Synapse
Energy Economics, Inc.

Demand Side Resource Potential

A Review of Global Energy Partners' Report for Midwest ISO

September 3, 2010

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Table of Contents

Introduction

In July 2010, Global Energy Partners (GEP) prepared a draft report[1] that established estimates of savings from demand response (DR) and energy efficiency (EE) resources for a twenty-year horizon, from 2010 through 2030. GEP developed a baseline peak demand and energy forecast from actual 2009 peak load and energy sales data and projected the values of peak demand and energy use twenty years forward. GEP invited comments on its draft report. Synapse Energy Economics, Inc. (Synapse) reviewed the GEP draft report on behalf of the Environmental Law and Policy Center (ELPC) and the Natural Resources Defense Council (NRDC) and wrote this report to support comments provided by ELPC and NRDC to the Midwest ISO (MISO) in conjunction with a MISO Demand Response Working Group meeting on August 30, 2010.

As a starting point, the GEP report assumes that in the first forecast year of 2010, that demand response (DR) accounts for 3.9% of the total baseline peak demand and 0.1% of the baseline energy forecast and EE accounts for 0.5% of total baseline peak demand and 0.5% of the baseline energy forecast. By 2030, the report projects that DR will account for 7.6% of the total peak demand and 0.1% of the baseline energy forecast and EE will account for 9.7% of the peak demand and 10.2% of the baseline energy forecast. GEP assumes, however, that the majority of savings from EE will accrue in the first ten years, with the average annual savings from EE of 1% in the first five years and 0.9% in the second five years, while assuming almost no additional savings from EE in the second decade, as shown in Table 1 below. Besides overall Midwest savings from EE and DR, GEP also developed estimates of savings by region and by program type.

Table 1. Summary of Midwest ISO Energy Savings 2010-2030 (GWh)

	2010	2015	2020	2025	2030
Energy Efficiency Savings (GWh)	2,502	26,211	47,010	54,443	57,774
Demand Response Savings (GWh)	284	354	507	665	831
Total Savings (GWh)	2,786	26,565	47,516	55,109	58,605
Baseline Electricity Forecast (GWh)	465,022	494,767	516,481	539,981	567,096
Total Savings as % of Baseline	0.6%	5.4%	9.2%	10.2%	10.3%
EE Savings as % of Baseline	0.5%	5.3%	9.1%	10.1%	10.2%
Average Annual EE Savings as % of Baseline	-	1.0%	0.9%	0.3%	0.1%
DR Savings as % of Baseline	0.1%	0.1%	0.1%	0.1%	0.1%

GEP developed their estimates of achievable potential of EE and DR, as well as forecasts of peak demand and energy, based on the data from 27 Midwest utilities. Then these estimates were compared to the results from five other studies and reports, which include EPRI (2008), FERC National Assessment of Demand Response, AmarenUE (2010), The Energy Center of

[1] Global Energy Partners. July 2010. "Assessment of Demand Response and Energy Efficiency Potential for Midwest ISO." Draft. Report #1314.

Wisconsin (ECW) study and McKinsey study.[2] The draft GEP report states that its estimates of savings from DR are in line with FERC's Business-as-Usual scenario estimates (4-5.5% savings of the baseline peak demand by 2020) but are more conservative than the Expanded BAU scenario estimates in the same study (10% savings by 2020) and AmarenUE estimates (realistic achievable potential at 10% of baseline peak demand in 2030). With regard to savings from EE, GEP's estimates are consistent with those from the EPRI report (7.5% savings relative to the baseline in 2030) and the AmarenUE study (7.3% savings in 2030), but are lower than those in the McKinsey study (economic potential of 23% in 2020) and the ECW study (realistic achievable potential at 8.9% in 2020).

The discussion that follows reflects our analysis of the GEP draft report as well as our recommendations for some alternative assumptions about EE and DR acquisition rates. We then compare these alternative assumptions to the GEP draft report to estimate future energy consumption and peak demand loads through 2030.

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[2] Electric Power Research Institute (EPRI). 2009. "Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S. (2010-2030): Executive Summary," available at http://mydocs.epri.com/docs/public/000000000001018363.pdf ("EPRI study");

The Federal Energy Regulatory Commission (FERC) Staff. June 2010. "National Action Plan on Demand Response," Docket No. AD09-10, available at http://www.ferc.gov/legal/staff-reports/06-17-10-demand-response.pdf;
AmerenUE. January 2010. "AmerenUE Demand Side Management (DSM) Market Potential Study Volume 2: Market Research. Results from the Saturation, Program Interest and Trade Ally Research," Report Number 1287-2, available at http://oa.mo.gov/purch/bids/b3z10177att2-2.pdf ("AmerenUE study");
The Energy Center of Wisconsin and ACEEE. A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest. A policy white paper in support of the Midwestern Governors Association Energy and Climate Change Platform. August 2009 ("ECW report");
McKinsey&Company. July 2009. "Unlocking Energy Efficiency in the U.S. Economy," available at http://www.mckinsey.com/clientservice/electricpowernaturalgas/downloads/US_energy_efficiency_full_report.pdf ("McKinsey study").

1. Energy Efficiency Potential in the Midwest

There are several assumptions in the GEP draft report that produce overly conservative estimates of EE resource acquisitions through 2030.

A. Pessimistic EE Penetration and Participation Rates: Assumption that EE Acquisition Rates Taper to Near Zero by 2030

i. GEP Scenario

As mentioned above, GEP assumes that EE resource acquisition will consistently decrease after the first five years. The acquisition rate drops to 0.9% in 2015, 0.3 % in 2020, and 0.1% in 2025. The premise for such assumptions is that there is a saturation level that exists for EE acquisition. The actual experience in EE programs has been that EE acquisition can (1) ramp upward for many years and (2) can maintain acquisition rates above 1% for many years. There are several factors that contribute to this[3]:

- There are economies of scale to individual programs that can actually reduce the EE acquisition cost as larger quantities are achieved[4];
- There are interactive effects between program measures that are often not captured in savings estimates;
- There are constant technological improvements that allow more savings per measure and making more measures cost-effective to acquire;
- The avoided cost values to screen measures are usually based on historical costs and do not anticipate future higher costs that will make more measures cost-effective to acquire;
- Major new potential resources, such as net-zero buildings or rooftop solar photovoltaic (PV) systems, are usually not evaluated, but are becoming cost-effective.

Most importantly, studies of EE potential that compare technical potential (all EE measures that would reduce consumption) with economic potential (all EE measures that are cost-effective, meaning the cost of EE being lower than the cost of energy supply) indicate that the economic potential may remain stable over time. ACEEE reported in January of 2010 that a technical/ economic potential study for New York state showed an identical economic potential (25%) for studies done in 1989 and fourteen years later in 2003 (after a decade of New York state programs).[5] One person summed this up by describing EE as "the tree that continually provides low-hanging fruit."

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[3] See *A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest*, a white paper in support of the Midwestern Governors Association's Energy and Climate Change Platform prepared by the Energy Center of Wisconsin and the American Council for an Energy Efficient Economy, August 2009 (ECW Report).

[4] Economies of scale were observed for energy efficiency programs in a study conducted by Synapse Energy Economics titled "Costs and Benefits of Electric Utility Energy Efficiency in Massachusetts," prepared for Northeast Energy Efficiency Council. (Available at http://www.synapse-energy.com/Downloads/SynapseReport.2008-08.0.MA-Electric-Utility-Energy-Efficiency.08-075.pdf).

[5] Nadel presentation at January 2010, MEEA conference.

Some examples of new savings opportunities from emerging technologies and practices that are not addressed by most current efficiency programs and potential studies are:

- *LED lighting*: LED lighting uses significantly less energy than fluorescent lighting and lasts much longer than CFLs (e.g., 40,000 hours for LED vs. 8,000 hours for CFL).[6] A recent energy efficiency potential study by the National Academy of Science estimated that replacing all lamps with CFLs would save lighting energy by 32%. Eventually replacing all lamps with LEDs would save lighting energy use by nearly 70% relative to the current levels.[7]
- *Heat pump and AC*: U.S. heat pumps and AC systems can be significantly more efficient using variable speed compressors such as DC inverters. One estimate provided by Daikin is 30% energy savings.[8] Most residential and commercial HVAC equipment in the U.S. operates in a binary (on or off) mode, but variable speed inverter technologies allow HVAC units to change their output in response to load and to save energy significantly.[9]
- *Net zero energy buildings*: new buildings that apply passive solar designs and significant amount of insulation can reduce both heating and cooling dramatically. New houses built in Massachusetts demonstrated that houses can be net zero energy consumers with PV. Sites without PV can reduce energy consumption from HVAC by more than 60% to 90%.[10]

We cannot support the draft report assumption of major savings from EE in the first decade and nearly no additional savings in the second decade. The savings goals established by several MISO states and the actual experience of states with EE programs is that incremental cost-effective savings from EE will continue to accrue after 2020. These savings will come from new emerging technologies and technological improvements and from economies of scale as more EE measures are installed.

ii. Modified GEP Scenario

To demonstrate the significance of GEP's assumptions about diminishing EE resources, we adapted GEP's results to an assumption of a constant 1% annual EE resource. Our new results show the cumulative savings from holding the 1% acquisition rate constant after 2015. Total savings from EE increase from 58,605 GWH to, 97,338 GWH in 2030. Total energy consumption in 2030 would decrease from 509,322 GWH to 469,758 GWH. Figure 1 below shows baseline energy forecast, GEP projection of energy sales net EE ("GEP Scenario"), and projected energy sales net EE if incremental annual savings from EE are held constant at 1% ("GEP Scenario with

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[6] Efficiency Vermont 2010. Led Eligible Products List for Commercial and Residential, available at http://www.efficiencyvermont.com/stella/filelib/LED_EligibleProductsList_Commercial_2010.pdf and http://www.efficiencyvermont.com/stella/filelib/LED_EligibleProductsList_Residential_2010.pdf

[7] National Academy of Sciences, National Academy of Engineering, and National Research Council (NAS et al.) 2009. "Real Prospects for Energy Efficiency in the United States," America's Energy Future Energy Efficiency Technologies Subcommittee; National Academy of Sciences; National Academy of Engineering; National Research Council, available at http://www.nap.edu/catalog/12621.html

[8] Daikin. 2010. "Understanding HVAC Efficiency Opportunities with Inverter Technology," presented at ACEEE Market Transformation Symposium in Washington DC, March 18, 2010.

[9] Synapse

[10] http://www.zechallenge.com

Fixed Incremental Savings”). As can be seen from Figure 1, such a modification to the GEP scenario results in nearly flat energy consumption.

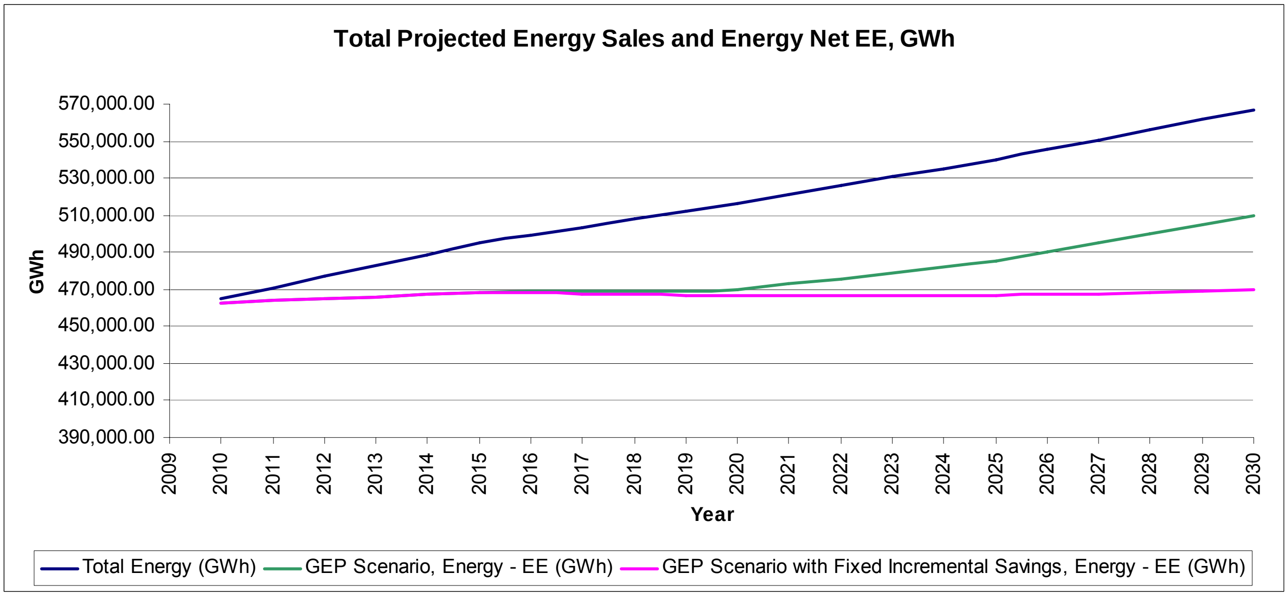

Figure 1. Projections of Energy Sales in "GEP Scenario" and "GEP Scenario with Fixed Incremental Savings"

B. Alternative Scenarios of EE Impact on Energy Consumption

i. States' Average EE Potential Scenario

Given current states' EE goals and achieved EE savings to date, we consider GEP's estimate of 10.3% total energy reduction by 2030 from EE to be an underestimation of the realistic achievable EE potential in the Midwest. The recent ECW study in support of the Midwestern Governors Association (MGA) Energy and Climate Change Platform[11] provides a review of EE potential studies in the Midwest and other regions. The study investigated annual achievable energy efficiency potential based on a total of twenty-two state, regional, and national studies. Figure 2 shows the annual EE percentage for those studies including the studies for Wisconsin, Iowa, and Kansas. Based on the estimates of EE potential in the studies summarized in the ECW study, Synapse determined an average annual achievable savings of about 1.4% per year.[12]

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[11] Energy Security and Climate Stewardship Platform for the Midwest 2007. Midwestern Governor Association. Available at http://www.midwesterngovernors.org/Publications/MGA_Platform2WebVersion.pdf. MGA set a target of at least 2 percent of regional annual retail sales of electricity through energy efficiency improvement by 2015, and additional 2 percent in efficiency improvements every year thereafter.

[12] As reported in Synapse Energy Economics report “Beyond Business as Usual: Investigating a Future without Coal and Nuclear Power in the U.S.”, May 2010, pp. 60-61.

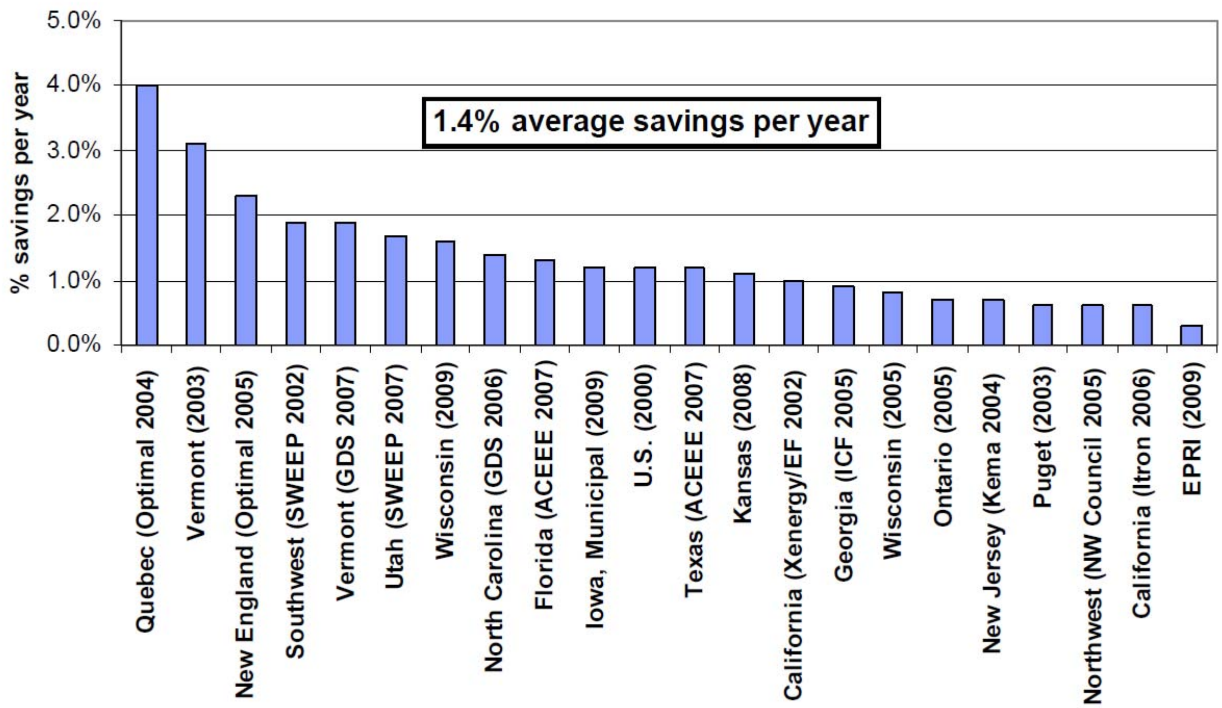

Figure 2. EE Potential by Study[13]

ACEEE developed a summary of state goals in June 2010. That summary shows that twenty states, including the Midwest states of Illinois, Minnesota, Iowa, Indiana, Ohio, and Michigan, all project total energy reductions form EE acquisition to be 10% or higher by 2020 (not 2030 as in the GEP study). Those estimates for EE potential in individual states (MISO and non-MISO) through 2020 are presented in Table 2.

[13] Source: Synapse Energy Economics report "Beyond Business as Usual: Investigating a Future without Coal and Nuclear Power in the U.S."

Table 2. 2020 Cumulative Electricity Savings Targets by State[14]

State	EE Savings, % of Energy	State	EE Savings, % of Energy
Vermont	30	***Indiana***	***14***
New York	26	Rhode Island	14
Massachusetts	26	Hawaii	14
Maryland	25	California	13
Delaware	25	***Ohio***	***12***
Illinois	***18***	Colorado	12
Connecticut	18	Utah	11
Minnesota	***17***	***Michigan***	***11***
Iowa	***16***	Pennsylvania	10
Arizona	15	Washington	10

As an alternative to the EE acquisition rates in the GEP report, we used the average annual savings EE rate of 1.4% ("States' Average EE Potential Scenario") derived from the ECW study. We believe this is a reasonable assumption given the recently established goals of several Midwestern states to meet or exceed this rate by 2020. This 1.4% scenario uses the same initial assumptions for 2010-2015 as those used in the GEP report (energy sales forecast and incremental annual savings from EE) but modifies the assumptions for the rest of the analyzed period, 2015-2030, to a constant 1.4%.[15]

Our modification uses gradual annual increases in the savings rate from 1% in 2015 to 1.4% in 2020 and then we fix the annual savings from EE at a constant 1.4% rate for the remainder of the study period. Then, we calculate annual savings from EE in GWH as a product of the current year savings rate and the previous year actual energy consumption (adjusted for EE).[16] Figure 3, below, shows a graphic comparison of this analysis to the GEP draft report and our modified GEP scenario of a constant 1%.

[14] ACEEE. June 2010. Presentation "Energy Efficiency Opportunities and Policies 101," by Steven Nadel, executive director of ACEEE, slide 28

[15] Because the draft report only provides forecasts and savings estimates in five-year blocks (not annual values), we extrapolate annual values of the energy and peak load forecasts and the annual savings based on the average growth rate within each five-year block.

[16] The GEP draft report does not specify whether the calculated savings are based on a percentage of the prior year or as a percentage of the 2009 base case. We recommend using the previous year's energy consumption for applying the annual EE acquisition rate because it is more dynamic (higher or lower) than using a static 2009 energy consumption value. We used a dynamic baseline (prior year estimated consumption) for our estimates of energy and peak load in all of our analyses in this report

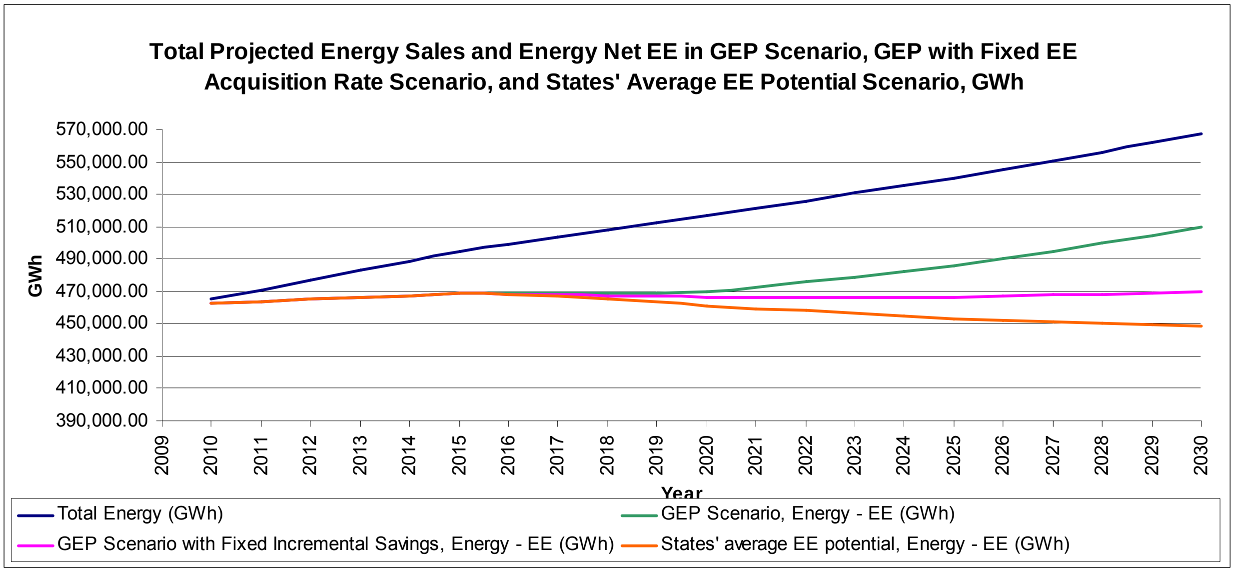

Figure 3. Projection of Energy Sales in 3 Scenarios

This alternative scenario with incremental annual savings from EE increasing over time to the level of 1.4%, "States' Average EE Potential Scenario", produces total cumulative savings from EE in 2030 of 118,740 GWH, compared to 58,605 GWH in the "GEP Scenario" (more than double) and significantly more (20%) than the 97,338 GWH in the "GEP Scenario with Fixed Incremental Savings." These cumulative savings result in the actual energy consumed in 2030 equal to 448,356 GWH, as opposed to 509,322 GWH in the "GEP Scenario." The 448,356 GWH estimate for 2030 is less than the 2010 load of ~468,000 GWH. It also is lower than the 469,758 GWH in the "GEP Scenario with Fixed Incremental Savings". Figure 3 above shows a baseline energy forecast, GEP projection of energy sales net EE ("GEP Scenario"), projected energy sales net EE if incremental annual savings from EE are held constant at 1% ("GEP Scenario with Fixed Incremental Savings"), and projected energy sales in our first alternative scenario ("States' Average EE Potential Scenario"). As can be seen from Figure 3, our alternative scenario results in decreasing energy consumption starting in 2016.

ii. Best Practices Average of 2.0%

Given existing conservatism and biases in the studies on EE potential in the Midwest, the ECW study concluded that the Midwest Governors Association goal of meeting 2 percent of the Midwest's annual retail sales of electricity through EE by 2015 is realistic. We support this view and believe that 2 percent is a more appropriate estimate of EE potential over the long term based on a "Best Practices" standard. This value of achievable energy efficiency potential is also supported by the recent report for the Massachusetts Energy Efficiency Advisory Council from

June 2009,[17] which suggests that a reasonable long-term value for all available cost-effective energy efficiency savings is at least 2.5 percent per year over a ten-year horizon. The validity of a 2 percent target is also confirmed by the "best practices", or the highest recent achieved efficiency savings levels, in the EE leading states and utilities, as shown in Table 3 below. Importantly, the numbers for EE savings in the table only reflect savings from utility programs, and do not include any additional savings that accrue from updated building codes and appliance standards.

Table 3. Achieved Efficiency Savings for Selected Entities' Efficiency Programs[18]

Entity	Annual Savings (%)	Year(s)	Source
Interstate Power & Light (MN)	2.6	2006	Garvey, E. 2007. "Minnesota's Demand Efficiency Program"
Efficiency Vermont (VT)	2.5	2008	Efficiency Vermont 2009. 2008 Highlights
Massachusetts Electric Co. (MA)	2.0	2006	EIA 861
Pacific Gas & Electric (CA)	1.9	2008	CPUC 2009. Energy Efficiency Verification Reports issued on February 5, 2009 and October 15, 2009
Minnesota Power (MN)	1.9	2005	Garvey, E. 2007. "Minnesota's Demand Efficiency Program"
Puget Sound Energy (WA)	1.4	2007	Northwest Power and Conservation Council
Connecticut IOUs (CT)	1.3	2006	CT Energy Conservation Management Board (ECMB). 2007
Pacific Corp (ID & WA)	1.3	2007	Northwest Power and Conservation Council
Energy Trust of Oregon (OR)	1.3	2005	Northwest Power and Conservation Council
Southern California Edison (CA)	1.2	2008	CPUC 2009
Avista Corp (ID, WA, MT)	1.1	2005	Northwest Power and Conservation Council
Idaho Power Co (ID)	1.1	2007	Northwest Power and Conservation Council
San Diego Gas & Electric (CA)	1.1	2008	CPUC 2009
PUD No 1 of Snohomish (WA)	1.0	2007	Northwest Power and Conservation Council
Otter Trail (MN)	0.9	2005	Garvey, E. 2007. "Minnesota's Demand Efficiency Program"
Seattle City Light (WA)	0.9	2007	Northwest Power and Conservation Council
MidAmerican (IA)	0.9	2008	Iowa Utilities Board 2006

Many MISO states are considering or implementing new programs to expand investment in energy efficiency resources. Twenty-four states nation-wide have established state Energy Efficiency Resource Standards (EERS) and goals, resulting in implied annual electricity savings, as a percentage of total forecast load, from 0.4% (North Carolina) to 3.3% (Maryland), targeted at

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[17] Assessment of All Available Cost-Effective Electric and Gas Savings: Energy Efficiency and CHP. Submitted to the MA EEAC by Consultants. June 19, 2009 (Draft). Available at http://www.ma-eeac.org/docs/090623-Assessment.pdf.

[18] Source: Synapse Energy Economics. May 2010 "Beyond Business as Usual: Investigating a Future without Coal and Nuclear Power in the U.S."

different years between 2010 and 2025.[19] In 2006, eighteen states attained annual electricity savings from efficiency programs that met or exceeded the national achievable potential of 0.4%. Three states – Rhode Island, Vermont, and Connecticut – implemented programs in 2006 that reduced electricity consumption that year by 1.1 to 1.2%. In 2007, Connecticut and Vermont achieved incremental savings from their EE programs of 1.3% and 1.8% of total energy sales, respectively.[20]

Given the peak load and energy consumption achievements and state EE goals to date by leading states and utilities, it is likely that MISO states, over a twenty-year planning horizon, can realize similar reductions. The potential exists for expanded energy efficiency programs to fully offset peak demand and energy consumption growth rates in the MISO footprint, leading to flat peak demand and energy growth over the 10-20 year horizon.

Based on our investigation of energy efficiency potential in the Midwest, coupled with the MGA's target, we recommend 2 percent per year for the achievable cost-effective electric energy efficiency annual savings over the 10-20 year horizon. We developed another alternative scenario of EE impact, "Best Practices Scenario", based on this recommendation as a realistic aggressive EE scenario. In this scenario, we used the same methodology as "GEP Fixed" with the exception of increasing the annual EE acquisition rate to 2.0% (instead of the 1.4 %) in 2020 and holding that 2% rate constant through 2030. This "Best Practices Scenario", produces total cumulative savings from EE in 2030 of150,347 GWH, compared to 58,605 in the "GEP Scenario GWH in the "States' Average EE Potential Scenario" (or almost three times the cumulative savings as the GEP analysis). It also exceeds the 118,740 GWH in the "Sates Average" scenario and the 97,338 GWH in the "GEP Scenario with Fixed Incremental Savings." These cumulative savings result in the actual energy consumed in 2030 equal to 416,749 GWH, as opposed to 448,356 GWH in the "States' Average EE Potential Scenario", 469,758 GWH in the "GEP Scenario with Fixed Incremental Savings", and 509,322 GWH in the "GEP Scenario". Figure 4 below shows baseline energy forecast and projections of energy sales net EE in two GEP scenarios and two proposed alternative scenarios. Figure 4 illustrates that the "Best Practices Scenario" results in an even faster declining energy consumption starting in 2016 than the "States' Average EE Potential Scenario".

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[19] ACEEE, Laying the Foundation for Implementing a Federal Energy Efficiency Standard, March 2009, report No. E091

[20] The Energy Center of Wisconsin and ACEEE. A Review and Analysis of Existing Studies of the Energy Efficiency Resource Potential in the Midwest. A policy white paper in support of the Midwestern Governors Association Energy and Climate Change Platform. August 2009.

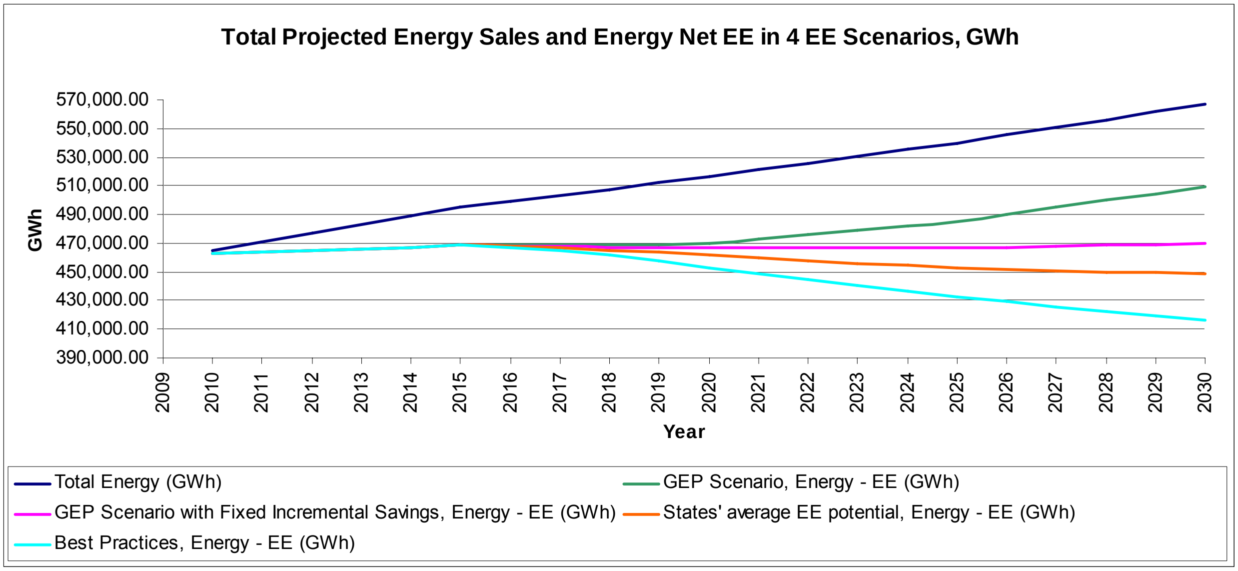

Figure 4. Projections of Energy Sales in 4 Scenarios

iii. EE Impact on Peak Load Forecast

In a similar manner to the scenarios of EE impact on energy consumption, we develop 4 scenarios of EE impact on peak load: 2 GEP scenarios (original "GEP Scenario" and "GEP Scenario with Fixed Incremental Savings") and 2 alternative scenarios ("States' Average EE Potential Scenario" and "Best Practices Scenario"). We again use GEP's peak load forecasts and apply the same assumptions about EE penetration as in the four above mentioned scenarios. In order to calculate the annual peak load savings in the two alternative scenarios, we found a "kW savings per MWh savings" ratio based on the GEP savings numbers (i.e., approximately 0.19 kW/MWh savings) and applied this ratio to the energy savings estimates we developed for the alternative scenarios. More specifically, we converted GWH energy savings from EE in all three scenarios we developed ("GEP with Fixed Savings" the "States' Average EE Potential Scenario" and "Best Practices Scenario") into MW peak load savings from EE.[21] Figure 5 below illustrates GEP projected peak load and projected peak load net EE in 4 scenarios. We find that if GEP keeps EE penetration rate constant at 1%, cumulative savings from EE will raise to 19,373 MW from 11,233 MW (in "GEP Scenario"), and net peak load forecast will drop from 104,932 MW to 96,792 MW. In the "States' Average EE Potential Scenario" and "Best Practices Scenario" cumulative savings from EE raise even higher, to 23,392 MW and 29,618 MW, respectively. These cumulative savings result in the net peak demand of 92,773 MW and 86,547 MW.

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[21] We use a "kW savings per MWh savings" ratio of 0.197 kW/MWh, which is close to the average of annual "kW savings per MWh savings" ratios. We calculated the peak loads based on GEP's numbers. "kW savings per MWh savings" ratios used in the GEP study are in line with the ratios used in the other studies. The values of kW to MWh savings ratio in the existing studies range from 0.05 to 0.27 kW/MWh, with the median of 0.16 and the average 0.13 kW/MWh. Therefore, we consider GEP's estimated to be reasonable and use the average "kW savings per MWh savings" to extrapolate MW peak savings in the scenarios of peak load reductions from EE.

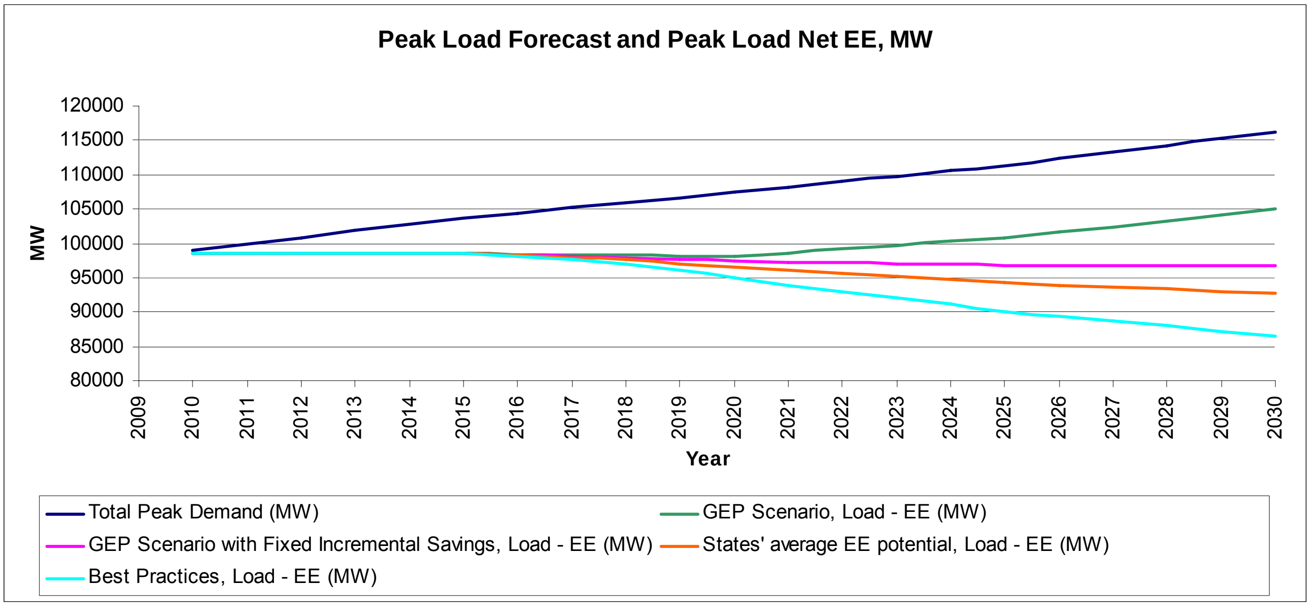

Figure 5. Projections of Peak Demand Forecast in 4 Scenarios

The graph above is consistent with an ACEEE (2009) report[22] that shows five MISO states have established energy efficiency goals leading to the implied annual peak load savings in the range of 1-2 percent of total forecast load by different target dates between 2010 and 2019.[23]

C. Using the EPRI Technical Study as a Benchmark

One of the studies that GEP relies upon in developing its estimates is the EPRI Technical study (January 2009). The EPRI report estimates the maximum impact of energy efficiency programs for the entire U.S. as 0.68% to 1.07% per year for energy consumption and a peak demand growth rate as between 0.53% to 1.5% per year for peak load growth.

The EPRI analysis included assumptions about a declining EE resource over time. EPRI's estimated achievable potential for EE between 5% and 10% of total sales in 2020, or between 0.40% and 0.85% per year in total load reductions from the base load forecast. We believe these estimates significantly understate EE potential for electricity savings. EPRI makes a set of assumptions that are too conservative. Similar to the conservative biases in the EE studies pointed out by the ECW study, the EPRI study also doesn't take into account new codes and efficiency standards, new technologies and improvements in existing technologies. The study doesn't go far beyond the programs that are already commercialized or cost-effective; it also doesn't assume early replacement of existing technologies before the end of their useful life, even if it is economically justified. In addition, the EPRI study does not include some of the current best

[22] ACEEE, Laying the Foundation for Implementing a Federal Energy Efficiency Standard, March 2009, report No. E091

[23] Minnesota – implied annual peak load savings of 1.5% of total forecast load by 2010; Illinois – 2% by 2015; Ohio – 2% by 2019; Michigan – 1% by 2012; Iowa – 1.5% by 2010.

practices. For example, while EPRI estimates the maximum achievable potential of 0.85% per year, Vermont Efficiency already reduced its energy use by 2% of sales from programs existing in 2008.[24] The EPRI report also assumes flat electricity real prices between 2008 and 2030, which in fact have been climbing significantly. Accounting for an increase in electricity prices would increase estimates of the quantity of achievable cost-effective EE potential.

ACEEE concluded that the EPRI "maximum" scenario was actually a "realistic" scenario that remained flawed due to the saturation level assumed in 2020 (for all scenarios). Below is one of the key graphs from the EPRI study that shows projections of energy consumption under the "Baseline", "AEO2008", "Realistic Achievable" and "Maximum Achievable" scenarios (and the sharp kink, or saturation point, in 2020). We agree with the ACEEE conclusion that EPRI's Maximum Achievable Scenario is actually representative of the quantities of EE in a "realistic achievable" scenario for the measures included in the study.

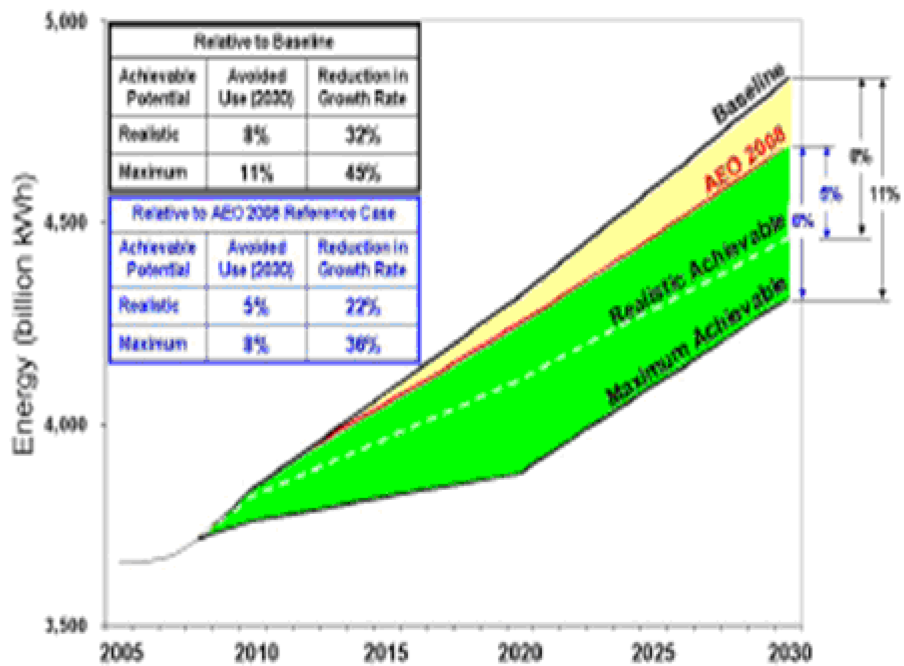

Figure 6. U.S. Energy Efficiency Achievable Potential, EPRI Study

The EPRI Study also shows that the Midwest has the lowest projected annual growth rate of electricity consumption of 0.7%, *before* subtracting potential savings from energy efficiency. Therefore, Midwest states, on average, need lower energy efficiency savings to offset peak demand and energy consumption growth rates.

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[24] See Joint Comments of the American Council for an Energy Efficient Economy, the Alliance to Save Energy, the Natural Resources Defense Council and Energy Center of Wisconsin on the January 2009 Report: "Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S." issued by EPRI

2. Demand Response potential

A. Expansion of Demand Response Participation in Energy Markets

The GEP draft report projected that DR in the Midwest ISO increases from 3.9% in 2020 to 7.6% of the baseline peak demand forecast by 2020, and remains at the same level through 2030 in terms of the percentage of the forecast. (See Table 4 below.)

Table 4. GEP's Demand Response Resource Estimates for Midwest ISO[25]

	2010	2015	2020	2025	2030
West Region:					
DR Savings (MW)	1,793	2,525	3,268	3,423	3,602
Baseline Peak Demand Forecast (MW)	32,098	32,659	33,071	33,515	33,861
Savings as % of Baseline	5.60%	7.70%	9.90%	10.20%	10.60%
Central Region:					
DR Savings (MW)	836	1,509	2,291	2,379	2,506
Baseline Peak Demand Forecast (MW)	32,018	32,669	33,127	33,074	33,095
Savings as % of Baseline	2.60%	4.60%	6.90%	7.20%	7.60%
East Region:					
DR Savings (MW)	1,251	1,906	2,580	2,637	2,703
Baseline Peak Demand Forecast (MW)	34,848	35,247	35,406	35,427	35,427
Savings as % of Baseline	3.60%	5.40%	7.30%	7.40%	7.60%
MISO Total:					
DR Savings (MW)	3,880	5,940	8,139	8,439	8,811
Baseline Peak Demand Forecast (MW)	98,963	103,716	107,382	111,390	116,165
Savings as % of Baseline	3.9%	5.7%	7.6%	7.6%	7.6%

This DR potential appears overly conservative based on a number of DR potential studies for regions across the nation. For example, the FERC study on demand response potentials published in 2009 estimated regional DR potentials in 2019[26] and found that the Northwest

[25] Based on Table ES-1-1 and ES-1-4 of GEP 2010 study.
[26] FERC 2009. A National Assessment of Demand Response Potential

Central region has about 5% DR potential under the BAU scenario, about 9.5% DR potential under the expanded BAU scenario, and about 14.5% DR potential under the Achievable Participation scenario. Given that DR will be playing a greater role in managing peak demand in the future, a GEP's estimate that is below FERC's estimate under the Expanded BAU may be overly conservative.[27]

In addition, there are various studies that have estimated higher DR potentials. Figure 7 below provides a comparison of such studies. As can be seen in the graph, GEP's estimate on DR potential is the lowest except for FERC's DR potential under its BAU scenario. Based on this review, we propose that MISO include DR penetration at about 8% in 2020 and increase it to 12% by 2030.

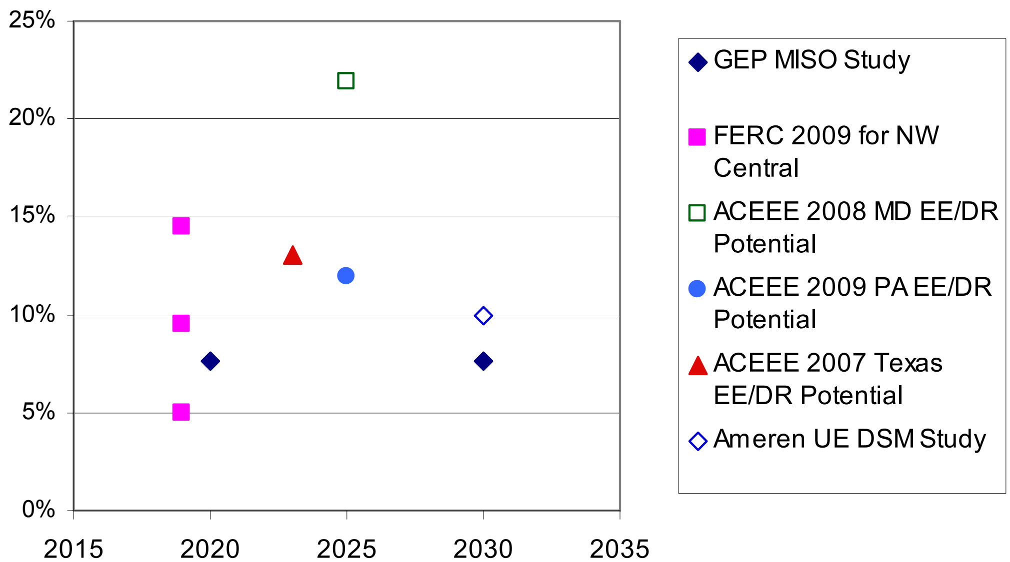

Figure 7. Summary of DR Potential Studies (% of Forecasted Peak Demand)[28]

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[27] According to FERC 2009, the Expanded BAU scenario is "the Business-as-Usual scenario with the following additions: 1) the current mix of demand response programs is expanded to all states, with higher levels of participation ("best practices" participation levels); 2) partial deployment of advanced metering infrastructure; and 3) the availability of dynamic pricing to customers, with a small number of customers (5 percent) choosing dynamic pricing." (page xi)

[28] GEP 2010; FERC 2009; xx organization 2010. AmerenUE DSM Potential Assessment; ACEEE et al. 2009. Potential for Energy Efficiency, Demand Response, and Onsite Solar Energy in Pennsylvania; ACEEE 2008. Energy Efficiency: The First Fuel for a Clean Energy Future: Resources for Meeting Maryland's Electricity Needs; ACEEE 2007. Potential for Energy Efficiency, Demand Response, and Onsite Renewable Energy to Meet Texas's Growing Electricity Needs

i. Retail Smart Grid Meters

There has been much industry discussion about the deployment of retail “smart meters” that could provide individual customers with the ability to interrupt and/or pre-program electricity consumption to either avoid high-cost periods or receive direct compensation for their reduced consumption. States are just beginning to address the myriad issues associated with smart meter deployment. Whatever programs are ultimately established, they will provide additional opportunities to adjust loads based on market signals that should lead to less volatility in demand and prices. Overall system utilization rates may actually reverse the trend of continual decline over the last few decades once retail customers start participating in load modification programs on a large scale.

3. Distributed Generation Potential

Although the GEP draft report did not address specific technologies that customers may develop to reduce grid-delivered electricity, some discussion is warranted to round out the estimates of future energy and peak load consumption to be considered in transmission planning.

A. Photovoltaics

Solar power is the most ubiquitous renewable resource in the country. It is also one of the largest renewable energy resources in the country.[29] Solar photovoltaic (PV) is the most popular form of power generation technology utilizing sunlight. PV is modular and is often installed on residential and commercial rooftops, and provides electricity to the buildings. But PV can also be aggregated as a utility PV plant and can remotely generate electricity from buildings.

To date, the United States has installed about 2,100 MW of PV, while Germany (a country that has much lower quantities of available solar radiation) installed a total of 9,677 MW of PV to date.[30] Comparatively, Germany receives about 1100 to 1200 kWh/m2/year of solar radiation and the majority of the U.S. (including the Midwest) receives at least 1500 to 1600 kWh/m2/year of solar radiation. This is one indicator that the U.S. could increase solar PV capacity dramatically in the coming decades.

Another reason for increasing estimates of PV capacity is the decreasing cost of PV. According to U.S. DOE's estimates, the installed cost of PV currently ranges from $4 to $5 per Watt for residential and commercial rooftop systems and from $3.2 to $3.5 per Watt for utility scale PV systems.[31] Furthermore, U.S. DOE and the California Energy Commission are predicting that the cost of PV will drop in half by 2020, making solar PV one of the lowest cost new generating resources.[32]

B. Combined Heat and Power

CHP is one form of distributed generation that can generate power and thermal energy at or near customer facilities to provide onsite energy needs. CHP utilizes energy normally wasted in central power generation (dissipated to the atmosphere) to produce electricity as well as heating and cooling. CHP can increase the rate of utilization of primary energy from 30-40% (for a central power plant) to as high as 80%. CHP provides electricity, space heating, process heating and even cooling services, and can be used for various applications in the residential, commercial and industrial sectors.

CHP consists of a prime mover (heat engine), generator, heat recovery, and electrical interconnection. Prime movers include various technologies such as reciprocating engines,

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[29] US DOE states that "the amount of solar energy falling on the United States in one hour of noontime summer sun is about equal to the annual U.S. electricity demand." US DOE 2010. Solar Vision Study – DRAFT – May 28, 2010, available at http://www1.eere.energy.gov/solar/vision_study.html

[30] Solar Energy Industries Association (SEIA) 2010. US Solar Industry year in Review 2009, available at http://www.seia.org/cs/about_solar_energy/industry_data

[31] US DOE 2010, Chapter 4, page 7.

[32] US DOE 2010; California Energy Commission 2010. Comparative Costs of California Central Station Electricity Generation , January 2010

combustion turbines, steam turbines, micro turbine, and fuel cells. These prime movers can burn a variety of fuels such as natural gas, coal, oil, and biomass.

CHP has been playing a significant role in the U.S. economy. According to Energy and Environmental Analysis/ICF, 13 states that are ranked 4 to 5 (5 is the highest) by ACEEE in 2009 in terms of having progressive CHP regulations and policies have installed a total of 50,000 MW of CHP systems to date (Table 5 below).[33] Among them, Indiana, Wisconsin, Illinois, and Ohio are included and have installed a total of about 5,800 MW to date.

Table 5. CHP Installed to Date by CHP Leading States (MW)

State	Installed Capacity
TX	16,829
CA	9,249
NY	5,837
NJ	3,441
PA	3,253
OR	2,535
IN	2,308
MA	1,908
WI	1,521
IL	1,308
ME	1,131
CT	674
OH	665
Total	50,659

Despite this significant penetration of CHP, past studies have shown that there are still tremendous amounts of CHP potential in the U.S. A national CHP potential study was conducted by Onsite Sycom Energy in 2000 (Onsite 2000) and assessed the technical potential of CHP in existing commercial buildings.[34] An Onsite 2000 study found that the four Midwestern states with leading CHP policies in the nation (selected in Table 5 above) have a total of 8,760 MW in technical potential of CHP.

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[33] Energy and Environmental Analysis Inc./ICF. "Combined Heat and Power Installation Database" available at http://www.eea-inc.com/chpdata/index.html

[34] ONSITE SYCOM Energy Corporation. 2000. The Market and Technical Potential for Combined Heat and Power in the Commercial/Institutional Sector

4. Summary

GEP has provided a useful analysis of existing Midwest utility programs that acquire EE and DR resources. GEP describes the impact of these resources on future energy consumptions and peak loads in a manner that provides useful tools for Midwest planning authorities.

GEP's analysis can be improved through the adoption of more realistic estimates of EE and DR potential based on actual program experiences in specific states as well as statutory and policy-based initiatives among the Midwest states to provide a range of possible future energy consumption and peak loads. We have provided several graphs that demonstrate this range of future demands on the electric system.

In addition, Federal policies and regulatory initiatives should also be incorporated into estimates of future energy consumptions and peak loads. These include FERC Orders and Rules on DR and Transmission expansion, EPA regulations, and Federal/State carbon reduction goals.

Finally, more analysis of new technologies, particularly small-scale generation options and smart meters, is necessary to estimate future implementation rates of these new technologies.