

ASSESSMENT OF DEMAND RESPONSE AND ENERGY EFFICIENCY POTENTIAL FOR MIDWEST ISO

Draft

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EXECUTIVE SUMMARY

The Midwest ISO models future transmission capacity needs. As part of this effort, it needs 20-year load forecasts that account for demand response (DR) and energy efficiency (EE) activities in the Midwest ISO region and for the Eastern Interconnection. In the past, the Midwest ISO assumed a reduction in sales and peak of 1% per year to approximate savings from DR and EE programs. In light of all the DR and EE activity taking place across the nation, Midwest ISO initiated this study to develop better and defensible estimates of EE and DR for their forecast.

This study develops estimates of DR and EE savings using program information obtained from utilities within the Midwest ISO region. The study uses this information to develop projections of DR and EE savings by program type and according to the taxonomy used to describe resources in the EGEAS model, which the Midwest ISO currently uses for transmission planning studies.

RESULTS FOR MIDWEST ISO

As part of this study, we developed baseline peak demand and electricity use forecasts that do not include any future DR or EE. The base year for the study is 2009, 2010 is the first forecast year, and 2030 is the last year of the forecast. The baseline peak demand forecast increases from 98,963 MW in 2010 to 116,165 MW in 2030, an average growth rate of 0.8% per year. The baseline electricity use forecast increases from 465,022 GWh in 2010 to 567,096 GWh in 2030, an average growth rate of 1.0% per year.

Peak Demand Savings

In 2010, the first forecast year, the peak demand savings from DR and EE programs combined within the Midwest ISO is 4,372 MW. This represents 4.4% of the total peak baseline forecast.

- Demand response accounts for 3,879 MW of the savings, which represents 3.9% of the total baseline peak demand.
- Energy efficiency accounts for 493 MW of the savings, which is 0.5% of the total baseline peak demand.

By 2030, the peak demand savings from DR programs and the cumulative effect of EE programs is expected to exceed 20,000 MW. This represents over 17% of the baseline peak demand forecast.

- Demand response accounts for 8,811 MW, 7.6% of the total.
- Energy efficiency accounts for 11,233 MW, 9.7% of the total.
- The savings from DR and EE combined more than offset the growth in peak demand between 2010 and 2030.

Table ES-1-1 and Figure ES-1-1 present the baseline peak demand forecast and savings estimates for selected forecast years. Figure ES-2 presents the baseline peak demand forecast together with the resulting forecasts after DR and EE savings are accounted for.

Table ES-1-1 Summary of Midwest ISO Peak Demand Forecast and Program Savings 2010-2030

	2010	2015	2020	2025	2030
Demand Response Savings (MW)	3,879	5,939	8,139	8,439	8,811
Energy Efficiency Savings (MW)	493	5,213	9,285	10,625	11,233
Total Savings (MW)	4,372	11,152	17,424	19,064	20,044
Baseline Peak Demand Forecast (MW)	98,963	103,716	107,382	111,390	116,165
Total Savings as % of Baseline	4.4%	10.8%	16.2%	17.1%	17.3%

Figure ES-1-1 Midwest ISO Peak Demand Savings 2010-2030 (MW)

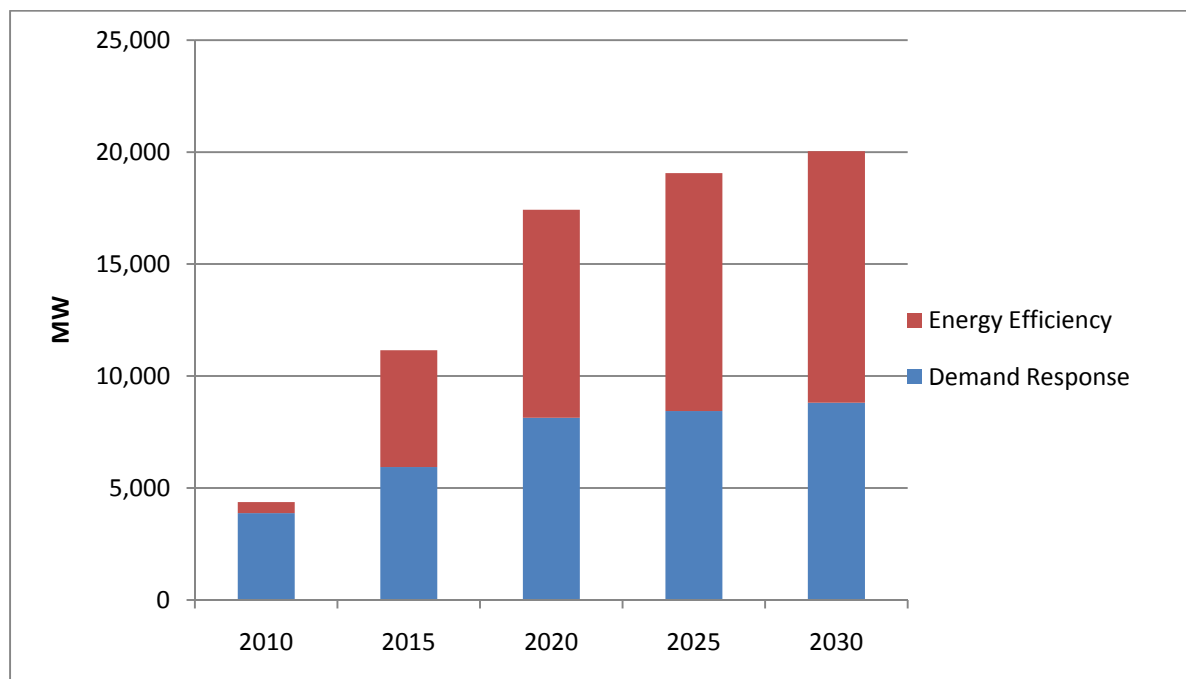
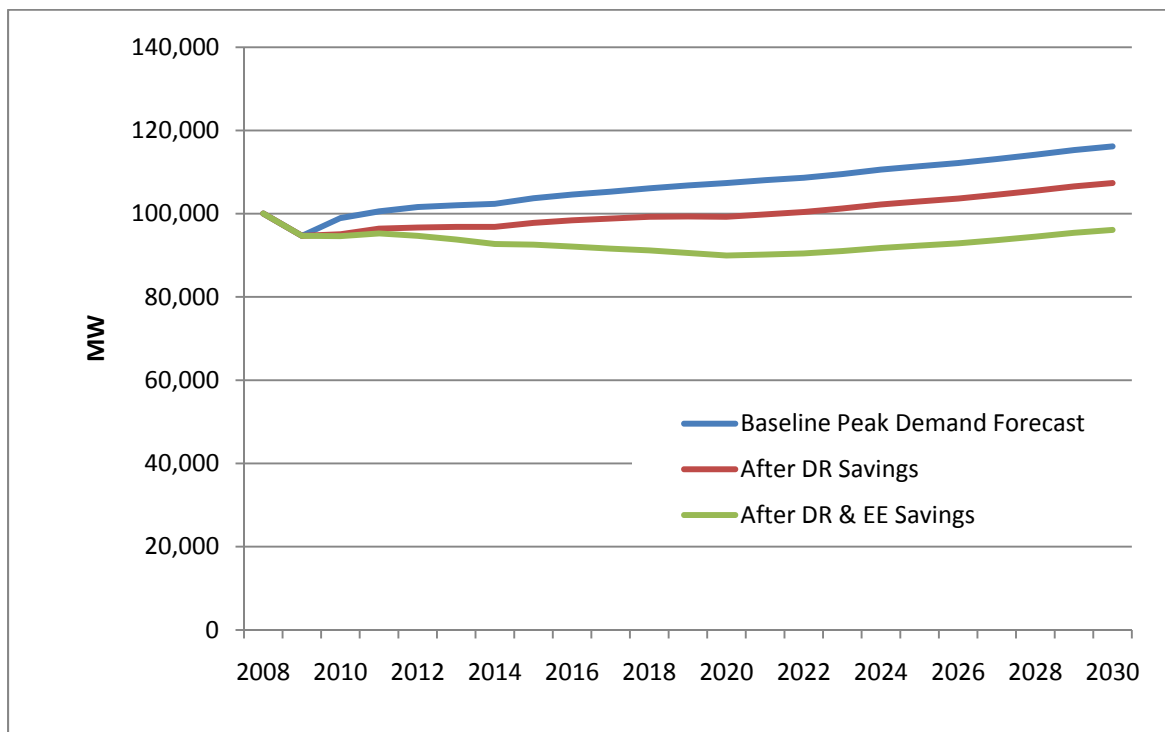


Figure ES-1-2 Midwest ISO Peak Demand Forecast 2009-2030 (MW)



Annual Electricity Savings

Both energy-efficiency and demand response programs also produce savings in annual electricity use. While the energy savings from DR are very small compared to EE savings, they have been estimated for this study.

In 2010, the cumulative energy savings from EE programs combined with the savings from DR programs in the Midwest ISO is 2,786 GWh. This represents 0.6% of the baseline electricity forecast.

- Energy efficiency accounts for 2,502 GWh, which is 0.5% of the baseline energy forecast.
- Demand response accounts for 284 GWh, which is 0.1% of the baseline energy forecast.

By 2030, the cumulative savings from EE programs combined with DR energy savings increases to over 58,600 GWh. This represents over 10% of the total energy baseline forecast.

- Energy efficiency accounts for 57,774 GWh, 10.2% of the total energy baseline.
- Demand response accounts for only 831 GWh, a negligible amount.
- By 2030, the cumulative savings offset 57% of the growth in annual electricity use.

Table ES-1-2 and Figure ES-1-3 present the annual electricity forecast and energy savings from EE and DR programs for selected years in the forecast.

Figure ES-4 presents the baseline electricity use forecast together with the resulting forecasts after EE and DR savings are accounted for.

Table ES-1-2 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%

Figure ES-1-3 Midwest ISO Energy Savings 2010-2030 (GWh)

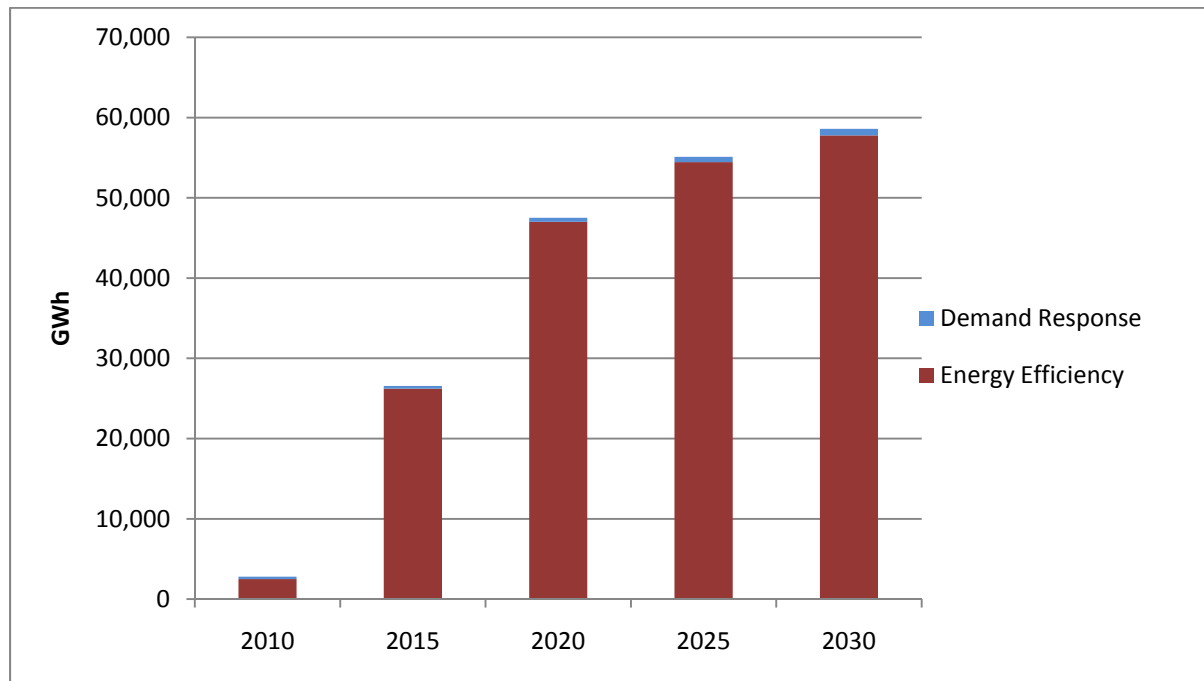
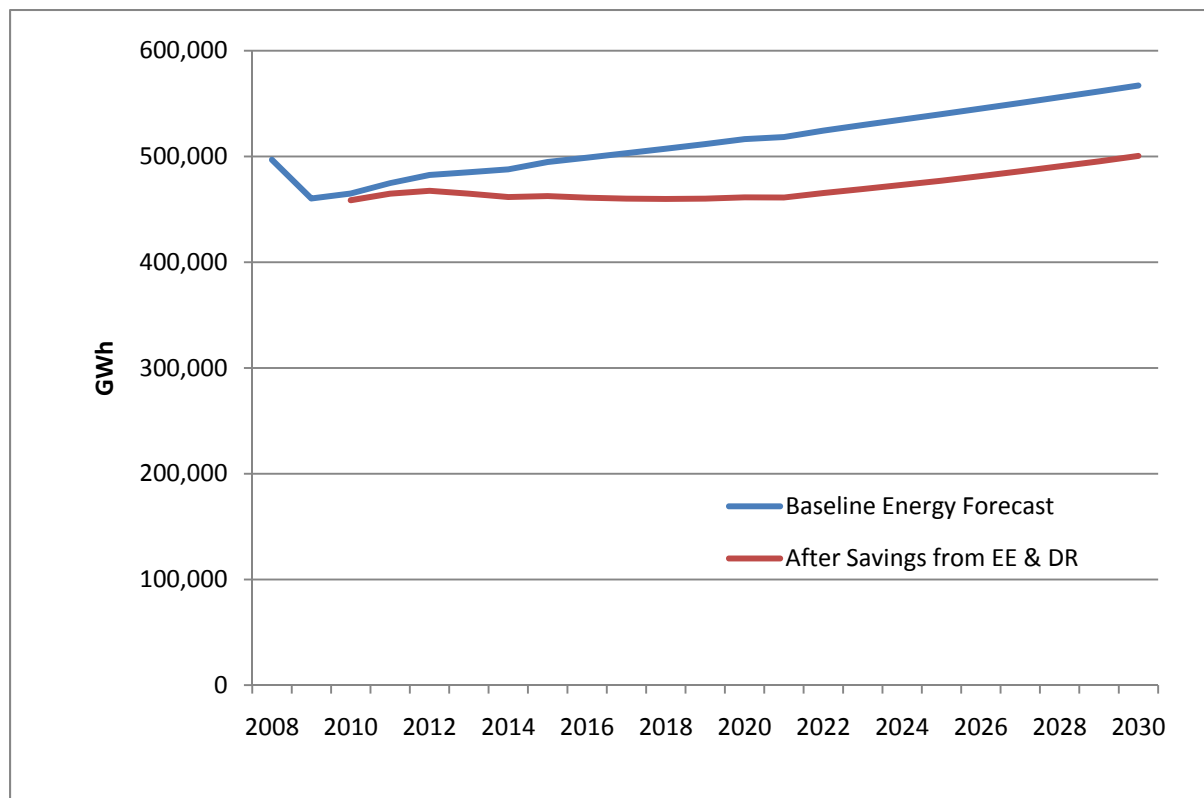


Figure ES-1-4 Midwest ISO Energy Savings 2010-2030



Summary of Demand Response for Midwest ISO

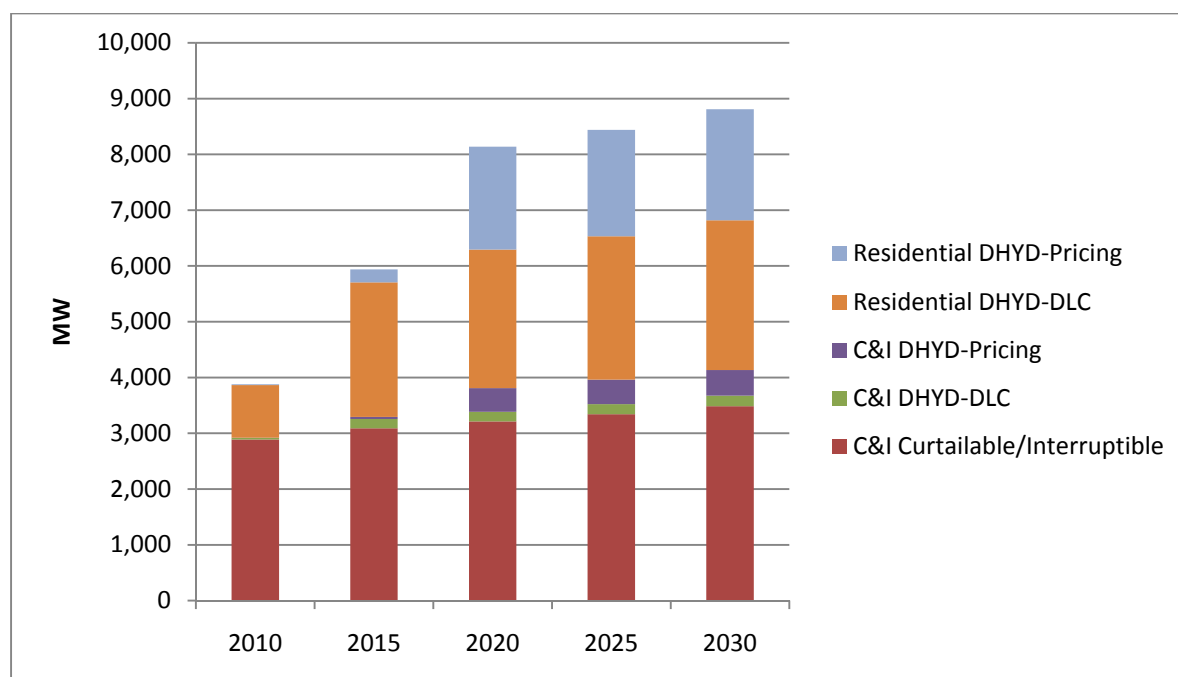
The analysis of demand response for the Midwest ISO includes five program types:

- **Commercial and industrial (C&I) curtailable/interruptible tariffs.** Curtailable programs are those in which a customer commits to curtailing a certain amount of load whenever an event is called in exchange for lower energy price. Interruptible programs are programs in which a customer agrees to be interrupted in exchange for a fixed reduction in the monthly demand billing rate. If a customer does not reduce their load per their commitment, the utility may levy a penalty.
- **C&I direct load control (DLC).** These programs are where the C&I customer agrees to allow the utility to directly control equipment such as an air conditioner or hot water heater during events in exchange for a payment of some type (a flat fee per year or season and/or a per-event payment). A controlling device such as a switch or programmable thermostat is required.
- **C&I dynamic pricing.** Dynamic pricing programs are structured so that customers have an incentive to reduce their usage during times of high energy demand or high wholesale energy prices. Under a critical peak pricing program, the customer pays a higher electricity rate during critical peak periods and pays a lower rate during off-peak periods. Often times, a critical peak pricing rate is combined with a time-of-use rate. Under a peak-time rebate program, the customer receives an incentive for reducing load during critical peak periods, and there is no penalty if the customer chooses not to participate.
- **Residential DLC.** These programs are where the residential customer agrees to allow the utility to directly control equipment such as an air conditioner or hot water heater during events in exchange for a payment of some type (a flat fee per year or season and/or a per-event payment). A controlling device such as a switch or programmable thermostat is required.
- **Residential dynamic pricing.** Dynamic pricing programs are structured so that customers have an incentive to reduce their usage during times of high energy demand or high wholesale energy prices. Under a critical peak pricing program, the customer pays a higher electricity rate during critical peak periods and pays a lower rate during off-peak periods. Often times, a critical peak pricing rate is combined with a time-of-use rate. Under a peak-time rebate program, the customer receives an incentive for reducing load during critical peak periods, and there is no penalty if the customer chooses not to participate.

In 2010, demand response programs account for 3,879 MW, which is 3.9% of the total peak baseline forecast. The majority of the savings come from C&I Curtailable/Interruptible programs, which account for almost three-quarters of the total impacts in 2010. In 2030, demand response programs account for 8,811 MW, which is 7.6% of the total peak baseline forecast. By 2030, the mix of savings changes to reflect the upswing in dynamic pricing.

Table ES-1-3 Demand Response Savings by Program Type (MW)

Program ¹	2010	2015	2020	2025	2030
C&I Curtailable/Interruptible	2,888	3,090	3,213	3,342	3,487
C&I DHYD-DLC	31	166	173	180	188
C&I DHYD-Pricing	2	38	424	440	458
Total C&I	2,921	3,294	3,809	3,962	4,133
Residential DHYD-DLC	942	2,412	2,486	2,571	2,686
Residential DHYD-Pricing	16	233	1,844	1,905	1,993
Total Residential	958	2,645	4,330	4,477	4,678
Total DR MISO	3,879	5,939	8,139	8,439	8,811

Figure ES-1-5 Demand Response Peak Impacts by Program Type (MW)

Summary of Demand Response by Region

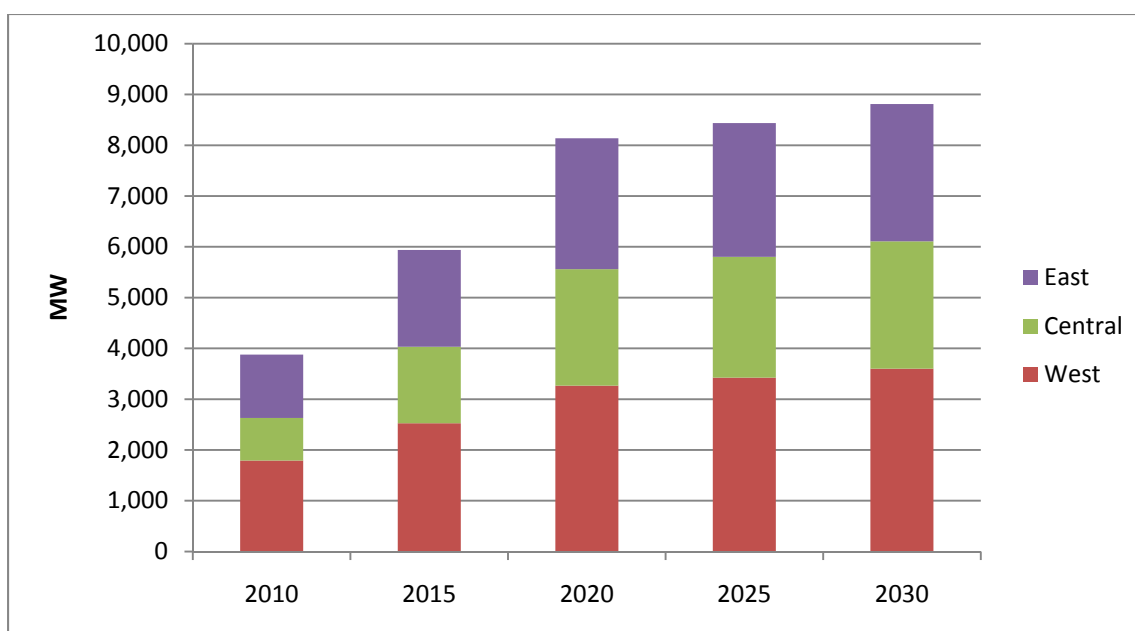
The regions vary considerably, reflecting the magnitude of their peak load and the differences in the current status of DR programs. Table ES-6 and Figure ES-5 present the results by region.

- In 2010, the West region had the highest impact from demand response with 1,793 MW, which is 5.6% of the regional peak baseline forecast. The Central region has the lowest amount of savings with 836 MW, which is 2.6% of the regional peak baseline forecast. The East region has 1,251 MW, which is 3.6% of the regional peak baseline forecast.
- In 2030, the West region again has the highest peak savings with 3,602 MW, which is 10.6% of the regional peak baseline forecast. The Central region sees significant growth over the forecast period, but still has the lowest demand savings with 2,506 MW, or 7.6% of the regional peak baseline forecast. The East region has 2,703 MW, which is 7.6% of the regional peak baseline forecast.

¹ **DHYD** = D indicates in EGEAS that it is a demand-side resource. HYD is short for Hydro; DHYD includes standard DR programs that are dispatchable and available for a limited number of hours such as demand bidding, capacity bidding, standby generation, critical peak pricing and peak time rebate programs.

Table ES-1-4 DR Savings by Region

	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	5.6%	7.7%	9.9%	10.2%	10.6%
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	2.6%	4.6%	6.9%	7.2%	7.6%
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	3.6%	5.4%	7.3%	7.4%	7.6%

Figure ES-1-6 Peak Demand Impacts by Region (MW)

Summary of Energy Efficiency for Midwest ISO

As with the demand response analysis, we utilized information gathered from utilities in the Midwest ISO area about their energy-efficiency program to develop projections of savings from energy efficiency. We reviewed and organized the program information to develop the following list of programs for our analysis:

Residential

Appliance incentives/rebates
Appliance recycling
Lighting initiatives
Low income programs
Multifamily programs
New construction programs
Whole home audit programs
All other residential programs

Commercial and Industrial

Lighting programs
Prescriptive rebates
Custom incentives
New construction programs
Retrocommissioning programs
All other C&I programs

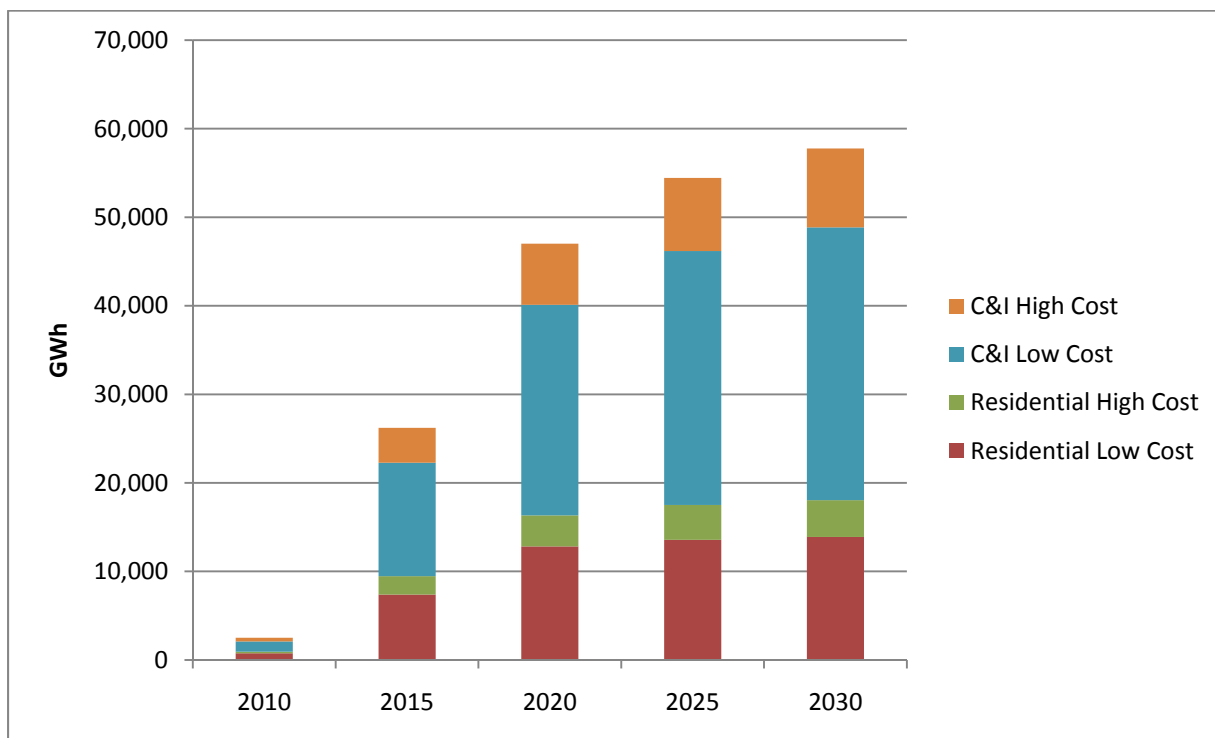
After we developed the list of programs, we assigned each utility program to a program type on the list. We further distinguished the utility programs as “low cost,” with cost less than \$1,000 per kW of peak demand savings and “high cost,” with cost greater than or equal to \$1,000 per kW of peak demand savings. The differentiation by cost is necessary for the EGEAS modeling. Assumptions about participation, growth and program impacts were made at the detailed program level and carried throughout the analysis.

Table ES-4 and Figure 3-6 present the cumulative savings from EE programs for selected forecast years in terms of the EGEAS blocks. Throughout the forecast period, more than three-fourths of the savings come from the low-cost programs.

- In 2010, energy efficiency programs account for 2,502 GWh, which is 0.5% of the total energy baseline forecast. The majority of the savings come from the commercial and industrial sector programs, accounting for almost two-thirds of the total energy impacts in 2010.
- In 2030, energy efficiency programs account for 57,774 MW, which is 10.2% of the total energy baseline forecast. By 2030, most of the energy savings (69%) come from the commercial and industrial sector.

Table ES-1-5 Cumulative Energy Efficiency Savings by Program Type (GWh)

EGEAS Block	2010	2015	2020	2025	2030
Residential Low Cost	747	7,382	12,831	13,572	13,891
Residential High Cost	179	2,074	3,506	3,938	4,153
Total Residential	926	9,456	16,337	17,510	18,043
C&I Low Cost	1,157	12,812	23,765	28,680	30,823
C&I High Cost	419	3,943	6,907	8,253	8,907
Total C&I	1,576	16,755	30,673	36,933	39,730
Total EE for MISO	2,502	26,211	47,010	54,443	57,774

Figure ES-1-7 Cumulative Energy Efficiency Savings by Program Type (GWh)

Tables ES-5 through Table ES-8 present results by block and program type. Among the residential low-cost programs:

- Appliance incentives/rebate programs provide the largest savings throughout the forecast period.
- Lighting initiatives are strong through 2015, prior to the effect of the lighting standards in the Energy Information and Security Act (EISA) which are fully in effect by 2014.
- The highest growth in savings is in multi-family programs.

Table ES-1-6 Cumulative EE Savings by Residential Low-Cost Program Type (GWh)

Detailed Program Type	2010	2015	2020	2025	2030
Appliance incentives/rebates	450	4,183	7,429	7,429	7,429
Appliance recycling	33	418	734	923	1,038
Lighting initiatives	148	769	1,042	1,044	1,044
Low income programs	7	110	171	186	190
Multifamily programs	58	1,241	2,164	2,388	2,443
New construction programs	9	72	123	155	174
Whole home audit programs	41	567	1,127	1,398	1,523
All other residential programs	2	22	41	48	51
Total for Residential Low-Cost	747	7,382	12,831	13,572	13,891

Among the residential high-cost programs, appliance incentives/rebate programs provide the largest savings throughout most of the forecast period. Appliance recycling and low-income programs show the strongest growth and by 2030 their cumulative savings are comparable to appliance incentives/rebates.

Table ES-1-7 Cumulative EE Savings by Residential High Cost Program Type (GWh)

Detailed Program Type	2010	2015	2020	2025	2030
Appliance incentives/rebates	82	627	1,063	1,063	1,063
Appliance recycling	22	455	838	1,070	1,212
Lighting initiatives	16	64	66	66	66
Low income programs	32	620	978	1,064	1,086
Multifamily programs	10	100	163	178	182
New construction programs	7	61	108	136	153
Whole home audit programs	8	131	265	330	360
All other residential programs	2	15	26	30	31
Total Projected Energy Reduction	179	2,074	3,506	3,938	4,153

As shown above, the low-cost C&I programs contribute the highest savings of the four blocks. Prescriptive rebates account for about half the total savings in 2010 and about 40% of the savings in 2030. Lighting and retrocommissioning programs show the highest growth.

Table ES-1-8 Cumulative EE Savings by C&I Low Cost Program Type (GWh)

Detailed Program Type	2010	2015	2020	2025	2030
Lighting programs	101	1,772	4,296	5,603	6,047
Prescriptive rebates	644	5,931	10,306	11,796	12,304
Custom incentives	247	3,279	5,717	6,850	7,376
New construction programs	73	561	1,158	1,679	2,103
Retrocommissioning programs	39	769	1,260	1,383	1,413
All other C&I programs	52	500	1,027	1,369	1,580
Total Projected Energy Reduction	1,157	12,812	23,765	28,680	30,823

Among the high-cost C&I programs, prescriptive rebate program is also a strong contributor. However, the programs showing the highest growth are custom incentives, retrocommissioning, and new construction programs. There are few high-cost lighting programs.

Table ES-1-9 Cumulative EE Savings by C&I High Cost Program Type (GWh)

Detailed Program Type	2010	2015	2020	2025	2030
Lighting programs	17	131	275	351	377
Prescriptive rebates	247	2,027	3,428	3,908	4,072
Custom incentives	55	923	1,620	1,937	2,081
New construction programs	15	150	346	518	657
Retrocommissioning programs	9	121	193	211	216
All other C&I programs	77	592	1,045	1,329	1,505
Total Projected Energy Reduction	419	3,943	6,907	8,253	8,907

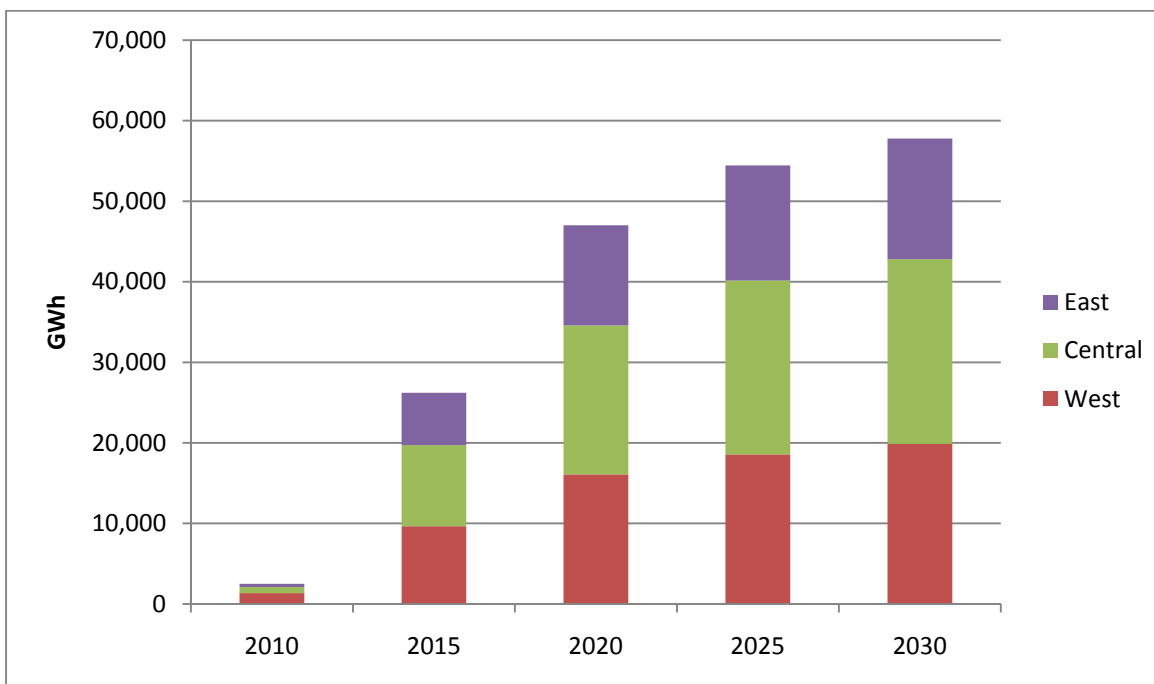
Summary of Energy Efficiency for Midwest ISO by Region

The regions vary considerably, reflecting the magnitude of their baseline energy and the differences in the current status of EE programs. Table ES-9 and Figure ES-8 show results by region.

- In 2010, the West region had the highest impact from energy efficiency with 1,351 GWh, which is 0.9% of the regional energy baseline forecast. The East region has the lowest amount of savings with 400 GWh, which is 0.3% of the regional energy baseline forecast. The Central region has 751 GWh, which is 0.5% of the regional energy baseline forecast.
- By 2030, the Central region sees significant growth over the forecast period with 23,484 GWh, or 11.5% of the regional energy baseline forecast. This growth leads the Central region to surpass the West region in cumulative savings from energy efficiency programs. The West region has cumulative energy savings in 2030 of 19,872 GWh, which is 10.2% of the regional energy baseline forecast. The East region still remains the lowest region with 14,979 GWh, which is 8.2% of the regional energy baseline forecast.

Table ES 1-10 EE Savings by Region

	2010	2015	2020	2025	2030
West Region:					
EE Savings (GWh)	1,351	9,658	16,078	18,566	19,872
Baseline Sales Forecast (GWh)	155,889	166,119	174,616	184,139	195,164
Savings as % of Baseline	0.9%	5.8%	9.2%	10.1%	10.2%
Central Region:					
EE Savings (GWh)	751	10,063	18,500	21,605	22,923
Baseline Sales Forecast (GWh)	156,911	163,960	171,998	179,423	189,012
Savings as % of Baseline	0.5%	6.1%	10.8%	12.0%	12.1%
East Region:					
EE Savings (GWh)	400	6,490	12,432	14,272	14,979
Baseline Sales Forecast (GWh)	152,221	164,688	169,867	176,418	182,920
Savings as % of Baseline	0.3%	3.9%	7.3%	8.1%	8.2%

Figure ES-1-8 Energy Impacts by Region (GWh), 2010 -2030

SUMMARY AND COMPARISON WITH OTHER STUDIES

This study estimates that the savings from demand response and energy efficiency programs combined over the next twenty years could exceed 20,000 MW. This would reduce the baseline peak demand forecast in 2030 from 116,165 MW to 96,121 MW, and completely offsets growth in peak demand.

The cumulative annual electricity savings in GWh from EE and DR programs are expected to reach 58,600 GWh by 2030. This represents almost 60% of the increase in forecasted electricity use over the 20 year forecast.

In both dimensions, peak demand and annual electricity use, the savings are substantial. But are they reasonable? To validate the results from the study, we looked at a few recent and comparable studies.

Energy Efficiency Comparison

Numerous utilities and organizations have estimated energy efficiency potential for utilities in the Midwest, for the Midwest region and for the U.S.:

- In 2008, EPRI estimated realistic achievable savings of 4.4% for the Midwest region in 2020 (relative to its baseline) and 7.5% in 2030.
- AmerenUE completed a study in early 2010. It estimated realistic achievable potential of 6.5% in 2020 and 7.3% in 2030, relative to its baseline.
- The Energy Center of Wisconsin estimated achievable savings of 13% by 2018 for the state of Wisconsin.
- McKinsey estimated economic potential for the U.S. at 23%.

This study estimates realistic achievable savings of 9.1% by 2020 and 10.2% by 2030. These estimates fall in the range of the comparable studies above.

Demand Response Comparison

There are fewer studies of demand response potential with which to compare the results from this study.

- FERC's National Assessment of Demand Response developed estimates by state and for two Midwest regions. The results for 2019 for the three relevant cases are:
 1. Business-as-usual case ranges from 4% to 5.5% of the baseline forecast
 2. Expanded Business-as-Usual case ranges from 8.5% to 9.5% of the baseline forecast
 3. Achievable Participation ranges from 12.5% to 14.5% of the baseline forecast
- AmerenUE DSM Potential Assessment (2010) estimated realistic achievable potential in 2030 at 10% of the baseline forecast

This study estimates that savings from demand response programs reach 7.6% of the baseline peak demand forecast by 2020, and 7.6% by 2030. These results fall in the range of these other studies as well.

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INTRODUCTION

1.1 RESEARCH OBJECTIVES

The primary objective of this study is to help the Midwest ISO enhance their modeling of future transmission capacity by providing a 20-year load forecast that accounts for demand response (DR) and energy efficiency (EE) for the Midwest ISO region and for the Eastern Interconnection. In the past, the Midwest ISO assumed a reduction in sales and peak of 1% per year to approximate savings from DR and EE programs. In light of all the DR and EE activity taking place across the nation, Midwest ISO initiated this study to develop better and defensible estimates of EE and DR for their forecast.

This study develops estimates of DR and EE savings using program information obtained from utilities within the Midwest ISO region. The study uses this information to develop projections of DR and EE savings by program type and according to the taxonomy used to describe resources in the EGEAS model, which the Midwest ISO currently uses for transmission planning studies.

1.2 ANALYSIS FRAMEWORK

For the Midwest ISO region, Midwest ISO staff wanted to engage the utilities in the area to support the study. Therefore, the project began with the development of a data request for the Midwest ISO utilities. The project team contacted the utilities and asked them to provide detailed DR and EE program information as well as load forecasts for the next 20 years. As described in detail in Chapter 2, most utilities responded and provided data and we filled the remaining gaps using proxy information and secondary sources.

The first analysis task was to develop a forecast of system peak demand and annual electricity use for 2010 through 2030 for the three Midwest ISO regions – East, Central and West. This forecast was to include no demand response and no energy-efficiency programs beyond what is already in place in 2009. We used the utility forecasts to develop the forecasts for the three regions.

The second analysis task was to develop projections of EE and DR savings using utility program information. The utility programs were grouped together into similar program types so that they could be analyzed in a format consistent with the Midwest ISO's planning model (EGEAS).

Finally, we compared the savings estimates to the baseline forecasts. We present the results of the analysis in Chapter 4.

1.3 REPORT ORGANIZATION

The report is organized into two volumes. This first volume focuses on the Midwest ISO area. It is organized as follows:

- *Chapter 2* describes the data collection and development approaches for the Midwest ISO analysis
- *Chapter 3* describes the analysis approach for developing the baseline load forecast, estimating demand response and energy efficiency impacts for the Midwest ISO
- *Chapter 4* presents the results of the Midwest ISO analysis.
- *Chapter 5* presents the results of the scenario analysis.

Volume 2 focuses on the Eastern Interconnection

DATA COLLECTION AND DEVELOPMENT

A key objective of this study was to utilize information from the utilities in the Midwest ISO region as much as possible and practical in developing the estimates of energy efficiency (EE) and demand response (DR) data for the region. The project team reached out to the 27 largest utilities in the Midwest ISO area and asked them to provide load forecast and program data. The majority of utilities responded by providing data. We used this information to develop 20-year load forecasts and base-year EE and DR program data as described in detail in this chapter.

2.1 DATA COLLECTION APPROACH

The purpose of the data collection task was to collect EE and DR program data, as well as 20-year forecasts of annual sales and peak demand, from the 27 key utilities identified within the Midwest ISO market footprint.

2.1.1 Data Request

We sought to obtain program and forecast data from each utility. Specifically, the data request included the following:

- Utility/Load Data Items
 - 20-year annual sales forecast (MWh) - System, Residential, Commercial, Industrial
 - 2008 or 2009 actual sales (MWh) - System, Residential, Commercial, Industrial
 - 20-year annual peak forecast (MW) - System, Residential, Commercial, Industrial
 - 2008 or 2009 actual peaks (MW) - System, Residential, Commercial, Industrial
 - The EE forecast of impacts (MWh, MW) – if included in the above forecast
 - The DR forecast of impacts (MWh, MW) – if included in the above forecast
 - 20-year annual average customer count forecast - System, Residential, Commercial, Industrial
 - 2008 or 2009 actual customer counts - System, residential, commercial, industrial
 - AMI roll-out schedule, if applicable
- Program Data Items
 - Current and planned EE programs by sector
 - Start date of each program
 - Annual cost/budget of each program
 - Annual energy savings of each EE program
 - Annual peak load reduction from each EE program
 - Number of participants of each program
- Current and planned DR programs by sector
 - Annual cost of each DR program
 - Annual peak reduction of each DR program

- Number of participants in each DR program

2.1.2 Recruitment

Working with the Midwest ISO, we identified 27 member utilities to target based on size and presence of demand side management (DSM) programs. Midwest ISO staff contacted each of the utilities first, followed up by Global staff. Recruitment took place in December 2009 and January 2010 via email and telephone. We requested response by January 31, 2010.

Midwest ISO's introductory email to their utility contacts informed them about the study and notified them that Global would contact them and request information. Global provided the utilities with the following information to familiarize them with the project:

Midwest ISO has recently engaged Global Energy Partners to contact utilities and develop an accurate estimate of present and expected future DR and EE programs. MISO will be using the information gathered in the study to improve their modeling capabilities in DR and EE for transmission planning purposes.

We will be collecting the following information from all the utilities within the Midwest ISO and aggregating the information. We will then provide the aggregated information to MISO.

- *Program costs, savings and participation in current and planned EE and DR programs by sector*
- *Forecasted peak load, annual usage, and number of customers by sector*

Table 2-1 shows a list of the utilities contacted with the corresponding state(s) and Midwest ISO region.

The utility response was good with the majority expressing an interest in providing their load forecast data and their current program data. There was some concern about confidentiality, so Global promised that the program information including impacts, costs, and customers would not be identified by utility, but instead only provided to Midwest ISO in aggregate. Even with this restriction, a couple of utilities required Global to sign their own confidentiality agreement. Both Global and Midwest ISO staff made several follow up contacts with each utility to ensure that all data were received by mid-February 2010.

Table 2-1 *List of Midwest ISO Utilities Contacted*

Utility Name	State	Midwest ISO Planning Area
Alliant	IA, MN, WI	West
AmerenIL	IL	Central
AmerenUE	MO	Central
City Water Light and Power	IL	Central
Columbia Water and Light	MO	Central
Consumers Energy	MI	East
Dairyland Power	IA, IL, MN, WI	West
Detroit Edison	MI	East
Duke Energy	IN, KY, OH	Central
First Energy	OH, PA	East
Great River Energy	MN	West
Hoosier Energy	IN	Central
Indianapolis Power and Light	IN	Central
Madison Gas & Electric	WI	West
MidAmerican	IL, IA, SD	West
Minnesota Power	MN, WI	West
Montana-Dakota Utilities Company	MT, ND, SD, WY	West
Muscatine Power	IA	West
Northern Indiana Public Service	IN	East
Northern States Power	MI, MN, ND, SD, WI	West
Northwestern WI Electric Company	WI	West
Otter Tail Power Cooperative	MN, ND, SD	West
Southern Illinois Power Cooperative	IL	Central
Southern Indiana Gas and Electric	IN	Central
Southern Minnesota Municipal Power Agency	MN	West
We Energies	MI, WI	West
Wisconsin Public Service	WI	West
Wolverine Power Supply Coop	MI	East

Most of the utilities provided long-term load forecasts. Twenty-four of the 27 utilities provided load data and program data. This represents 89% of the total number of utilities who provided data, and 94% of the total Midwest ISO load. Utilities that have operating areas in more than one state consistently provided data for each state separately. Table 2-2 summarizes the data received from each utility.

Table 2-2 Data Received from Midwest ISO Utilities

Utility Name	State	Midwest ISO Planning Area	Load Data Provided	Program Data Provided
Alliant	IA, MN, WI	West	x (except WI)	x (except WI)
AmerenIL	IL	Central	x	x
AmerenUE	MO	Central	x	x
City Water Light and Power	IL	Central	x	x
Columbia Water and Light	MO	Central		
Consumers Energy	MI	East	x	x
Dairyland Power	IA, IL, MN, WI	West	x	x
Detroit Edison	MI	East	x	x
Duke Energy	IN, KY, OH	Central	x	x
First Energy	OH, PA	East	x	x
Great River Energy	MN	West	x	x
Hoosier Energy	IN	Central	x	x
Indianapolis Power and Light	IN	Central	x	x
Madison Gas & Electric	WI	West	x	x
MidAmerican	IL, IA, SD	West	x	x
Minnesota Power	MN, WI	West	x	
Montana-Dakota Utilities Company	MT, ND, SD, WY	West	x	
Muscatine Power	IA	West	x	x
Northern Indiana Public Service	IN	East		
Northern States Power	MI, MN, ND, SD, WI	West	x	x
Northwestern WI Electric Company	WI	West		
Otter Tail Power Cooperative	MN, ND, SD	West	x	x
Southern Illinois Power Cooperative	IL	Central	x	x
Southern Indiana Gas and Electric	IN	Central	x	x
Southern Minnesota Municipal Power Agency	MN	West	x	x
We Energies	MI, WI	West	x	x
Wisconsin Public Service	WI	West	x	x
Wolverine Power Supply Coop	MI	East	x	x

2.2 DATA DEVELOPMENT

Two key objectives of this study were to develop estimates of EE and DR potential for the Midwest ISO region and to develop these estimates according to the requirements of the EGEAS model. In this section, we describe

- Organization of utility program data according to EGEAS categories
- The approach for filling gaps in the data
- Development of the load forecasts
- Development of base-year program data

2.2.1 Assignment to EGEAS Categories

The first step in this process was to assign the individual program data to EGEAS “buckets” and “blocks.” There are four EGEAS buckets-- DTHR, DHYD, DSTO and DNDT. The “D” at the beginning of each bucket name indicates to the EGEAS model that it is a demand-side resource.

The remaining letters refer to the type of programs that are in the bucket. As information about a program was collected, it was assigned to one of the four EGEAS “buckets.”

- **DTHR** – THR = Thermal; dispatchable programs that are available any time of the day such as interruptible and emergency programs.
- **DHYD** – HYD = Hydro; includes standard DR programs that are dispatchable and available for a limited number of hours such as demand bidding, capacity bidding, stand by generation, critical peak pricing and peak time rebate programs.
- **DSTO** – STO = Storage; programs that involve resources aimed at shifting loads from on-peak to off-peak hours such as thermal energy storage, combined heat and power, and cogeneration programs.
- **DNDT** – NDT = Non-dispatchable; typical EE programs such as equipment rebates, new construction, low-income and real time pricing.

For this study, we did not receive any information from the utilities that would fall into the DSTO bucket. Therefore, we used only three EGEAS buckets.

In addition to categorizing data by the resource type, the EGEAS model compares the DSM resource in each bucket to baseload resources which vary by cost as follows:

- Combustion turbine (CT)- 500-700
- Combustion turbine (CT)- 1,000-1,500
- Coal – 3,000-4,000
- Nuclear – 5,000-8,000

In addition to variation in cost, other factors can be identified for differentiation. For this study, we determined that program type was a useful distinction. As a result, the four buckets were divided into blocks as follows:

- **DTHR**. This bucket contains only C&I interruptible/curtailable programs. Therefore, it was determined that a single block is sufficient to describe in the base year and in the future.
- **DHYD**. This bucket includes four types of DR programs, organized by sector and program type.
- **DNDT**. Within the DNDT bucket, the overall average cost of the DNDT programs is \$1,707 per kW saved. However, 75% of the programs have a cost that is less than \$1,000 per kW saved, with an average of \$335 per kW. Therefore, it was decided to create two blocks with a breakpoint of \$1,000 per kW. In addition, the DNDT bucket contains a wide variety of types of energy efficiency programs. Therefore, we further disaggregated each block into specific program types. In doing so, we could more accurately make assumptions about the growth of each block within the DNDT bucket.

At this stage of analysis, the study had nine bucket-block categories:

1. C&I DTHR Interruptible/Curtailable
2. C&I DHYD Direct Load Control
3. C&I DHYD Pricing
4. Residential DHYD Direct Load Control
5. Residential DHYD Pricing
6. C&I High Cost (Greater than or equal to \$1,000 per kW)
7. C&I Low Cost (Less than \$1,000 per kW)
8. Residential High Cost (Greater than or equal to \$1,000 per kW)
9. Residential Low Cost (Less than \$1,000 per kW)

Table 2-3 presents a summary of the program data collected from the utilities by the bucket-block categories. For the DNDT bucket, it lists the programs that were isolated.

Table 2-3 Summary of Program Types and Impacts Collected by Bucket for 2009

Program Types by Bucket	Count of Utilities	Total MW Savings	Total MWh Savings
DTHR			
C-Curtailable/interruptible	12	1,124	12,515
DHYD			
C-Demand bidding	1	7	
C-Direct load control	1	2	
C-Dynamic pricing	1	-	-
Other	1		
R-Direct Load Control	20	465	3,686
R-Dynamic Pricing	4	2	-
Total DHYD	28	476	3,686
DNDT			
Agricultural program	6	1	9,137
C- Lighting Program	8	50	80,404
C-Custom incentives	18	37	221,765
C-Government Public utilities	2	0	449
C-New construction	9	20	78,887
C-Prescriptive rebates	60	152	763,138
C-Renewable resources	1	0	-
C-Retro-commissioning	6	3	30,384
C-Whole facility audits	8	12	77,300
Financing	6	0	122
Information	17	3	3,508
Other	17	5	26,364
R- Multifamily	7	8	40,506
R-Appliance incentives/rebates	52	176	448,931
R-Appliance recycling	10	9	37,455
R-Lighting Initiatives	8	80	158,084
R-Low income assistance	23	6	23,984
R-New construction	11	6	14,071
R-Renewable resources	3	0	105
R-Whole home audits	18	18	35,932
DNDT Total	290	586	2,050,525
Grand Total	330	2,187	2,066,725

R = Residential

C = C & I

2.2.2 Approach for Filling Missing Data

While most utilities responded to the data request, there were gaps in the data. With respect to the forecast data, there were relatively few gaps. However, there were more gaps in the program data. The utilities often provided a forecast of programs for only a few years and some of the requested data items were not provided at all. In this section, we describe the approach for filling the missing data.

2.2.2.1 Baseline Forecast

This study required a baseline forecast of annual sales (energy use), peak demand, and customers by customer class. The annual sales and peak forecasts should reflect sales and peak in absence of any future EE and DR programs (after 2009). We asked the utilities to provide these forecasts. If the utility forecast included DR and EE program impacts, then the utilities were asked to provide the DR and EE impacts separately so that the energy and load data could be adjusted appropriately. Table 2-4 summarizes the forecast data received from each utility.

Only four utilities did not provide forecast data. For these utilities, we first estimated base-year sales, peak demand and customer counts using EIA Form 861. Then, we developed the forecasts using growth rates from neighboring utilities.

For the remaining utilities, the most common data issues were either: 1) a forecast that ended prior to the end of the study horizon, or 2) a forecast that did not include a load forecast by customer class. Both issues were handled using simple methods. In the case of a utility with a load forecast that ended prior to the end of the study horizon, annual growth rates were calculated by class for each segment of available data and then a four-year compound growth rate, which captured the most recent forecasted trend, was used to fill in the missing data up to the year 2030.

If a utility did not provide a forecast of MW by class, one of two solutions was utilized depending on the available data. If the utility provided actual MW by class, the fixed ratio of each class to the total MW was applied to the total MW forecasted in each year. However, if the utility did not estimate MW by class at all, then the ratio of class energy usage to total energy usage in each forecast year was applied to the total MW in that forecast year to estimate the MW by class. A similar method was used to fill in missing customer forecasts and the sales forecast. .

Finally, three utilities were unable to provide either a baseline forecast absent DR and EE programs or the impacts from their DR and EE programs. This means that historical DR and EE program impacts are embedded in the data and therefore part of the forecast. Unfortunately, there is no good way to remove embedded impacts without more information about historical program impacts. Therefore, the decision was made to ignore the embedded impacts for these three utilities.

Table 2-4 Utility Load Forecast Data Summary

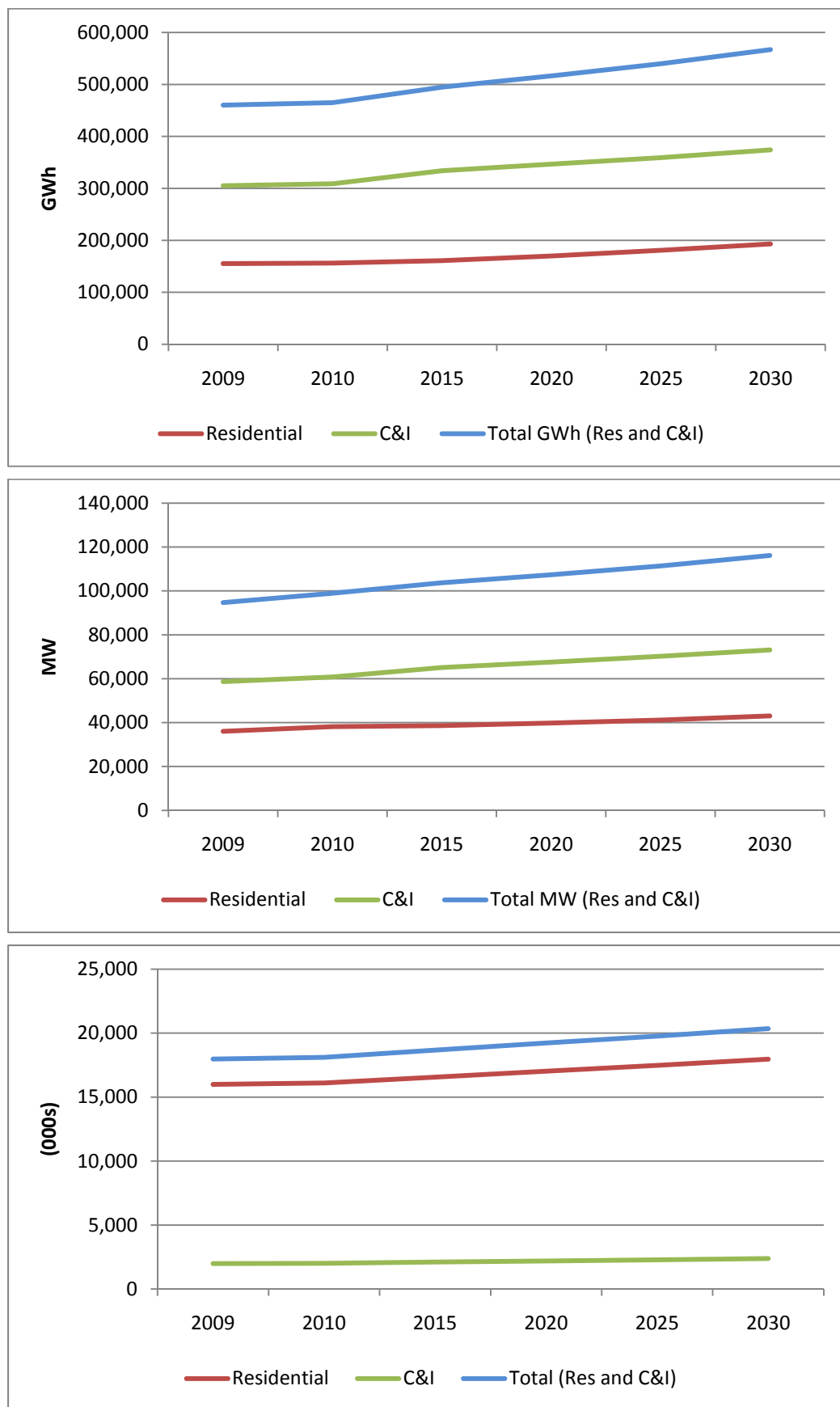
Utility Name	Request Status	Forecast End Year	DSM Impacts Included	Missing Data
Alliant - IPL Iowa	Received	2025	No	MW by class, Customer forecast by class
Alliant - IPL MN	Received	2030	Yes, embedded	MW by class
Alliant - IPL WI	No Data	NA	N/A	All
AmerenIL	Received	2030	Yes, provided	N/A
AmerenUE	Received	2030	Yes, provided	N/A
City Water Light and Power	Received	2030	Yes, embedded	MW by class, Customer forecast by class
Columbia Water and Light	No Data	NA	N/A	All
Consumers Energy	Received	2019	No	MW by class, Customer forecast by class
Dairyland Power	Received	2027	No	MW by class
Detroit Edison	Received	2029	Yes, provided	N/A
Duke Energy	Received	2030	No	MW by class
First Energy	Received	2025	No	MW by class
Great River Energy	Received	2027	Yes, embedded	MW by class
Hoosier Energy	Received	2029	Yes, provided	MW by class
Indianapolis Power and Light	Received	2020	Yes, provided	MW by class
Madison Gas & Electric	Received	2018	No	MW by class
Manitoba Hydro	Received	2029	No	MW by class
MidAmerican	Received	2029	No	MW by class
Minnesota Power	Received	2021	No	MW by class
Minnkota Power Company	Received	2031	Yes, provided	All class level data
Montana Dakota Utilities	No Data	NA	N/A	All
Muscatine Power	Received	2019	Yes, provided	MW by class
Northern Indiana Public Service	No Data	NA	N/A	All
Northern States Power	Received	2029	Yes, provided	N/A
Northwestern WI Electric Company	No Data	NA	N/A	All
Otter Tail Power Cooperative	Received	2028	No	MW by class, Customer forecast by class
Southern Illinois Power Coop.	Received	2030	No	N/A
Southern Indiana Gas and Electric	Received	2029	Yes, provided	MW by class
Southern Minnesota Municipal Power Agency	Received	2024	Yes, provided	MW by class
Upper Peninsula Power Co.	No Data	NA	N/A	All
We Energies	Received	2018	Yes, provided	MW by class
Wisconsin Public Service	Received	2028	Yes, provided	MW by class
Wolverine Power Supply Coop	Received	2029	Yes, provided	MW by class

Once the data gaps were filled, we computed an aggregated forecast by state and Midwest ISO region. Table 2-5 presents the aggregated baseline forecast for the Total Midwest ISO region for selected years and broken out by sector. The three graphs in Figure 2-1 show the energy sales forecast in GWh, the peak demand forecast in MW, and the customer forecast. This baseline forecast does not include the impacts from demand response and energy efficiency programs beyond 2009.

Overall, sales are growing faster than peak demand. This is somewhat unusual compared to other parts of the country, but is probably an indication that most homes and businesses already have air conditioning. The residential sector has the highest growth rate in sales.

Table 2-5 Total Midwest ISO Aggregated Utility Baseline Forecast

Sales (GWh)	2009	2010	2015	2020	2025	2030	% Increase (2010-30)	Average Annual Growth (%)
Residential	155,212	156,223	160,801	169,873	180,793	192,944	24%	1.1%
C&I	305,024	308,799	333,966	346,609	359,187	374,151	21%	1.0%
Total GWh	460,236	465,022	494,767	516,481	539,981	567,096	22%	1.0%
Peak Demand (MW)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Annual Growth (%)
Residential	36,048	38,177	38,631	39,810	41,160	43,037	19%	0.6%
C&I	58,647	60,786	65,084	67,572	70,230	73,129	25%	0.9%
Total MW	94,696	98,963	103,716	107,382	111,390	116,165	23%	0.8%
Customers (000)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Annual Growth (%)
Residential	15,993	16,102	16,566	17,031	17,486	17,971	12%	0.5%
C&I	1,985	2,007	2,109	2,195	2,286	2,381	20%	0.9%
	17,978	18,109	18,675	19,227	19,772	20,352	13%	0.6%

Figure 2-1 Total Midwest ISO Aggregated Baseline Forecast by Customer Class

As a sanity check, we compared the baseline forecast we developed for this study with the Midwest ISO Module-E long-term forecast for 2009. We did this comparison at the regional level. This involved aggregating the baseline utility forecasts to state and regional totals. It also involved organizing the Module-E data into the three regions in a two-step approach. First, the balancing authorities in the Module-E forecast were mapped to specific utilities using Table 26 in the 2007-2008 NERC Balancing Authority Certification of the Midwest ISO report. Then those utilities were matched to their appropriate regions (Central, East or West).

The result is a Midwest ISO regional forecast that is comparable to the baseline regional forecast developed using utility data. It is important to note that the Module-E forecast assumes that First Energy will depart Midwest ISO in 2011. The study assumes that First Energy is part of the East region of Midwest ISO throughout the forecast period since it was a part of Midwest ISO at the onset of this study. Figure 2-2 presents the comparison. Table 2-6 also presents the utility forecast as a percent of the Midwest ISO forecast for each year from 2009-2019².

Figure 2-2 Comparison of Utility Data to Midwest ISO Forecast

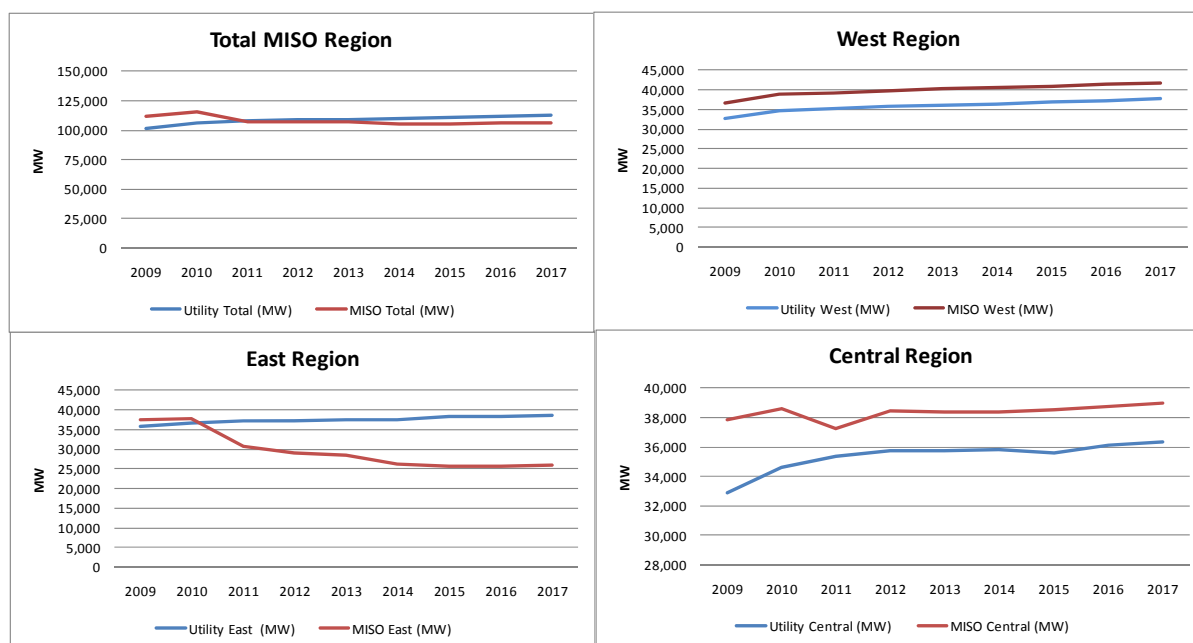


Table 2-6 Peak Forecast: Utility Load as a Percent of Midwest ISO 2009 Module E Forecasts

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Total MISO	91%	92%	101%	101%	102%	104%	105%	106%	106%	106%	106%
West Region	90%	89%	90%	90%	90%	90%	90%	90%	90%	91%	91%
East Region	95%	97%	121%	129%	131%	143%	149%	149%	149%	149%	150%
Central Region	87%	90%	95%	93%	93%	93%	92%	93%	93%	94%	94%

Overall, the aggregated utility forecast is approximately 9% lower than the Midwest ISO Module-E forecast, with the Central Region about 13% lower and the Western Region about 10% lower. The East region is close to the Module-E forecast for the years where both forecasts include First Energy. They diverge when the Module-E forecast no longer includes First Energy. In addition to this, there are some important differences in the two datasets that would lead us to expect lower numbers, on average, than those forecasted by Midwest ISO.

² The Module E long-term forecast only goes out to 2019 so the comparison only shows 2009 through 2019. The utility forecast extends out to 2030, the end of the study period.

- The utility data were purposely kept at the customer level, by excluding losses whenever possible. In our experience, we have seen line loss factors ranging from 7-10%, on average. The utility data also excludes any resale and wholesale sales of energy that the utility may have provided, which again is important for keeping the baseline forecast at the customer level.
- However, the exclusion of DR and EE impacts would likely lead to slightly higher forecasts in some cases. For the regions like the West Region that have more DR programs, the exclusion of those impacts may have produced numbers on the high side.

In summary, we find the comparison between the two forecasts quite favorable, showing consistent and comparable growth rates across regions with reasonable and explainable differences between the two datasets. Therefore, we felt confident in using the baseline forecast developed using the utility data for the analysis.

2.2.2.2 Demand Response Program Data

While many utilities provided some DR program data, all but one utility provided program data for three years or less. For 2009, we were able to use utility data for most utilities. For the remaining utilities, we used Module-E forecasts provided by Midwest ISO and regional averages calculated from available utility-provided data.

The results of the data-filling analysis for the C&I DTHR bucket are presented in Table 2-7, Table 2-8 and Table 2-9 show the results for the two DLC program buckets. These tables present the original data, as well as the filled data. Cells shaded in green were filled using data from the Module-E forecast and cells shaded in purple were filled using regional averages. In these tables, the rows are either individual program data or aggregated data, developed either by summing programs by utility (shaded in grey) or summing programs by region (in bold). For example, the first three rows of Table 2-7 represent individual program data for Utility 2, and the fourth row is the sum of those three programs, representing the total for Utility 2. Regional and Midwest ISO totals are in bold type and indicated in the first column, as are rows filled with Module-E forecast data. It is important to note that no program data were provided by the utilities for the C&I DHYD-DLC bucket in the East region. Secondary data sources confirm a lack of C&I DLC programs in general within Midwest ISO and in the East region especially.

The approach used to fill the data with regional values (purple shaded cells) is described below. Note that all programs have a value for MW savings or a value for budget – either provided by the utility or the Module-E forecast.

1. Actual utility program data for each bucket were separated by region.
2. The data for each region were examined and a few outliers were excluded.
3. For each region, the available data were used to calculate a per-program average for each of the following variables: budget, participation, MWh savings, MW savings, cost/kW and cost/kWh.
4. If, for a particular region, no actual program data were collected for one of the above variables, then the Midwest ISO regional average was used.
5. Using a set of conditional statements, missing variables were filled on a program-by-program basis by using regional averages and actual data (either MW savings or budget)
 1. Missing budget:
$$\text{Filled budget} = \text{MW savings} * \text{average cost/kWh}$$
 2. Missing MW savings:
$$\text{Filled MW savings} = \text{budget} / [\text{average cost/kW} / 1000]$$
 3. Missing participation:

Filled participation = MW savings (or filled MW savings) * average participants/MW

4. Missing MWh savings:

Filled MWh savings = budget (or filled budget) / [average cost/kWh / 1000]

5. Missing cost/kWh:

Filled cost/kWh = budget (or filled budget) / MWh savings (or filled MWh savings) * 1000

6. Missing cost/kW:

Filled cost/kW = budget (or filled budget) / MW savings (or filled MW savings) * 1000

Table 2-7 C&I DHTR – Curtailable/Interruptible Program Data Summary

Program Name	Utility	Budget	Participation	MWh Savings	MW Savings	Cost per kW	Cost per kWh
Central Region							
Commercial Demand Credit	Utility 2	\$102,617	6	93	5	\$22.00	\$1.11
C&I Demand Credit	Utility 2	\$400,000	50	760	38	\$11.00	\$0.53
Industrial Interruptible Tariff	Utility 2	\$2,000,000	62	3,800	48	\$42.00	\$0.53
<i>Utility 2 DTHR</i>	<i>Utility 2</i>	<i>\$2,502,617</i>	<i>118</i>	<i>4,653</i>	<i>90</i>	<i>\$27.78</i>	<i>\$0.54</i>
Non Residential DR	Utility 7	\$5,660,000	150	7,825	155	\$37.00	\$0.72
Non Residential DR	Utility 7	\$265,000	10	366	11	\$24.00	\$0.72
Non Residential DR	Utility 7	\$3,260,283	91	4,507	94	\$35.00	\$0.72
<i>Utility 7 DTHR</i>	<i>Utility 7</i>	<i>\$9,185,283</i>	<i>251</i>	<i>251</i>	<i>260</i>	<i>\$35.31</i>	<i>\$0.72</i>
Rider 17 Curtailment	Utility 10	\$69,000	9	95	7	\$9.58	\$0.72
Rider 14 Interruptible	Utility 10	\$350,000	16	484	13	\$28.00	\$0.72
Rider 15 Load Displacement	Utility 10	\$620,000	52	857	40	\$15.50	\$0.72
<i>Utility 10 DTHR</i>	<i>Utility 10</i>	<i>\$1,039,000</i>	<i>78</i>	<i>1,436</i>	<i>60</i>	<i>\$17.40</i>	<i>\$0.72</i>
Interruptible - Module E	Utility 19	\$6,498,000	299	8,983	228	\$28.50	\$0.72
Central Total		\$19,224,900	747	27,771	638	\$30.14	\$0.69
East Region							
Interruptible General Service	Utility 6	\$1,596,000	146	1,660	42	\$38.00	\$0.96
Interruptible Supply Rate	Utility 6	\$3,800,000	192	3,951	100	\$38.00	\$0.96
Interruptible Supply Rider	Utility 6	\$7,030,000	65	7,310	185	\$38.00	\$0.96
<i>Utility 6 DTHR</i>	<i>Utility 6</i>	<i>\$12,426,000</i>	<i>403</i>	<i>12,921</i>	<i>327</i>	<i>\$38.00</i>	<i>\$0.96</i>
Interruptible - Module E	Utility 22	\$17,643,400	365	18,347	464	\$38.00	\$0.96
Interruptible - Module E	Utility 23	\$3,800,000	79	3,951	100	\$38.00	\$0.96
East Total		\$33,869,400	847	35,219	891.3	\$38.00	\$0.96
West Region							
Nonresidential Interruptible	Utility 1	\$23,865,587	154	790	255	\$94.00	\$30.21
Nonresidential Load Management	Utility 13	\$308,577	5	193	7	\$42.00	\$1.60
Nonresidential Load Management	Utility 13	\$8,883,541	150	6,879	184	\$48.00	\$1.29
<i>Utility 13 DTHR</i>	<i>Utility 13</i>	<i>\$9,192,118</i>	<i>155</i>	<i>7,072</i>	<i>192</i>	<i>\$47.98</i>	<i>\$1.30</i>
Electric Rate Savings	Utility 21	\$627,550	110	888	25	\$25.00	\$0.71
Interruptible - Module E	Utility 24	\$418,000	6	348	8	\$52.25	\$1.20
Interruptible - Module E	Utility 11	\$1,410,750	20	1,176	27	\$52.25	\$1.20
Interruptible - Module E	Utility 15	\$8,307,750	117	6,923	159	\$52.25	\$1.20
Interruptible - Module E	Utility 20	\$16,362,088	231	13,635	313	\$52.25	\$1.20
Interruptible - Module E	Utility 25	\$15,715,233	222	13,096	301	\$52.25	\$1.20
Interruptible - Module E	Utility 1	\$5,092,000	105	5,295	134	\$38.00	\$0.96
West Total		\$80,991,075	1,120	49,223	1414	\$57.29	\$1.65
Midwest ISO Total		\$134,085,375	2,713	112,213	2943	\$45.56	\$1.19

Green shaded cells represent Data filled with Module-E

Purple shaded cells represent data filled with regional averages

Table 2-8 C&I DHYD DLC Program Data Summary

Program Name	Utility	Budget	Participation	MWh Savings	MW Savings	Cost per kW	Cost per kWh
Central Region							
Air Conditioning Load Control	Utility 10	\$133,000	187	3	0	\$304.00	\$39.91
Commercial Direct Load Control	Utility 19	\$53,724	653	1	2	\$22.00	\$39.91
Central Total		\$186,724	840	5	3	\$66.69	\$39.91
West Region							
Business Saver Switch	Utility 21	\$1,979,611	1,164	50	25	\$78.00	\$39.91
DLC Module E	Utility 21	\$23,164,627	2,779	580	297	\$78.00	\$39.91
<i>Utility 21 C&I DLC - DHYD</i>	<i>Utility 21</i>	<i>\$25,144,238</i>	<i>3,943</i>	<i>630</i>	<i>322</i>	<i>\$78.00</i>	<i>\$39.91</i>
DLC Module E	Utility 25	\$3,962,400	475	99	51	\$78.00	\$39.91
West Total		\$29,106,638	4,418	729	373	\$78.00	\$39.91
Midwest ISO Grand Total		\$29,293,362	5,258	734	376	\$77.91	\$39.91

Green shaded cells represent Data

filled with Module-E

Purple shaded cells represent data filled with regional averages

Table 2-9 Residential DHYD DLC Program Data Summary

Program Name	Utility	Budget	Participation	MWh Savings	MW Savings	Cost per kW	Cost per kWh
Central Region							
Residential DR - Direct Load Control	Utility 2	\$851,820	9,201	530	6	\$145.00	\$1.61
Residential DR - Direct Load Control	Utility 2	\$1,300,000	17,622	1,013	11	\$115.00	\$1.28
<i>Utility 2 Residential DLC - DHYD</i>	<i>Utility 2</i>	<i>\$2,151,820</i>	<i>26,824</i>	<i>1,543</i>	<i>17</i>	<i>\$125.11</i>	<i>\$1.39</i>
Residential DR	Utility 7	\$875,000	2,280	606	2	\$438.00	\$1.45
Residential DR	Utility 7	\$2,850,000	43,000	1,972	40	\$72.00	\$1.45
Residential DR	Utility 7	\$1,542,928	26,000	1,068	23	\$68.00	\$1.45
<i>Utility 7 Residential DLC - DHYD</i>	<i>Utility 7</i>	<i>\$5,267,928</i>	<i>71,280</i>	<i>3,646</i>	<i>65</i>	<i>\$81.55</i>	<i>\$1.45</i>
Air Conditioning Load Control	Utility 10	\$1,511,000	7,018	1,046	5	\$336.00	\$1.45
Residential Direct Load Control	Utility 19	\$1,020,756	28,885	706	26	\$39.00	\$1.45
Central Total		\$9,951,504	134,006	6,940	112	\$88.54	\$1.43
East Region							
Residential Interruptible Water Heating	Utility 6	\$4,895,833	59,800	585	25	\$195.83	\$8.36
Residential Interruptible Air Conditioning	Utility 6	\$42,495,826	281,500	5,082	217	\$195.83	\$8.36
Utility 6 Residential DLC-DHYD	Utility 6	\$47,391,659	341,300	5,668	242	\$195.83	\$8.36
East Total		\$47,391,659	341,300	5,668	242	\$195.83	\$8.36
West Region							
Residential Direct Load Control	Utility 1	\$3,465,302	52,867	298	27	\$126.00	\$11.63
Cycled AC (Efficiency and Load Management)	Utility 8	\$2,276,408	6,618	529	7	\$344.00	\$4.30
Residential Load Management	Utility 13	\$375,206	1,313	20	2	\$227.00	\$18.80
Residential Load Management	Utility 13	\$3,458,485	62,308	790	62	\$56.00	\$4.38
<i>Utility 13 Residential DLC - DHYD</i>	<i>Utility 13</i>	<i>\$3,833,691</i>	<i>63,621</i>	<i>810</i>	<i>64</i>	<i>\$60.37</i>	<i>\$4.73</i>
Air Conditioning Control *	Utility 17	\$9,500	30	1	0	\$298.00	\$6.47
Residential Demand Control	Utility 17	\$97,800	85	51	1	\$147.00	\$1.92
Residential Demand Control	Utility 17	\$6,800	8	5	0	\$129.00	\$1.41
Air Conditioning Control	Utility 17	\$80,000	690	34	1	\$120.00	\$2.38
<i>Utility 17 Residential DLC - DHYD</i>	<i>Utility 17</i>	<i>\$194,100</i>	<i>813</i>	<i>91</i>	<i>2</i>	<i>\$129.40</i>	<i>\$2.14</i>
Direct Load Control program	Utility 18	\$954,441	33,324	96	2	\$453.00	\$9.90
Residential Load Control	Utility 20	\$3,753,340	2,820	379	12	\$310.00	\$9.90
Load Management Segment - Residential Saver's	Utility 21	\$6,479,078	21,000	171	63	\$102.00	\$37.80
DLC Module E	Utility 21	\$155,832,499	172,764	15,742	741	\$210.18	\$9.90
<i>Utility 21 Residential DLC - DHYD</i>	<i>Utility 21</i>	<i>\$162,311,577</i>	<i>193,764</i>	<i>15,914</i>	<i>805</i>	<i>\$201.70</i>	<i>\$10.20</i>
DLC Module E	Utility 1	\$2,545,833	26,099	304	13	\$195.83	\$8.36
West Total		\$176,788,859	379,926	18,422	931	\$189.91	\$9.60
Midwest ISO Grand Total		\$234,132,022	855,232	31,030	1,285	\$182.16	\$7.55

The data provided by the utilities for pricing and “other” DR programs were extremely limited. After some consideration by the Global and Midwest ISO team, we concluded that this is due to a lack of true pricing programs rather than missing or incomplete data. Therefore, we used the information gathered from utilities on pricing and other DR programs informational purposes as we developed the forecast of DR potential for those program types (described in Chapter 3), with a full understanding of its limitations.

Table 2-10 below presents the utility data provided for the Residential and C&I pricing programs and C&I other programs.

Table 2-10 C&I and Residential DHYD Pricing and Other Program Data Summary

Region	Sector	Year	Program Type	Budget	Participation	kWh Savings	MW Savings	Cost per KW
West	C&I	2009	C-Demand bidding	\$180,826	29	-	7.1	\$26
Central	C&I	2010	C-Dynamic Pricing	\$500,000	-	159,000	1.8	\$278
Central	Residential	2010	R-Dynamic Pricing	\$500,000	-	178,000	2.0	\$250
West	Residential	2010	R-Dynamic Pricing	\$-	-	-	0.1	\$2,679
West	Residential	2009	R-Dynamic Pricing	\$665,550	-	-	0.5	\$1,441
West	Residential	2009	R-Dynamic Pricing	\$780,200	-	-	1.6	\$490

2.2.2.3 Energy Efficiency Program Data

The data collection process described in Section 2.1 resulted in more information about energy-efficiency programs compared to demand response programs. However there were still numerous gaps in the EE program data. The following is a description of the methodology used to fill in the data gaps and develop the 2009 baseline year data for energy efficiency programs.

- The starting point is the program data collected from all of the Midwest ISO utilities. The following are the key data elements concerning each program that were used for the energy-efficiency potential analysis:
 - Annual program budget
 - Number of participants in each year
 - Energy savings per year (MWh)
 - Peak demand savings (MW)
- Each program was then assigned to a sub-category within the following categories:
 - Midwest ISO region
 - West
 - Central
 - East
 - Market sector
 - Residential
 - C&I
 - Program type

- a. Appliance incentives and rebates
 - b. Appliance recycling
 - c. Lighting initiatives
 - d. Low income programs
 - e. Multifamily programs
 - f. New construction programs
 - g. Whole home audit programs
 - h. All other residential programs
- 3. A significant number of programs in the collected data were missing one or more of the key data elements for program year 2009. One of the following methods was used to fill in the missing data. Note that the method selected depends on the data available from other program years or a similar program implemented by another Midwest ISO utility:
 - a. In the case where some 2009 data were available for one of the four key data elements, we filled in the missing 2009 data by using the available data for 2010 – 2013 from the same program by developing correlation relationships between the different data components (e.g. ratio of budget to kWh savings, ratio of number of participants to kWh savings, etc.).
 - b. In some instances, we only had 2008 data for a program. In these cases, we filled in the missing 2009 data by making it the same as 2008 data from the same program. This method was used only if no data was available for the same program in the future years (2010 – 2013).
 - c. In the case where a program exists in 2009, but the 2009 data was missing, and the same data were available for the future years (2010 – 2013) from the same program, we filled in the missing 2009 data by trending the available data during the 2010 – 2013 timeframe and extrapolated the data value in 2009.
 - d. In some cases it was possible to fill in the missing 2009 data by extrapolation using available data for 2010 or 2011 from the same program. This extrapolation was performed by using trends developed from similar programs implemented by other Midwest ISO utilities.
 - e. For a few rare cases, it was necessary to fill in the missing 2009 data by using the average value from other similar programs in the entire Midwest ISO area or the appropriate Midwest ISO region for the utility in question. The choice of which average value to use was made after considering the number of data points available for the average value calculation.
 - f. For a significant number of instances, a program would be completely missing one (or more) of the key data elements in 2009 and all future years. In these cases, it was necessary to fill in the missing 2009 data by using correlation relationships between the different data elements developed from other similar 2009 programs. To accomplish this, we developed the following relationships for each program type:
 - i. ratio of program budget to energy savings
 - ii. ratio of program budget to number of participants
 - iii. ratio of energy savings to the number of participants
 - iv. ratio of energy savings to demand savings

4. Once all the missing data for 2009 were filled in, we calculated the budget per kW savings (\$/kW) value for each program. All programs with a \$/kW value of less than \$1,000 per kW were categorized as "low cost", and all programs with a \$/kW value of greater than or equal to \$1,000 per kW were categorized as "high cost."
5. We created the different EE program blocks by further disaggregating the "low cost" and "high cost" programs into their respective market sector (residential vs. C&I programs) and Midwest ISO region (West, Central, and East). As such, there are a total of twelve energy-efficiency program blocks:
 - a. Midwest ISO West Region – Residential Low-Cost Programs
 - b. Midwest ISO West Region – Residential High-Cost Programs
 - c. Midwest ISO West Region – Commercial Low-Cost Programs
 - d. Midwest ISO West Region – Commercial High-Cost Programs
 - e. Midwest ISO Central Region – Residential Low-Cost Programs
 - f. Midwest ISO Central Region – Residential High-Cost Programs
 - g. Midwest ISO Central Region – Commercial Low-Cost Programs
 - h. Midwest ISO Central Region – Commercial High-Cost Programs
 - i. Midwest ISO East Region – Residential Low-Cost Programs
 - j. Midwest ISO East Region – Residential High-Cost Programs
 - k. Midwest ISO East Region – Commercial Low-Cost Programs
 - l. Midwest ISO East Region – Commercial High-Cost Programs

Table 2-11 through Table 2-22 show the results of the data development for 2009 that are used as inputs into the analysis of the energy-efficiency potential in the Midwest ISO regions.

Table 2-11 Residential Low-Cost Program Data for West Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	172,554	48,654	0.282	\$46,830,866	\$271
Appliance recycling	11,949	3,047	0.255	\$1,215,199	\$102
Lighting initiatives	109,658	20,969	0.191	\$4,712,306	\$43
Low income programs	2,245	829	0.369	\$402,352	\$179
Multifamily programs	2,624	695	0.265	\$189,199	\$72
New construction programs	8,248	2,558	0.310	\$2,007,995	\$243
Whole home audit programs	20,663	6,901	0.334	\$3,811,538	\$184
All other residential programs	1,008	267	0.265	\$229,896	\$228
Total	328,948	83,920	0.255	\$59,399,351	\$181

Table 2-12 Residential High-Cost Program Data for West Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	37,657	9,977	0.265	\$10,710,089	\$284
Appliance recycling	373	95	0.255	\$95,500	\$256
Lighting initiatives	15,817	2,230	0.141	\$524,491	\$33
Low income programs	2,339	620	0.265	\$1,787,860	\$764
Multifamily programs	6,009	1,592	0.265	\$1,244,263	\$207
New construction programs	5,126	1,358	0.265	\$1,797,752	\$351
Whole home audit programs	3,156	836	0.265	\$1,959,377	\$621
All other residential programs	1,752	464	0.265	\$868,221	\$495
Total	72,230	17,172	0.238	\$18,987,553	\$263

Table 2-13 C&I Low-Cost Program Data for West Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	13,159	14,625	1.111	\$498,347	\$38
Prescriptive rebates	319,028	60,948	0.191	\$23,547,099	\$74
Custom incentives	117,900	21,118	0.179	\$13,411,034	\$114
New construction programs	66,264	11,747	0.177	\$10,238,459	\$155
Retrocommissioning programs	0	0	0.000	\$0	\$0
All other C&I programs	39,580	7,083	0.179	\$5,621,532	\$142
Total	555,931	115,521	0.208	\$53,316,470	\$96

Table 2-14 C&I High-Cost Program Data for a West Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	15,672	2,013	0.128	\$4,068,667	\$260
Prescriptive rebates	174,764	30,809	0.176	\$95,255,147	\$545
Custom incentives	0	0	0.000	\$0	\$0
New construction programs	10,641	1,876	0.176	\$3,162,718	\$297
Retrocommissioning programs	3,497	13,861	3.964	\$1,014,600	\$290
All other C&I programs	68,005	12,018	0.177	\$15,420,591	\$227
Total	272,578	60,577	0.222	\$118,921,723	\$436

Table 2-15 Residential Low-Cost Program Data for Central Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	148,965	38,190	0.000	\$23,910,103	\$161
Appliance recycling	269	68	0.000	\$73,308	\$273
Lighting initiatives	1,436	203	0.000	\$157,519	\$110
Low income programs	1,839	472	0.000	\$426,811	\$232
Multifamily programs	28,325	7,262	0.000	\$1,394,025	\$49
New construction programs	0	0	0.000	\$0	\$0
Whole home audit programs	9,053	2,321	0.000	\$1,222,778	\$135
All other residential programs	60	16	0.000	\$9,447	\$156
Total	189,948	48,532	0.000	\$27,193,990	\$143

Table 2-16 Residential High-Cost Program Data for Central Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	33,683	8,635	0.256	\$6,717,936	\$199
Appliance recycling	8,897	2,264	0.254	\$2,887,500	\$325
Lighting initiatives	0	0	0.000	\$0	\$0
Low income programs	10,071	2,582	0.256	\$4,747,405	\$471
Multifamily programs	0	0	0.000	\$0	\$0
New construction programs	77	20	0.260	\$100,000	\$1,299
Whole home audit programs	2,513	644	0.256	\$631,497	\$251
All other residential programs	0	0	0.000	\$0	\$0
Total	55,241	14,145	0.256	\$15,084,337	\$273

Table 2-17 C&I Low-Cost Program Data for Central Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	25,372	3,274	0.129	\$7,279,220	\$287
Prescriptive rebates	158,915	28,028	0.176	\$16,601,020	\$104
Custom incentives	71,836	12,670	0.176	\$6,213,395	\$86
New construction programs	247	44	0.178	\$262,531	\$1,064
Retrocommissioning programs	24,007	4,652	0.194	\$600,000	\$25
All other C&I programs	4,716	832	0.176	\$556,875	\$118
Total	285,092	49,500	0.174	\$31,513,041	\$111

Table 2-18 C&I High-Cost Program Data for Central Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	0	0	0.000	\$0	\$0
Prescriptive rebates	31,583	4,192	0.133	\$15,119,319	\$479
Custom incentives	0	0	0.000	\$0	\$0
New construction programs	1,736	3,587	2.066	\$772,000	\$445
Retrocommissioning programs	2,880	1,215	0.422	\$704,745	\$245
All other C&I programs	950	1,787	1.881	\$240,314	\$253
Total	37,150	10,781	0.290	\$16,836,378	\$453

Table 2-19 Residential Low-Cost Program Data for East Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	55,365	13,948	0.252	\$3,478,163	\$63
Appliance recycling	12,289	3,083	0.251	\$1,132,371	\$92
Lighting initiatives	31,173	4,395	0.141	\$2,353,306	\$75
Low income programs	542	137	0.253	\$186,903	\$345
Multifamily programs	1,692	426	0.252	\$335,883	\$198
New construction programs	74	19	0.256	\$29,027	\$391
Whole home audit programs	546	138	0.253	\$89,616	\$164
All other residential programs	435	110	0.253	\$72,701	\$167
Total	102,116	22,256	0.218	\$7,677,970	\$75

Table 2-20 Residential High-Cost Program Data for East Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Appliance incentives/rebates	708	178	0.251	\$2,881,808	\$4,070
Appliance recycling	3,679	923	0.251	\$384,762	\$105
Lighting initiatives	0	0	0.000	\$0	\$0
Low income programs	6,948	1,750	0.252	\$11,647,543	\$1,676
Multifamily programs	1,856	468	0.252	\$1,777,608	\$958
New construction programs	546	138	0.253	\$775,567	\$1,420
Whole home audit programs	0	0	0.000	\$0	\$0
All other residential programs	0	0	0.000	\$0	\$0
Total	13,737	3,457	0.252	\$17,467,288	\$1,272

Table 2-21 C&I Low-Cost Program Data for East Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	26,200	3,368	0.129	\$3,321,568	\$127
Prescriptive rebates	67,659	11,909	0.176	\$5,386,116	\$80
Custom incentives	0	0	0.000	\$0	\$0
New construction programs	0	0	0.000	\$0	\$0
Retrocommissioning programs	0	0	0.000	\$0	\$0
All other C&I programs	251	44	0.175	\$35,976	\$143
Total	94,111	15,321	0.163	\$8,743,660	\$93

Table 2-22 C&I High-Cost Program Data for East Region (2009)

Program Type	Total Incremental Energy Savings (MWh)	Total Incremental Peak Demand Savings (kW)	kW savings per MWh savings	Total Incremental Program Budget	\$ Budget per MWh savings
Lighting programs	0	0	0.000	\$0	\$0
Prescriptive rebates	11,188	1,969	0.176	\$5,464,970	\$488
Custom incentives	32,028	5,638	0.176	\$6,495,160	\$203
New construction programs	0	0	0.000	\$0	\$0
Retrocommissioning programs	0	0	0.000	\$0	\$0
All other C&I programs	0	0	0.000	\$0	\$0
Total	43,216	7,607	0.176	\$11,960,130	\$277

ANALYSIS APPROACH FOR MIDWEST ISO

This section describes the approach used for developing projections of demand-response and energy-efficiency impacts. It also presents the results of this analysis in the context of the baseline forecast. In addition to the utility data we collected for this project, we utilized the following data sources in our analysis:

- **A National Assessment of Demand Response Potential**, FERC, June 2009, hereafter referred to as the FERC Study. Global Energy Partners was a member of the project team, with primary responsibility for data development. The report is available at <http://www.ferc.gov/industries/electric/indus-act/demand-response/dr-potential.asp>.
- **Assessment of Achievable Potential from Energy Efficiency and Demand Response Programs in the U.S.** (2010-2030, EPRI 1019867, January 2009), hereafter referred to as the EPRI Study. Global Energy Partners was the prime contractor for this study with primary responsibility for the data development and analysis.

3.1 DEMAND RESPONSE MODELING ASSUMPTIONS

The first step was to review the program types identified in the utility analysis (presented in Table 2-3). Originally, we thought the “C&I Other DR” category would represent demand-bidding type programs. However, there was only one utility with this type of program currently and it was not anticipated that other Midwest ISO utilities would have demand-bidding type programs in absence of a wholesale market³. Table 3-1 shows the final bucket and program type combinations.

Table 3-1 *List of Demand Response Program Types*

Region	Class	EGEAS Bucket Name	Program Type
East, West, Central & Total	C&I	DTHR	Curtable / Interruptible
East, West, Central & Total	C&I	DHYD	Direct Load Control
East, West, Central & Total	C&I	DHYD	Dynamic Pricing
East, West, Central & Total	Residential	DHYD	Direct Load Control
East, West, Central & Total	Residential	DHYD	Dynamic pricing

We developed a separate model and input assumptions for each program type. The key inputs for each model include:

- Definition of the eligible market
- Participation rates
- Assumptions about control technologies
- Program impacts and costs, specified on a per-participant basis

These are described below for each program.

³ Note that demand bidding programs are currently available in other areas of the country, so this “other” category is included in the Eastern Interconnection analysis presented in Volume 2.

3.1.1 DTHR – Curtailable/Interruptible Program

Curtailable programs are programs in which a customer commits to curtailing a certain amount of load whenever an event is called in exchange for lower energy price. Interruptible programs are programs in which a customer agrees to be interrupted in exchange for a fixed reduction in the monthly demand billing rate. If a customer does not reduce their load per their commitment, the utility may levy a penalty.

- **Eligible Market Segment.** All C&I customers are considered eligible to participate in the curtailable/interruptible programs, although in practice these types of programs are generally for very large C&I customers who can provide load relief in 500-2000 kW range.
- **Participation Rates.** These are based on the current average regional participation rates collected from the utility DR program data. Current participation rates across the three regions are similar and are presented below in Table 3-2. Overall participation rates are quite low, but this is typical across the industry of these types of programs, and the rates seen here are comparable to those presented for a similar program type in the FERC report.

This type of program has been available for many years at many utilities, so we have held the participation rate fixed at the 2009 value. However, the number of participants does fluctuate somewhat as the C&I population increases in all three regions. Offsetting customer growth is the assumption of a drop-out rate, which represents the number of customers who leave the program each year due to attrition. We have assumed 1% for this rate.

The final element that affects the participation rate is the customer opt-out rate. The concept is similar to a forced outage rate for CT or CC generators and represents the uncertainty surrounding the load on particular event days. For our purposes, the customer opt-out rate represents the percentage of customers who choose not to participate in an event on a given event day. For the curtailable/interruptible programs the opt-out rate is quite low, at 3%, representing the heavy penalties generally associated with non-performance on these types of programs.

- **Control Technology Assumptions.** When participating in a curtailable/interruptible program, participants are generally under contract to reduce a specific amount of load when called upon and can do so in any manner that they choose, without utility rebates or assistance in enabling technology. Therefore, for those programs, no assumptions are made as to what type of enabling technology the participants may have. In the models, an enabling technology take-rate of 0% is filled in, but is only for ease of modeling and has no bearing on the potential estimation.
- **Per-Participant Impacts and Costs.** For the curtailable/interruptible programs, the per-participant impacts and costs for 2009 were calculated on a regional basis directly from the utility DR program data provided. The impacts grow at the same rate as the per-customer kW or kWh grows over time, as calculated by the baseline data. The costs are escalated at a constant rate of 3%, consistent with the Federal Reserve escalation rate on 3/10/2010. The regional per-participant impacts and costs are presented below in Table 3-3.

Table 3-2 Participation Rates in Interruptible/Curtailable Programs by Region

Region	2009 Participation	2010 Participation	2015 Participation	2030 Participation
East	0.13%	0.13%	0.15%	0.15%
West	0.15%	0.15%	0.13%	0.13%
Central	0.12%	0.12%	0.12%	0.13%

Table 3-3 Interruptible/Curtailable Programs per Participant Impacts and Costs (2009)

Region	kW Impact	kWh Impact	Cost/kW
East	1,051	47,832	\$38
West	1,263	43,774	\$57
Central	854	37,176	\$30

3.1.2 DTHR – Direct Load Control Programs

Direct load control programs are available in the C&I and residential sectors. In direct load control programs, the customer agrees to allow the utility to directly control equipment such as an air conditioner or hot water heater during events in exchange for a payment of some type (a flat fee per year or season and/or a per-event payment). A controlling device such as a switch or programmable thermostat is required. Model inputs for these DLC programs are described below.

3.1.2.1 Eligible Market

Again, the first step is to determine which customers will be eligible to participate in each of the programs. We considered all C&I customers and all residential customers with the appropriate end uses eligible to participate in a DLC program. Even though a small set of C&I customers may already be participating in the curtable/interruptible programs, we believe there is virtually no overlap because DLC programs generally target small and medium sized participants.

3.1.2.2 Control Technologies

Participation in an Air Conditioner DLC program requires some type of enabling technology for the participant. The most common options for residential customers are AC switches, which are controlled by the utility to cycle the AC unit's compressor and programmable communicating thermostats or PCTs. Regardless of the type of control, technology impacts for residential customers are similar, and therefore we did not make a distinction between the two types of technologies here. C&I customers usually have PCTs installed due to the more complicated nature of their AC systems, and large C&I customers typically use an automated DR (Auto-DR) system or other energy management system to participate in a DLC program.

3.1.2.3 Participation Rates

For the base year, (2009), participation rates for both the C&I and residential DLC programs were calculated based on average participation rates provided by utilities in the DR program data. The utility program data were robust for the residential DLC programs in each Midwest ISO region. Therefore the 2009 participation rate for each region is based on the average participation rate within each region. There was less information available for the C&I DLC programs, so it was not possible to differentiate by region and the participation rate computed for the entire Midwest ISO was used for each region. These values were compared against the FERC study and were quite close.

In order to estimate a likely future participation rate we relied on the state-level estimates of participation in the Expanded Business As Usual (EBAU) scenario from the FERC Study. Both the Residential and C&I DLC programs start at an actual current participation rate in 2009 and reach their full participation rate in 2015. The participation rates for each class vary by region for both 2009 and 2015 and are presented below in Table 3-4.

Table 3-4 Participation Rates for Direct Load Control⁴

Region	Class	2009 Participation	2010 Participation	2015 Participation	2020 Participation	2030 Participation
East	Residential	6.00%	6.75%	15.00%	15.00%	15.00%
East	C&I DLC	0.25%	0.50%	2.50%	2.50%	2.50%
West	Residential DLC	6.00%	6.75%	15.00%	15.00%	15.00%
West	C&I DLC	0.25%	0.50%	2.50%	2.50%	2.50%
Central	Residential DLC	2.50%	3.75%	15.00%	15.00%	15.00%
Central	C&I DLC	0.25%	0.50%	2.50%	2.50%	2.50%

It is important to keep in mind that the participation rates above in Table 3-4 are true population participation rates. Because DLC programs presuppose the presence of specific end uses – central air conditioning (CAC) in residential sector and any air conditioning (AC) in the C&I sector – participation rates are often applied only to a percentage of the population. However, because the 2009 participation rates are calculated directly from utility supplied data, and are true population participation rates, the 2015 participation rates are also true population participation rates. Additionally overall AC saturations in the Midwest are high, 65-75% for residential customers and 75-85% for C&I customers.

Another parameter for participation rates is the ramp rate which indicates what percentage of participants is added each year in order to reach the full participation rate. For the DLC programs, full participation is reached in 6 years (in 2015), and the majority of the customers will be added during a three year period, 2010-2012. We make this assumption because utilities typically start a program and have a period of heavy recruitment lasting a couple of years, then taper off allowing customers to continue to enroll. Since the East and West regions already have direct load control programs in place, the ramp rates are the same, starting at a higher percentage than the Central region. The ramp rates for each program/region are presented below in Table 3-5. The percentage in each cell is always multiplied by the 2020 participation rate to determine the effective participation in a particular year. For example, using the ramp rate for the East & West region for residential DLC, 40% of 15% yields the 6% effective participation rate for 2009 as shown in above in Table 3-4.

Table 3-5 Ramp Rates for Direct Load Control Programs by Region

Year	East & West Residential DLC	Central Residential DLC	All Regions C&I DLC
2009	40%	17%	10%
2010	45%	25%	20%
2011	50%	40%	40%
2012	75%	65%	60%
2013	85%	75%	75%
2014	95%	85%	85%
2015	100%	100%	100%

⁴ These participation rates are with respect the total population of customers, not the eligible population.

For all DLC programs a constant drop-out rate of 1% is assumed. This drop-out rate represents the number of customers who leave the program each year due to attrition which is normal for these types of programs.

Finally, we also assume an opt-out rate for the DLC programs. The opt-out rate represents the number of customers who choose not to participate in a particular event (of those that are given that choice) and those who may have a mechanical failure in their control systems on an event day. The opt-out rate for both Residential and C&I DLC programs is 5%. The rate is intentionally low, reflecting the recent industry trend toward either limiting opt-outs or intentionally making opt-outs more difficult. It also reflects the lower failure rate associated with newer installations of switches and other control systems.

3.1.2.4 Per-Participant Impacts and Costs

The per-participant impacts are estimates of kW reductions per unit controlled. The estimates of per unit reduction for the residential program were based on the utility DR program data that were provided. In the East region, the data were fairly limited; however both the West and Central regions had fairly robust datasets. The savings per participant from the utility data were 0.98 kW per participant in the West Region and 1.03 kW per participant in the Central region. Therefore we used 1 kW per participant for all three regions, which is consistent with the value commonly used in the industry.

Unfortunately the program data for C&I DLC programs was much more limited and consisted of essentially one large utility program which was determined not to be representative for other utilities. Therefore, the per-unit average impacts for C&I DLS were estimated based on representative state-level data from the FERC Study. For each region, a weighted average impact was created from the FERC data based on the states within that region. The per-unit impacts for both residential and C&I DLC programs are presented in Table 3-6.

Table 3-6 Direct Load Control Program per Participant Impacts and Costs (2009)

Region	kW Impact	kWh Impact	Average Cost/kW Saved
East – Residential DLC	1.0	32	\$184
East – C&I DLC	3.0	96	\$78
West – Residential DLC	1.0	32	\$184
West- C&I DLC	3.4	109	\$78
Central – Residential DLC	1.0	32	\$184
Central – C&I DLC	3.2	102	\$78

Energy savings for both the residential and C&I customers were estimated by assuming a specific number of event-hours for each year. We assumed a total of eight four-hour events per season yielding a total of 32 event-hours. Therefore, the average kW impact for each program and region combination was multiplied by 32 to estimate kWh impacts.

Since there was limited utility data within each region, the cost/kW was calculated directly from the utility data provided for the entire Midwest ISO territory. This gives an average for residential DLC of \$184/kW and an average for C&I DLC of \$78/kW.

3.1.3 Dynamic Pricing

Dynamic pricing programs are structured so that customers have an incentive to reduce their usage during times of high energy demand or high wholesale energy prices. Under a critical peak pricing program, the customer pays a higher electricity rate during critical peak periods and pays a lower rate during off-peak periods. Often times, a critical peak pricing rate is combined with a time-of-use rate. Under a peak-time rebate program, the customer receives an incentive for reducing load during critical peak periods, and there is no penalty if the customer chooses not to

participate. Advanced metering infrastructure (AMI) is helpful, although not necessary, for enabling these rates. The modeling assumptions for residential and C&I dynamic pricing programs are described below.

3.1.3.1 Eligible Market

Generally, the same customer population that is eligible for DLC programs is also eligible for dynamic pricing programs. Therefore, we defined the eligible market for dynamic pricing as the total sector less those customers who already participate in DLC programs. This eliminates the concern of double counting impacts and costs.

3.1.3.2 Participation Rates

Almost no data were available for dynamic pricing programs in the Midwest ISO region. After some secondary research, the project team determined that this reflects a lack of current experience with dynamic pricing programs. However, the industry is trending toward offering dynamic pricing, at least on a voluntary basis, to both residential and C&I customers in the next few years. This is facilitated by AMI implementations happening throughout North America. Therefore, we include a trend toward dynamic pricing in this study for the Midwest ISO.

Participation rates for both residential and C&I customers start at 0% in 2009, reflecting the lack of current programs in the area. Based on assumptions in the FERC Study and Global experience with other utilities, the residential participation rate is assumed to reach 20% in 2020, while the C&I participation rate reaches 10%.

Participation rates for the residential class are based on utilities within the Midwest ISO region who are currently offering a voluntary dynamic pricing rate in the Peak Time Rebate (PTR) style, which is a “no loser” rebate program/rate being offered in Maryland and California on a default basis and being considered at many other utilities. With a PTR rate, customers receive a rebate of a certain amount per kWh difference in usage during a peak period on event days relative to a baseline. If customers do not reduce usage during that period, there is no penalty – customers pay their normal utility bill. The PTR style of rate enables higher participation rates in residential classes because it is a rebate-only rate rather than a critical peak pricing style rate that has a high on-peak price and a low off-peak price. In reality the 20% participation for the entire Midwest ISO will likely represent a wide variety of dynamic pricing programs, both optional and mandatory offered by the individual utilities. Using a 20% participation rate is both conservative and plausible based on Global’s current industry experience and expertise.

The participation rate for C&I customers is half that of the residential class. This is mainly attributed to two things. One, small C&I customers (which make up the bulk of the C&I population) tend to be one of the harder classes to recruit, and tend to have a much lower response. Two, we do not see utilities offering a rebate-only style program to C&I customers. Most utilities offer a more traditional critical peak pricing (CPP) style rate with both a high and low price, which will have lower acceptance rates.

The effective participation rates for the residential and C&I classes are presented below in Table 3-7.

Table 3-7 Participation Rates in Dynamic Pricing Programs

Region	Class	2009 Participation	2010 Participation	2015 Participation	2020 Participation	2030 Participation
All	Residential	0%	0%	3%	20%	20%
All	C&I	0%	0%	2%	10%	10%

To develop participation rates for the intervening years, a ramp rate, shown in Table 3-8, is applied. These ramp rates were developed based on Global's expertise and industry experience. The ramp rate for each program must add participants in each year, moving from the current participation rate in each region to the full participation rate shown above in Table 3-7. The dynamic pricing program ramp rates follow the same logic as the direct load control. However, for dynamic pricing programs, the ramp rate is also tied to an assumption that smart meter rollouts will take place over the next five to ten years throughout the Midwest ISO territory. Pricing programs reach full participation in 11 years, with very low participation rates over the first six years, and participation rates increasing substantially after in the period from 2016-2019, as smart meters are rolled out and utilities roll out dynamic pricing programs along with the new infrastructure. For example, using the ramp rate for the residential dynamic pricing program in 2015 (Table 3-8), 15% of 20% full participation rate in 2020 yields the 3% effective participation rate for 2015 in Table 3-7.

Table 3-8 Ramp Rates for Dynamic Pricing Program Participation Rates

Year	Residential Dynamic Pricing	C&I Dynamic Pricing
2009	1%	1%
2010	1%	1%
2011	1%	1%
2012	5%	5%
2013	5%	5%
2014	10%	10%
2015	15%	15%
2016	25%	25%
2017	35%	35%
2018	50%	50%
2019	75%	75%
2020	100%	100%

For all dynamic pricing programs a constant drop-out rate of 1% is assumed. This drop-out rate represents the number of customers who leave the program each year due to attrition which is normal for these types of programs.

3.1.3.3 Control Technologies

One of the best ways to improve customer response and satisfaction on dynamic pricing programs is to offer participants enabling technology. The enabling technology is generally a PCT for residential and small to medium C&I customers and a more sophisticated Auto DR or energy management system for medium-large C&I customers. In order to take into account the effects of enabling technology on impacts, we had to first, determine the percentage of customers eligible for enabling technology using average AC saturation. Secondly, we had to determine what percentage of those eligible customers would accept the enabling technology option. AC saturations for each region were estimated base on the state specific data from the FERC study. The saturations were not found to be highly variable in the states within the Midwest ISO's region and therefore a simple average saturation number was used. The average saturations by region are presented below in Table 3-9.

Table 3-9 Average Air Conditioning Saturations by Region (2009)

Region and Class	Average AC Saturation
East – Residential	61%
East – C&I	75%
West – Residential	58%
West- C&I	75%
Central – Residential	75%
Central – C&I	78%

The average saturations determine what percentage of potential participants is eligible for enabling technology. We then apply a percentage to those customers, which increases over time, to estimate the number of customers in each region and class who accept a dynamic pricing option enabled with technology. The take rates, which represent the percentage of customers willing to accept an enabling technology, are presented below in Table 3-10.

Table 3-10 Take-Rates for Enabling Technology by Class

Year	Residential Take Rate	C&I Dynamic Pricing
2009	40%	20%
2010	40%	20%
2011	40%	20%
2012	40%	20%
2013	40%	20%
2014	45%	20%
2015	50%	25%
2016	55%	30%
2017	60%	35%
2018	65%	40%
2019	70%	45%
2020	75%	50%

The take rate for residential customers increases to 75% over the entire ramping period, while the take rate for C&I customers only increases to 50%. This is in large part due to the fact that enabling technology for residential customers is cheaper and easier to install than for C&I customers. Many utilities also offer to pay for the entire cost of the enabling technology for residential customers while they will only cover a portion or offer a rebate for C&I customers.

The opt-out rate for the dynamic pricing programs is set to 0% because it is embedded in the customer percentage impact. The impact for pricing programs is estimated as a percentage of total peak load which reflects the average impact for a group of customers on a particular event day including those customers who do nothing and those customers who have very high response on that event.

3.1.3.4 Per-Participant Impacts and Costs

As mentioned above, the impacts for the dynamic pricing program are based on a percentage reduction of average peak kW per customer. Therefore, in order to estimate the impacts, we

needed an estimate of average peak kW. This was done by dividing the total regional peak kW for the respective classes in 2009 by the total number of customers in each class in 2009. For the residential class, a further refinement was estimated to show an average peak kW value for both the average customer and a customer with AC. We estimated peak kW for those with AC by using the DOE-2⁵ estimates for a customer with and without AC in the Midwest ISO region and applying the percentage increase to the average customer peak kW. The values are presented for each region below in Table 3-11. The peak kW values presented below represent the values for 2009 and are tied to the annual growth rate of the per customer peak for each region and class. As a result, the per-customer impacts change over the course of the study.

Table 3-11 *Estimates of Peak kW for Residential and C&I Customers by Region (2009)*

Region	Average Peak kW	Average Peak kW with CAC
East – Residential	2	2
East – C&I	34	NA
West – Residential	2	2
West- C&I	27	NA
Central – Residential	3	3
Central – C&I	28	NA

The per-participant impacts are based on the percentage impacts estimated for dynamic pricing in the FERC study and are presented below in Table 3-12. The impacts differentiate between a customer with enabling technology and without enabling technology, but do not vary by region. As shown, a customer without technology can still see impacts, by manually changing its energy use.

Table 3-12 *Dynamic Pricing Percentage Impacts (2009)*

Region	With Technology	Without Technology
Residential Dynamic Pricing	34%	17%
C&I Dynamic Pricing	15%	2%

Energy savings for both the Residential and C&I sectors were estimated by assuming a specific number of event-hours for each year. We assumed a total of 60 event-hours over the course of the season because most utilities currently offering these types of programs plan to call them often throughout the summer season.

Because we did not have any data available from the utilities to calculate the costs the dynamic pricing programs we relied on estimates of costs from our previous work estimating DR program potentials and costs in the Midwest. We assumed two levels of costs for the pricing programs. One, higher cost, would be effective during the ramp-up period. This cost reflects the higher costs associated with marketing the program and educating and recruiting customers during the initial program years. The second level of costs are the maintenance costs, which reflect lower costs for program maintenance after the program is fully rolled out. The costs for both the residential and C&I programs are presented below in Table 3-13.

⁵ DOE-2 is a building energy simulation program that predicts the energy use and cost for all types of buildings. DOE-2 uses a description of the building layout, constructions, operating schedules, conditioning systems (lighting, HVAC, etc.) and utility rates provided by the user, along with weather data, to perform an hourly simulation of the building and to estimate utility bills.

Table 3-13 Dynamic Pricing Program Costs in \$/kW (2009)

Region	Initial Costs	Maintenance Costs
Residential Dynamic Pricing	\$95	\$25
C&I Dynamic Pricing	\$70	\$26

3.1.4 DR Impact Calculation

To estimate the overall savings, the number of participants is multiplied by the participation rates, the control-technology take rates and the per customer impacts. Costs represent total utility costs or the annual budget and they are calculated by multiplying the escalated cost/kW by the total kW saved for the program in each year.

3.2 ENERGY EFFICIENCY PROGRAM ANALYSIS

Using the baseline load forecast and the base-year energy efficiency program impacts, we developed the forecast of potential from energy efficiency for the Midwest ISO. We describe the analysis approach below.

3.2.1 Overview of EE Programs

For each region and customer class, we identified several program types within the DNDT bucket. Table 3-14 shows the list of program types.

Table 3-14 List of Energy Efficiency Program Types within DNDT bucket

Region	Class	Bucket	Block	Program Type
East, West, Central & Total	C&I	DNDT	Low cost, high cost	Lighting programs
East, West, Central & Total	C&I	DNDT	Low cost, high cost	Prescriptive rebates
East, West, Central & Total	C&I	DNDT	Low cost, high cost	Custom incentives
East, West, Central & Total	C&I	DNDT	Low cost, high cost	New construction programs
East, West, Central & Total	C&I	DNDT	Low cost, high cost	Retrocommissioning programs
East, West, Central & Total	C&I	DNDT	Low cost, high cost	All other C&I programs
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Appliance incentives/rebates
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Appliance recycling
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Lighting initiatives
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Low income programs
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Multifamily programs
East, West, Central & Total	Residential	DNDT	Low cost, high cost	New construction programs
East, West, Central & Total	Residential	DNDT	Low cost, high cost	Whole home audit programs
East, West, Central & Total	Residential	DNDT	Low cost, high cost	All other residential programs

We used a separate model to estimate the EE potentials by class, block, and program type for each of the three regions, and the regions were summed to calculate the potential for all of the Midwest ISO.

3.2.2 EE Key Modeling Assumptions

For each of the two program blocks (defined as high and low cost), there were six C&I and eight residential EE program types for each region. As discussed earlier, the breakpoint for the blocks is \$1,000 per kW savings; programs whose budget per kW savings were less than \$1,000 are classified as "low cost" and greater than or equal to \$1,000 per kW are classified as "high cost."

3.2.2.1 Eligible Market Segment

All C&I customers are considered eligible for the C&I programs at both cost levels. Likewise, all residential customers are considered eligible for the residential programs.

3.2.2.2 Per-Participant Impacts and Costs

For each program type, the per-participant impacts for 2009 were calculated for the entire Midwest ISO using the utility EE program data provided. These impacts were not calculated at the regional or cost block level because not enough data were available; several utilities did not provide the number of participants in the programs. The per-participant impacts are presented below in Table 3-15.

Table 3-15 EE Per-Participant Impacts in kWh/year by Program Type (2009)

Sector	Program Type	kWh/yr savings per Participant
Residential	Appliance incentives/rebates	1,486
Residential	Appliance recycling	1,008
Residential	Lighting initiatives	183
Residential	Low income programs	1,172
Residential	Multifamily programs	819
Residential	New construction programs	2,564
Residential	Whole home audit programs	1,379
Residential	All other residential programs	1,245
C&I	Lighting programs	52,727
C&I	Prescriptive rebates	15,473
C&I	Custom incentives	151,241
C&I	New construction programs	196,324
C&I	Retrocommissioning programs	150,000
C&I	All other C&I programs	114,929

The 2009 base year costs were calculated directly from the utility EE program data provided. Table 3-16 shows the total incremental program budget divided by energy savings (MWh) for each region. The costs are escalated at a constant rate of 3%, consistent with the Federal Reserve escalation rate on 3/10/2010.

Table 3-16 EE Budget per MWh Savings (2009)

Block/Program Type	West	Central	East
<i>DNDT - RES Low Cost</i>			
Appliance incentives/rebates	\$271	\$161	\$63
Appliance recycling	\$102	\$273	\$92
Lighting initiatives	\$43	\$110	\$75
Low income programs	\$179	\$232	\$345
Multifamily programs	\$72	\$49	\$198
New construction programs	\$243	\$0	\$391
Whole home audit programs	\$184	\$135	\$164
All other residential programs	\$228	\$156	\$167
<i>Total RES Low Cost (weighted average)</i>	\$181	\$143	\$75
<i>DNDT - RES High Cost</i>			
Appliance incentives/rebates	\$284	\$199	\$4,070
Appliance recycling	\$256	\$325	\$105
Lighting initiatives	\$33	\$0	\$0
Low income programs	\$764	\$471	\$1,676
Multifamily programs	\$207	\$0	\$958
New construction programs	\$351	\$1,299	\$1,420
Whole home audit programs	\$621	\$251	\$0
All other residential programs	\$495	\$0	\$0
<i>Total RES High Cost (weighted average)</i>	\$263	\$273	\$1,272
<i>DNDT - C&I Low Cost</i>			
Lighting programs	\$38	\$287	\$127
Prescriptive rebates	\$74	\$104	\$80
Custom incentives	\$114	\$86	\$0
New construction programs	\$155	\$1,064	\$0
Retrocommissioning programs	\$0	\$25	\$0
All other C&I programs	\$142	\$118	\$143
<i>Total C&I Low Cost (weighted average)</i>	\$96	\$111	\$93
<i>DNDT - C&I High Cost</i>			
Lighting programs	\$260	\$0	\$0
Prescriptive rebates	\$545	\$479	\$488
Custom incentives	\$0	\$0	\$203
New construction programs	\$297	\$445	\$0
Retrocommissioning programs	\$290	\$245	\$0
All other C&I programs	\$227	\$253	\$0
<i>Total C&I High Cost (weighted average)</i>	\$436	\$453	\$277

3.2.2.1 Participation Rates

Participation rates for both the C&I and residential EE programs for the base year (2009) were calculated by dividing the total incremental energy savings by the per-participant impacts for each program type. In order to calculate the participation in EE programs through the forecast period, growth rates are applied to the base year participation. The growth rates for 2010 through 2015 are based on the primary data collected from the utilities on growth in energy savings. For 2016 through 2030, the growth rates are based on a recent potential study for AmerenUE, conducted by Global.

Table 3-17 through Table 3-19 present the participation rates for each program type, block and region.

Table 3-17 Cumulative Participation Rates in EE Programs in West Region (% of class)

Block/Program Type	2010	2015	2020	2030
DNDT - RES Low Cost				
Appliance incentives/rebates	2.31%	3.10%	0.94%	0.00%
Appliance recycling	0.24%	0.28%	0.16%	0.06%
Lighting initiatives	10.63%	2.44%	0.00%	0.00%
Low income programs	0.04%	0.05%	0.01%	0.00%
Multifamily programs	0.06%	0.09%	0.03%	0.00%
New construction programs	0.06%	0.09%	0.05%	0.02%
Whole home audit programs	0.30%	0.41%	0.25%	0.05%
All other residential programs	0.02%	0.02%	0.01%	0.00%
DNDT - RES High Cost				
Appliance incentives/rebates	0.50%	0.68%	0.21%	0.00%
Appliance recycling	0.01%	0.01%	0.01%	0.00%
Lighting initiatives	1.53%	0.35%	0.00%	0.00%
Low income programs	0.04%	0.05%	0.01%	0.00%
Multifamily programs	0.15%	0.20%	0.06%	0.00%
New construction programs	0.04%	0.05%	0.03%	0.01%
Whole home audit programs	0.05%	0.06%	0.04%	0.01%
All other residential programs	0.03%	0.04%	0.02%	0.00%
DNDT - C&I Low Cost				
Lighting programs	0.04%	0.05%	0.05%	0.01%
Prescriptive rebates	3.04%	4.00%	1.64%	0.18%
Custom incentives	0.12%	0.15%	0.07%	0.01%
New construction programs	0.05%	0.07%	0.07%	0.04%
Retrocommissioning programs	0.00%	0.00%	0.00%	0.00%
All other C&I programs	0.05%	0.07%	0.04%	0.01%
DNDT - C&I High Cost				
Lighting programs	0.04%	0.06%	0.06%	0.01%
Prescriptive rebates	1.67%	2.19%	0.90%	0.10%
Custom incentives	0.00%	0.00%	0.00%	0.00%
New construction programs	0.01%	0.01%	0.01%	0.01%
Retrocommissioning programs	0.00%	0.00%	0.00%	0.00%
All other C&I programs	0.09%	0.11%	0.07%	0.02%

Table 3-18 Cumulative Participation Rates in EE Programs in Central Region (% of class)

Block/Program Type	2010	2015	2020	2030
DNDT - RES Low Cost				
Appliance incentives/rebates	2.54%	3.40%	1.03%	0.00%
Appliance recycling	0.01%	0.05%	0.03%	0.01%
Lighting initiatives	0.32%	2.41%	0.59%	0.00%
Low income programs	0.06%	0.34%	0.08%	0.00%
Multifamily programs	1.42%	7.50%	2.30%	0.13%
New construction programs	0.00%	0.00%	0.00%	0.00%
Whole home audit programs	0.27%	1.44%	0.90%	0.18%
All other residential programs	0.00%	0.01%	0.01%	0.00%
DNDT - RES High Cost				
Appliance incentives/rebates	0.57%	0.77%	0.23%	0.00%
Appliance recycling	0.36%	1.72%	1.02%	0.35%
Lighting initiatives	0.00%	0.00%	0.00%	0.00%
Low income programs	0.35%	1.87%	0.45%	0.03%
Multifamily programs	0.00%	0.00%	0.00%	0.00%
New construction programs	0.00%	0.01%	0.00%	0.00%
Whole home audit programs	0.07%	0.40%	0.25%	0.05%
All other residential programs	0.00%	0.00%	0.00%	0.00%
DNDT - C&I Low Cost				
Lighting programs	0.13%	0.67%	0.67%	0.07%
Prescriptive rebates	1.84%	2.64%	1.14%	0.12%
Custom incentives	0.13%	0.57%	0.26%	0.05%
New construction programs	0.00%	0.00%	0.00%	0.00%
Retrocommissioning programs	0.04%	0.19%	0.05%	0.00%
All other C&I programs	0.01%	0.07%	0.06%	0.02%
DNDT - C&I High Cost				
Lighting programs	0.00%	0.00%	0.00%	0.00%
Prescriptive rebates	0.37%	0.52%	0.23%	0.02%
Custom incentives	0.00%	0.00%	0.00%	0.00%
New construction programs	0.00%	0.01%	0.02%	0.01%
Retrocommissioning programs	0.01%	0.02%	0.01%	0.00%
All other C&I programs	0.00%	0.01%	0.01%	0.00%

Table 3-19 Cumulative Participation Rates in EE Programs in East Region (% of class)

Block/Program Type	2010	2015	2020	2030
DNDT - RES Low Cost				
Appliance incentives/rebates	0.96%	3.93%	1.32%	0.00%
Appliance recycling	0.31%	1.10%	0.65%	0.23%
Lighting initiatives	3.24%	4.35%	0.89%	0.00%
Low income programs	0.01%	0.05%	0.01%	0.00%
Multifamily programs	0.05%	0.22%	0.07%	0.00%
New construction programs	0.00%	0.00%	0.00%	0.00%
Whole home audit programs	0.01%	0.04%	0.03%	0.01%
All other residential programs	0.01%	0.04%	0.02%	0.00%
DNDT - RES High Cost				
Appliance incentives/rebates	0.01%	0.05%	0.02%	0.00%
Appliance recycling	0.09%	0.33%	0.19%	0.07%
Lighting initiatives	0.00%	0.00%	0.00%	0.00%
Low income programs	0.15%	0.62%	0.15%	0.01%
Multifamily programs	0.06%	0.24%	0.07%	0.00%
New construction programs	0.01%	0.02%	0.01%	0.00%
Whole home audit programs	0.00%	0.00%	0.00%	0.00%
All other residential programs	0.00%	0.00%	0.00%	0.00%
DNDT - C&I Low Cost				
Lighting programs	0.13%	0.60%	0.60%	0.06%
Prescriptive rebates	1.17%	4.65%	2.01%	0.22%
Custom incentives	0.00%	0.00%	0.00%	0.00%
New construction programs	0.00%	0.00%	0.00%	0.00%
Retrocommissioning programs	0.00%	0.00%	0.00%	0.00%
All other C&I programs	0.00%	0.00%	0.00%	0.00%
DNDT - C&I High Cost				
Lighting programs	0.00%	0.00%	0.00%	0.00%
Prescriptive rebates	0.19%	0.77%	0.33%	0.04%
Custom incentives	0.06%	0.21%	0.10%	0.02%
New construction programs	0.00%	0.00%	0.00%	0.00%
Retrocommissioning programs	0.00%	0.00%	0.00%	0.00%
All other C&I programs	0.00%	0.00%	0.00%	0.00%

3.2.3 EE Impact Calculations

Total savings are calculated as the product of the number of participants and the per-participant savings. Costs represent total utility costs or the annual budget and they are calculated by multiplying the escalated cost per kW by the total kW saved for the program in each year.

RESULTS FOR MIDWEST ISO

This chapter presents analysis results for the Midwest ISO as a whole and by region. These results include:

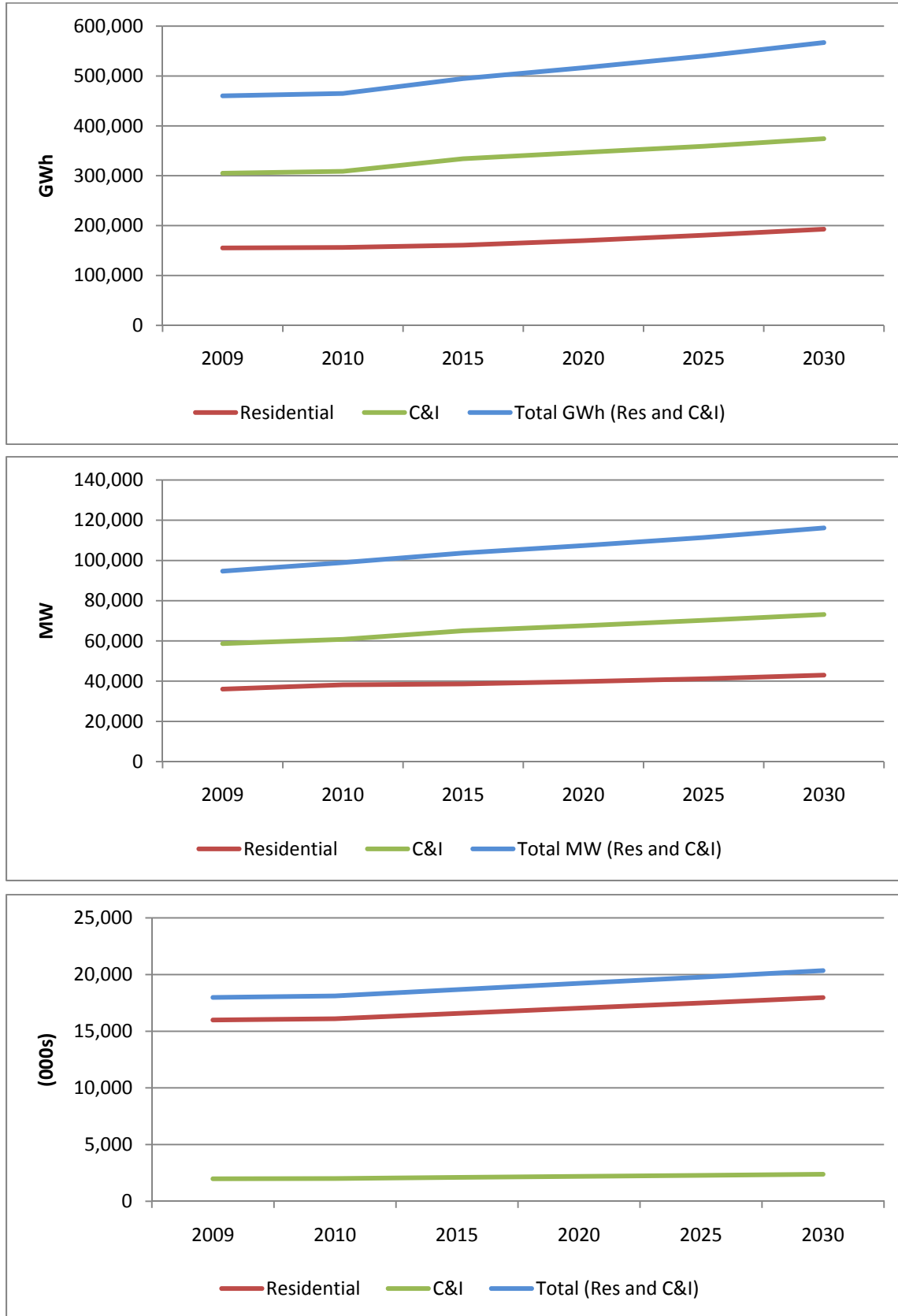
- Baseline forecast
- Estimates of achievable demand-response potential
- Estimates of achievable energy-efficiency potential

4.1 BASELINE FORECAST FOR MIDWEST ISO

Table 4-1 and Figure 4-1 present the baseline forecast for the entire Midwest ISO area. The three graphs show energy in GWh, peak load in MW, and number of customers. This baseline forecast does not include the impacts from future demand response and energy efficiency programs (beyond 2009). The residential sector accounts for about one-third of sales, one-third of peak demand, and 89% of the customer base. It has the highest growth in terms of electricity use, but the slowest growth in terms of peak demand. The C&I sector accounts for about two-thirds of sales, two-thirds of peak demand, and 11% of the customer base. The overall increase in sales between 2010 and 2030 is 22% and the increase in peak demand is 23%.

Table 4-1 *Baseline Forecast for Midwest ISO*

Sales (GWh)	2009	2010	2015	2020	2025	2030	% Increase (2010-30)	Average Annual Growth (%)
Residential	155,212	156,223	160,801	169,873	180,793	192,944	24%	1.1%
C&I	305,024	308,799	333,966	346,609	359,187	374,151	21%	1.0%
Total GWh	460,236	465,022	494,767	516,481	539,981	567,096	22%	1.0%
Peak Demand (MW)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Annual Growth (%)
Residential	36,048	38,177	38,631	39,810	41,160	43,037	19%	0.6%
C&I	58,647	60,786	65,084	67,572	70,230	73,129	25%	0.9%
Total MW	94,696	98,963	103,716	107,382	111,390	116,165	23%	0.8%
Customers (000)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Annual Growth (%)
Residential	15,993	16,102	16,566	17,031	17,486	17,971	12%	0.5%
C&I	1,985	2,007	2,109	2,195	2,286	2,381	20%	0.9%
Total	17,978	18,109	18,675	19,227	19,772	20,352	13%	0.6%

Figure 4-1 Baseline Forecast by Customer Class for Midwest ISO

4.1.1.1 Midwest ISO Baseline Load Forecast by Region

Table 4-2 through Table 4-4 shows the forecasts of electricity sales, peak demand, and customers forecast for each region. Sales across each of the regions grow steadily with 20-30% in each region. The West region has the largest growth in sales with 25%, with the largest growth coming from the residential sector. The Central and East regions have the same overall growth in sales with 20%. In both of these regions the growth in the residential and C&I sectors are about the same.

The growth in peak demand varies across the regions, ranging from 11% to 23%. The West has the largest growth with 23%, which is consistent with the growth in electricity sales. Peak demand in the Central region increases by 19%, which is consistent with the growth in electricity sales. For the East region, growth in peak demand only increases by 11%, compared to a 20% increase in electricity sales. This difference is driven by the baseline forecast provided by one major utility within the East region. We verified that the numbers provided by the utility were consistent with their internal load forecast.

Table 4-2 Baseline Forecast for the East Region

Sales (GWh)	2009	2010	2015	2020	2025	2030	% Growth (2010-2030)	Average Annual Growth (%)
Residential	50,525	50,734	51,081	53,794	57,199	60,641	20%	0.9%
C&I	101,715	101,487	113,607	116,073	119,219	122,279	20%	0.9%
Total GWh	152,240	152,221	164,688	169,867	176,418	182,920	20%	0.9%
Peak Demand (MW)	2009	2010	2015	2020	2025	2030	% Growth (2010-2030)	Average Annual Growth (%)
Residential	12,244	13,387	12,902	13,024	13,273	13,608	2%	0.1%
C&I	21,602	21,461	23,252	23,770	24,391	25,004	17%	0.8%
Total MW	33,846	34,848	36,154	36,793	37,664	38,612	11%	0.5%
Customers (000)	2009	2010	2015	2020	2025	2030	% Growth (2010-2030)	Average Annual Growth (%)
Residential	5,905	5,916	5,930	5,989	6,070	6,1721	4%	0.2%
C&I	633	641	669	685	702	719	12%	0.6%
Total	6,538	6,557	6,590	6,674	6,772	6,891	5%	0.2%

Table 4-3 Baseline Forecast for the Central Region

Sales (GWh)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	54,847	55,432	56,807	59,511	62,776	66,991	21%	0.9%
C&I	98,081	101,479	107,154	112,487	116,647	122,021	20%	0.9%
Total GWh	152,929	156,911	163,960	171,998	179,423	189,012	20%	0.9%
Peak Demand (MW)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	12,820	13,362	13,602	14,051	14,513	15,336	15%	0.7%
C&I	17,073	18,655	19,758	20,696	21,692	22,738	22%	1.0%
Total MW	29,893	32,018	33,360	34,748	36,206	38,074	19%	0.9%
Customers (000)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	4,444	4,507	4,720	4,883	5,038	5,194	15%	0.7%
C&I	610	619	649	679	710	742	20%	0.9%
Total	5,054	5,126	5,370	5,562	5,748	5,936	16%	0.7%

Table 4-4 Baseline Forecast for the West Region

Sales (GWh)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	49,840	50,056	52,914	56,567	60,818	65,312	30%	1.3%
C&I	105,227	105,833	113,205	118,049	123,322	129,852	23%	1.0%
Total GWh	155,067	155,889	166,119	174,616	184,139	195,164	25%	1.1%
Peak Demand (MW)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	10,984	11,428	12,127	12,735	13,373	14,092	23%	1.0%
C&I	19,973	20,670	22,075	23,106	24,147	25,387	23%	1.0%
Total MW	30,957	32,098	34,202	35,841	37,520	39,479	23%	1.0%
Customers (000)	2009	2010	2015	2020	2025	2030	% Growth (2010-30)	Average Growth (%)
Residential	5,643	5,679	5,916	6,159	6,378	6,605	16%	0.8%
C&I	742	747	790	832	874	920	23%	1.0%
Total	6,385	6,426	6,706	6,991	7,252	7,525	17%	0.8%

4.2 DEMAND RESPONSE FOR MIDWEST ISO

For the Midwest ISO, demand response potential in 2010 is 3,879 MW, which represents 3.7% of the baseline peak-demand forecast. In 2020, the DR potential has increased to 8,139 MW, or 7.2% of the baseline forecast. Between 2020 and 2030, DR potential increases slightly to 8,811 MW, 7.2% of the baseline forecast.

Table 4-5 shows DR potential for each region. The West Region is expected to contribute the most throughout the forecast period. However, DR potential in the East and Central regions grows at a faster rate than the West. Details for each region follow.

Table 4-5 Demand Response Potential for the Midwest ISO

Region	Demand Savings (MW)					Percentage of Baseline				
	2010	2015	2020	2025	2030	2010	2015	2020	2025	2030
West	1,793	2,525	3,268	3,423	3,602	5.3%	7.0%	8.7%	8.7%	8.7%
Central	836	1,509	2,291	2,379	2,506	2.4%	4.3%	6.2%	6.2%	6.2%
East	1,251	1,906	2,580	2,637	2,703	3.4%	5.0%	6.7%	6.7%	6.7%
Total	3,879	5,939	8,139	8,439	8,811	3.7%	5.4%	7.2%	7.2%	7.2%

Table 4-6 shows the cumulative demand savings potential by the program types. These savings are then graphically presented in Figure 4-2.

Table 4-6 Demand Response Potential by Program for Midwest ISO (MW)

Program	2010	2015	2020	2025	2030
C&I DTHR	2,888	3,090	3,213	3,342	3,487
C&I DHYD-DLC	31	166	173	180	188
C&I DHYD-Pricing	2	38	424	440	458
Total C&I	2,921	3,294	3,809	3,962	4,133
RES DHYD-DLC	942	2,412	2,486	2,571	2,686
RES DHYD-Pricing	16	233	1,844	1,905	1,993
Total RES	958	2,645	4,330	4,477	4,678
Total DR Midwest ISO	3,879	5,939	8,139	8,439	8,811

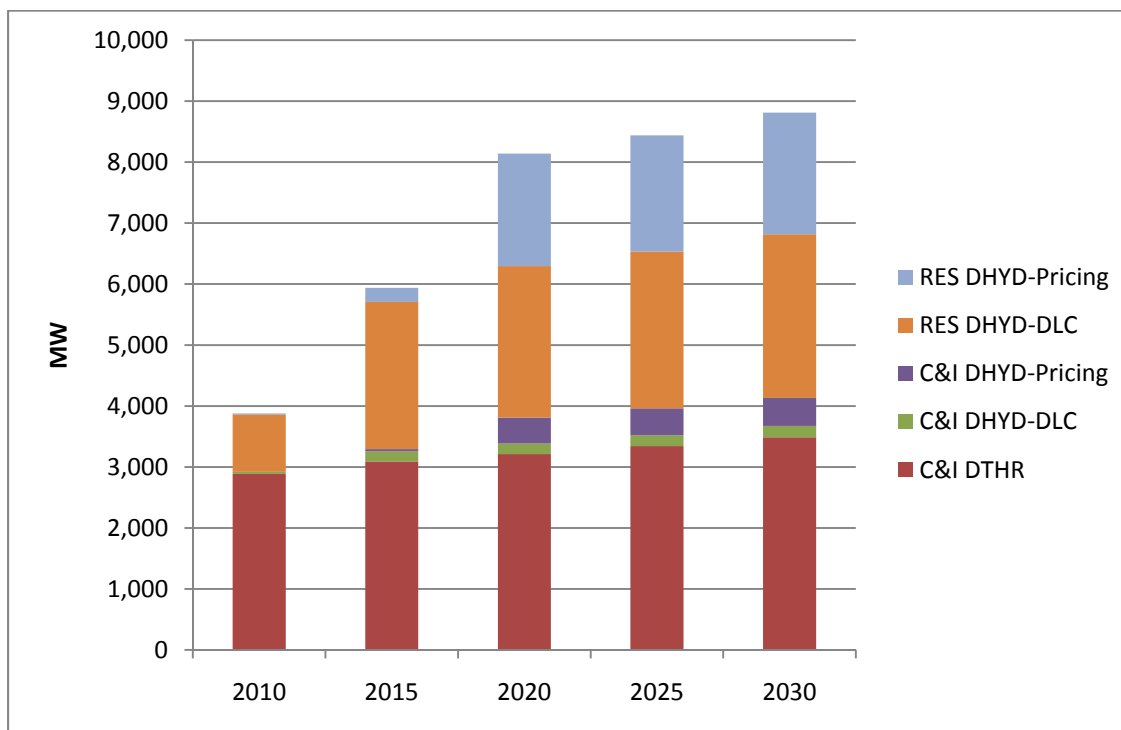
Figure 4-2 Demand Response Potential by Program for Midwest ISO (MW)

Table 4-7 shows the estimate of the budget in nominal dollars required to implement the demand response programs and achieve the incremental savings.

Table 4-7 Demand Response Program Budgets for Midwest ISO (\$ millions)

Program	2010	2015	2020	2025	2030
C&I DTHR	\$135	\$168	\$202	\$244	\$295
C&I DHYD-DLC	\$2	\$15	\$19	\$23	\$27
C&I DHYD-Pricing	\$0	\$3	\$44	\$53	\$65
Total C&I	\$138	\$186	\$265	\$320	\$387
RES DHYD-DLC	\$179	\$530	\$634	\$760	\$920
RES DHYD-Pricing	\$2	\$26	\$242	\$290	\$352
Total RES	\$180	\$557	\$876	\$1,050	\$1,272
Total Budget Midwest ISO	\$318	\$743	\$1,141	\$1,370	\$1,660

Table 4-8 shows the average cost per incremental kW saved for the demand response programs.

Table 4-8 Average Cost per kW Saved for Midwest ISO

Program	2010	2015	2020	2025	2030
C&I DTHR	\$47	\$54	\$63	\$73	\$85
C&I DHYD-DLC	\$80	\$93	\$108	\$125	\$145
C&I DHYD-Pricing	\$72	\$84	\$105	\$122	\$141
Average C&I (weighted average)	\$47	\$57	\$70	\$81	\$94
RES DHYD-DLC	\$190	\$220	\$255	\$295	\$343
RES DHYD-Pricing	\$98	\$113	\$132	\$152	\$177
Average RES (weighted average)	\$188	\$210	\$202	\$235	\$272
Average Cost Midwest ISO (weighted average)	\$82	\$125	\$140	\$162	\$188

4.2.1 Demand Response Results by Midwest ISO Region

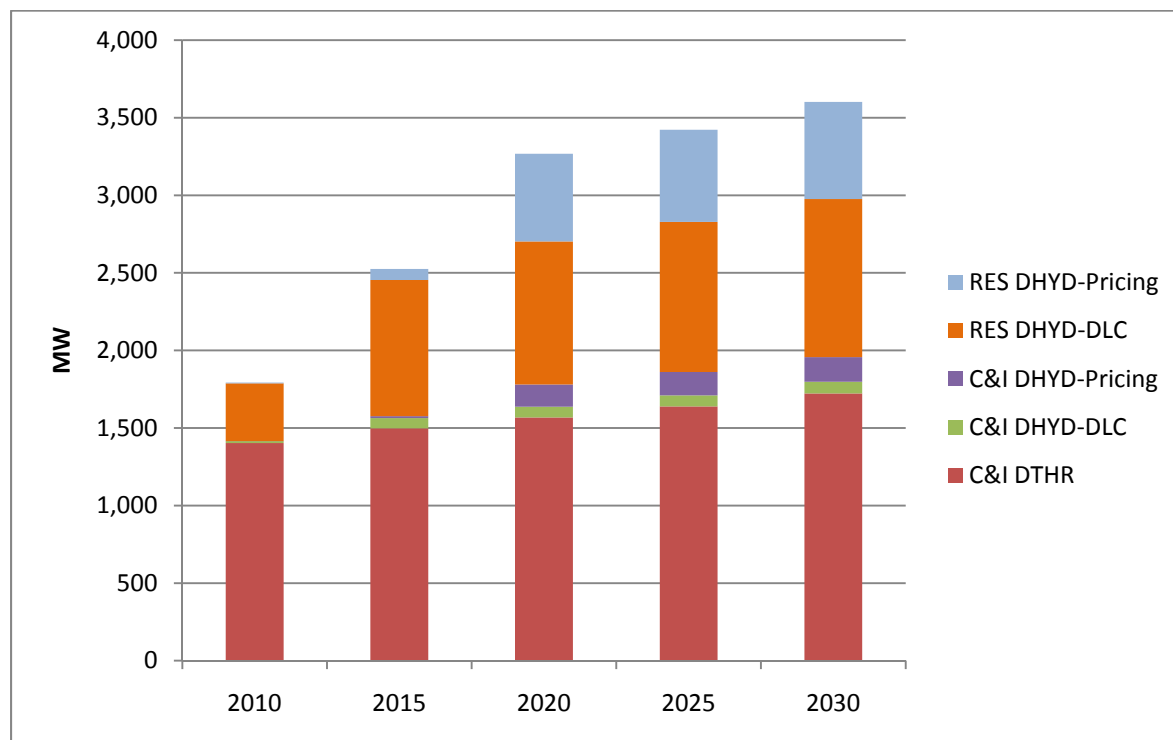
The following sections present more detailed results for each Midwest ISO region. Note that the dollar amounts shown are nominal dollars throughout the report.

4.2.1.1 West Region

The West Region currently gets the most demand savings from C&I Interruptible and Curtailable programs. As AMI is implemented, dynamic pricing is expected to grow, as well as direct load control.

Table 4-9 Demand Response Potential by Program for West Region (MW)

Program	2010	2015	2020	2025	2030
C&I DTHR	1,403	1,498	1,568	1,639	1,723
C&I DHYD-DLC	12	65	69	72	75
C&I DHYD-Pricing	1	13	144	150	158
Total C&I	1,416	1,576	1,781	1,861	1,956
RES DHYD-DLC	372	877	921	968	1,020
RES DHYD-Pricing	5	71	566	594	626
Total RES	377	948	1,487	1,562	1,646
Total DR West	1,793	2,525	3,268	3,423	3,602

Figure 4-3 Demand Response Savings for West Region (MW)**Table 4-10 Demand Response Program Budgets for West Region (\$ millions)**

Program	2010	2015	2020	2025	2030
C&I DTHR	\$82	\$102	\$124	\$150	\$183
C&I DHYD-DLC	\$1	\$6	\$7	\$9	\$11
C&I DHYD-Pricing	\$0	\$1	\$17	\$21	\$26
Total C&I	\$83	\$109	\$148	\$180	\$219
RES DHYD-DLC	\$71	\$193	\$235	\$286	\$349
RES DHYD-Pricing	\$0	\$8	\$74	\$91	\$111
Total RES	\$71	\$201	\$309	\$376	\$460
Total Budget West	\$154	\$310	\$458	\$556	\$679

Table 4-11 Average Cost per kW Saved for West Region

Program	2010	2015	2020	2025	2030
C&I DTHR	\$59	\$68	\$79	\$91	\$106
C&I DHYD-DLC	\$80	\$93	\$108	\$125	\$145
C&I DHYD-Pricing	\$72	\$84	\$120	\$139	\$161
Average C&I (weighted average)	\$59	\$69	\$83	\$97	\$112
RES DHYD-DLC	\$190	\$220	\$255	\$295	\$343
RES DHYD-Pricing	\$98	\$113	\$132	\$152	\$177
Average RES (weighted average)	\$189	\$212	\$208	\$241	\$279
Average Cost West (weighted average)	\$86	\$123	\$140	\$163	\$189

4.2.1.2 Central Region

The Central Region currently does not have significant demand response programs. However, that is expected to change throughout the study period. The growth in dynamic pricing and direct load control is larger than what is seen in the West region, which currently has more demand response programs.

Table 4-12 Demand Response Potential by Program for Central Region (MW)

Program	2010	2015	2020	2025	2030
C&I DTHR	656	695	727	762	799
C&I DHYD-DLC	10	53	55	58	61
C&I DHYD-Pricing	1	12	132	138	144
Total C&I	667	759	914	958	1,004
RES DHYD-DLC	163	664	685	708	748
RES DHYD-Pricing	6	86	691	714	754
Total RES	169	750	1,377	1,421	1,502
Total DR Central	836	1,509	2,291	2,379	2,506

Figure 4-4 Demand Response Savings for Central Region (MW)

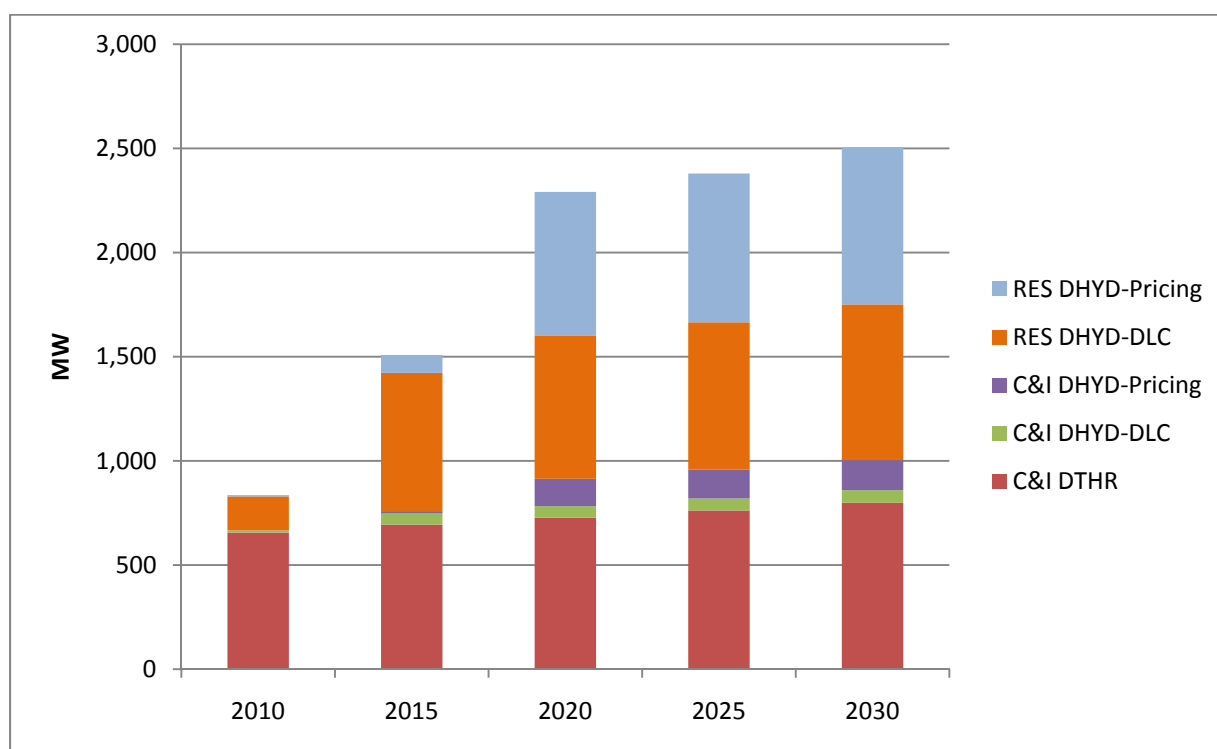


Table 4-13 Demand Response Program Budgets for Central Region (\$ millions)

Program	2010	2015	2020	2025	2030
C&I DTHR	\$20	\$25	\$30	\$37	\$45
C&I DHYD-DLC	\$1	\$5	\$6	\$7	\$9
C&I DHYD-Pricing	\$0	\$1	\$13	\$15	\$19
Total C&I	\$21	\$31	\$49	\$59	\$72
RES DHYD-DLC	\$31	\$146	\$175	\$209	\$256
RES DHYD-Pricing	\$1	\$10	\$91	\$109	\$133
Total RES	\$32	\$156	\$266	\$318	\$389
Total Budget Central	\$53	\$186	\$315	\$377	\$462

Table 4-14 Average Cost per kW Saved for Central Region

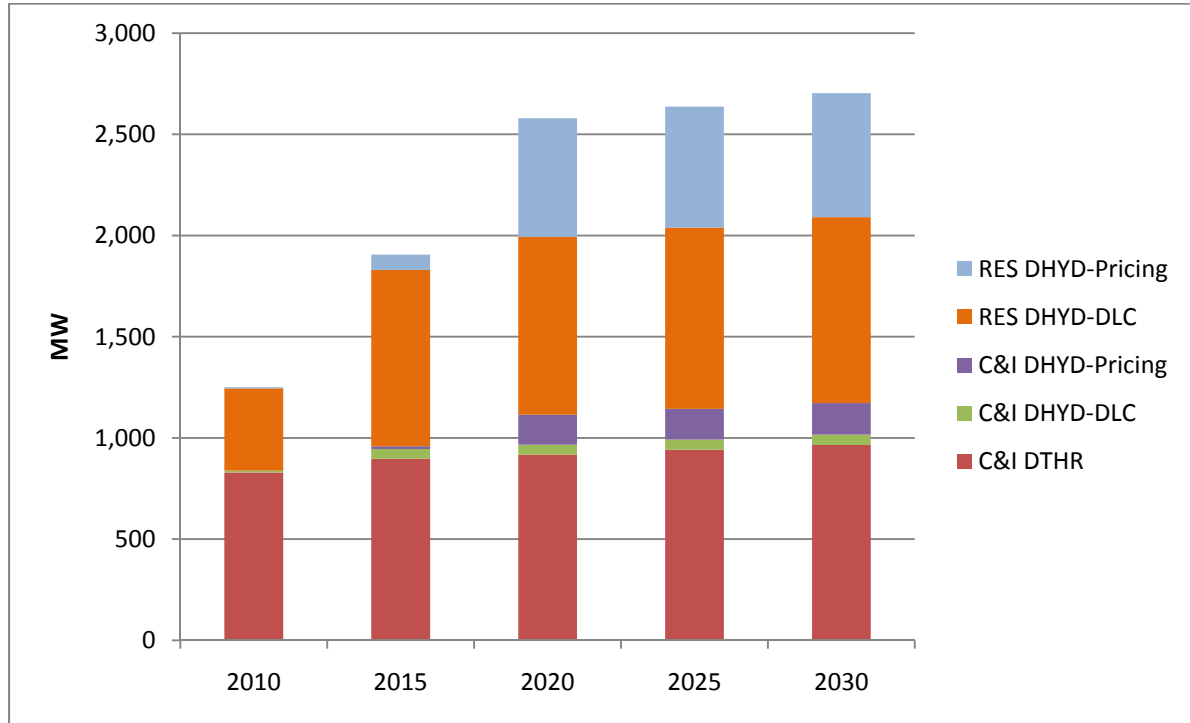
Program	2010	2015	2020	2025	2030
C&I DTHR	\$31	\$36	\$42	\$48	\$56
C&I DHYD-DLC	\$80	\$93	\$108	\$125	\$145
C&I DHYD-Pricing	\$72	\$84	\$97	\$112	\$130
Average C&I (weighted average)	\$32	\$41	\$54	\$62	\$72
RES DHYD-DLC	\$190	\$220	\$255	\$295	\$343
RES DHYD-Pricing	\$98	\$113	\$132	\$152	\$177
Average RES (weighted average)	\$186	\$208	\$193	\$224	\$259
Average Cost Central (weighted average)	\$63	\$124	\$137	\$159	\$184

4.2.1.3 East Region

The East Region currently has relatively few demand response programs, but is expected to increase its offerings through 2030. C&I Curtailable and Interruptible programs will remain flat, but dynamic pricing and direct load control are expected to increase as utilities install their AMI systems.

Table 4-15 Demand Response Potential by Program for East Region (MW)

Program	2010	2015	2020	2025	2030
C&I DTHR	829	897	917	941	965
C&I DHYD-DLC	9	48	49	50	52
C&I DHYD-Pricing	1	13	148	152	156
Total C&I	838	959	1,114	1,144	1,172
RES DHYD-DLC	407	871	879	896	919
RES DHYD-Pricing	5	76	586	597	612
Total RES	412	947	1,465	1,493	1,531
Total DR East	1,251	1,906	2,580	2,637	2,703

Figure 4-5 Demand Response Savings for East Region (MW)**Table 4-16 Demand Response Program Budgets for East Region (\$ millions)**

Program	2010	2015	2020	2025	2030
C&I DTHR	\$32	\$41	\$48	\$57	\$68
C&I DHYD-DLC	\$1	\$4	\$5	\$6	\$7
C&I DHYD-Pricing	\$0	\$1	\$14	\$17	\$20
Total C&I	\$33	\$46	\$68	\$81	\$96
RES DHYD-DLC	\$77	\$192	\$224	\$265	\$315
RES DHYD-Pricing	\$1	\$9	\$77	\$91	\$108
Total RES	\$78	\$200	\$301	\$356	\$423
Total Budget MISO East	\$111	\$246	\$369	\$437	\$519

Table 4-17 Average Cost per kW Saved for East Region

Program	2010	2015	2020	2025	2030
C&I DTHR	\$39	\$45	\$53	\$61	\$71
C&I DHYD-DLC	\$80	\$93	\$108	\$125	\$145
C&I DHYD-Pricing	\$72	\$84	\$97	\$112	\$130
Average C&I (weighted average)	\$40	\$48	\$61	\$71	\$82
RES DHYD-DLC	\$190	\$220	\$255	\$295	\$343
RES DHYD-Pricing	\$98	\$113	\$132	\$152	\$177
Average RES (weighted average)	\$188	\$211	\$206	\$238	\$276
Average Cost East (weighted average)	\$89	\$129	\$143	\$166	\$192

4.3 ENERGY EFFICIENCY FOR MIDWEST ISO

The following sections present the results of the energy efficiency analysis for the Midwest ISO as a whole and by region. Table 4-18 and Table 4-19 show the cumulative energy and demand savings potential due to energy-efficiency programs within the Midwest ISO.

Cumulative energy savings due to energy-efficiency programs are projected to be over 57,700 GWh (over 10% of baseline energy consumption) by 2030. Cumulative demand savings due to energy-efficiency programs are projected to be over 11 GW (over 9% of baseline demand) by 2030.

- The West Region currently provides the most energy and demand savings, but by 2015, the Central region will account for the largest amount of savings. This result is consistent with the fact that utilities in the West Region have established experience in the implementation of energy-efficiency programs while utilities in the Central Region do not have as much experience, but are generally ramping up energy-efficiency efforts. However, the Central Region is expected to surpass the West Region in terms of capturing more savings relative to the baseline. Cumulative energy savings will be almost 12% of the baseline for the Central Region by 2030, whereas that of the West Region will be about 9%.
- The East Region is expected to lag behind both the West and Central Regions due to the minimal level of existing program experience and slower ramp-up of energy-efficiency efforts.

Table 4-18 Energy Efficiency Potential– Cumulative Energy Savings for Midwest ISO

Region	Cumulative Energy Savings (GWh)					Percentage of Baseline				
	2010	2015	2020	2025	2030	2010	2015	2020	2025	2030
West	1,351	9,658	16,078	18,566	19,872	0.8%	5.3%	8.5%	9.3%	9.4%
Central	751	10,063	18,500	21,605	22,923	0.4%	5.8%	10.2%	11.5%	11.5%
East	400	6,490	12,432	14,272	14,979	0.2%	3.7%	6.9%	7.6%	7.7%
Total Midwest ISO	2,502	26,211	47,010	54,443	57,774	0.5%	5.0%	8.5%	9.4%	9.6%

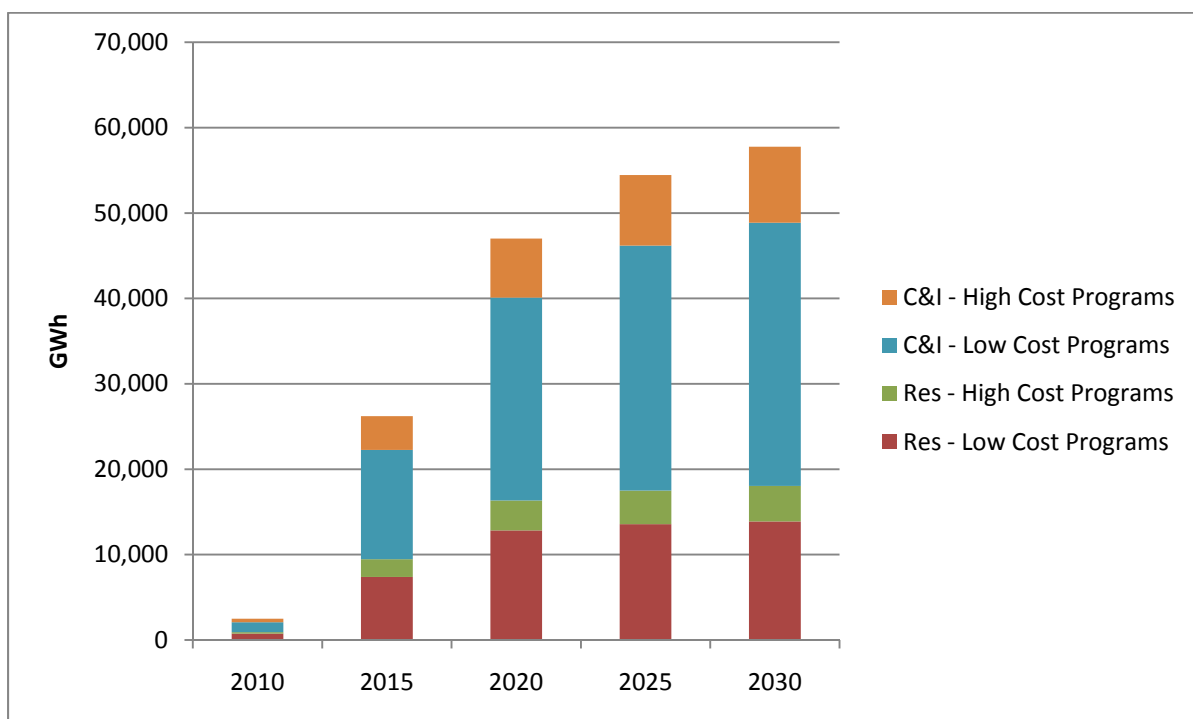
Table 4-19 Energy Efficiency Potential– Cumulative Peak Demand Savings for Midwest ISO

Region	Cumulative Demand Savings (MW)					Percentage of Baseline				
	2010	2015	2020	2025	2030	2010	2015	2020	2025	2030
West	260	1,878	3,139	3,587	3,824	0.8%	5.2%	8.3%	9.1%	9.2%
Central	157	2,074	3,755	4,332	4,578	0.5%	5.9%	10.2%	11.3%	11.4%
East	77	1,261	2,391	2,706	2,831	0.2%	3.3%	6.2%	6.8%	7.0%
Total Midwest ISO	493	5,213	9,285	10,625	11,233	0.5%	4.8%	8.2%	9.2%	9.2%

Table 4-20 and Table 4-21 show the cumulative energy and demand savings potential by the four program cost blocks. These savings are graphically presented in Figure 4-6 and Figure 4-7. The C&I Low Cost Programs account for the largest portion of the total savings. Residential Low Cost Programs and C&I High Cost Programs also contribute a significant amount of savings, while Residential High Cost Programs account for a relatively small portion of the total savings in the Midwest ISO.

Table 4-20 Energy Efficiency Potential – Cumulative Energy Savings by Program Cost Category (GWh)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	747	7,382	12,831	13,572	13,891
Residential - High Cost Programs	179	2,074	3,506	3,938	4,153
Total Residential Programs	926	9,456	16,337	17,510	18,043
C&I - Low Cost Programs	1,157	12,812	23,765	28,680	30,823
C&I - High Cost Programs	419	3,943	6,907	8,253	8,907
Total C&I Programs	1,576	16,755	30,673	36,933	39,730
Total Midwest ISO	2,502	26,211	47,010	54,443	57,774

Figure 4-6 Energy Efficiency Potential – Cumulative Energy Savings by Program Cost Category**Table 4-21 Energy Efficiency – Cumulative Demand Savings in Midwest ISO by Program Cost (MW)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	176	1,808	3,175	3,365	3,446
Residential - High Cost Programs	44	525	893	1,003	1,058
Total Residential Programs	220	2,334	4,068	4,368	4,505
C&I - Low Cost Programs	200	2,188	4,008	4,815	5,172
C&I - High Cost Programs	73	691	1,208	1,442	1,556
Total C&I Programs	273	2,879	5,216	6,257	6,729
Total Midwest ISO	493	5,213	9,285	10,625	11,233

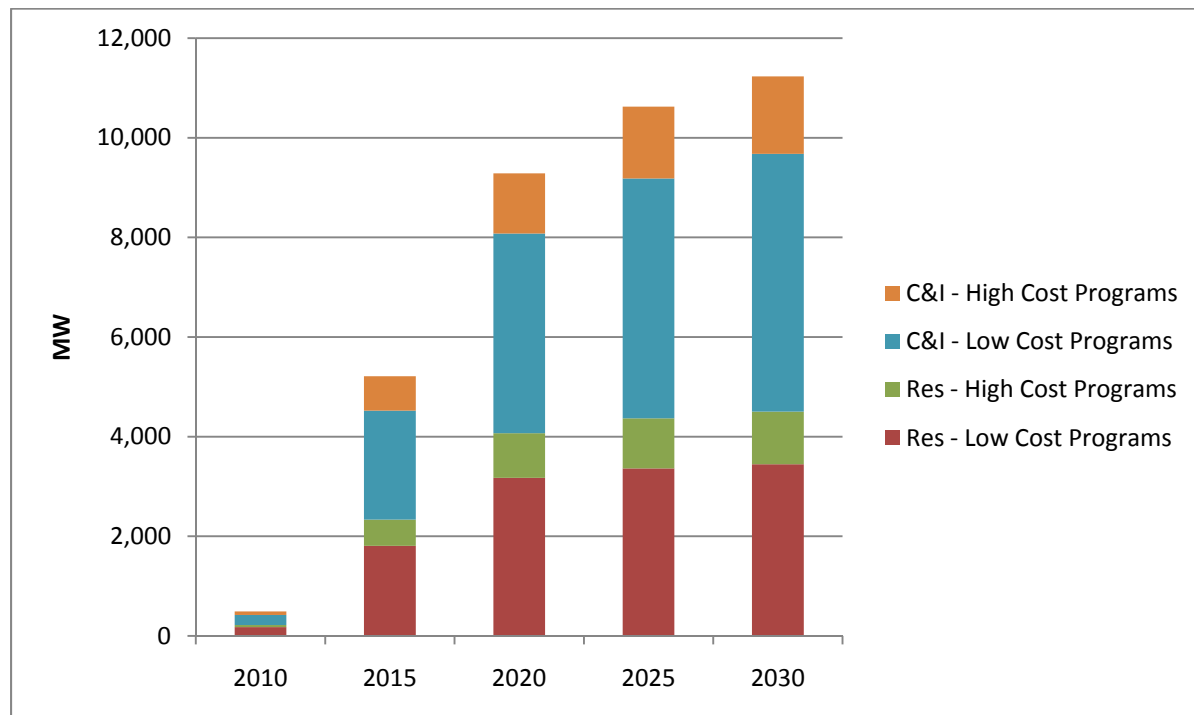
Figure 4-7 Energy Efficiency – Cumulative Demand Savings in Midwest ISO (by Program Cost)

Table 4-22 shows the estimate of the budget associated with achieving the incremental savings from the energy-efficiency programs. During the 2010-2020 timeframe, the annual program budget requirements ramp up during the first portion of the period and then decline during the latter portion of the period. The ramping up corresponds to the expected increase in energy-efficiency program implementation and activities during the next several years. The energy-efficiency program spending will start to decline as more customers participate and the market for energy-efficiency technologies approaches saturation limits.

Table 4-22 Energy Efficiency – Program Budget Requirement for Midwest ISO (\$ millions)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$114	\$237	\$98	\$22	\$11
Residential - High Cost Programs	\$71	\$241	\$106	\$46	\$27
Total Residential Programs	\$185	\$478	\$204	\$68	\$38
C&I - Low Cost Programs	\$120	\$346	\$230	\$110	\$58
C&I - High Cost Programs	\$177	\$372	\$227	\$122	\$74
Total C&I Programs	\$296	\$718	\$456	\$232	\$132
Total Midwest ISO	\$481	\$1,196	\$660	\$300	\$170

Table 4-23 shows the average cost per kWh saved for the energy-efficiency programs. The values show an increasing trend over time since the “low-hanging fruits” are captured in the early portion of the forecast horizon and utilities are left with increasingly difficult segments of the market to achieve savings during the latter portion of the forecast.

Table 4-23 Energy Efficiency – Average Cost per kWh Saved for Midwest ISO

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$0.15	\$0.16	\$0.18	\$0.21	\$0.24
Residential - High Cost Programs	\$0.40	\$0.55	\$0.61	\$0.73	\$0.83
Total Residential Programs (weighted average)	\$0.20	\$0.24	\$0.28	\$0.41	\$0.49
C&I - Low Cost Programs	\$0.10	\$0.12	\$0.14	\$0.16	\$0.19
C&I - High Cost Programs	\$0.42	\$0.45	\$0.54	\$0.63	\$0.74
Total C&I Programs (weighted average)	\$0.19	\$0.20	\$0.22	\$0.27	\$0.32
Total Midwest ISO (weighted average)	\$0.19	\$0.21	\$0.24	\$0.29	\$0.35

4.3.1 Energy Efficiency Results by Midwest ISO Region

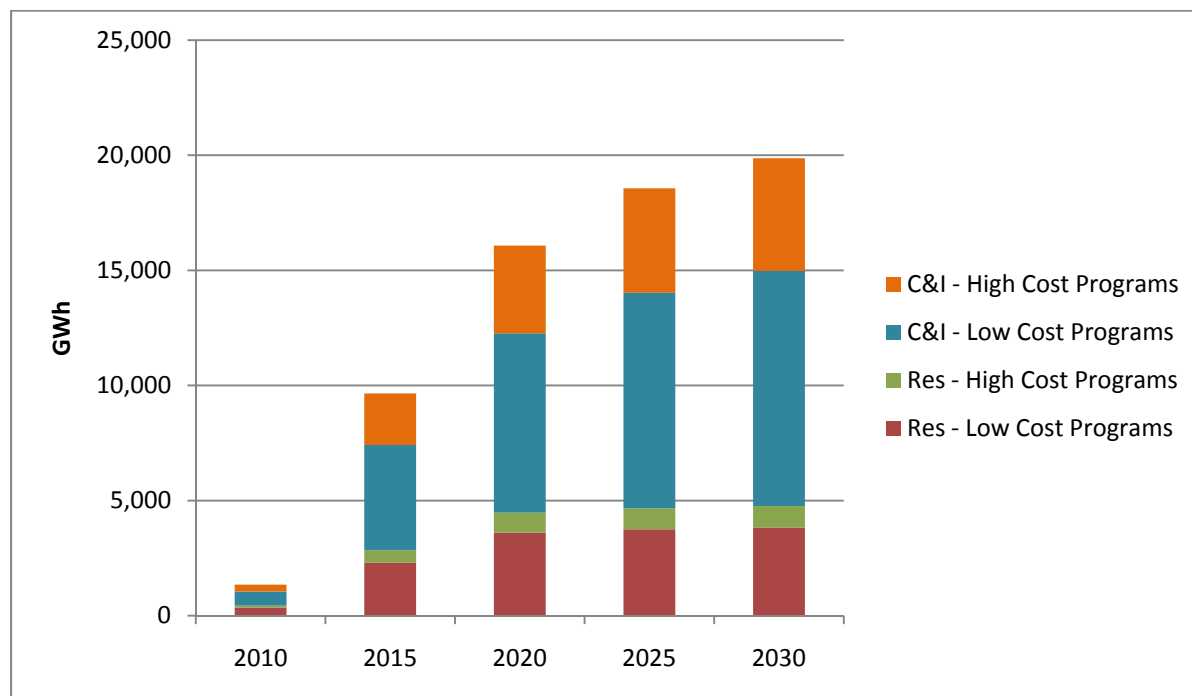
The following sections present more detailed results for each Midwest ISO region. Note that the dollar amounts shown are nominal dollars throughout the report.

4.3.1.1 West Region

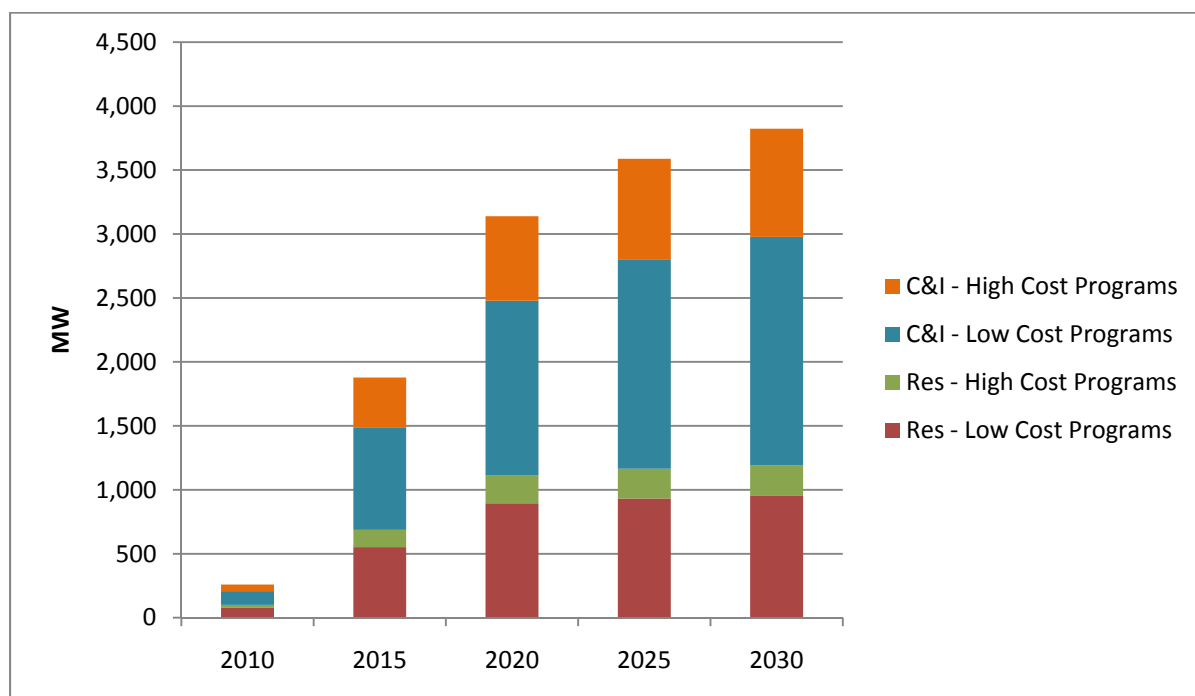
The West Region is generally characterized by utilities having the most experience in energy-efficiency program implementation and achieving program impacts. For many of the utilities in this region, energy-efficiency programs have been established and in place for a number of years. The following figures and tables show that cumulative energy savings will reach almost 20,000 GWh (over 9% of baseline) by 2030, and cumulative demand savings will reach over 3,800 MW (over 9% of baseline) by 2030.

Table 4-24 Energy Efficiency Potential – Cumulative Energy Savings by Program Cost Category for West Region (GWh)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	358	2,302	3,609	3,755	3,831
Residential - High Cost Programs	80	543	868	912	933
Total Residential Programs	438	2,844	4,477	4,667	4,764
C&I - Low Cost Programs	613	4,573	7,788	9,362	10,216
C&I - High Cost Programs	300	2,241	3,813	4,538	4,893
Total C&I Programs	913	6,813	11,601	13,900	15,109
Total Midwest ISO	1,351	9,658	16,078	18,566	19,872

Figure 4-8 Energy Efficiency Potential – Cumulative Energy Savings in West Region (GWh)**Table 4-25 Energy Efficiency – Cumulative Demand Savings in West Region by Program Cost (MW)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	81	552	894	932	952
Residential - High Cost Programs	19	135	221	233	238
Total Residential Programs	100	687	1,115	1,165	1,190
C&I - Low Cost Programs	107	802	1,363	1,638	1,787
C&I - High Cost Programs	52	390	660	785	846
Total C&I Programs	160	1,191	2,024	2,423	2,634
Total Midwest ISO	260	1,878	3,139	3,587	3,824

Figure 4-9 Energy Efficiency – Cumulative Demand Savings in West Region (MW)**Table 4-26 Energy Efficiency – Program Budget Requirement for West Region (\$ millions)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$67	\$80	\$32	\$6	\$4
Residential - High Cost Programs	\$22	\$29	\$12	\$3	\$2
Total Residential Programs	\$88	\$109	\$44	\$9	\$5
C&I - Low Cost Programs	\$61	\$99	\$63	\$37	\$24
C&I - High Cost Programs	\$135	\$219	\$138	\$73	\$44
Total C&I Programs	\$196	\$318	\$200	\$110	\$68
Grand Total	\$284	\$427	\$244	\$119	\$74

Table 4-27 Energy Efficiency – Average Cost per kWh Saved for West Region

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$0.19	\$0.22	\$0.25	\$0.29	\$0.34
Residential - High Cost Programs	\$0.27	\$0.31	\$0.36	\$0.42	\$0.49
Total Residential Programs (weighted average)	\$0.20	\$0.24	\$0.27	\$0.32	\$0.37
C&I - Low Cost Programs	\$0.10	\$0.11	\$0.13	\$0.15	\$0.18
C&I - High Cost Programs	\$0.45	\$0.52	\$0.60	\$0.70	\$0.81
Total C&I Programs (weighted average)	\$0.21	\$0.25	\$0.29	\$0.32	\$0.36
Grand Total (weighted average)	\$0.21	\$0.24	\$0.28	\$0.32	\$0.36

4.3.1.2 Central Region

The Central Region is generally characterized by utilities that are relatively new to energy-efficiency program implementation. However, utilities in this region are planning and/or are mandated to aggressively pursue energy-efficiency in the future. The following figures and tables show that cumulative energy savings will reach almost 23,000 GWh (11.5% of baseline) by 2030, and cumulative demand savings will reach almost 4,600 MW (11.4% of baseline) by 2030.

Table 4-28 Energy Efficiency Potential – Cumulative Energy Savings by Program Cost Category for Central Region (GWh)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	245	2,987	5,294	5,721	5,869
Residential - High Cost Programs	78	1,175	2,042	2,346	2,501
Total Residential Programs	324	4,161	7,336	8,067	8,370
C&I - Low Cost Programs	383	5,449	10,301	12,467	13,359
C&I - High Cost Programs	44	453	863	1,071	1,193
Total C&I Programs	427	5,902	11,164	13,538	14,553
Grand Total	751	10,063	18,500	21,605	22,923

Figure 4-10 Energy Efficiency Potential – Cumulative Energy Savings in Central Region (GWh)

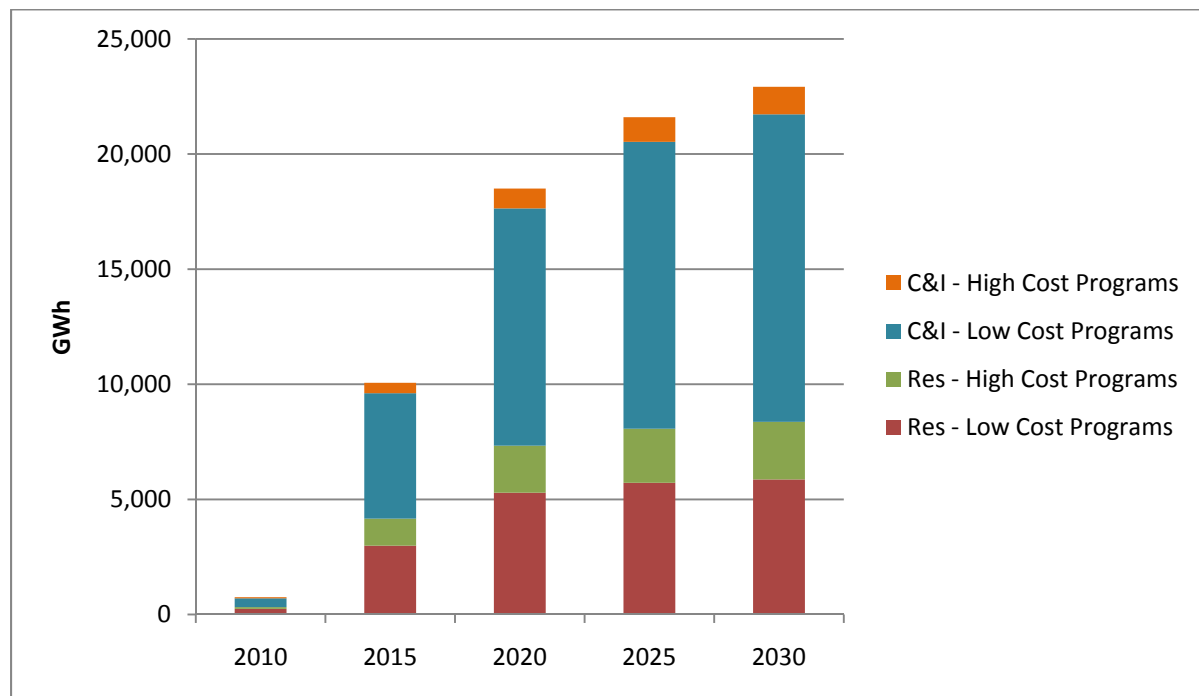
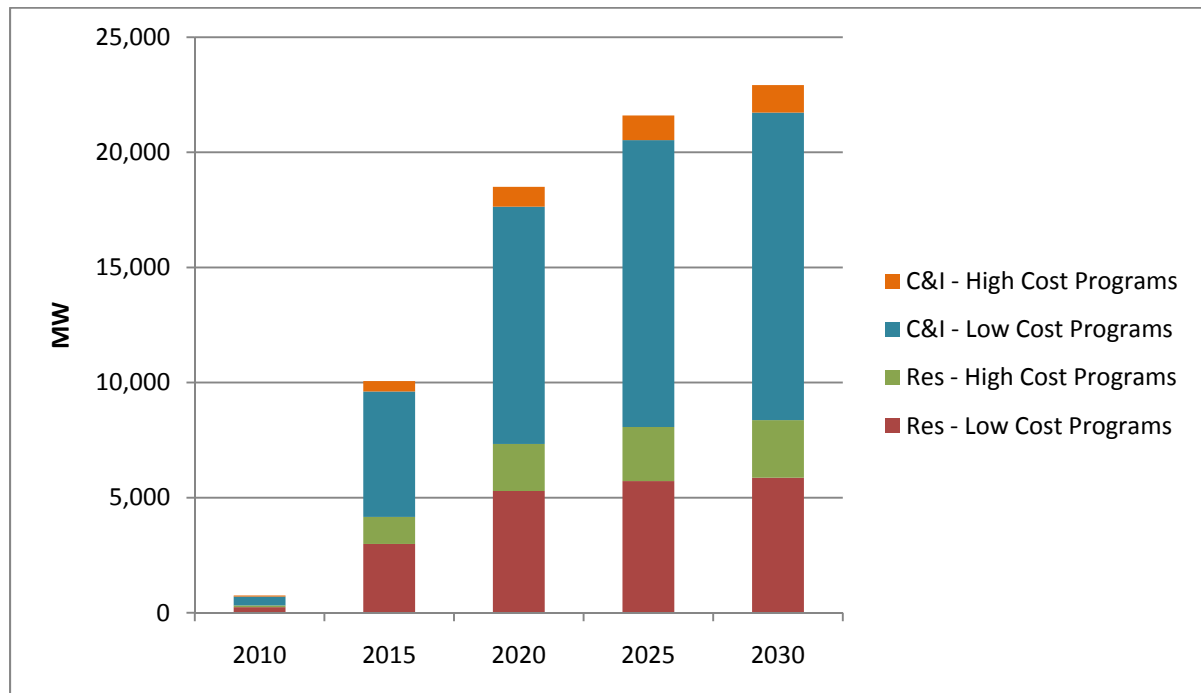


Table 4-29 Energy Efficiency – Cumulative Demand Savings in Central Region by Program Cost (MW)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	63	758	1,339	1,448	1,486
Residential - High Cost Programs	20	300	522	600	639
Total Residential Programs	83	1,058	1,861	2,048	2,126
C&I - Low Cost Programs	66	934	1,739	2,092	2,239
C&I - High Cost Programs	8	81	155	192	213
Total C&I Programs	74	1,015	1,894	2,284	2,453
Grand Total	157	2,074	3,755	4,332	4,578

Figure 4-11 Energy Efficiency – Cumulative Demand Savings in Central Region (MW)**Table 4-30 Energy Efficiency – Program Budget Requirement for Central Region (\$ millions)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$36	\$114	\$48	\$12	\$5
Residential - High Cost Programs	\$22	\$87	\$42	\$20	\$12
Total Residential Programs	\$58	\$200	\$89	\$32	\$17
C&I - Low Cost Programs	\$44	\$170	\$111	\$52	\$25
C&I - High Cost Programs	\$21	\$55	\$38	\$24	\$17
Total C&I Programs	\$64	\$226	\$149	\$75	\$43
Grand Total	\$122	\$426	\$239	\$107	\$60

Table 4-31 Energy Efficiency – Average Cost per kWh Saved for Central Region

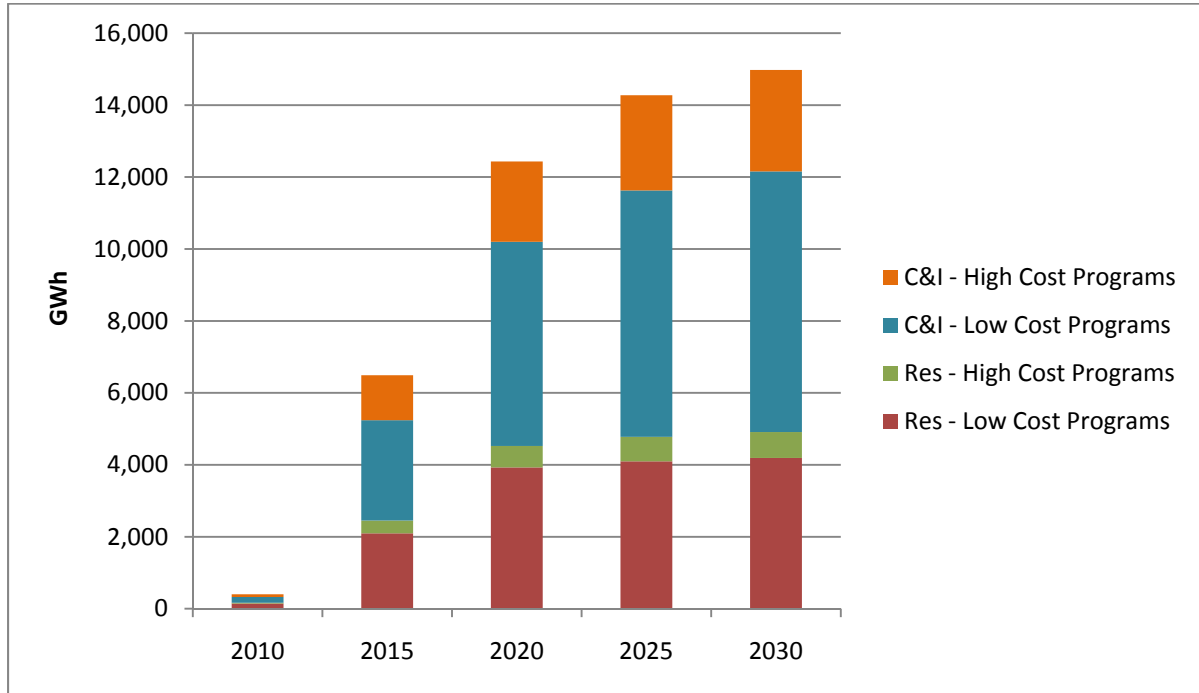
Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$0.15	\$0.17	\$0.20	\$0.23	\$0.27
Residential - High Cost Programs	\$0.28	\$0.33	\$0.38	\$0.44	\$0.51
Total Residential Programs (weighted average)	\$0.18	\$0.22	\$0.25	\$0.33	\$0.40
C&I - Low Cost Programs	\$0.11	\$0.13	\$0.15	\$0.18	\$0.21
C&I - High Cost Programs	\$0.47	\$0.54	\$0.63	\$0.73	\$0.84
Total C&I Programs (weighted average)	\$0.15	\$0.16	\$0.19	\$0.23	\$0.30
Grand Total (weighted average)	\$0.16	\$0.18	\$0.21	\$0.25	\$0.32

4.3.1.3 East Region

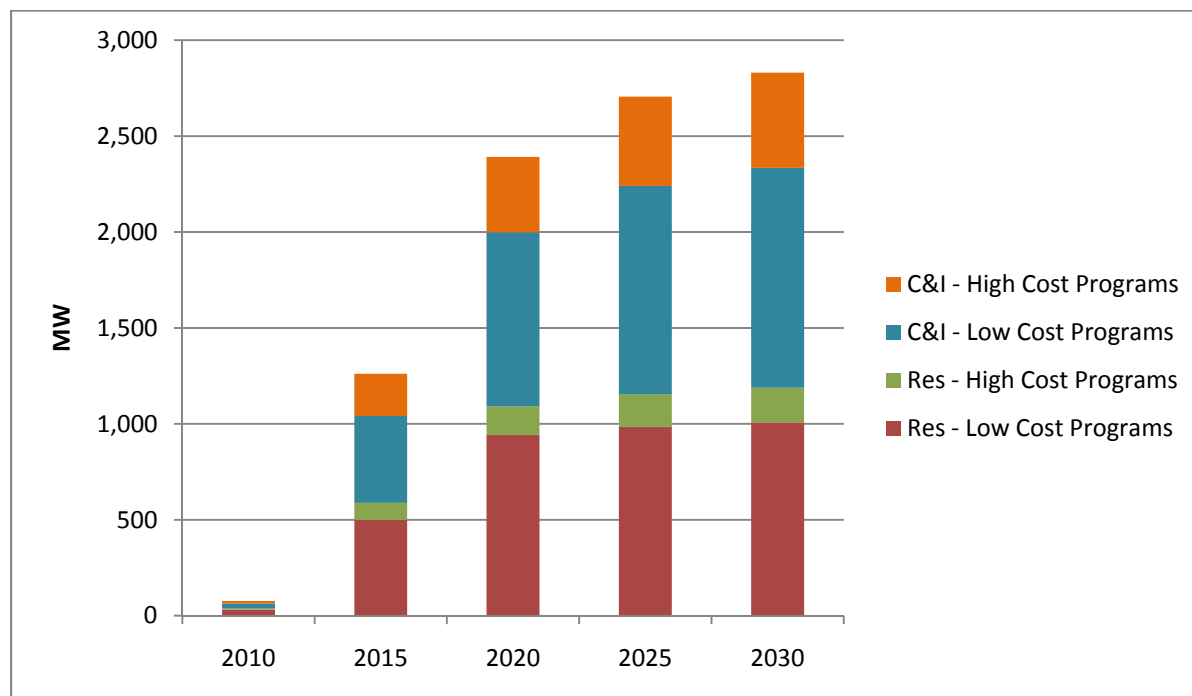
The East Region is generally characterized by utilities that generally do not have significant experience with energy-efficiency program implementation and/or are not required to achieve specific energy-efficiency goals. The following figures and tables show that cumulative energy savings will reach almost 15,000 GWh (over 7% of baseline) by 2030, and cumulative demand savings will reach over 2,800 MW (7% of baseline) by 2030.

Table 4-32 EE Potential – Cumulative Energy Savings by Program Cost Category for East Region (GWh)

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	144	2,094	3,928	4,096	4,191
Residential - High Cost Programs	21	357	596	680	719
Total Residential Programs	165	2,450	4,525	4,777	4,910
C&I - Low Cost Programs	161	2,790	5,676	6,851	7,248
C&I - High Cost Programs	74	1,249	2,232	2,644	2,821
Total C&I Programs	236	4,040	7,907	9,496	10,069
Grand Total	400	6,490	12,432	14,272	14,979

Figure 4-12 Energy Efficiency – Cumulative Energy Savings in East Region (GWh)**Table 4-33 Energy Efficiency – Cumulative Demand Savings in East Region (by Program Cost) (MW)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	32	499	942	984	1,008
Residential - High Cost Programs	5	90	150	171	181
Total Residential Programs	38	588	1,092	1,155	1,189
C&I - Low Cost Programs	26	453	906	1,085	1,146
C&I - High Cost Programs	13	220	393	465	496
Total C&I Programs	39	673	1,299	1,551	1,642
Grand Total	77	1,261	2,391	2,706	2,831

Figure 4-13 Energy Efficiency – Cumulative Demand Savings in East Region (MW)**Table 4-34 Energy Efficiency – Program Budget Requirement for East Region (\$ millions)**

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$11	\$43	\$18	\$3	\$2
Residential - High Cost Programs	\$27	\$125	\$52	\$24	\$14
Total Residential Programs	\$39	\$168	\$70	\$27	\$16
C&I - Low Cost Programs	\$15	\$77	\$55	\$22	\$8
C&I - High Cost Programs	\$21	\$97	\$51	\$25	\$13
Total C&I Programs	\$37	\$174	\$107	\$47	\$21
Grand Total	\$75	\$343	\$177	\$74	\$37

Table 4-35 Energy Efficiency – Average Cost per kWh Saved for East Region

Cost Block	2010	2015	2020	2025	2030
Residential - Low Cost Programs	\$0.08	\$0.09	\$0.10	\$0.12	\$0.14
Residential - High Cost Programs	\$1.31	\$1.52	\$1.76	\$2.04	\$2.37
Total Residential Programs (weighted average)	\$0.23	\$0.30	\$0.34	\$0.71	\$0.76
C&I - Low Cost Programs	\$0.10	\$0.11	\$0.13	\$0.15	\$0.17
C&I - High Cost Programs	\$0.29	\$0.33	\$0.38	\$0.44	\$0.51
Total C&I Programs (weighted average)	\$0.16	\$0.18	\$0.19	\$0.23	\$0.29
Grand Total (weighted average)	\$0.19	\$0.22	\$0.23	\$0.31	\$0.39

4.4 COMPARISON OF RESULTS

The results of this study were compared with a few recent similar studies.

4.4.1 Demand Response

For demand response we compared our results to the FERC National Assessment of Demand Response and the AmerenUE DSM Potential Assessment (2010). The FERC National Study included regional estimates for 2019. Therefore, we compared the Midwest ISO result for 2020 to the FERC Study's Midwest region. In 2020, this study shows that demand response for the Midwest ISO is 7.6% of peak baseline. The FERC Study included results for three scenarios:

- Business-as-Usual= 4 to 5.5%
- Expanded Business-as-Usual=8.5% to 9.5%
- Achievable Participation= 12.5% to 14.5%

The assumptions made for this study most closely resemble the Expanded Business-as-Usual scenario.

The AmerenUE DSM Potential Assessment, completed in January 2010, shows realistic achievable potential in 2030 at 10% of the peak baseline. In comparison, our estimates of 7.6% are slightly more conservative.

4.4.2 Energy Efficiency

This study estimates the realistic achievable savings from energy efficiency for the entire Midwest ISO area will be 0.5% of the baseline energy in 2010 and 9.7% in 2030. For the residential sector, the savings in 2010 are 0.2% of the baseline forecast and 3.2% in 2030. For the C&I sector, the savings in 2010 are 0.3% of the baseline forecast and in 2030 the savings are 7.0% of the baseline forecast.

For comparison, we looked at the EPRI Study, the AmerenUE DSM Potential Assessment, Energy Center of Wisconsin study, and McKinsey Study.

- The EPRI National Study reported realistic achievable potential for the Midwest Census region to be 0.5% in the first year, and 7.5% of baseline in 20 years. For the Residential sector the EPRI National study shows 0.8% savings in the first year and 7.0% in 20 years. For the C&I sector, the EPRI National study, shows realistic achievable potential in the Midwest region is 0.3% in the first year and 7.8% in year 20.
- The AmerenUE DSM Potential Assessment study also uses realistic achievable within the state of Missouri. In the AmerenUE study, the impact from energy efficiency is expected to be 7.3% overall in year 20.
- The Energy Center of Wisconsin (ECW) did a study of achievable potential for the state of Wisconsin. In the tenth year, the ECW study shows achievable potential of 13.0%, while this study shows realistic achievable of 8.9% in the tenth year.
- The McKinsey study looked at economic potential for the entire United States and came up with an estimate of 23.0% impact from energy efficiency in the tenth year. Economic potential does not take into consideration consumer preferences, so it is expected to be higher than estimates of realistic achievable potential.

The estimates from this study are in line with the EPRI and AmerenUE studies, but lower than the ECW and McKinsey studies.

ABOUT GLOBAL

Established in 1998, Global Energy Partners, LLC is a premier provider of energy and environmental engineering and technical services to utilities, energy companies, research organizations, government/regulatory agencies and private industry.

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