

# Technical and Economic Potential - A New Method

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The term potential, as used in demand-side management, refers to energy and demand savings that can theoretically be obtained within a geographical region. Wisconsin's utilities are required to estimate the statewide demand-side potential, to provide bounds for evaluating their demand-side plans and to help policy-makers understand the limits of and opportunities for demand-side management. This paper presents a method collaboratively developed to estimate both technical and economic demand-side potential.

The method uses a statewide database of demand-side technology options to provide technical and market data for each demand-side measure considered. Measures examined included energy conservation, load management, and fuel switching options. Participating utilities contributed population information and economic data, including forecasts and avoided cost information.

This paper presents the calculation method used, including the key assumptions. A step-by-step outline of the method is presented, including sample calculations for one end use. Some results are presented for illustrative purposes. Finally, the paper identifies key underlying issues, and discusses how some of them may be resolved.

The value of the paper lies less in the results presented than in the method itself. This method could be adapted and used with suitable input data and assumptions to estimate potential in other jurisdictions. Furthermore, it serves as a useful starting point for developing improved methods for estimating potential.

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## Introduction

Every two to three years, Wisconsin's utilities file long-term integrated resource plans (IRP) with the state regulatory body, the Public Service Commission of Wisconsin (PSCW). These plans, called Advance Plans, include forecasts of the energy and demand savings from utility demand-side management (DSM) programs. To provide an upper bound for evaluating DSM forecasts, and to provide a common estimate of the limits of and opportunities for DSM in Wisconsin, a method for estimating DSM potential was developed.

To develop the method an ad hoc committee was formed, including representatives of the utilities, the PSCW, and several intervenor groups. All the major stakeholders were included, to encourage the widest possible acceptance of the results. A search of the literature was conducted for methods of estimating DSM potential (Bonneville 1992; Faruqui et al. 1990a; Faruqui et al. 1990b; Xenergy 1991; Mowris 1990; Nadel and Tress 1990; Koomey et al.

1991; and Geller and Nadel 1989). The committee worked by consensus to develop the method, which was then implemented by the Wisconsin Center for Demand-Side Research (WCDSR).

This method, called the Statewide Technical and Economic Potential (STEP) Method, is presented in some detail in this paper. Some results are presented briefly for illustrative purposes, but we emphasize that they reflect a specific set of assumptions and available data. The value of the paper lies in the presentation of the algorithm, which could be used with appropriate data and assumptions to estimate potential in other jurisdictions.

## Objectives

The Advance Plan 6 order document issued by the PSCW stated that "The utilities, in consultation with Commission staff and intervenors, shall prepare a new estimate of

demand-side economic potential for Advance Plan 7.” (PSCW 1991) The STEP project was designed to respond to this order.

Specifically, the project’s objectives were to:

- develop a method for estimating the demand-side potential for electricity use and demand savings over 20 years,
- implement the method as a software tool, with the versatility to be modified as needed, and
- use the software to estimate Wisconsin’s DSM potential.

### **Definitions**

The STEP method is based on the following definitions of DSM potential (WCDSR 1994). In both of the definitions below, load refers to both electricity consumption and demand.

Technical potential is the electrical load reduction that results when the most efficient demand-side measures are adopted by the entire population in the base year, without consideration for economics.

Economic potential is the electrical load reduction that results when the most efficient demand-side measures are adopted by the entire eligible population when it is economical to do so from society’s overall perspective. For this purpose, technologies were screened using the *technical cost test*, as defined by Wisconsin’s *Least-cost Planning Guidelines* (PSCW 1990). Only technologies that passed this test were considered under economic potential. The *technical cost test* used in Wisconsin is similar to the *total resource cost test* (Krause and Eto 1988), but does not include DSM program administrative costs.

Estimates of technical and economic potential provide upper bounds on the actual potential savings. A subset of economic potential is the market potential, which includes only those measures that pass a market screen. The achievable potential is a subset of market potential, taking into account the expected customer participation rates in proposed DSM programs.<sup>1</sup> Both the market potential and the achievable potential were beyond the scope of this study .

### **Sources of Information**

The estimates of potential are based on technology information, market saturations, and economic projections provided by the participating utilities or through statewide research efforts. The technology and saturation informa-

tion was incorporated into an on-line database called the Wisconsin Demand-side Options Database (W-DOD).<sup>2</sup> W-DOD provides comparisons between demand-side alternatives and conventional technologies for end uses in the agricultural, commercial, industrial, and residential sectors. It is primarily used for long-term DSM program planning.

W-DOD is most complete in the commercial and residential sectors, with fewer end uses included in the agricultural and industrial sectors. The last major update to the data took place in 1991.

### **Methodology**

In this section, the committee’s consensus decisions on key methodological issues are discussed. Early on, the committee decided that W-DOD would be used with minimal alteration: new technologies would not be added specifically for STEP. The first subsection in this section discusses some of the implications of this decision. The committee did not reach complete consensus on some other issues, such as the avoided cost figures to be used. Consequently, results were calculated for several scenarios, as discussed in the second subsection. Finally, key assumptions agreed upon by the committee are presented in the last subsection.

### **DSM Measures Included**

Only the DSM measures included in W-DOD could be considered in the STEP calculations. The information in W-DOD is limited to those DSM measures that are commercially available in Wisconsin, are supported by reliable test data, and seem to require utility DSM programs to encourage their adoption. The STEP estimates therefore do not account for energy and demand savings from all possible technologies.

Because the W-DOD includes only technologies commercially available in 1991, energy and demand savings from technologies emerging since then (and throughout the 20 years considered by STEP) are underestimated. This effect is partially offset by the use of W-DOD’s base case technology efficiency data throughout the 20 year period: in fact, the efficiency of the base case (or standard) technology tends to rise over time, decreasing the potential savings.

The DSM measures included in W-DOD can be divided into three broad categories:

- conservation measures, which conserve energy;
- load management measures, which control demand in peak hours, often by shifting it to off-peak hours; and

- fuel switching measures, which eliminate electricity demand by switching to other forms of energy. In this study, only measures that switch to natural gas are considered.

### Scenarios Considered

To investigate the effects of each different DSM type separately, technical potential was calculated for four scenarios: fuel switching measures only; conservation measures only; load management measures only; and all three types of measures considered together. The conservation only scenario, for example, permits only conservation-type measures to be considered as replacements or add-ons.

Economic potential was calculated using two approaches: maximization of energy and demand savings and maximization of cost savings. These two approaches result in slightly different rankings of some technologies, depending on the ratio of electricity costs to other costs. In the first approach, technologies are ranked from best to worst in order of increasing avoided cost of electricity consumption and demand. In the second approach, technologies are ranked in order of increasing total cost, including capital costs.

In each approach, results were calculated using two different statewide average avoided cost scenarios: with avoided costs including adders for sulfur dioxide emissions, and with avoided costs including adders for both sulfur dioxide and greenhouse gas emissions (WCDSR 1994).

### Key Assumptions

The following key assumptions were made in developing the STEP method (WCDSR 1994):

- In calculating technical potential, all measures are assumed to be employed at the beginning of the base year. Economic potential is assumed to occur steadily throughout the 20 years. Because, however, most measures have less than a 20-year lifetime it is assumed that all economically viable measures will be employed by the end of the period.
- The method assumes steady energy and demand growth rates, taken from a consensus of utility forecasts, throughout the 20-year planning period. Obviously the results are likely to be more correct in the near term than in the long term. Changes in costs or benefits that may take place over time are not treated, nor are changes in the avoided cost of energy and demand. The capability to adjust these with time was not included in the model, but could be added.

- Fuel switching is limited to customers currently connected to gas mains, due to a lack of information on future gas main expansion. This assumption results in an underestimate of potential. The societal cost of natural gas is not included in the cost of fuel switching measures. Although most fuel switching measures would remain viable with fuel costs included, the economic potential for energy and demand savings from fuel switching may be somewhat overestimated. Cost savings from fuel switching are certainly overestimated.
- No limits were placed on load management measures in the STEP method. Because excessive shifting of summer peak loads would result in a new peak at a different time, there are practical limits to load management. STEP may therefore slightly overestimate the potential demand savings from load management.
- The capacity costs associated with transmission and distribution are included in the statewide average avoided cost of demand. The reported potential energy and demand savings, however, are as measured at the customer meter. Savings at the power plant would be larger by a transmission and distribution loss factor.
- Because of the three-year difference between the W-DOD base year (1991) and the STEP base year (1994), several adjustments were needed. Two of these are described later in this paper. Technology cost data were not adjusted for price inflation between 1991 and 1994; while some technologies became more expensive, others became less so.
- Measures adopted in STEP are assumed to remain employed throughout the rest of the planning period: the persistence is 100%. This assumption will overstate energy and demand savings.
- Finally, the STEP model does not distinguish between naturally occurring savings and those caused by utility programs.

### Example Calculations

To demonstrate how the method works, the calculations will be briefly summarized for one end use: single-family domestic water heating.

#### Calculating Technical Potential

The calculation of technical potential for an end use can be divided into twelve steps (WCDSR 1994). Figure 1 summarizes these steps. The steps will be illustrated by showing how they apply to single-family domestic water

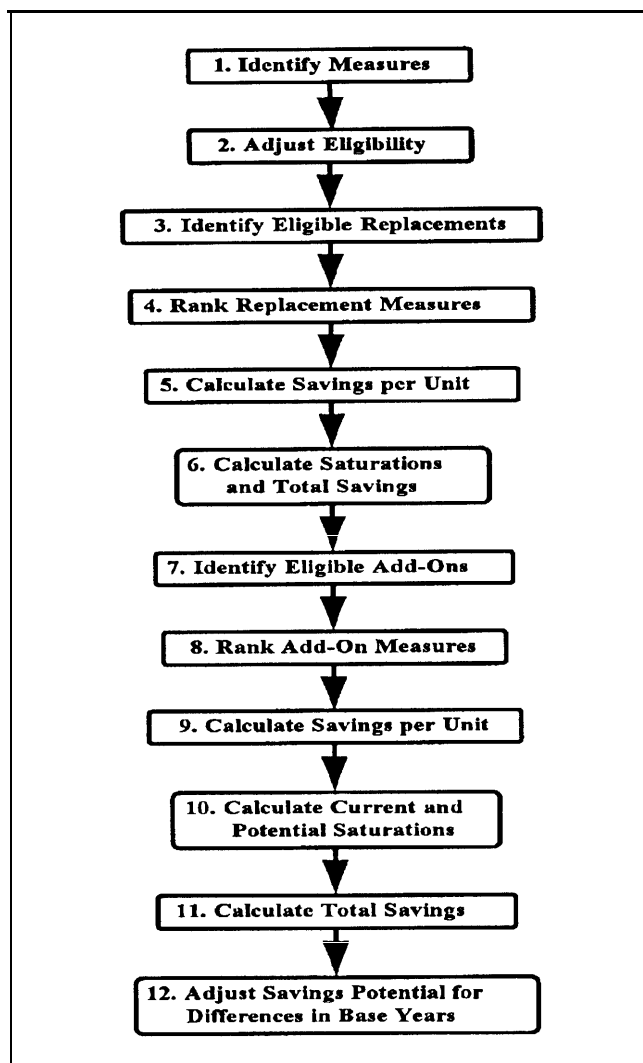


Figure 1. Technical Potential Calculation Steps

heating. To simplify the example, only the *Conservation Only* scenario will be considered (for an explanation, see the section on *Scenarios Considered*).

**Identify a Set of Measures to Analyze.** The base case technology for single-family domestic water heating, *Elect. Water Heater, 1992*, is an electric water heater with efficiency typical of those installed in 1992. Replacement technologies include:

- *Gas Water Heater, 1992*,
- *Elect. Water Heater, Efficient*,
- *Heat Pump Water Heater*, and
- *Solar Water Heater*.

Add-on measures include:

- *Water Heater Pipe Wrap*,
- *Water Heater Wrap*,
- *Desuperheater*,

- *Low-flow Showerhead*,
- *Faucet Aerators*, and
- *Direct Load Control*.

These measures are considered suitable add-ons for the base case technology and most of its replacements. Data are provided to the STEP model on the applicability of add-on measures to each replacement, so that unsuitable add-on measures will automatically be disallowed.

**Adjust the Eligibility Values for Fuel Switching Measures to Reflect Access to Natural Gas.** The W-DOD provides fuel switching eligibility figures for customers who have access to natural gas. These figures must be adjusted downward to reflect the percentage of electrical customers who do not have natural gas available (refer to the *Key Assumptions* subsection for further information on natural gas availability). This step is not pertinent to the measures eligible under the *Conservation Only* scenario.

**Identify Eligible Measures for Each Scenario.** In this step, measures not applicable to the current scenario are discarded. In the current example, the *Conservation Only* scenario is being considered. All the measures listed under the first step are conservation measures except the *Gas Water Heater, 1992*, and *Direct Load Control*.

**Rank the Replacement Measures Listed Above.** The replacement measures are ranked from least to greatest energy consumption and demand based on W-DOD data. The ranking of water heating measures is shown below:

- *Gas Water Heater, 1992*,
- *Heat Pumps Water Heater*,
- *Solar Water Heater*,
- *Elect. Water Heater, Efficient*, and
- *Elect. Water Heater, 1992*.

**Calculate the Energy and Demand Savings per Unit Replaced for Each Replacement Measure.**

The W-DOD provides data on the average energy use of the base case technology, in this case 4,230 kWh/yr per water heater, and on the average energy savings expected from a replacement. For example, if the *Heat Pump Water Heater* replaces the base case, on average 50% of the energy will be saved, or 2,115 kWh/yr per unit.

Load shape data (included in W-DOD) provided as an input to the STEP model provides the ratio of peak summer demand to energy consumption. For a water heater, this ratio is 0.00009 kW per kWh/yr. From W-DOD, a *Heat Pump Water Heater* that replaces the base case will save an average of 50% of the demand.

Therefore, the average demand savings expected would be:

$$\begin{aligned} \Delta D_r &= \Delta D_{\text{dod}} \times \text{Rat}_{\text{Is}} \times U_{\text{bc}} \\ &= 50\% \times 0.00009 \text{ kW}/(\text{kWh}/\text{yr}) \\ &\quad \times 4,230 \text{ kWh}/\text{yr}/\text{unit} \\ &= 0.19 \text{ kW}/\text{unit} \end{aligned} \quad (1)$$

where:

$$\begin{aligned} \Delta D_r &= \text{demand savings from this replacement} \\ &\quad [\text{kW}/\text{unit}] \\ \Delta D_{\text{dod}} &= \text{demand savings from W-DOD} [\%] \\ \text{Rat}_{\text{Is}} &= \text{ratio of peak demand to energy use} \\ &\quad [\text{kW}/(\text{kWh}/\text{yr})] \\ U_{\text{bc}} &= \text{base case energy use} [\text{kWh}/\text{yr}/\text{unit}] \end{aligned}$$

**Calculate the Savings and Potential Saturations as the Replacements are Carried Out Throughout the Market.** The replacements are then carried out, with the technologies that save the most energy and demand replacing those below them. The W-DOD provides data on the saturations for each measure, i.e., the percentage of the population with a given type of water heater. In this example, 24.1% of households have *Elect. Water Heater, Efficient*, and 13.2% have *Elect. Water Heater, 1992*. (Other households do not use electricity to heat water.) The most efficient replacement measure in the *Conservation Only* scenario, the *Heat Pump Water Heater*, could technically replace all the existing electric water heaters, according to W-DOD.

The energy savings for a replacement are calculated by multiplying the savings per unit replaced by the change in saturations by the population.<sup>3</sup> For the replacement of *Elect. Water Heater, 1992* by the *Heat Pump Water Heater*, energy savings would be:

$$\begin{aligned} \Delta E_{\text{pot}} &= \Delta E_r \times (\text{Sat}_1 - \text{Sat}_2) \times \text{Pop} \\ &= 2,115 \text{ kWh}/\text{yr}/\text{household} \\ &\quad \times (13.2\% - 0\%) \times 1,430,000 \text{ households} \\ &= 1,060 \times 10^6 \text{ kWh}/\text{yr} \end{aligned} \quad (2)$$

where:

$$\begin{aligned} \Delta E_{\text{pot}} &= \text{potential energy savings for this replacement} \\ &\quad \text{measure} [\text{kWh}/\text{yr}] \\ \Delta E_r &= \text{energy savings per replacement} \\ &\quad [\text{kWh}/\text{yr}/\text{household}] \\ \text{Sat}_1 &= \text{original saturation of the measure being} \\ &\quad \text{replaced} [\%] \\ \text{Sat}_2 &= \text{new saturation of the measure being replaced} \\ &\quad [\%] \\ \text{Pop} &= \text{population} [\text{households}] \end{aligned}$$

Demand savings are calculated in a similar way.

**Identify the Add-on Options that can be Applied.** For each replacement measure remaining in the population, identify the applicable add-on measures.

**Rank the Add-on Measures Identified Above.** The add-ons are ranked in order from greatest to least energy and demand avoided cost savings.

**Calculate the Energy and Demand Savings per Unit for Each Add-on Measure.** For each replacement measure, the corresponding add-on measures are applied in the order found in the paragraph above. Energy and demand savings are calculated for each successive measure applied. To avoid double-counting of savings, the percent savings expected for a given measure are applied to the energy or demand after the application of the previous measures.

**Calculate the Current and Potential Saturations for Each Add-on Measure.** The current and potential saturations given in W-DOD for each add-on are next adjusted for the change in saturations of the various replacement measures.

**Calculate the Savings as the Add-on Measures Are Applied Throughout the Eligible Market.** The energy savings for an add-on are calculated by multiplying the savings per unit by the change in saturations by the population. Demand savings are calculated in a similar way.

**Adjust the Energy and Demand Savings Potential for Differences Between the Base Year of W-DOD and the Base Year of STEP.** The base year for the data in W-DOD at the time of this work was 1991. The base year for the STEP results and most other input data was 1994. The energy and demand savings figures are adjusted for this difference in two ways:

- energy and demand savings are increased by a factor equal to the total forecast growth in energy and demand<sup>4</sup> from 1991 to 1994; and
- energy and demand savings for each end use are reduced by a factor equal to the energy and demand savings captured through utility programs and other market forces<sup>5</sup> between 1991 and 1994.

### Calculating Economic Potential

The calculation of economic potential for an end use can be divided into eleven steps (WCDSR 1994). The domestic water heating example used in the first subsection of this section will again be used here. To simplify the

example, only the *Maximization of Energy and Demand Savings* approach will be presented.

**Identify Measures and Adjust Fuel Switching Eligibility.** The first two steps are as in the *Calculating Technical Potential*.

**Rank the Replacement Measures.** For the *Maximization of Energy and Demand Savings* approach, this step is identical to the section *Rank the Replacement Measures*. The *Maximization of Cost Savings* approach results in a slightly different ranking.

**Calculate the Energy and Demand Savings per Unit Replaced for Each Replacement Measure.**

The energy and demand savings are calculated as in an earlier subsection. Cost savings for the replacement measures are also calculated, using: the calculated energy and demand savings; data on avoided costs of energy and demand; the capital cost, maintenance cost and lifetime information from W-DOD; and the real discount rate. The calculations are complex and so are not shown here. The example replacement in that subsection shows the energy and demand savings from replacing the *Elect. Water Heater, 1992* with a *Heat Pump Water Heater*. The cost calculations show that such a replacement would result in a net loss of \$880 per unit.

**Calculate the Savings and Potential Saturations as the Replacements are Carried Out Throughout the Market.** This calculation is similar to that shown in the earlier subsection of the same title. There are two key differences, however. First, all measures are considered together in the economic potential calculations:

thus the fuel switching and load management options are included along with the conservation measures. Under this scenario, most electric water heaters are replaced by the *Gas Water Heater, 1992*.

Second, replacements that save energy and demand but do not have cost savings do not take place. Therefore, the *Heat Pump Water Heater* does not replace any of the existing water heaters.

**Identify the Add-on Options That Can Be Applied.** All add-on options listed in the subsection, *Identify a Set of Measures ...* can be applied to the remaining electric water heaters. None are applicable to the gas water heaters, because gas conservation is not part of this study.

**Rank the Add-on Measures.** For the *Maximization of Energy and Demand Savings* approach, the measures are ranked in the same order as in the technical potential calculations. The ranking differs slightly when the *Maximization of Cost Savings* approach is used. In each

approach, measures drop off the list if they do not save both avoided cost of electrical consumption and demand and total cost.

**Calculate Savings and Saturations and Adjust for Base Year Differences.** These steps are similar to subsections *Calculate the Energy...*, through *Adjust the Energy and Demand . . .*

## Selected Results

The STEP method produced estimates of energy and demand savings potential based on assumptions of state-wide electricity use applicable to Wisconsin. The results were presented in total, but were also presented for individual market sectors, types of measure, and end uses. Savings potentials for individual technologies were not presented: the STEP method was not intended to produce results disaggregated to that level.

This section briefly presents a few sample results from STEP. These results are based on data specific to the state of Wisconsin, and the specific set of assumptions adopted by the STEP Committee. They should therefore be understood as illustrative rather than as representative of actual Wisconsin potential.

### Projected Energy and Demand Savings Potential

Figure 2 shows the projected energy consumption over the next 20 years, assuming a constant rate of growth. Line (2) in the figure would be the consumption if all the technical potential were realized immediately. Line (3) would be the consumption if the economic potential were realized gradually over 20 years.

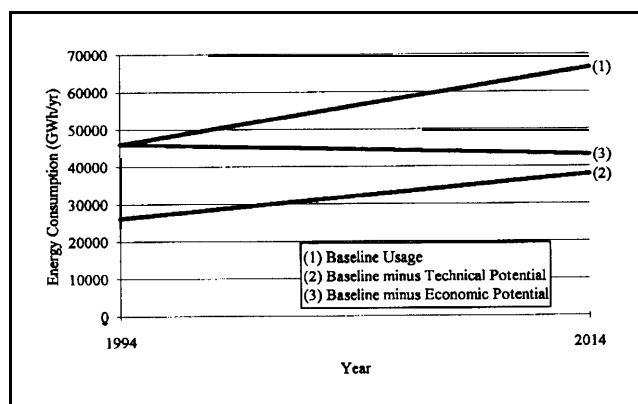


Figure 2. Energy Consumption over 20 Years

Figure 3 shows the projected summer peak demand over the next 20 years, assuming a constant rate of growth. Line (2) in the figure would be the demand if all the

technical potential were realized immediately. Line (3) would be the demand if the economic potential were realized gradually over 20 years.

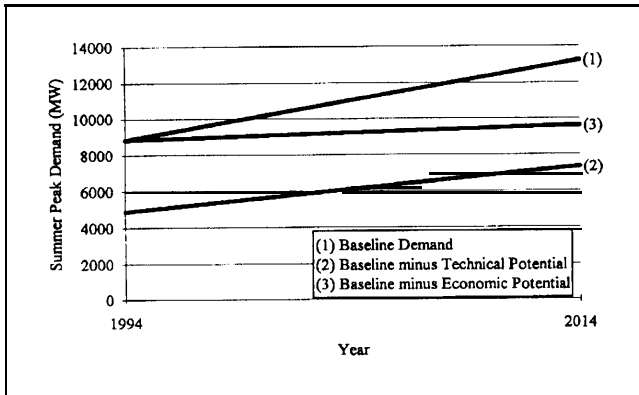


Figure 3. Summer Peak Demand over 20 Years

### Potential Energy and Demand Savings by Market Sector

Figure 4 shows estimated consumption savings potential for four sectors: agricultural, commercial, industrial, and residential. Figure 5 shows estimated demand savings potential for the four sectors. In each chart, the top of each bar represents the total projected consumption without realization of any potential savings. Economic potential is the top region of each bar. Technical potential includes the top two regions of each bar.

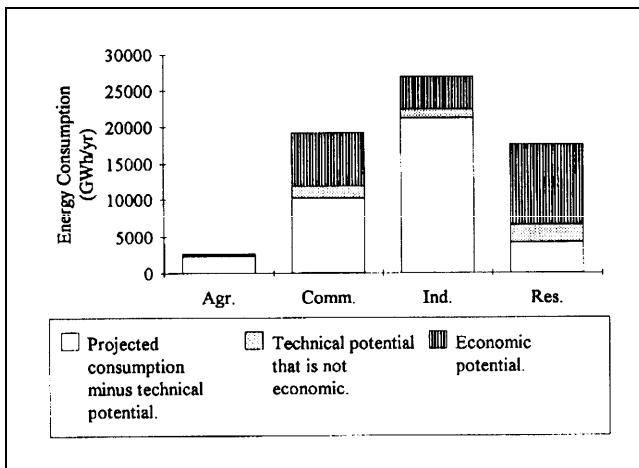


Figure 4. Consumption by Sector

### Potential Energy and Demand Savings by Type of Measure

Figure 6 shows estimated consumption savings potential for three types of measures: conservation, fuel switching, and load management. Figure 7 shows estimated demand savings potential for the three types of measures. In each chart, the top of the "Total" bar represents total projected consumption without realization of any potential savings. Economic potential is the top region of each bar. Technical potential includes the top two regions of each bar.

savings for the three types of measures. In each chart, the top of the "Total" bar represents total projected consumption without realization of any potential savings. Economic potential is the top region of each bar. Technical potential includes the top two regions of each bar.

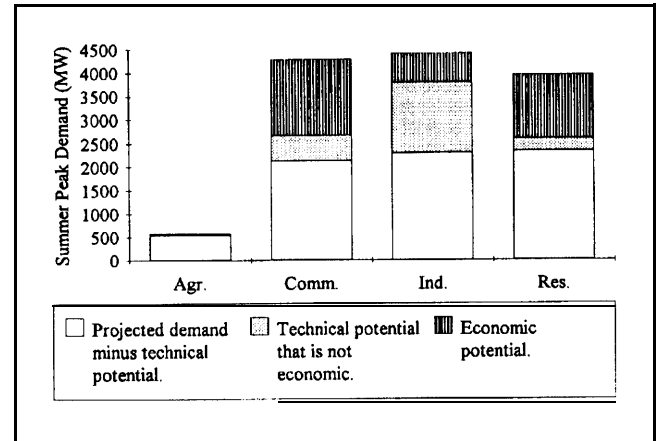


Figure 5. Demand by Sector

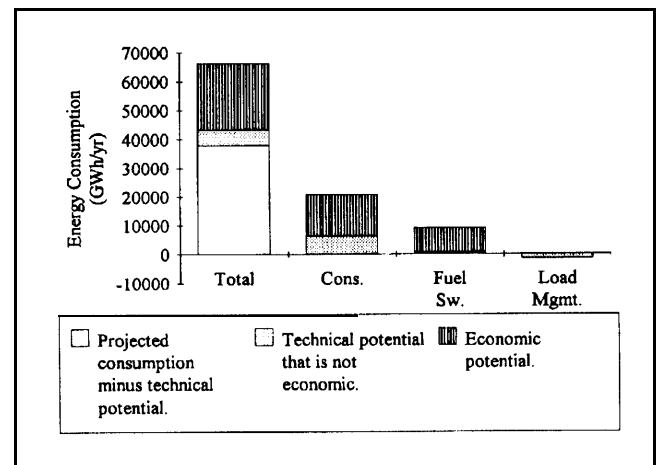


Figure 6. Consumption Savings by Type of Measure

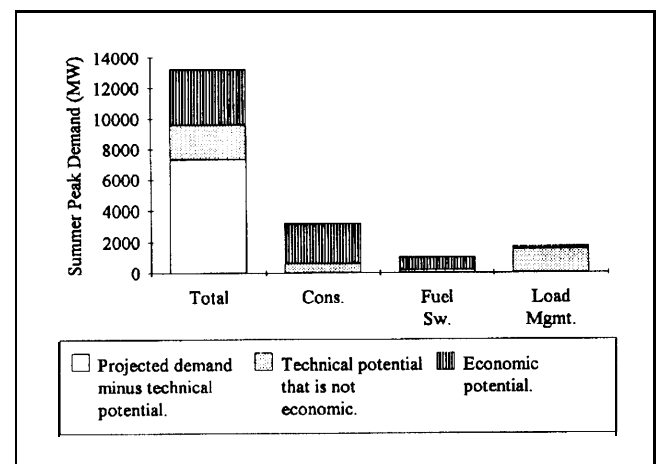


Figure 7. Demand Savings by Type of Measure

## Discussion

The results presented in the preceding section provide only an indication of the kinds of output the STEP model can produce. More significant to individuals not involved in Wisconsin's IRP process are the lessons learned from the collaborative process of developing the model, and the potential applicability of the model elsewhere.

### Issues Raised

Potential calculations using any method are sensitive to a wide variety of factors. Inevitably the process of arriving at a calculation method involves a host of assumptions. The consensus approach used was designed to incorporate a wide range of views, so that the results would be supported by most of the stakeholders.

As with any model, the quality of the results is a function of the quality and completeness of the input data. W-DOD is widely used within Wisconsin for planning purposes, but users recognize that not all of its data are fully up-to-date and that many end uses and technologies are not included. The additional data provided to STEP are subject to similar issues of accuracy and completeness. Because the participating utilities did not have access to some of the information STEP required, some compromises were made to produce timely estimates.

Review of the STEP method and results is likely to result in plans for additional model runs with modified data or assumptions. In most cases where there is debate on the validity of the input data, the model is flexible enough to accommodate required changes. For example, an average inflation rate for equipment cost changes from the base year of W-DOD to the base year of STEP could be incorporated very simply. The model can also be adapted to carry out sensitivity analyses; for example, it has already been used to determine the sensitivity of potential to avoided cost.

Some data changes would require only modest changes to the STEP model, but would involve significant effort to collect the data. For example, the energy and demand savings at the customer meter level now reported by STEP could be adjusted to savings at the power plant using transmission and distribution loss factors.

Similarly, gas main expansion information could be incorporated by changing the natural gas availability factors, if such were available. If an acceptable approximation of the societal cost of gas can be developed, the STEP model could be adapted to include it.

Other data-related issues would require more adaptation of either W-DOD or STEP. For example, the STEP model

focuses on average values for energy and demand savings and costs, neglecting the effects of unusually favorable or unfavorable applications. A possible expansion of the model would be to develop a probabilistic estimate based on high, average, and low values of savings and costs.

Any model for calculating potential will be better at estimating the immediate potential than at projecting savings over a long period. In STEP, simple linear projection was used to estimate potential over the 20 year period of this study, primarily to meet the requirements of the IRP process in Wisconsin. Adapting the model to a shorter timeframe could improve confidence in the results.

### Broader Applicability of the Model

The STEP model exists as a software tool designed to be as flexible as possible. Review of the method and initial results is expected to generate proposed changes in the assumptions and input data to the model. In many cases, these changes will involve changes to only the input data files, while the calculation steps will remain the same. Hence, the model provides a useful tool for policy-makers to test the sensitivity of technical and economic potential to various factors.

The model was, of course, designed to work specifically with W-DOD as its main source of input data. As W-DOD is updated, the model can be run with the new versions. Furthermore, with modest changes to the algorithm or to W-DOD itself, the STEP model could produce other types of results. For example, if potential is required for an individual market segment, building type, or standard industrial classification (SIC) group, the model could be adapted to use corresponding data in the W-DOD.

The STEP model requires a great deal of input data. The calculation of Wisconsin's potential was made easier through the use of the data in W-DOD. To calculate potential in other regions or service territories, similar data would be needed. Some nearby states or utilities could use W-DOD along with economic and forecast data specific to their territory. For more distant locations, the general principles of the STEP algorithm will provide a useful starting point for method development. A comparison of STEP with other methods used elsewhere would be a necessary part of this process, but is beyond the scope of this paper.

## Conclusions

The process of reaching consensus on a method for STEP raised significant issues about both the input data and the assumptions. This highlights the complexity of producing a hard estimate of potential, when, so far at least, a clear,

unambiguous definition of potential does not exist. Although the method and results of STEP will be subject to considerable discussion and review, it represents significant progress. Furthermore, implementation of the model in software offers the opportunity to further refine it as the remaining issues are resolved.

## Acknowledgments

The authors would like to acknowledge the members of the Ad Hoc STEP Committee and the other advisory groups involved in the STEP process. We would also like to thank the other staff members of the Wisconsin Center for Demand-Side Research, whose contributions were invaluable to the project.

## Endnotes

1. A. Faruqui and J. H. Chamberlain, "Barakat & Chamberlin's Approach to DSM Planning," unpublished memorandum.
2. All data described as W-DOD data is from the Wisconsin Demand-side Options Database, an on-line database maintained by the Wisconsin Center for Demand-Side Research, Madison, Wisconsin. The last major revision was in 1991.
3. Population data were provided by Wisconsin's Load Forecasting Task Force.
4. Load growth data were provided by Wisconsin's Load Forecasting Task Force.
5. Savings capture data were provided by Wisconsin's Demand-Side Management Task Force.

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