

Greater Impacts at Reasonable Costs—Setting and Meeting Energy Efficiency Resource Standards with Best Practices

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ABSTRACT

What Energy Efficiency Resource Standards (EERS) are sufficiently aggressive yet actually achievable? How can utilities meet new and rising energy efficiency performance standards at reasonable costs?

While more states pass energy efficiency performance standards and some states with existing EERS laws increase their standards, these standards are often set without discussion of the actual results and costs achieved by utilities with top performing DSM portfolios.

This presentation will summarize the authors' research to identify both typical and best practice DSM portfolios across North America and discuss the potential implications of these actual DSM program results for policymakers and utility professionals. Top-performing DSM portfolios were analyzed to identify features and programs that characterize best practices.

The analysis spans 22 utilities and agencies in North America. 2006 program results and costs were collected from official annual DSM reports and normalized for the utilities'/states' baseline sales, peak demands, and revenues to produce the following estimates per utility/state agency for overall results and for the residential and commercial/industrial sectors separately:

- Energy savings as percentages of baseline sales.
- Peak demand reductions as percentages of utility or state peak demands.
- Percentages of revenues spent on DSM.
- First year costs of conserved energy and peak demand reductions.

For the organizations reviewed, the 2006 overall median energy savings as a percentage of annual sales is 0.8%, and the median first year costs for energy savings is \$0.18/kWh, but the organizations with the largest relative energy savings and below median costs achieved their energy savings at about 1.3% of annual sales. The results for demand savings as a percentage of peak demand are similar: the median savings is 0.6% of peak demand and the median cost is \$836/kW, but the organizations with the largest relative peak demand savings and below median costs saved about 1.1% of peak demand.

Introduction

Energy Efficiency Resource Standards (EERS) are key to effecting high DSM savings: states with mandated goals for utilities' DSM programs generally achieve high DSM savings. While more states pass Energy Efficiency Resource Standards (EERS), and some states with existing EERS laws increase their standards, these standards are often set without discussion of the actual results and costs achieved by utilities with top performing DSM portfolios.

What standards are sufficiently aggressive yet actually achievable? How can utilities meet these new and rising EERS at reasonable costs?

This study compares demand-side management (DSM) results of selected utilities and agencies in the Midwest, Northeast, West, and British Columbia, Canada¹. The analysis compares detailed program results by customer sector of those utilities identified as achieving high levels of DSM savings for below median costs to identify common best practices of top performers. Thus, as utility professionals and policymakers evaluate their current results and plan future goals, this presentation will give benchmarks for comparison and directions for best practice—on the basis of actual results.

Methodology

Data and information were collected for 2006 (or 2005) DSM program results for twenty-two utilities and energy agencies in eleven states across three regions in the US and for one Canadian utility (see Table 1 below).

Table 1. Benchmarked Utilities and Agencies²

| Region | Utility/Agency | State |
|---------------|---|------------------|
| Midwest | Duke Energy | Indiana |
| | Great River Energy | Minnesota |
| | Indianapolis Power & Light | Indiana |
| | Interstate Power & Light | Iowa |
| | Interstate Power & Light | Minnesota |
| | MidAmerican Energy | Iowa |
| | Minnesota Power | Minnesota |
| | Otter Tail Power | Minnesota |
| | Southern Minnesota Municipal Power Agency: The Triad ³ | Minnesota |
| | Wisconsin Focus on Energy | Wisconsin |
| | Xcel Energy | Minnesota |
| Northeast | Connecticut Energy Efficiency Fund | Connecticut |
| | Efficiency Vermont | Vermont |
| | Efficiency Maine | Maine |
| | National Grid | Massachusetts |
| | New Jersey Clean Energy Program | New Jersey |
| | New York State Energy Research and Development Authority | New York |
| | NSTAR | Massachusetts |
| West | Pacific Gas & Electric | California |
| | San Diego Gas & Electric | California |
| | Southern California Edison | California |
| Canada | BC Hydro and Power Authority | British Columbia |

¹ The authors wish to acknowledge the contributions of Gay Cook, Summit Blue Consulting, LLC, to earlier versions of this study.

² Because 2006 results (both costs and impacts) were not available for BC Hydro, Duke Energy Indiana, Great River Energy, Indianapolis Power & Light, CEEF, NSTAR, New Jersey Clean Energy Program, and the California utilities, their 2005 results are used here. Indianapolis Power & Light DSM results were available only for the residential sector.

³ The Triad consists of Austin Utilities, Owatonna Public Utilities, and Rochester Public Utilities.

This analysis normalized the reported total program results for utility or agency size and sales to major customer sector. The benchmarking data were prepared as follows:

- **Compiled 2006 reported program results**—program descriptions, energy and demand savings, and costs.⁴ The sources for almost all of the data were utilities’ and agencies’ annual reports on their 2006 DSM program results. Where 2006 data were not available, 2005 data were used.
- **Categorized actual DSM program results by major customer sector**—residential and commercial & industrial (C&I)—and calculated percentages for each sector.
- **Normalized results by utility or agency overall sales and peak demands** to produce estimates of DSM savings as percentages of overall sales and peak demand (where data were available). The main source for the baseline sales and peak demand data was FERC Form 861 from the Energy Information Administration’s web site (www.eia.doe.gov).
- **Divided spending by the DSM program energy and demand savings** to determine each utility’s first year cost of conserved energy and cost of demand in terms of \$/kWh and \$/kW.⁵

Although every effort was made to collect comparable data, given the inherent variation in organizations’ evaluation and reporting practices, the results cannot be considered a strictly “apples-and-apples” comparison. For example, utilities may report estimated savings at meter, busbar, or generator; some utilities’ methods for estimating savings may be more accurate than other utilities’; only some annual DSM reports included savings that were verified. However, despite these reporting and evaluation variations, the results provide calibration targets for DSM potential estimates and identify key programs and results for top-performing portfolios.

Also significant are the regulatory and market contexts of each organization. Regulatory environment, DSM requirements, DSM funding, and cost recovery mechanisms significantly influence overall program results. For example, in Minnesota, electric utilities currently must spend 1.5%-2% of their revenues on EE/DR. Program cost recovery is guaranteed, and performance-based EE/DR financial incentives can be up to 30% of program costs. In contrast, Indiana grants EE/DR cost recovery, but it sets no requirements, nor does it offer any financial incentives, and Indiana is the only jurisdiction reviewed that focuses C&I EE programs on small businesses. These differences in regulatory contexts are reflected in the following results.

Results

Overall DSM Results

Table 2 shows the median result for DSM spending, savings, costs, and energy costs over all customer sectors for the reviewed organizations.

⁴ Costs for load management programs exclude rate discount incentives.

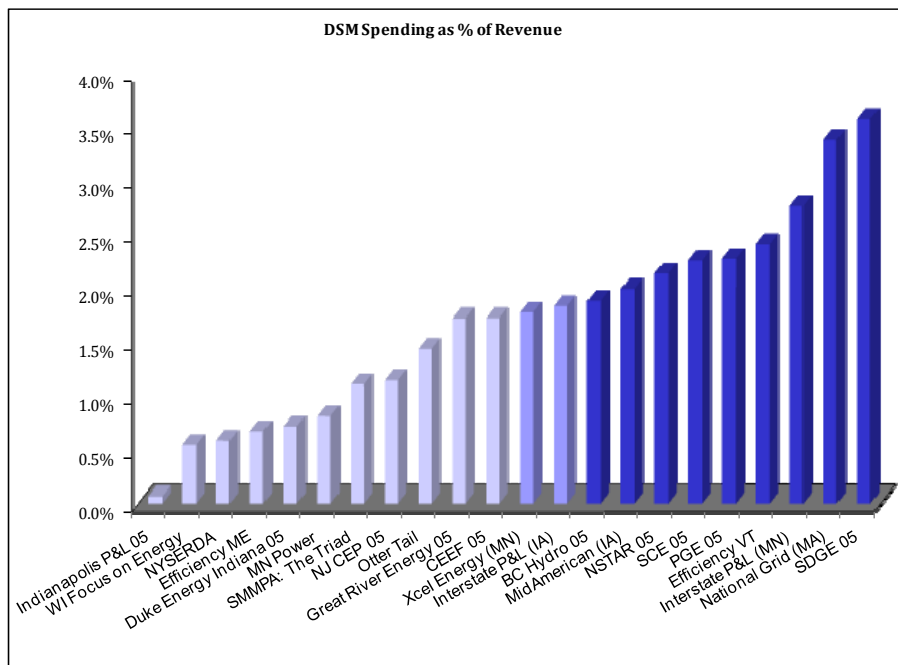
⁵ Converted program spending to US dollars where needed using the 2005 average currency exchange of US\$1=CDN\$1.21.

Table 2. Medians for Overall Results

| Spending as % of Revenue | Energy Savings as % of Sales | Demand Savings as % of Peak Demand | Cost of Energy \$/kWh | Cost of First Year Savings | |
|-----------------------------|---------------------------------|---------------------------------------|--------------------------|----------------------------|--------------|
| | | | | \$/kWh | \$/kW |
| 1.8% | 0.8% | 0.6% | \$0.08 | \$0.18 | \$836 |

DSM spending. The spending on DSM as a percentage of revenue for the organizations reviewed ranges from 0.1% to 3.6% with the median at 1.8%. Figure 1 below shows the distribution of spending on DSM as a percentage of annual revenues. Utilities with spending rates in the top quartile are PGE, Efficiency VT, Interstate P&L (MN), National Grid (MA), and SDGE which has the highest spending rate, about double the median.

Figure 1. DSM Spending as % of Revenue



Energy and demand savings. All of the nine organizations with above median DSM spending rates also achieved above median energy savings as a percentage of sales: SDGE has the highest energy savings as a percentage of sales at about 2.1%, three times the median of 0.8%, while Interstate P&L (MN), SCE, and PGE achieved savings rates of about 1.5% of sales; Efficiency VT, NSTAR, MidAmerican (IA), National Grid (MA), and BC Hydro achieved savings rates of about 0.9%, (Figure 2).

Figure 3 shows DSM incremental demand savings as a percentage of annual peak demand. SDGE has the highest demand savings as a percentage of peak demand, at 1.9%, about 3 times the median of 0.6%. Most of the utilities with above median demand savings rate have rates of DSM spending at or above the median: Interstate P&L (MN), PGE, SCE, and Xcel Energy (MN) conserved about 1.2% of peak demand while Efficiency VT, Interstate P&L (IA), and MidAmerican (IA) conserved about 0.9% of peak demand.

Figure 2. DSM Energy Savings as % of Sales First Year

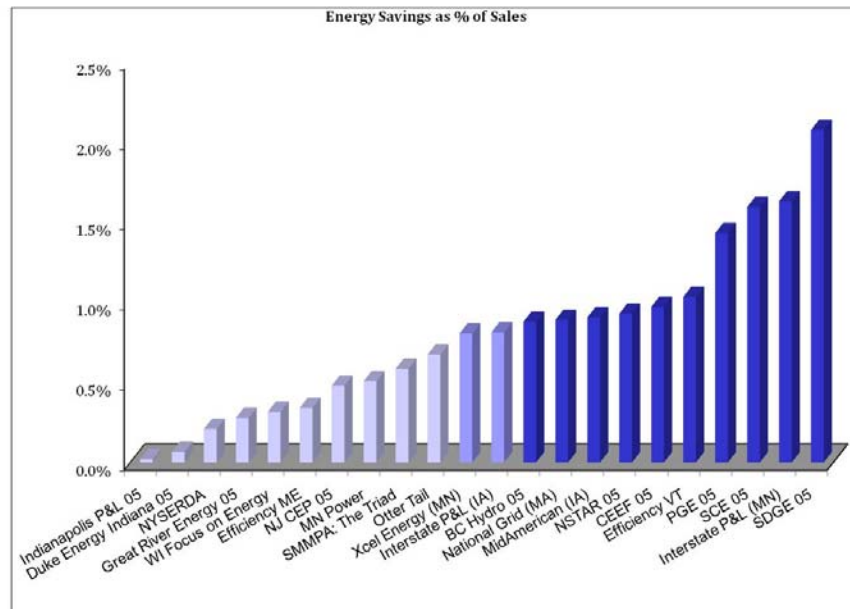
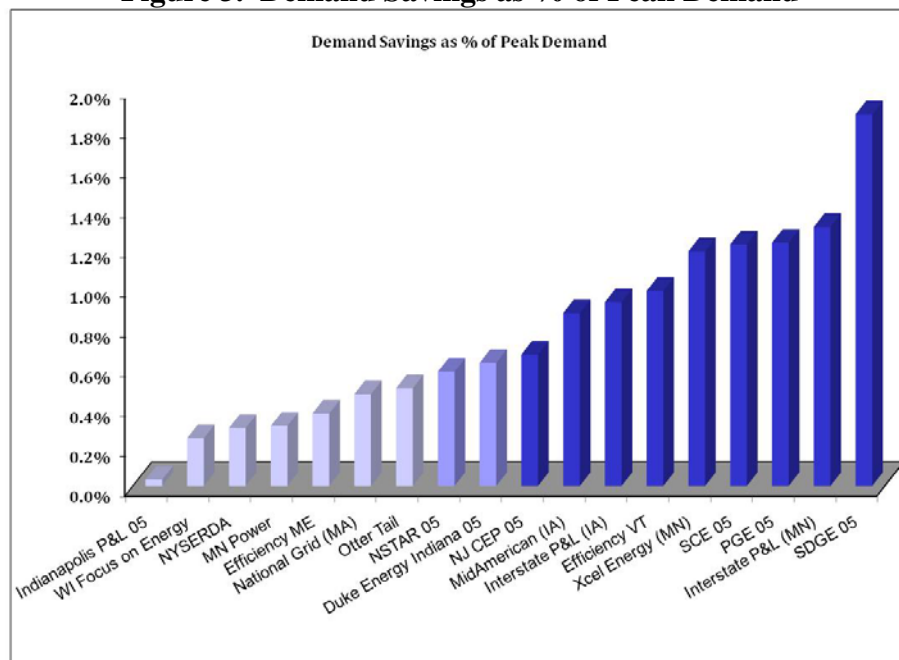


Figure 3. Demand Savings as % of Peak Demand



Cost of savings. As shown in Figure 4 below, the first year cost of energy savings ranges from \$0.08/kWh to \$0.60/kWh, with the median at \$0.18/kWh. MN Power achieved the lowest cost of energy savings. BC Hydro, MidAmerican (IA), Interstate P&L (MN), and SCE also achieved their energy savings at costs below the median, near \$0.15/kWh, but these four utilities achieved these low cost energy savings with above median DSM spending rates (as a percentage of revenue) and above median energy savings rates (as a percentage of sales).

Figure 4. Cost of Energy Savings (\$/kWh) First Year

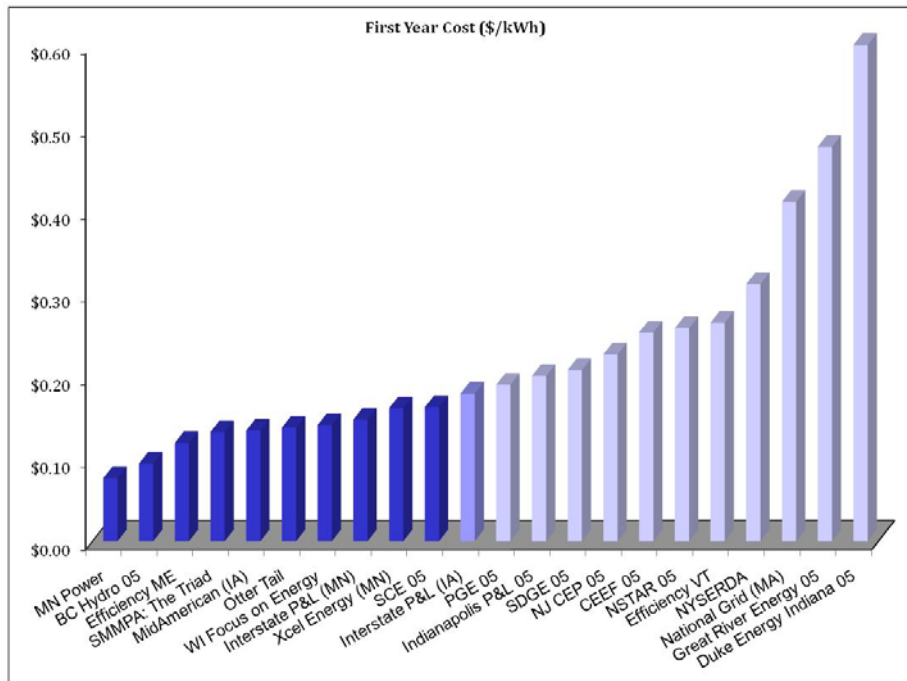


Figure 5 below shows that Duke Energy Indiana, at \$265/kW, and Xcel Energy (MN), at \$401/kW, have the lowest costs of conserved demand, well below the median of \$836/kW. Duke Energy Indiana's direct load control program is responsible for the company's low cost of demand savings and high cost of energy savings.

The scatter plot in Figure 6 below illustrates where each organization falls relative to median energy savings and median costs. SDGE achieved the greatest energy savings as percentage of sales, 2.1%, but achieved these savings at a cost, \$0.21/kWh, above the median, \$0.18/kWh. The utilities listed below achieved median or higher energy savings as a percentage of sales very near or lower than the median cost:

1. Interstate P&L (MN): 1.6%, \$0.15/kWh
2. SCE: 1.6%, \$0.16/kWh
3. PG&E: 1.4%, \$0.19 /kWh
4. MidAmerican (IA): 0.9%, \$0.13/kWh
5. BC Hydro: 0.9%, \$0.09/kWh
6. Xcel Energy: 0.8%, \$0.16/kWh
- Interstate P&L (IA): 0.8%, \$0.18/kW

Figure 5. Cost of Demand Savings (\$/kW)

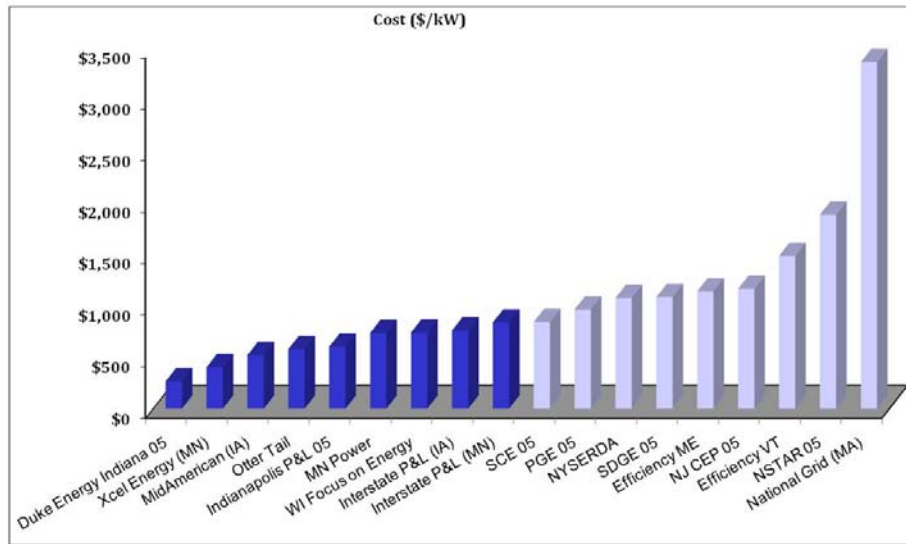
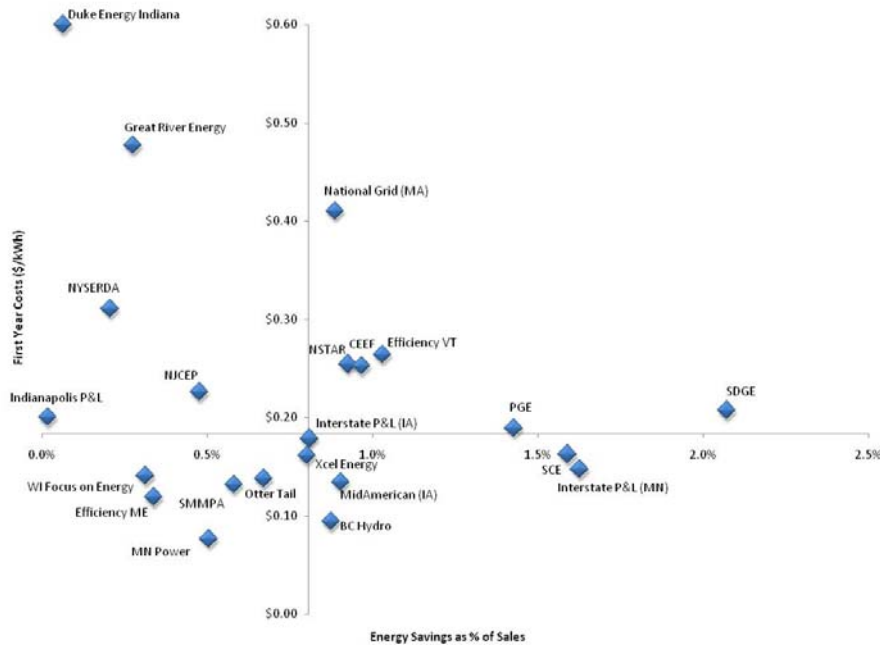


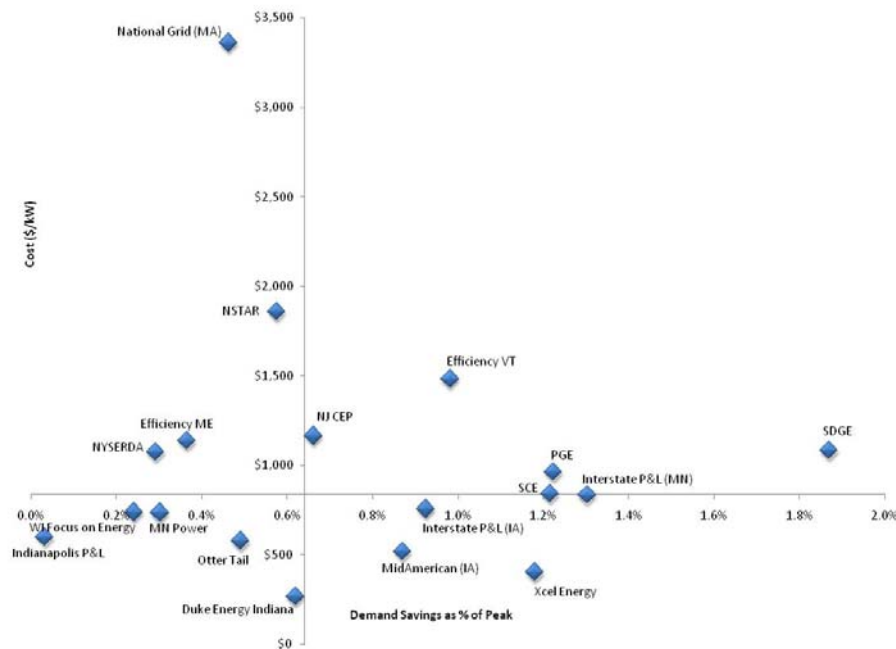
Figure 6. Scatter Plot of Energy Savings and First Year Costs (\$/kWh)



The scatter plot shown in Figure 7 below illustrates organizations' results relative to median demand savings and median costs. SDGE achieved the greatest percentage of peak demand savings but at \$1,081/kW, costs above the median, \$836/kW. The utilities listed below achieved higher than median demand savings as a percentage of peak demand very near or lower than the median cost:

1. Interstate P&L (MN): 1.1%, \$833/kW
2. SCE: 1.2%, \$839/kW
3. Xcel Energy: 1.2%, \$401/kW
4. Interstate P&L (IA): 0.9%, \$756/kW
5. MidAmerican (IA): 1.1%, \$519/kW

Figure 7. Scatter Plot of Demand Savings and Costs (\$/kW)



The shape of the energy savings and costs scatter plot illustrates greater variation in costs of energy savings among the organizations that have below median savings as a percentage of sales. Specifically, these data suggest that an organization with an energy savings rate above the median (0.8% of sales) is more likely to save at or below median costs \$0.18/kWh) than is an organization that has an energy savings rate below the median. The scatter plot of demand savings and costs, however, suggests a more complex relationship between demand savings and costs of demand savings.

Sector Analysis

This section compares 2006 DSM program results for the commercial and industrial (C&I) and residential sectors and reviews program-level detail for those organizations that achieved high savings at low costs.

C&I sector. Table 3 shows median impacts, costs, and spending for the C&I sector.

Table 3. Medians for C&I Results

| Spending as % of Revenue | Energy Savings as % of Sales | Demand Savings as % of Peak Demand | Cost of Savings | |
|--------------------------------|---------------------------------|--|-----------------|--------------|
| | | | \$/kWh | \$/kW |
| 1.7% | 0.7% | 0.6% | \$0.14 | \$682 |

Table 4 below shows results for programs delivered by the utilities that achieved above median energy savings rates at below median costs in the C&I sector. Interstate P&L (MN) achieved most of their energy savings with custom type rebate programs. Xcel Energy, which gained most of its savings from several programs, also achieved significant savings with programs for custom rebates, motors, cooling/heating/roofing, but earned most of its savings with programs for new construction and lighting. MidAmerican (IA) achieved most of its savings not only from new construction and lighting but also from motors.⁶

Table 4. Energy Savings for C&I Programs as % of Sales

| C&I Program/Measures | Interstate P&L (MN) | MidAmerican (IA) | Xcel Energy (MN) |
|--|--------------------------------|------------------------------|-------------------------|
| Lighting | 0.02% | 0.50% | 0.27% |
| Cooling/Heating/Roofing | 0.02% | | 0.10% |
| Refrigeration | | | 0.02% |
| Motors | | (see Lighting ⁶) | 0.10% |
| Compressed Air | | | 0.12% |
| Custom Rebates | 2.36% | 0.12% | 0.17% |
| Energy Audit | | 0.07% | |
| New Construction | | 0.27% | 0.26% |
| Agriculture | 0.13% | | 0.01% |
| C&I Interruptible Rates | | 0.04% | 0.01% |
| C&I Direct Load Control | | | |
| Total C&I Savings (GWh) | 13 | 126 | 244 |
| Annual C&I Sales (GWh) | 517 | 12,665 | 23,029 |
| C&I Savings as % of C&I Sales | 2.53% | 1.00% | 1.06% |

As seen in Table 5 below, costs of energy savings per program varies widely. But Interstate P&L (MN)'s costs for its custom type rebate program, which earned almost Interstate P&L (MN)'s entire C&I energy savings, is below the median cost. Its costs for its agriculture programs, at \$0.08/kWh, are also below the median. MidAmerican (IA)'s costs per kWh for its high achieving program, the Nonresidential Equipment Program, is just \$0.05/kWh, well below the median. Xcel Energy's costs per kWh per program are at or below the median for most programs.

⁶ Here MidAmerican (IA)'s lighting savings are from their Nonresidential Equipment Program. While this is a program of incentives for a range of measures, including (in addition to lighting) heating, cooling, and motors, most of this program's 2006 energy savings, 47% of the program total, is from lighting measures while 45% of the program's total energy savings is from VSD/motors.

Table 5. Costs of C&I Energy Savings by Type of Program

| C&I Program/Measures | Interstate P&L (MN) | MidAmerican (IA) | Xcel Energy (MN) |
|--|--------------------------------|------------------------------|-------------------------|
| Lighting | \$0.31 | \$0.05 | \$0.16 |
| Cooling/Heating/Roofing | \$0.53 | | \$0.14 |
| Refrigeration | | | \$0.07 |
| Motors | | (see Lighting ⁶) | \$0.07 |
| Compressed Air | | | \$0.03 |
| Custom Rebates | \$0.12 | \$0.09 | \$0.06 |
| Energy Audit | | \$0.21 | |
| New Construction | | \$0.12 | \$0.10 |
| Agriculture | \$0.08 | | \$0.14 |
| C&I Interruptible Rates | | \$0.22 | \$0.35 |
| C&I Direct Load Control | | | |
| Total C&I Savings (GWh) | 13 | 126 | 244 |
| Total Costs (\$M) | 1.6 | 12.2 | 27.9 |
| Costs of C&I Savings (\$/kWh) | \$0.12 | \$0.10 | \$0.11 |

Residential sector. Table 6 shows median impacts, costs, and spending for the residential sector.

Table 6. Medians for Residential Results

| Spending as % of Revenue | Energy Savings as % of Sales | Demand Savings as % of Peak Demand | Cost of Savings | |
|-------------------------------------|---|---|------------------------|--------------|
| | | | \$/kWh | \$/kW |
| 1.7% | 0.6% | 0.9% | \$0.27 | \$915 |

Table 7 and Table 8 below show results and costs for programs delivered by the utilities that achieved above median energy savings rates at below median costs in the residential sector. MN Power, PG&E, SDG&E, and SCE achieved most of their high savings at costs well below the median from their programs which combine multiple measures. MN Power's Triple E Plus program includes product incentives for lighting, cooling/heating/roofing, and building envelope as well as services for new construction; the California IOU's each have several combination programs which include incentives for lighting, programmable thermostats, cooling, and appliances. For these four utilities, most of the energy savings of their combination programs were achieved by lighting measures, and their costs were kept low by leveraging community and national (e.g., Energy Star) resources for delivery. Interstate P&L (IA) also achieved most of its savings from its combination program, Prescriptive Rebates, at median costs, and most of the savings for that program were from lighting and cooling. MidAmerican (IA) achieved most of its savings well below median costs from its energy audit program which includes (in addition to the audit) installation of free water heating and lighting measures and incentives for window improvements and insulation—most of this program's 2006 activity was with lighting. Efficiency VT and BC Hydro also achieved most of their energy savings from lighting measures below median costs.⁷

⁷ Efficiency VT reports only impacts per end-use and reports costs at the program level.

Table 7. Energy Savings for Residential Programs as % of Energy Sales

| Residential Program/Measures | BC Hydro | Efficiency VT | Interstate P&L (IA) | MidAmerican (IA) | MN Power | PGE | SDGE | SCE |
|--------------------------------------|---------------|---------------|---------------------|------------------|--------------|---------------|--------------|---------------|
| Lighting | 0.94% | 1.11% | | | | | | |
| Cooling/Heating/Roofing | | 0.05% | | 0.11% | | | | 0.03% |
| Building Envelope | 0.01% | | | | | | | |
| Refrigerator/Freezer Removal | 0.22% | | 0.15% | | | | 0.10% | |
| ES Appliances | | 0.09% | | | | | | |
| Water Heating | | 0.01% | | | | | | |
| Energy Audit | | | 0.07% | 0.30% | | | | |
| Combination | | | 0.51% | | 0.72% | 1.34% | 2.10% | 1.78% |
| Low Income | | | 0.05% | 0.04% | 0.18% | | 0.07% | |
| New Construction | 0.03% | 0.11% | 0.09% | 0.19% | | 0.01% | 0.03% | 0.04% |
| Fuel Switch | 0.01% | 0.08% | | | | | | |
| Res Direct Load Control | | | | 0.02% | | | | |
| Total Res Savings (GWh) | 191 | 30 | 32 | 34 | 9 | 401 | 163 | 534 |
| Annual Res Sales (GWh) | 15,814 | 2,051 | 3,751 | 5,086 | 1,012 | 29,752 | 7,105 | 28,889 |
| Res Savings as % of Res Sales | 1.21% | 1.45% | 0.86% | 0.67% | 0.90% | 1.35% | 2.29% | 1.85% |

Table 8. Costs of Residential Energy Savings by Type of Program

| Residential Program/Measures | BC Hydro | Efficiency VT | Interstate P&L (IA) | MidAmerican (IA) | MN Power | PGE | SDGE | SCE |
|--------------------------------------|---------------|---------------|---------------------|------------------|---------------|---------------|---------------|---------------|
| Lighting | \$0.03 | | | | | | | |
| Cooling/Heating/Roofing | | | | \$0.41 | | | | \$0.21 |
| Building Envelope | \$0.33 | | | | | | | |
| Refrigerator/Freezer Removal | \$0.12 | | \$0.13 | | | | \$0.21 | |
| ES Appliances | | | | | | | | |
| Water Heating | | | | | | | | |
| Energy Audit | | | \$0.26 | \$0.12 | | | | |
| Combination | | \$0.14 | \$0.27 | | \$0.12 | \$0.13 | \$0.12 | \$0.11 |
| Low Income | | | \$0.20 | \$0.22 | \$0.20 | | \$1.29 | |
| New Construction | \$0.08 | \$1.23 | \$0.35 | \$0.28 | | \$1.23 | \$1.67 | \$0.79 |
| Fuel Switch | \$0.08 | \$0.18 | | | | | | |
| Res Direct Load Control | | | | \$1.00 | | | | |
| Total Res Savings (GWh) | 191 | 30 | 32 | 34 | 9 | 401 | 163 | 534 |
| Total Costs (\$M) | 11.4 | 7.3 | 9.9 | 9.3 | 1.5 | 63.0 | 29.5 | 70.4 |
| Costs of Res Savings (\$/kWh) | \$0.06 | \$0.25 | \$0.30 | \$0.27 | \$0.16 | \$0.16 | \$0.18 | \$0.13 |

Conclusions

For the 22 organizations reviewed, the overall median energy savings as a percentage of annual sales for 2006 is 0.8%, and the median costs for first year energy savings is \$0.18/kWh,

but the organizations with the largest relative energy savings and below median costs achieved their energy savings at about 1.3% of annual sales. The results for demand savings as a percentage of peak demand are similar: the median savings is 0.6% of peak demand and the median cost is \$836/kW, but the organizations with the largest relative peak demand savings and below median costs saved about 1.1% of peak demand.

The organizations with the above median relative energy savings at costs at or below the median in the C&I sector, Interstate P&L (MN), Xcel Energy, and MidAmerican (IA), achieved most of their energy savings with custom rebates, lighting, and new construction. These programs also provided most of the C&I demand savings, however Xcel Energy achieved significant demand savings with very low cost load management programs.

In the residential sector, several organizations achieved high energy savings as a percentage of sales at low costs: SDG&E, SCE, Efficiency VT, PG&E, BC Hydro, MN Power, and MidAmerican (IA). These savings were achieved with programs that combined a range of product incentives and services (and, in one case, an energy audit service), the majority of activity and impacts of these programs being lighting measures. Delivery approaches which leverage community and national resources may have been especially cost-effective for MN Power and the California IOUs.

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