



**ENERGY CENTER**  
OF WISCONSIN

**PREPARED BY**  
Energy Center of Wisconsin

**with the assistance of**

- The American Council for an Energy-Efficient Economy
- GDS Associates, Inc.
- L&S Technical Associates

# **ENERGY EFFICIENCY AND CUSTOMER-SITED RENEWABLE RESOURCE POTENTIAL IN WISCONSIN**

**FOR THE YEARS 2012 AND 2018**

August 2009

**EXECUTIVE SUMMARY**



ECW Report Number 244-1

# **Energy Efficiency and Customer-Sited Renewable Resource Potential in Wisconsin**

*For the Years 2012 and 2018*

## *EXECUTIVE SUMMARY*

August 2009



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**EXECUTIVE SUMMARY: ENERGY EFFICIENCY**

The Public Service Commission of Wisconsin (PSCW) retained the Energy Center of Wisconsin (Energy Center) for the purpose of analyzing the potential for Wisconsin to increase its use of energy efficiency resources. In developing this energy efficiency potential estimate, the Energy Center drew on the expertise of our co-consultants on this project, the American Council for an Energy-Efficient Economy (ACEEE) and GDS Associates (GDS). We also obtained key technology forecasts from more than 30 Wisconsin-based energy efficiency experts. The assistance of these capable individuals resulted in a more thorough analysis, and allowed us to develop a study that transcends that which the Energy Center alone could have provided.<sup>1</sup>

The modeling of energy efficiency potential was technology-based and was conducted by sector. We employed a bottom-up approach for estimating energy efficiency potential in the residential sector, aggregating savings potential associated with individual types of energy-using equipment found in Wisconsin homes. For the commercial, industrial, and agricultural sectors, we employed a top-down approach, disaggregating savings estimates based on an assumed distribution of energy use within each market segment.

We analyzed a base case scenario focusing on the economic benefits from saving energy and the environmental benefits of avoided carbon emissions.<sup>2</sup> In addition, we conducted scenario analysis, varying key input assumptions to test the outer bounds of our potential estimates. In reporting the scenario analysis results, we focus on the scenario with the greatest deviation from the base case, referred to as the “environmental scenario.” Under that scenario we: (1) quantified the value of avoided non-carbon emissions (sulfur dioxide, oxides of nitrogen, and mercury); (2) included measures that are marginally below the base case cost-effectiveness threshold; and (3) employed a lower discount rate to account for the fact that energy efficiency investments made today are likely to be more valuable to future generations in a carbon-constrained world.

In developing our estimates for all scenarios, including the base case, we viewed the term “potential” as representing a reasonable outer bound. In other words, our estimates do not reflect business-as-usual trends, but rather reflect what could be achieved under an aggressive program effort. Those interested in a comparison of the energy efficiency potential estimates developed through this study relative to those estimated in the Energy Center’s 2005 Wisconsin potential study should refer to the Addendum at the end of the energy efficiency section of the report.

**RESULTS: BASE CASE**

Under the base case we estimate that by 2012, Wisconsin could save 1,200 GWh of electric energy per year, reduce peak electric demand by 250 MW, and save 37 million therms of natural gas/propane per

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<sup>1</sup> While the subcontractors and the individual experts provided useful input to this study, in the end, this report represents the explicit views and judgments of the Energy Center of Wisconsin. The fact that individuals or firms participated in the study does not imply that they necessarily agree with all statements contained in our report.

<sup>2</sup> We assumed that in the near future carbon emissions will be priced, either via a carbon tax or a cap-and-trade mechanism.

year.<sup>3</sup> Expressed as a percentage of projected baseline energy sales for 2012, these results are equivalent to 1.6 percent of electricity sales, 1.6 percent of peak electric demand, and 1.0 percent of natural gas/propane sales. Achieving these results would reduce greenhouse gas emissions by 1.3 million tons per year.

Under the assumed ramp-in from current energy efficiency program efforts to the aggressive efforts projected in this study, the cumulative energy efficiency potential from 2009 through 2012 is 3,300 GWh of electricity savings, 670 MW of demand reduction, and 100 million therms of natural gas/propane savings.

If savings continue at the annual rates projected for 2012, by 2018 the cumulative effect would amount to 11,000 GWh of electric savings, 2,200 MW of demand reduction, and 330 million therms of natural gas/propane savings. Expressed as a percentage of projected baseline energy sales for 2012, these results are equivalent to 13 percent of electricity sales, 13 percent of peak electric demand, and 8.7 percent of natural gas/propane sales.

## **RESULTS: SCENARIO ANALYSIS**

As discussed above, the Energy Center conducted a number of scenario analyses, varying key input assumptions to test the outer bound of our potential estimates. We focus on the scenario which produces the greatest deviation from base scenario results, the “environmental scenario.” Key assumptions under this scenario include higher avoided costs, a less-restrictive cost-effectiveness screen, and a lower discount rate.

Under the environmental scenario we estimate that by 2012, Wisconsin could save 1,400 GWh of electric energy per year, reduce peak electric demand by 300 MW, and save 47 million therms of natural gas/propane per year. Expressed as a percentage of projected baseline energy sales for 2012, these results are equivalent to 1.9 percent of electricity sales, 1.9 percent of peak electric demand, and 1.2 percent of natural gas/propane sales. Achieving these results would reduce greenhouse gas emissions by 1.5 million tons per year.

Under the assumed ramp-in from current energy efficiency program efforts to the aggressive efforts projected in this study, the cumulative energy efficiency potential from 2009 through 2012 is 4,000 GWh of electricity savings, 800 MW of demand reduction, and 126 million therms of natural gas/propane savings.

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<sup>3</sup> Throughout this study, references to natural gas savings potential include natural gas and propane savings resulting from installation of energy-efficient and renewable energy generating technologies.

If savings continue at the annual rates projected for 2012, by 2018 the cumulative effect would amount to 13,000 GWh of electric savings, 2,700 MW of demand reduction, and 400 million therms of natural gas/propane savings. Expressed as a percentage of projected baseline energy sales for 2012, these results are equivalent to 16 percent of electricity sales, 16 percent of peak electric demand, and 11 percent of natural gas/propane sales.

## **ECONOMIC IMPACTS**

Achieving the increased levels of energy efficiency projected in this study will reduce energy-related expenditures for Wisconsin consumers and create Wisconsin jobs.

Under the base case scenario, achieving projected annual levels of energy efficiency potential will produce net savings of around \$900 million in 2012 (present value, 2008 dollars). The corresponding 2012 net savings estimate under the environmental scenario is approximately \$2 billion. Note, however, that the net savings estimates are not directly comparable because they were developed using different economic discount rates (five percent in the base case; two percent in the environmental scenario).<sup>4</sup>

Achieving the 2012 annual energy efficiency potential levels suggested by the base case scenario are estimated to produce between 7,000 and 9,000 new Wisconsin jobs. Achieving the savings suggested in the environmental scenario would produce between 11,000 and 13,000 new jobs.

## **ENERGY EFFICIENCY PROGRAM CHANGES**

We estimate that annual energy efficiency program investments of up to \$350 million per year would be necessary to achieve projected 2012 savings levels derived under the base case.<sup>5</sup> Achieving the 2012 savings levels derived in the environmental scenario would require approximately twice as much annual spending.

Increased spending alone will not deliver the achievable energy efficiency savings identified here. Innovation in energy efficiency program design for all market sectors will also be necessary.<sup>6</sup> Innovative program strategies could include:

- Aggressive strategies for capturing neglected opportunities through large-scale retrofits of existing buildings.
- Upstream incentives for equipment suppliers and retailers to affect net increases in the market share for efficient products without diverting large amounts of funding for purchases that would have occurred without program influence.

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<sup>4</sup> The difference in discount rates reflects different perspectives on the value of a dollar of energy saved in the future. For a given level of Btus saved, the associated dollar savings under a low discount rate will be higher than the savings under a high discount rate merely because the lower discount rate implies that future cash flows are relatively more valuable than that suggested by the higher discount rate. Thus, the estimate of dollar savings under various discount rates reflects different value judgments across individuals, and not necessarily that one scenario is preferable to the other on economic grounds.

<sup>5</sup> Energy efficiency program investments include programs administered by the State of Wisconsin, voluntary programs administered by Wisconsin utilities, and self-directed initiatives undertaken by large energy users.

<sup>6</sup> For illustrative purposes, the study discusses a number of innovative program strategies in Chapter EE-4. However, developing detailed program design guidance for the purposes of energy efficiency program planning is outside the scope of this study.

Though we did not develop quantitative estimates of potential energy savings and demand reduction from expansion of behavior-based approaches to motivating energy efficiency improvement, or from deployment of advanced rate designs that reduce peak electric demand, such strategies could deliver additional savings to Wisconsin residents and businesses.

The programmatic shifts above will likely also require some adjustments to program protocols.<sup>7</sup>

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<sup>7</sup> These issues are discussed in Chapter EE-5.

**EXECUTIVE SUMMARY: RENEWABLE ENERGY**

Renewable energy technologies generate heat or electricity using resources such as the sun, the wind, and biomass, rather than through combustion of fossil fuels. Unlike energy efficiency measures which reduce energy consumption, renewable energy technologies displace fossil fuels and associated pollutants and greenhouse gas emissions. Renewable energy technologies can be deployed in utility-scale installations, or in distributed applications for homes and businesses (“customer-sited” installations). This study estimates the potential for deployment of customer-sited renewable energy technologies in Wisconsin through 2018.

The Energy Center of Wisconsin (Energy Center) evaluated the cost-effectiveness of fifteen renewable energy technologies using the total resource cost test (TRC), which compares the cost of installing and maintaining the renewable energy system with the benefits of avoided utility-supplied energy.

A number of the renewable energy technologies evaluated in this study are cost-effective today, including distributed wind projects with utility-scale turbines, anaerobic digesters, biomass combustion systems (residential- and commercial-scale), and large-scale biomass combustion for electricity generation. For the technologies that do not pass the TRC test under current conditions, there is considerable economic option value associated with building and maintaining an infrastructure that enables Wisconsin to significantly ramp-up deployment of distributed renewable resources should conditions change in the future. This flexibility benefit of renewable resources may be much larger than the value associated with the technologies that are currently cost-effective.

Considering only those technologies that are cost-effective today, we estimate that by 2012, customer-sited renewable energy technologies could have a peak generating capacity of 12.5 megawatts (MW), displace around 31 million kilowatt hours (kWh) of grid-supplied electricity per year, and displace around 1.6 million therms of natural gas/propane per year. By 2018, estimated annual renewable electricity generation capacity increases to approximately 37 MW, displacing 77 million kWh per year. The growth in potential for electricity-generating technologies from 2012 to 2018 is substantial—a 300 percent increase in peak generating capacity over the period, and a 250 percent increase in electricity generation. Over the same time period, the capacity for displacement of natural gas/propane increases to around 2 million therms per year—an increase of 30 percent.

We note that even if Wisconsin promoted all of the renewable resource technologies addressed in this study *regardless of cost-effectiveness*, the total capacity pales in comparison to that available in the energy efficiency arena. The 2012 annual achievable potential for the technologies addressed in the energy efficiency component of this study is 30 times greater than the renewable potential estimate, or 1.1 billion kWh for energy efficiency compared with 36 million kWh for customer-sited renewables (includes those technologies that are not currently cost-effective as determined by the TRC). Similar comparisons can be made for peak generating capacity (231 MW for energy efficiency versus 17 MW for renewables) and for natural gas/propane displacement (37 million therms for energy efficiency versus 1.7 million therms for renewables).

While we expect the potential for energy efficiency to grow at a fairly even rate after 2012, the potential for renewable resources expands much more rapidly over the same period, particularly for electricity-generating technologies. These results suggest a different strategy for state support of customer-sited renewable resources as compared with energy efficiency resources. For energy efficiency measures that

are cost-effective today, aggressive acquisition may be the appropriate path. *For renewable resources, the optimal strategy may be to develop the capability for large-scale expansion should future conditions warrant.*

The costs that a statewide renewable energy program would incur to achieve projected 2012 results are estimated to be between \$13 million and \$22 million per year (2008 dollars). These results would reduce utility-based greenhouse gas emissions by between 21,000 and 39,000 tons per year. They would also support between 240 and 350 Wisconsin jobs.

The renewable energy generating potential estimated in this study would generate as much as \$21 million in net benefits for Wisconsin consumers (present value, 2008 dollars). Almost 90 percent of estimated net benefits are associated with thermal energy generating technologies. However, the electricity-generating renewable energy technologies addressed in this study are expected to experience faster growth than the thermal energy-generating technologies.