Modeling Markets to Estimate Achievable Potential for Energy Efficiency and Renewable Energy to Support Statewide Policymaking

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ABSTRACT

Wisconsin has mandated programs to help its residents and businesses use energy more efficiently for over 15 years. The spending level peaked in 1993 at $85 million, and was $37 million in 2005. Determining the right amount to spend on programs is an important policy question. In 2004, the Governor's Task Force on Energy Efficiency and Renewables commissioned this study to estimate the achievable potential for energy efficiency and customer-sited renewable energy in advance of developing new statewide energy legislation.

Our study examined thirty business and residential energy efficiency markets and six customer-sited renewable energy markets in Wisconsin. For each, we studied the nature and status of the market, sought input from Wisconsin stakeholders, and examined achievements from programs in Wisconsin and nationwide. We then outlined likely program approaches for each market, and assessed the probable costs and energy savings. Our overall goal was to ground our assessments in realistic notions of what can be achieved through statewide programs to promote energy efficiency and customer-sited renewable energy.

Our study estimated achievable program-induced savings in electricity usage, summer peak demand, and natural gas consumed. We modeled markets individually, and employed a probabilistic approach (Monte Carlo analysis) to account for uncertainty in our assumptions. Our results suggest that, over the next five years, an average of up to $75 to $120 million per year could be spent cost-effectively on statewide programs aimed at improving energy efficiency in Wisconsin homes and businesses. For the six customer-sited renewable energy markets, our analysis suggests that up to $7 to $11 million could be cost effectively spent on programs.

Time to Recalibrate Funding Levels – Legislative and Regulatory Context

For more than 15 years, Wisconsin has mandated or administered programs to help its residents, businesses, and industry use energy more efficiently. These programs save energy beyond that which would occur naturally through individuals' and businesses' choices.

Prior to 2000, Wisconsin's utilities administered and delivered or contracted their own programs to their customers. Spending levels and goals were set by the Public Service Commission of Wisconsin (PSCW). Combined utility conservation expenditures peaked in 1993 at $85 million.

Since 2001, the State of Wisconsin has administered a suite of programs that are delivered by various energy organizations and firms. Wisconsin's current energy efficiency programs were initiated as part of the 1999 Wisconsin Act 9 legislation addressing long-term energy reliability issues in the state. The legislation, , directed the State to collect fees from Wisconsin's electric providers which were mandated to join the "*public benefits program,*" while municipal utilities and electrical cooperatives were allowed to "opt in."

Funding for public benefits was determined by the legislature in 1999 after considerable debate among stakeholders. It was not based on an analysis of energy efficiency potential and the cost to achieve that potential. Instead, the Legislature set funding of public benefits programs to match the 1998 levels of investment in energy efficiency by Wisconsin utilities.

Beginning in fiscal year 2003, after a two-year ramp-up period, revenue for energy efficiency programs, including renewable resources and environmental research, was approximately $62 million collected from investor-owned utilities and from participating municipal and cooperative utilities. However, actual spending reached only $53 million in 2003. With the passage of the biennial budgets of fiscal years 2004-2005 and 2006-2007, the State of Wisconsin diverted a portion of the public benefits funds to help reduce the state budget deficit. Actual spending in fiscal years 2004 and 2005 was $42 million and $38 million, respectively. In total, the Legislature has diverted over $100 million dollars.

In 2004, as part of a larger initiative to address Wisconsin's leadership in energy efficiency and renewable energy, the Governor's Task Force on Energy Efficiency and Renewables examined the structure and funding levels of the public benefits programs. The Task Force recognized that funding levels and corresponding energy savings goals had evolved from several years of stakeholder negotiations and needed to be "recalibrated" to current load growth projects and achievable energy saving potential.

The Task Force recommended that the PSCW be responsible for establishing future funding levels for Wisconsin's public benefits programs. To assist the PSCW, the Task Force commissioned the Energy Center of Wisconsin to perform a study, under the oversight of a Task Force subcommittee, to estimate the range for an appropriate funding level based on what was achievable and cost-effective in the market.

Method and Scope – Can We Go Straight to the Bottom-Line?

The study described in this paper was intended to provide information to policymakers, regulators, utilities and other energy stakeholders in Wisconsin to determine the appropriate level of investment in Wisconsin's energy efficiency and renewable energy "public benefits" programs. The method and scope of the study were developed to focus on the bottom line question from the Task Force: "If we spent X amount of dollars, what could we achieve?"

Given the need to know only the achievable cost and savings bottom-line, there was no desire by the Task Force to expend time or resources to calculate a "technical" potential. Estimating technical potential was seen as not germane to the study; a compendium of measures, many of which that could in theory save energy, but whose individual cost-effectiveness and market adoption potential was endlessly debatable. A further concern was raised that market research had been sparse since the most recent statewide potential study, completed by the Energy Center of Wisconsin in 1994, leaving little authority to resolve debates. Thus, working through the tens of thousands of cost, savings, and saturation assumptions inherent in the use of bottom-up, measure-by-measure-by market DSM potential models and databases was rejected. It was also agreed that uncertainty be explicitly acknowledged, not hidden by a data intensive bottom-up approach that implied better data than what existed.

The Energy Center team decided that a market opportunity approach would provide the best tool to estimate "achievable" energy efficiency savings. This achievable potential encompasses those savings that are technically feasible, cost-effective when compared to the cost of generation, and likely to be accepted by the market with program interventions such as education and information, incentives and technical assistance. Our achievable potential is not a theoretical "maximum achievable potential," rather it accounts for incomplete adoption of feasible, cost effective measures offered by program interventions facing barriers in real-world implementation. Our achievable potential results could be used as the goals and budgets for fielding program interventions in Wisconsin.

We sought input from a wide group of stakeholders on the most cost effective markets based on results in Wisconsin and other states. The achievable potential provides a realistic estimate of how consumers and businesses in each market will adopt options offered by a statewide program. Each market is comprised of a portfolio of approaches to save energy at a time when customers consider retrofits, replacements or new purchases of energy using equipment and buildings.

Methodology Details

The fundamental approach we used for this study was to:

- Identify 30 energy efficiency markets and 6 renewable energy markets for inclusion in the study
- Estimate potential electricity and natural gas savings based on identifiable program approaches;
- Aggregate the net, program-induced savings potential across these markets; and
- Expand these aggregated results to include all energy efficiency markets applicable to Wisconsin.

In each of these steps, we relied on an extensive set of empirical data and input from both the Task Force advisory committee and a large group of project stakeholders and market observers. Empirical data was based on past and existing programs in Wisconsin, experiences of model programs in other states (including Iowa, Minnesota, California, New York, Massachusetts, Connecticut, Vermont, and the Pacific Northwest), market and economic statistics, the Energy Policy Act of 2005 and state-level legislation, and other sources.

In most respects, our method resembles those of achievable potential studies conducted in other states, although we note these key aspects:

- We limited our analysis to energy savings associated with program approaches that could be clearly enunciated or identified. This assumes that program approaches that have not been clearly enunciated would be unlikely to be implemented.
- The impacts that we credited to the programs are *net* impacts; that is they represent the net difference in statewide energy consumption and peak electricity demand with the program in place compared to a no-program scenario.

Our study was atypical in one respect:

- Each of our approximately 1,200 model inputs includes an uncertainty range that acknowledges the varying degrees of precision in our estimates and whose aggregate effects are accounted for through the use of a Monte Carlo model to aggregate individual market results. Consequently, our results are shown as ranges, rather than specific numbers.

Identifying Key Markets

The first step of our analysis was to identify the markets to be studied in detail. We sought input from a wide group of stakeholders on the most cost effective markets based on results in Wisconsin and other states. We chose 36 markets based, in part, on available budget and the belief that we could address 75-90 percent of the available potential by studying these markets. These markets were split among the residential sector (15 markets), the commercial/industrial sector (15 markets), and the customer-sited renewable sector (6 markets). Individual markets comprised particular types of products, such as clothes washers, and functional activities that have an energy implication, such as construction of new buildings.

Selection of the 36 markets, provided in Table 1, was based on a review of potential studies in other states and input from the advisory committee and stakeholders. To determine if there were any significant gaps or omissions, we benchmarked our list of 30 energy efficiency markets against other achievable energy efficiency studies:

- A 2003 study of achievable electric energy and demand potential Conducted for the New York State Energy Research and Development Authority (NYSERDA);
- A 2004 study of achievable electric energy potential in Connecticut;
- A 2004 study of achievable gas energy potential for a Utah gas utility.
- A 2004 study by the Northwest Energy Efficiency Alliance (industrial only)
- A 2004 study for the Energy Trust of Oregon

The analysis involved mapping the proposed Wisconsin study markets to measures and end-uses defined for the studies, and adjusting potential estimates for major differences in subsector weightings and baseline conditions. While the process cannot be considered to be an exact one, it does provide at least a rough sense of how the proposed Wisconsin markets stack up against potential estimates from other studies. We determined that our 30 markets covered most major market opportunities. The benchmarking indicated that 10 to 25 percent of energy efficiency potential in the other studies would not be covered within our 30 energy efficiency markets.

Estimating Potential Energy Savings

Once the markets were established, we estimated costs and impacts for one or more program approaches for each market. These were based on stakeholder input, data on similar programs in other states, and our own secondary research into the nature of each market. The estimates are meant to represent aggressive—but achievable—levels of program activity one would associate program attributes such as high incentives up to 100% of incremental cost, and adequate budgets for promotion, technical assistance, training, and field support.

The specific approach that we used varied from market to market, but generally involved the following steps:

Table 1. Thirty-Six Markets Included in the Achievable Potential Study

Sector	Market
Commercial and Industrial	High Performance New Buildings
	Unitary HVAC Replacement and System Improvements
	Lighting Remodeling & Replacement Upgrades
	Boiler Replacement & Systems Improvements
	Lighting System Retrofit Improvements
	Chiller Replacement and System Improvements
	Ventilation System Improvements
	Refrigeration System Improvements
	Motors: New, Replacement and Repair Market
	Compressed Air Systems Improvements
	Fan and Blower Systems Improvements
	Pump Systems Improvements
	Manufacturing Process Upgrades
	Water & Wastewater System Improvements
	Agriculture Energy Efficiency Upgrades
Residential	Consumer Electronics
	Incentives for CFLs
	Multi-family Common Area Lighting – Direct Install Market
	Incentives for Variable Speed Furnaces
	Central AC
	Multi-family Heating System Replacement
	Room AC
	Homeowner Water Heater Purchases
	New Home Construction
	Remodeling
	Dehumidifier
	Direct Install Market
	Shell Improvements
	Incentives for Homeowner Clothes Washer Purchases
	Multi-family Fuel Switching
Customer-Sited Renewables	Customer-sited, Grid-connected, Commercial Solar Photovoltaics (PV)
	Commercial Solar Thermal (Hot Water)
	Residential Solar Thermal (Hot Water)
	Wood Residue for Commercial/Institutional Heat
	Customer-sited, Grid-connected, Commercial Wind Energy
	Agriculture Anaerobic Digestion

1. Assess per-unit savings associated with the energy efficiency measures (or renewable energy technology) promoted by each program;
2. Project program participation trends across the 10-year analysis period;
3. Estimate program costs; and,
4. Estimate the life of the measures promoted by the program.

Altogether, we assessed 44 program approaches for the 36 markets and defined about 1,200 input variables.

The impacts that we credited to the programs are *net* impacts: that is, they represent the net difference in statewide energy consumption and peak electricity demand with the program in place compared to a no-program scenario. In this sense, the estimates are meant to exclude naturally occurring market trends, program free riders, and market transformation effects, during the analysis period. We did not, however, attempt to model market effects caused by the programs beyond the ten-year analysis horizon.

The costs that we estimated include only program-related costs such as financial incentives, marketing and administrative costs. We did not include the costs to consumers or businesses to purchase higher efficiency equipment or retrofit their buildings for energy savings: the analysis thus reflects the perspective of the cost effectiveness of program investment. This is often called the Program Administrator perspective.

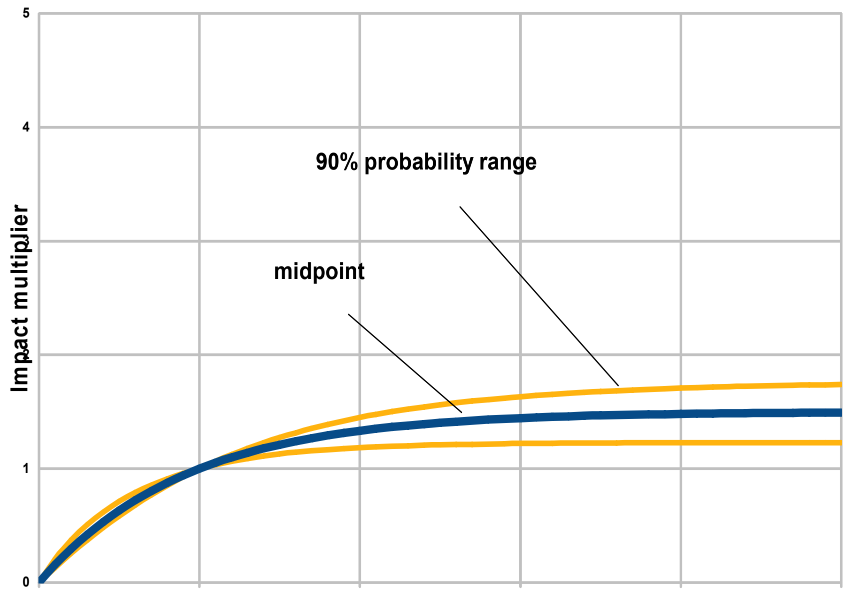
We calculated the levelized resource costs separately for electric energy, electric demand, and gas for each program. This key calculation spreads the program costs over the life of the impacts from the program (using an appropriate discount rate). It provides a lifecycle measure of the cost of each saved kilowatt-hour of electricity, kilowatt of summer peak demand or therm of gas. These levelized resource costs can be directly compared to the levelized costs for generating or purchasing electricity and natural gas. In fact, the crux of the study is to estimate the potential for energy efficiency and renewable energy savings at or below these utility avoided costs.

For many programs, we found that the calculated resource cost was well below the current range of utility avoided costs—a finding that has been documented elsewhere as well. For these programs, the base analysis underestimates the full potential for the market to the extent additional funding could increase program impacts even if the marginal savings are not as great. If a program produces electricity savings at, say, two cents per kWh compared to a utility cost of 6 cents/kWh to generate electricity, then it is cost effective to spend additional money on the program up to the point where the marginal cost of savings equals the utility avoided cost.

Similarly, there may be instances where a program model may produce levelized savings that are above the avoided cost target, but where, if the program was scaled back (say by reducing incentives), it could produce impacts at or below the target avoided cost.

We addressed these situations by defining relative scaling functions that define the relationship between overall program spending and impacts. Our presumption was that, as program funding is increased, program impacts also increase, albeit at a declining rate. The curves also presume that there is a fundamental upper limit to the impacts that can be obtained from a given program even with infinite funding. We assigned a scaling curve to each program in the analysis to allow for increased, or decreased, program expenditures and impacts depending on how the base resource cost of the program compares to the target utility avoided cost. An example of a scaling curve where increasing program incentives and costs provides little additional impacts is provided in Figure 1.

Figure 1. Example Curving Scale



Aggregation

We estimated the aggregate statewide potential by summing across the individual programs, looking at statewide potential in two ways. The first approach looks individually at each of the three resources (electric energy, electric demand and natural gas energy). For these analyses, we ran our model through a range of avoided costs for each resource, calculating the achievable potential and implied program funding at each target avoided cost. We then assembled these results into supply curves showing how program spending and savings vary with avoided cost.

The second approach looked simultaneously at the combined potential for savings (and the implied program funding levels) across all three resources. For this analysis, we fixed avoided costs at reasonable current values, and then tallied the potential impacts for all programs that provided cost effective savings for at least one of the three resources.

This combined analysis differs from the supply-curve approach in several ways. First, while the supply-curve approach focuses exclusively on one resource at a time, the combined analysis is more reflective of a balanced portfolio of programs to address natural gas and electric energy as well as peak electric demand.

Second, the combined analysis includes savings potential that would not be included if the sole focus was on an individual resource. For example, some programs produce electric energy savings quite cheaply, but are expensive when viewed solely in terms of peak electric demand reductions. In the combined analysis, the peak demand savings from programs that are cost effective on the basis of *energy savings* are included in the aggregate potential: in the supply-curve analysis, these peak demand savings would not be counted if they are not cost-effective on their own account.

Finally, the combined analysis accounts for negative impacts from programs that produce savings for one resource at the expense of increased use for another. Chief among these are fuel-switching efforts, such as a program to encourage homeowners to switch from electric to natural gas water heating. In the combined analysis the increased natural gas consumption from fuel-switching is deducted from the aggregate savings potential: in the supply-curve analysis, cross-resource effects are not counted, since the focus is on the potential for a single resource.

For estimates of statewide potential from energy efficiency programs, we applied a multiplier to extrapolate the results from the 30 markets included in the study to all energy efficiency markets. As noted above, the multiplier assumes that the markets included in the study represent 75 to 90 percent of all possible markets, based on our analysis of other potential studies.

For renewables, we did not feel that the six markets included in the study could be reasonably extrapolated to all renewable energy markets. The results presented here are therefore confined to the six markets included in the study. These markets were intended to represent the most cost effective opportunities. However, there are other renewable market opportunities not included in the study.

Uncertainty Analysis

Uncertainty is inherent in this kind of study, requiring as it does projections of future program participation, estimates of how program impacts change with funding levels—as well as estimates of the impacts and lifetimes of the measures addressed by the program, not all of which are well-documented.

We addressed the issue of uncertainty explicitly for this study by defining uncertainty ranges for all inputs in the analysis. We then propagated the uncertainty in the inputs through to the results using a probabilistic approach known as Monte Carlo analysis. The essence of the technique is to re-run each analysis over many iterations (we typically used 1,000 to 5,000) while randomly varying the analysis inputs within their defined uncertainty bands. Each iteration produces a somewhat different result based on the random variation in the inputs, and this collection of results can be reported in probabilistic terms. Throughout, we report results in terms of 90 percent probability ranges from the Monte Carlo analyses: that is to say, if a particular Monte Carlo run produced a distribution of results from 1,000 random iterations, we would report the range representing the 5^{th} and 95^{th} percentiles, which would correspond to discarding the lowest and highest 50 iterations, and reporting the minimum and maximum of those that remain.

Although all 1,200 inputs to our analysis had uncertainty ranges assigned to them, a significant proportion of the uncertainty in the overall results derives from a handful of global parameters that affect estimates for most or all of the markets. These include inputs and ranges such as real discount rate (3% to 7%), portfolio level administrative cost adder (15% to 25% of total program costs), and avoided costs ($60 to $80 per kW per year for electric demand, 4 to 8 cents per kWh for electric energy, and 60 to 140 cents/therm for natural gas energy).

We used uniform distributions for all inputs: that is, all valued in an input parameter's uncertainty range were considered to be equally likely. Some early analysis with alternative distributions (Gaussian and triangular) suggested that the choice of the distribution shape did not have a substantial impact on the output of uncertainties. Finally, we also defined numerous correlations across inputs. In some cases the same input value was used in more than one market: we made sure that these were fully correlated. We also defined lesser degrees of correlation among input variables that were likely to vary up or down together.

Five-Year Annual Results

The results of our analysis suggest that, over the next five years, an average of up to $75 to $121 million per year could be spent cost-effectively on statewide programs aimed at improving energy efficiency in Wisconsin homes and businesses. (Note: the ranges are 90% probability boundaries from probabilistic uncertainty analysis). These programs would save energy beyond that which would occur naturally in the absence of programs. For each year of operation, these programs could save up to:

- 320 to 482 million kilowatt-hours of electric energy (0.5 to 0.7 percent of annual statewide electricity use and 20 to 30 percent of annual growth) in the first year and 3.8 to 5.6 billion kilowatt-hours over the lives of the energy saving measures affected by the program;
- 44 to 70 megawatts of electric demand (0.3 to 0.5 percent of utility summer peak electric demand and 10 to 20 percent of annual growth) with half of the measures lasting 10 years or more; and
- 7 to 14 million therms of natural gas (0.2 to 0.4 percent of annual statewide natural gas consumption) in the first year and 120 to 220 million therms over the lives of the measures affected by the program.

For the six renewable energy markets that we studied (which do not include utility-scale renewable energy projects), our analysis suggests that up to $7 to $11 million could be cost effectively spent on programs, with annual incremental savings of:

- 19 to 27 million kilowatt-hours of annual statewide electricity use;
- 1.9 to 2.7 megawatts of utility summer peak electric demand; and
- 800,000 to 1.3 million therms of annual statewide natural gas consumption.

Because the limited number of renewable energy markets in the analysis were not intended to cover all possible renewable opportunities, actual renewable potential may be greater than that reported here.

10-Year Analysis Results

The table below shows estimates of combined achievable potential over a ten-year period beginning in 2006. As with other reported results, the figures for energy efficiency below are extrapolated to all energy efficiency markets, but the renewables results are confined to the six markets included in the study.

Table 2. Estimated 10-Year Achievable Potential

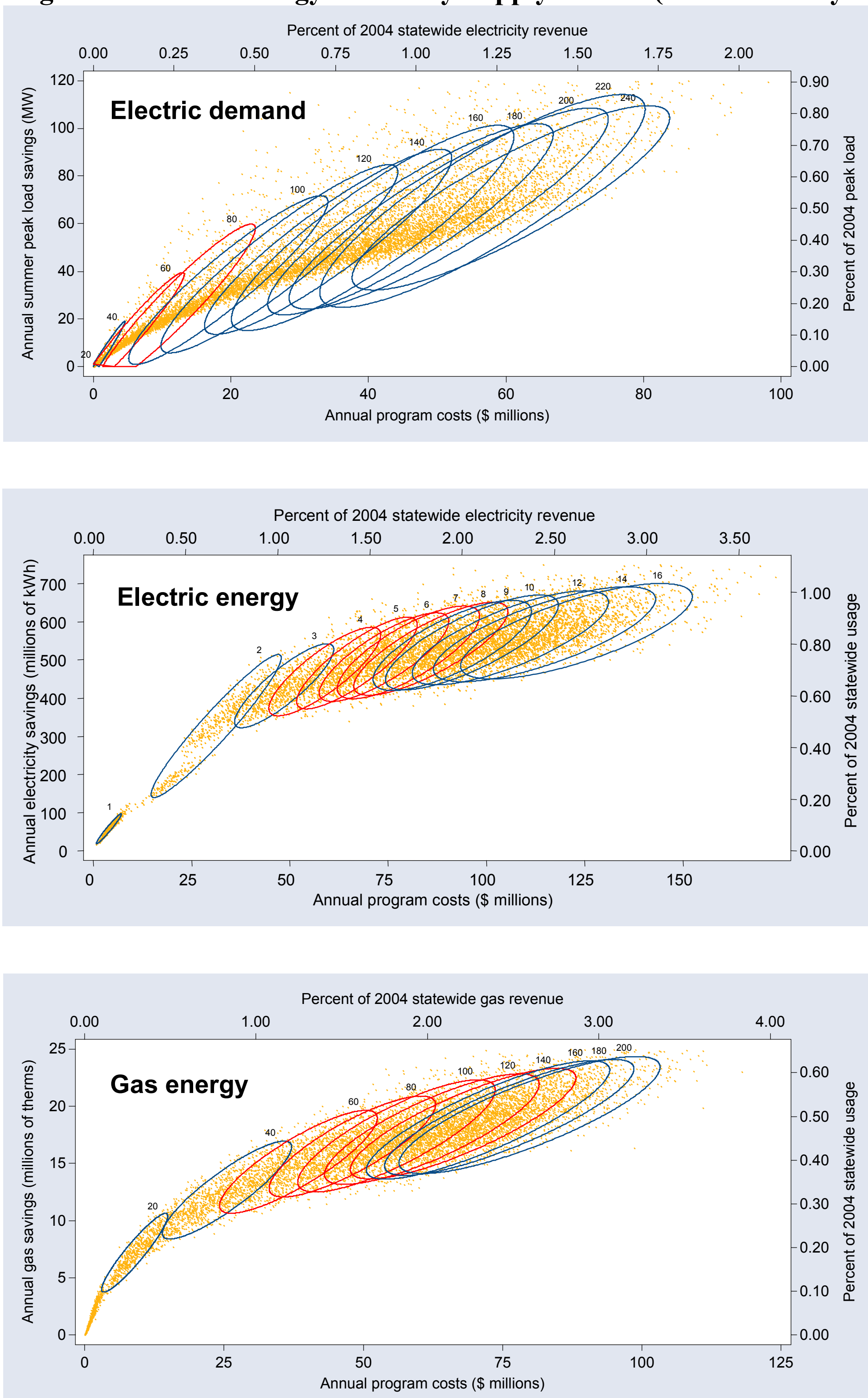
	Average annual	(% of 2004)[a]	10-year total	(% of 2004)[a]
Overall Energy Efficiency				
Program Funding ($ millions)	101 to 163	(1.3 to 2.1)	1,011 to 1,629	(13.0 to 21.0)
Electric Demand (MW)	56 to 106	(0.4 to 0.8)	560 to 1,061	(4.2 to 8.0)
Electric Energy (millions of kWh)	414 to 624	(0.6 to 0.9)	4,137 to 6,239	(6.1 to 9.2)
Natural Gas Energy (millions of therms)	11 to 20	(0.3 to 0.5)	114 to 197	(3.0 to 5.2)
C&I Sector Energy Efficiency				
Program Funding ($ millions)	47 to 80	(0.6 to 1.0)	468 to 798	(6.0 to 10.3)
Electric Demand (MW)	36 to 54	(0.3 to 0.4)	363 to 543	(2.7 to 4.1)
Electric Energy (millions of kWh)	221 to 326	(0.3 to 0.5)	2,207 to 3,262	(3.3 to 4.8)
Natural Gas Energy (millions of therms)	5 to 10	(0.1 to 0.3)	50 to 100	(1.3 to 2.6)
Residential Sector Energy Efficiency				
Program Funding ($ millions)	48 to 92	(0.6 to 1.2)	475 to 922	(6.1 to 11.9)
Electric Demand (MW)	15 to 60	(0.1 to 0.5)	153 to 599	(1.2 to 4.5)
Electric Energy (millions of kWh)	164 to 331	(0.2 to 0.5)	1,644 to 3,307	(2.4 to 4.9)
Natural Gas Energy (millions of therms)	5 to 11	(0.1 to 0.3)	52 to 114	(1.4 to 3.0)
Six Renewables Markets				
Program Funding ($ millions)	9 to 14.9	(0.12 to 0.19)	92 to 149	(1.18 to 1.92)
Electric Demand (MW)	3.5 to 4.9	(0.03 to 0.04)	35 to 49	(0.27 to 0.37)
Electric Energy (millions of kWh)	34.6 to 49.7	(0.05 to 0.07)	346 to 497	(0.51 to 0.73)
Natural Gas Energy (millions of therms)	1.1 to 1.8	(0.03 to 0.05)	11 to 18	(0.28 to 0.46)

[a]For energy and demand savings, figures are percent of 2004 annual statewide usage and summer peak demand. For program funding, figures are percent of 2004 statewide electricity and gas revenues.
Note: ranges are 90% probability boundaries from probabilistic uncertainty analysis.

Individual Resource Supply Curves

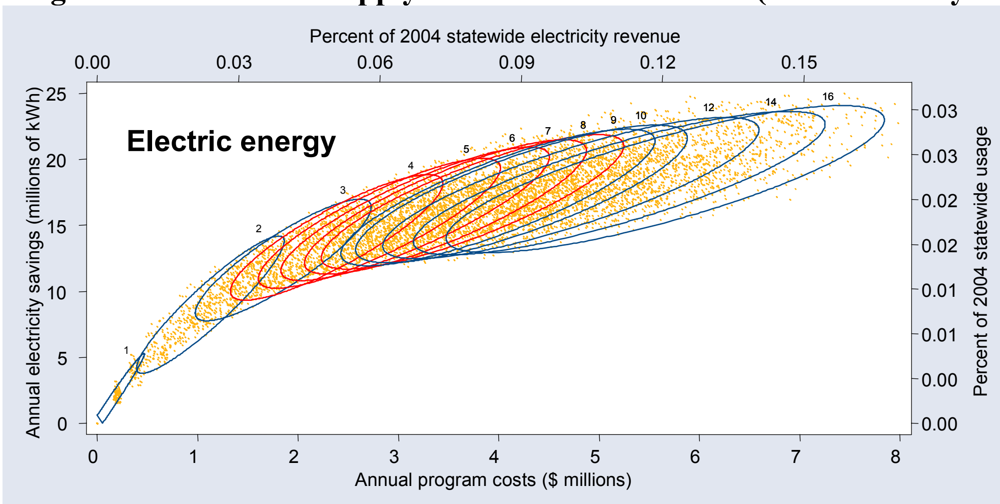
In addition to the combined analysis of potential across all three resources, we also generated supply curves for each resource individually. A supply curve plots levels of energy efficiency investment against savings for each resource. For these analyses, we looked at the potential ability of each program area to provide impacts across a range of avoided costs. As with the other analyses for the study, we developed these supply curves probabilistically; that is, the data points from our probabilistic model represent a range of spending levels and savings potential at any particular avoided cost. To build up the supply curves we plotted ellipses that enclose the majority (90 percent) of the estimates at each avoided cost. The avoided cost value is marked at the top of each ellipse. The savings estimates are represented as points within each ellipse. The series of ellipses can be viewed as a supply "curve." Figures 2 and 3 show the aggregate supply curve estimates for all energy efficiency resources and renewables.

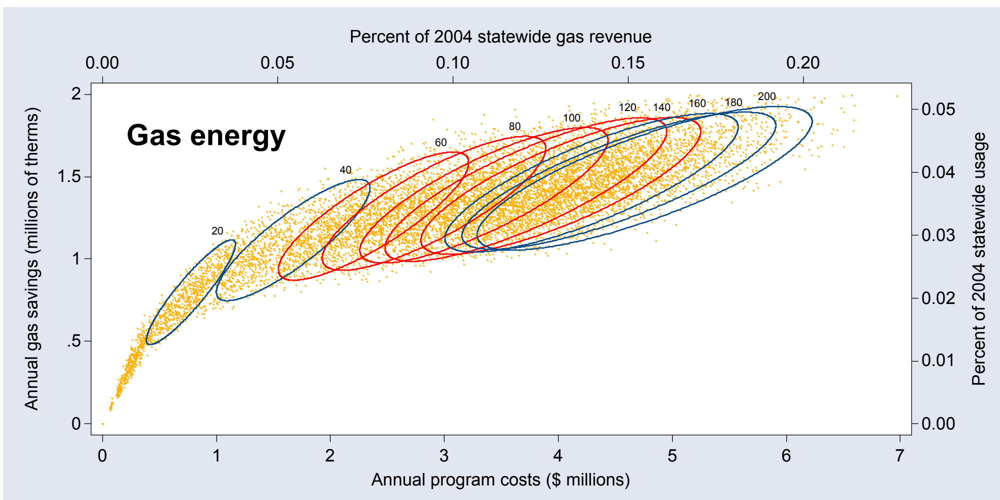
Figure 2. Overall Energy Efficiency Supply Curves (10-Year Analysis)



Key:
– Ellipses represent 90% probability region for program cost and savings at a given avoided cost noted above each ellipse
– Red ellipses depict avoided cost range used in combined analysis
– Points are individual iterations of probabilistic analysis (10% sample of iterations shown)

Figure 3. Renewables Supply Curves for Six Markets (10-Year Analysis)





Key:
– Ellipses represent 90% probability region for program cost and savings at a given avoided cost noted above each ellipse
– Red ellipses depict avoided cost range used in combined analysis
– Points are individual iterations of probabilistic analysis (10% sample of iterations shown)

The Wisconsin Legislature and Governor Act in 2006

Wisconsin made an important commitment to clean energy and energy efficiency when the state legislature passed 2005 Wisconsin Act 141 in March 2006. This legislation is an example of consensus and collaboration on the part of Senator Robert Cowles (R-Green Bay), Representative Phil Montgomery (R-Ashwaubenon), the Governor's Task Force on Energy Efficiency and Renewables and the entire legislature. This legislation becomes fully effective on July 1, 2007.

Many of the recommendations in the legislation resulted from the work of the Governor's Task Force on Energy Efficiency and Renewables. The Energy Center of Wisconsin contributed to their efforts with the study referred to in this paper, providing critical information on the achievable potential from investment in energy efficiency and renewable energy in Wisconsin.

As a result of the legislation, utilities will collect and contribute 1.2% of their annual gross revenues to statewide public benefits energy programs. The recent total operating annual revenues of all energy utilities was $6.87 billion; 1.2% of that amount is about $82 million. This compares with public benefits spending of about $37 in 2005, and a spending range in the Energy Center achievable potential study of $82 million to $133 million for energy efficiency and renewables. We believe this study made a real difference!

References

Pigg, S., Bensch, I., Grabner, K., Kelley, I., Stratton, S. (2005). *Energy Efficiency and Customer-Sited Renewable Energy: Achievable Potential in Wisconsin 2006-2015*. Energy Center of Wisconsin, Madison, WI.

Public Service Commission of Wisconsin (PSCW). (2004). *Wisconsin's Strategic Energy Assessment, Energy 2010*. Public Service Commission of Wisconsin, Madison, WI.

Wisconsin Center for Demand Side Research (WCDSR). (1994). Wisconsin's Statewide Technical & Economic Potential. Energy Center of Wisconsin, Madison, Wisconsin.

Wisconsin Department of Administration, Division of Energy (DOA). (2004). *2004 Wisconsin Energy Statistics*. Wisconsin Department of Administration, Madison, WI.