electric (thermal) renewable energy sources that are placed in service after the date of enactment to qualify for the standard. We did not model this provision as we were not able to find reliable estimates of the potential contribution these technologies could make to the standard. Including these technologies in the analysis would likely lower the cost of compliance with the standard, but would also reduce our projected development of electricity-producing renewable energy technologies.
- We did not model the proposed renewable energy feed-in tariff in the bill that would require electric utilities to purchase customer-generated electricity at rates that will be set by the Public Service Commission. It is not clear what contribution customer-sited renewable energy technologies will make until these rates are set.

The following describes other key cost and technology assumptions used in the modeling:

- We updated the model with more recent cost and performance assumptions for renewable and conventional electricity technologies and wholesale electricity price projections for the upper Midwest that were developed for our 2009 report, Climate 2030 Blueprint.[18] The technology assumptions are based primarily on data from actual projects, renewable energy experts, and recent studies that include the escalation in power plant construction and commodity costs that has occurred over the past 5 to 10 years. We supplemented this with Wisconsin-specific data, where available. Our assumptions are in line with those recently developed by two multi-stakeholder groups for the Midwestern Governors Association's and the Organization of MISO (Midwest Independent System Operator) States' modeling efforts.[19]

- We included 590 MW of planned wind and biopower projects over the next three years that the Public Service Commission of Wisconsin has approved. These projects include the Glacier Hills (162 MW) and Shirley (20 MW) wind projects and the Stoneman (40 MW), Bayfront (20 MW), and Domtar (50 MW) biomass projects in Wisconsin; the Bent Tree (200 MW) wind project in Minnesota; and the Crane Creek (99 MW) wind project in Iowa. We also included cost estimates for these projects in the model.
- We included a cost for complying with future federal limits on CO_2 emissions based on recent analyses by the Energy Information Administration and the Environmental Protection Agency (EPA) of the American Clean Energy Security Act, a comprehensive climate and energy bill passed in June 2009 by the U.S. House of Representatives.[20] These studies project allowance prices ranging from $11.50 to $18 per ton of CO_2 in 2012, increasing to $28 to $65 per ton in 2030. For the purposes of this analysis, we conservatively used the lower EPA allowance price projections. Because new renewable energy projects are projected to displace both the electricity and CO_2 emissions generated from new and existing coal and natural gas plants, including a price for CO_2 reduces the cost of compliance with the renewable electricity standard.
- We included transmission interconnection and upgrade costs of $150/kW for renewable energy projects built in Wisconsin based on data from recent wind projects. For imports, we assumed costs of $500/kW for major new transmission lines that will be needed in the near future to accommodate new wind projects and other power plants based on recent studies by MISO. How these costs will be allocated to generators and electricity consumers is currently under discussion at MISO with multiple stakeholders. For the purposes of this analysis, we assume that renewable energy generators will pay 50 percent of these costs and electricity customers and other electricity generators that will likely use these lines will pay the remaining 50 percent.
- To estimate the net jobs and macroeconomic impacts of building and operating new renewable energy technologies in Wisconsin, we assumed that 50 percent of the renewable energy generation would displace electricity from new fossil fuel power plants and the other 50 percent would displace generation from existing plants. For both new and existing plants, we also assumed that new renewable energy generation would displace a mix of two-thirds coal generation and one-third natural gas generation. For biomass cofiring in existing coal plants, we assumed that 10 percent of the coal generation would be displaced at plants where it is economic to do cofiring.
- We used several conservative assumptions to calculate jobs and other macroeconomic impacts. We conservatively use the IMPLAN model's default assumptions for the local share of construction and manufacturing of renewable energy technologies installed in Wisconsin, which assumes that approximately 25 percent of the components for wind turbines, towers, and blades and 5 percent of the components for biopower plants come from Wisconsin. We do not include any increase in these local shares over time, which would likely occur due to the long-term commitment and favorable investment climate created by the 25 percent renewable electricity standard. We also do not include any jobs or economic development that would result from Wisconsin-based manufacturers exporting equipment to other states or countries. If Wisconsin is able to attract renewable energy manufacturers that will produce equipment both for use in the state and for export, jobs and income generated by the renewable electricity standard would increase significantly.
- For wind power, we conservatively assumed that only 8 percent of the installed wind capacity would get credit in displacing natural gas and coal capacity based on recent information from MISO. We also included costs of $5/MWh for integrating wind power into the electricity system based on data from several recent utility studies.

A fully referenced version of this fact sheet is available online at *www.ucsusa.org/clean_energy.*

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

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ENDNOTES

[1] Clemmer, S., B. Grace, and K. Cory. 2003. *A study to evaluate the impacts of increasing Wisconsin's renewable portfolio standard*. Prepared by the Union of Concerned Scientists for the University of Wisconsin-Madison and the Wisconsin Division of Energy. October 31. Online at *http://energytaskforce.wi.gov/docview.asp?docid=2*. And Clemmer, S. 2006. *Increasing Wisconsin's renewable energy standard will create jobs and help stabilize electricity bills*. Online at *http://www.ucsusa.org/clean_energy/solutions/renewable_energy_solutions/increasing-wisconsins.html*.

[2] Energy Information Administration. 2009. Monthly Nonutility Fuel Receipts and Fuel Quality Data, 2002–2007. EIA-423. Online at *http://www.eia.doe.gov/cneaf/electricity/page/eia423.html*. While Wisconsin imported coal by rail and barge from eight states and one foreign country (Colombia) in 2007, more than three-fourths of this coal was delivered on coal trains from Wyoming.

[3] Wind Powering America. 2010. Wisconsin wind map and resource potential. Washington, DC: U.S. Department of Energy. Online at *http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=wi*. The assessment excludes 31 percent of Wisconsin's land area to account for protected lands, incompatible land uses, and other considerations.

[4] Based on data developed by Dr. Marie Walsh, agricultural economist at the University of Tennessee, in January 2010. The data are consistent with the biomass potential data used in: Cleetus, R., S. Clemmer, and D. Friedman. 2009. *Climate 2030: A national blueprint for a clean energy economy.* Cambridge, MA: Union of Concerned Scientists. Online at *http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/climate-2030-blueprint.html.* The technical appendix describing the bioenergy supply assumptions is online at *http://www.ucsusa.org/assets/documents/ global_warming/climate2030-app-g-biomass.pdf.*

[5] Wisconsin's landfill gas potential of 110 MW is based on the U.S. Environmental Protection Agency's Landfill Methane Outreach Program database, available online at *http://www.epa.gov/landfill/documents/xls/lmopdata.xls*.

[6] The potential for anaerobic digesters on dairy farms (250 MW) and wastewater treatment plants (6.7 MW) is based on data from the Public Service Commission of Wisconsin and the Department of Natural Resources. 2008. *Final Environmental Impact Statement.* Docket 6680-CE-170, Application of Wisconsin Power and Light Company, d/b/a Alliant Energy, for Authority to Construct a New Coal-Fired Electric Generation Unit Known as the Nelson Dewey Generating Station in Cassville, Grant County, Wisconsin. Online at *http://psc.wi.gov*. Recent digester projects in Wisconsin—such as a processing-waste digester constructed at a cheese factory in Beaver Dam, a community manure digester under development in Dane County that will serve three medium-size dairies, and a dry-fermentation digester using food scraps at the University of Wisconsin-Oshkosh—illustrate that additional biogas generation may be possible using newer technology and system designs.

[7] Existing hydropower capacity and generation is based on data from: Wisconsin Division of Energy. 2008. *2008 Wisconsin Energy Statistics*. Online at *http://energyindependence.wi.gov/docview.asp?docid=15597&locid=160.* And: Energy Information Administration. 2009. Renewable Energy Annual 2007. May. Online at *http://www.eia.doe.gov/cneaf/solar.renewables/page/rea_data/rea_sum.html*. The potential for increasing generation at existing hydropower projects and existing dams that currently do not generate power is based on: Clemmer, S., B. Grace, and K. Cory. 2003. *A study to evaluate the impacts of increasing Wisconsin's renewable portfolio standard*. Prepared by the Union of Concerned Scientists for the University of Wisconsin-Madison and the Wisconsin Division of Energy, p. 12. October 31. Online at *http://energytaskforce.wi.gov/docview.asp?docid=2.*

[8] M. Chaudhari, L. Frantzis, and T. Hoff. 2004. *PV grid connected market potential under a cost breakthrough scenario*. Navigant Consulting, Inc. September. Online at: *http://www.ef.org/documents/EF-Final-Final2.pdf.* The potential estimate is for the year 2025, assuming 22 percent of the roof area is available on residential buildings and 65 percent of the roof area in Wisconsin is available on commercial and industrial buildings for photovoltaics.

[9] For example, the spot market price for Powder River Basin coal, the single largest source of Wisconsin coal imports, has increased over 25 percent in the last four months (from $8.40/ton on December 18, 2009, to $12.70/ton on March 5, 2010). See: Energy Information Administration. 2010. Coal news and markets. Online at *http://www.eia.doe.gov/cneaf/coal/page/coalnews/coalmar.html.*

[10] The federal production tax credit is currently set to expire after 2012 for wind power and 2013 for biopower and other renewable energy technologies. The investment tax credit for solar is set to expire after 2016. For information on potential natural gas savings that could occur under a state or national renewable standard, see: Wiser, R., M. Bolinger, and M. St. Clair. 2005. *Easing the natural gas crisis: Reducing natural gas prices through increased deployment of renewable energy and energy efficiency*. LBNL-56756. Online at: *http://eetd.lbl.gov/EA/emp/reports/56756.pdf.*

[11] U.S. Environmental Protection Agency. State CO_2 emissions from fossil fuel combustion, 1990–2007. Online at *http://www.epa.gov/climatechange/emissions/state_energyco2inv.html.*

[12] Jobs and macroeconomic impacts include direct, indirect, and induced impacts that would occur from the respending of money in the state (also known as the multiplier effect).

[13] New capital investment, bioenergy revenues, local tax revenues, and land lease payments are presented in cumulative net present value 2007 dollars, using a 7 percent real discount rate.

[14] State of Wisconsin, Departments of Commerce, Natural Resources, Transportation, and Workforce Development, and Public Service Commission. 2010. Economic Assessment of Clean Energy Jobs Act. Memorandum to the Wisconsin Office of Energy Independence, January 5. Online at *http://www.wisgov.state.wi.us/docview.asp?docid=18757*.

[15] For example, according to figures on Manitoba Hydro's website, estimated capital costs are: $5 billion, or $3,367/kW, for the proposed 1,485 MW Conawapa Generating Station (generation costs only); $3.5 billion, or $5,645/kW, for the 620 MW Keeyask project (generation and transmission); and $1.6 billion, or $8,000/kW, for the 200 MW Wuskawatim project (generation and transmission). See *http://www.hydro.mb.ca/projects/index.shtml.*

[16] IMPLAN economic impact modeling software is used to create complete, extremely detailed social accounting matrices and multiplier models of local economies. Online at *http://implan.com/v3*.

[17] The Jobs and Economic Development Impact (JEDI) model estimates the economic impacts of constructing and operating power generation and biofuel plants at the local (usually state) level. Based on project-specific or default inputs (derived from industry norms), JEDI estimates the number of jobs and economic impacts to a local area that could reasonably be supported by a power generation project. Online at *http://www.nrel.gov/analysis/jedi/ about_jedi.html.*

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