# Demand Response and AMI Assessment Report: What's New Since 2008?

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## ABSTRACT

Many utilities and regulatory agencies have identified the functionality for managing electric loads for reliability and economic dispatch (in addition to operation and maintenance improvements) as a key aspect of their business cases to justify their adoption of Advanced Metering technology. As entities continue to deploy AMI technology (even more so with the availability of funding via American Recovery and Reinvestment Act) we will continue to see an increase in potential demand resources derived from incentive and time-based demand response (DR) programs. As DR as a resource continues to grow, there is an effort to ensure the comparable treatment of DR resources in wholesale markets. In March 2010, a Notice of Proposed Rulemaking (NOPR) was issued proposing that DR providers in organized energy markets be compensated at the full market price in all hours in which DR resources are provided in response to price signals. In March of 2011, the NOPR was further refined by FERC Order 745, which mandated ISO/RTOs to compensate dispatched demand response resources' locational marginal price (LMP) when deploying demand response results in an overall savings to the customer base served by the market according to a net benefits test. This requirement will further spur the need for evaluators to accurately quantify and track resource contributions from DR programs. This paper reports on work KEMA Inc., completed on behalf of FERC for the recently released 2010 Assessment of Demand Response and Advanced Metering Staff Report. KEMA's work for this study provides details on penetration and saturation of AMI resources along with estimates of demand response resources on a state-by-state and regional basis that will enable evaluators the ability to identify and quantify recent trends regarding AMI and DR resources in targeted territories.

## Introduction

The 2010 Assessment of Demand Response and Advanced Metering Infrastructure (AMI) Report documents the third survey conducted in compliance with; *The Energy Policy Act of 2005 (EPAct 2005) that requires preparation of pertinent data and publishing an annual report that evaluates the progression of technology and practices which increase reliability in the electric system, specifically deployment of advanced metering and implementation of demand response programs*[1]. EPAct 2005 expressly requires the FERC to quantify and review:

(A) saturation and penetration rates of advanced meters and communications technologies, devices, and systems;

(B) existing demand response programs and time-based rate programs;

(C) the annual resource contribution of demand resources;

(D) the potential for demand response as a quantifiable, reliable resource for regional planning purposes;

[1] Energy Policy Act of 2005, Pub. L. No. 109-58, §1252(e) (3), 119 Stat/ 594 (2005) (EPAct 2005 section 1252(e) (3)).

(E) steps taken to ensure that, in regional transmission planning and operations, demand resources are provided equitable treatment as a quantifiable, reliable resource relative to the resource obligations of any load-serving entity, transmission provider, or transmitting party; and

(F) regulatory barriers to improved customer participation in demand response, peak reduction, and critical period pricing programs.

In response to EPAct 2005, FERC prepares and publishes an annual report that assesses, by appropriate region, electricity and demand resources among private and public entities that provide electric power. In support of the report FERC conducts a comprehensive nationwide survey bi-annually among electricity providers. FERC also provides an update based on publicly available information and discussions with market participants and industry experts during the intervening years. This paper will focus on the work KEMA Inc. completed towards addressing items (A) through (D) of the EPAct 2005, namely the saturation, penetration of AMI meters and quantifying demand response resources.

FERC conducted the first comprehensive survey in 2006 and the second in 2008. The 2010 report represents the third FERC survey and provides a time-series comparison to the two previous studies. The targeted populations for the DR and AMI Assessment survey are respondents to the Energy Information Administration (EIA) Form EIA-861. By targeting this group, FERC can leverage their responses to the EIA Form-861 for weighting and quality control purposes. The EIA population primarily consists of Investor-owned Utilities (IOUs), Cooperatives, and Municipalities. FERC also included Regional Transmission Organizations, Independent System Operators., and customer service providers. FERC sent the voluntary surveys via email to 3,454 entities and a total of 1755 entities responded. These responses represent 112 million electricity customers (77 percent) out of 145 million electricity customers nationally.

The goal of the survey was to collect responses that estimate the saturation and penetration rates of AMI by entity-type, electric customer category, by state and by NERC region. It also provides estimates on current DR program offerings by program, entity-type, customer category, and by state and NERC region. These results present changes in saturation and penetration over time and allow for comparisons of advancement of AMI. More importantly, the survey also provides estimates of annual resource contribution from DR and time-based rate DR programs and analyzes the potential for DR as a quantifiable, reliable resource.

## Methodology

FERC contracted with Z, INC. to carry out the data collection; and Z subcontracted with KEMA Inc. to conduct the analysis and reporting of survey results and technological developments in the electricity industry related to AMI and DR. FERC provided oversight of all activities and provided discussions regarding state and federal regulatory changes and barriers to demand response. FERC and its contractors initiated the survey during the first half of 2010. The voluntary survey requested responses covering entity status as of 2009. The survey solicited general information about the respondent; the number of advanced meters and the number of total meters; existing demand response and time-based rate programs, including their current level of resource contributions, and near and medium-term plans for new demand response programs. The 2010 report includes a comparison of the survey results from the 2008 and 2006 reports that reported on survey results in 2007 and 2005 respectively.

As stated earlier, FERC sent the survey to 3,454 entities in all 50 states and representing all aspects of the electricity delivery industry: investor-owned utilities, municipal utilities, rural electric cooperatives,

power marketers, state and federal agencies, and demand response providers.[2] A total of 1,755 entities responded to the 2010 Survey, a response rate of over 52 percent. For comparison, the 2008 Survey response rate was 60 percent for advanced metering and 55 percent for demand response.

Z INC. distributed the survey through a mass e-mailing. The email included an introduction to the survey, directions, glossary and the survey in a PDF format that allowed the respondents to enter responses directly on the form. This was a departure from the 2008 survey where respondents completed an online survey. The respondents emailed the completed survey form to an email account set up specifically for the survey collection. Respondents without internet access or with non-functional email accounts received the survey via postal mail to make sure they had a chance to respond. The data collection process included reminder emails and follow-up phone calls to statistically relevant sample strata that tend to have lower response rates in previous surveys, (in this case mostly larger companies.) In all, Z, INC. made followup phone calls to more than 1,200 individual companies.

The survey required separate responses for each entity serving retail electricity customers, and completion of separate responses from entities such as RTOs and Generation &Transmission coops serving wholesale customers with demand response programs. Z INC., created a database that included the EIA-861 data and FERC's records, linked to the surveys in order to run data checks and data cleaning as needed.

**Survey and Sampling Design**

The survey instrument while appearing to be fairly simple with only nine questions, proved to be challenging when it came to the analysis. The survey design consists of nine questions organized into three sections. The three sections include one parent section where there should only be one response per utility; an AMI section, and a section for retail and wholesale demand response and time-based programs. For the latter section, retail entities and aggregators could report if they had demand response and time-based programs whose potential also serves a regional entity such as an ISO or RTO. Conversely, a regional entity could provide responses on their wholesale demand response programs that sometimes include the utility-operated or aggregator demand response programs (that the utility or aggregator also included in their survey). This created a major concern for double-counting responses. The survey also included provisions for estimating the amount of electric load that is callable via demand response (i.e., potential demand response) and the actual load reductions during 2009 (i.e., realized demand response). Below are the nine questions included in the survey.

<u>Parent record (only one record per Utility)</u>

1. Utility ID, company name, ownership type and survey contact information.
2. Advanced (AMI) and total meter counts by State and customer class
3. Number of retail customers and meters by NERC region and customer class (optional, skip if there are demand response programs)
4. Number of retail customers that can access the amount and frequency of their electricity use (measured at least hourly), by display type and by customer class.
5. Demand response programs plans over next 5 years by number of programs and potential peak reduction.
6. NERC regions and States in which they operate

[2] 2010 FERC Assessment of Demand Response & Advanced Metering Staff Report. Appendix CD and CH includes detailed information on the survey and sample design. Appendix CE lists the respondents to the survey.

7. Number of retail customers for each NERC/State combination in Question 6 and by customer class.

Child 1 Record (repeated as needed)

8. Detailed retail demand response program information by NERC region, State, Customer class and Program type. (Complete one for each program offered.)

Child 2 Record (repeated as needed)

9. Detailed wholesale demand response program information by NERC region, State and Program type. (Complete one for each program offered.)

Shifting the detailed Demand Response Program information to the end of the survey lessens the burden on small utilities without demand response programs since they now only have to complete Questions 1 through 3. Also, by having all the information relative to one demand response program on one page (Child record), respondents could copy as many pages as required to cover each of their programs.

**The Respondent Universe**

Using the North American Electric Reliability Corporation (NERC) regional definitions allows data collection according to how the industry trades and manages energy. NERC is an international non-profit organization certified by FERC as the electric reliability organization for the U.S. NERC works with eight regional entities, each composed of members from all segments of the electric industry. NERC regions provide the most useful grouping for assessing demand response resources and advanced metering deployment. Figure 1 below shows the boundaries of these regional entities.

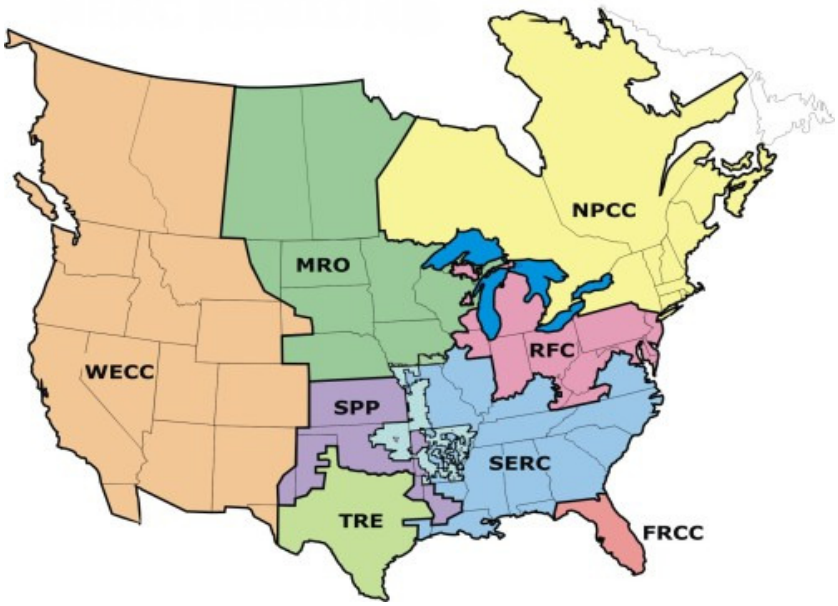


**FIGURE 1 – NERC REGIONS**[3]

[3] Note: The Alaska Systems Coordinating Council (ASCC, not shown) is an affiliate NERC member. Hawaii and Alaska are not included in most regional data listings but they are included in the state-by-state data.

**FRCC** - Florida Reliability Coordinating Council
**MRO** - Midwest Reliability Organization
**NPCC** - Northeast Power Coordinating Council
**RFC** - Reliability*First* Corporation
**SERC** - SERC Reliability Corporation
**SPP** - Southwest Power Pool, RE
**TRE** - Texas Regional Entity
**WECC** - Western Electricity Coordinating Council

The 2010 Survey comprises the U.S. domestic area of the NERC regional entities, and uses the regional divisions to better identify trends and align regulatory and industry geographical units. Table 1 provides the sample distribution of electric entities by EIA classifications and compares them to the classifications used in the 2008 Survey.

| 2010 Group Name | 2010 No. | 2008 Group Name | 2008 No. |
|---|---|---|---|
| Municipally Owned Utility | 1,840 | Municipal | 1,845 |
| Cooperatively Owned Utility | 878 | Cooperative | 884 |
| Investor Owned Utility | 207 | Investor Owned | 223 |
| Retail Power Marketer | 128 | Retail | 107 |
| Wholesale Power Marketer | 46 | Power Marketer | 162 |
| Political Subdivision | 127 | Public Utility District | 126 |
| Municipal Power Agency | 21 | Municipal Authority | 21 |
| | | State | 21 |
| Federal and State | 29 | Federal | 10 |
| Regional Transmission Organization/ Independent System Operator | 7 | Independent System Operator | 8 |
| Curtailment Service Provider | 11 | N/A | |
| Transmission | 7 | N/A | |
| Total Classified | 3,301 | | |
| Unclassified | 57 | N/A | |
| Active Total | 3,358 | - | |
| Inactive | 96 | - | |
| Grand Total | 3,454 | | 3,407 |

(Unclassified refers to responding entities we were unable to classify into the above categories. Inactive are entities outside the scope of the survey or no longer in operation and their records are not active in the database.)

**Table 1: Respondent Universe of the 2010 Survey**

## Survey Population Expansion

For the report we analyzed survey results and present reported and extrapolated penetration estimates for AMI and Demand Response. We report results according to entity- survey responses. We provide aggregated estimates of AMI and DR information by state, region, and national levels, and by entity type.

The approach taken by KEMA to expand estimates for AMI to desired population levels was to make statistically informed imputations of the number of advanced and total meters for non-responding entities using published information from the 2008 EIA-861 and 2008 Survey. The EIA-861 file 2 contains customer counts at the entity level by customer class. Number of customers is highly correlated with total meter counts. Other survey items – customer counts and AMI meters – have direct counterparts in the EIA-

861. For the "Other" customer class (i.e., retail customers not classified as residential, commercial, or industrial), there is no comparable field in the EIA-861 to link to the 2010 Survey. For this customer class, we used the 2008 Survey for the comparison survey field. In total, we imputed meters counts for 1437 entities, representing 10% of all meters. We imputed AMI meters counts for a total of 115 entities, accounting for approximately 4% of the estimated AMI meters.

Trends in survey fields between survey years often reflect general growth or decline. For example, increases or decreases in total meter count tend to reflect population dynamics. Advanced meter count changes may reflect population dynamics as well, but also programmatic initiatives by the electricity retailer and other drivers. Simple imputation of 2008 EIA-861 or 2008 Survey field values for missing values in the 2010 Survey would not reflect the general trends. To account for these trends, we used statistical models to create trend factors to apply to the 2008 data. We built the models using entities that responded to both the 2010 survey and to either the 2008 Survey or the EIA-861. We then applied the factors produced by these models to the value for the 2008 comparison survey field for the 2010 Survey nonrespondent. Separate models were fit for small, medium, and large entities for each survey field to reflect different growth among size classes of load-serving entities. Instead of a straight substitution of the 2008 EIA-861 AMI meter count into the 2010 Survey, we multiply the 2008 Survey count by the modeled growth rate between 2008 EIA-861 and the 2010 Survey. If the entity reported 8,000 advanced meters in 2008 and the modeled growth rate was twenty percent for other entities in its size class, we impute the 2010 as 8,000 x 1.2 = 9,600 advanced meters.

To restrict the effect of the modeled growth rates on the analysis, the sets of entities used in the statistical models were restricted to those whose 2010 counts were between half and double their 2008 counts – so if several entities had ten times the advanced meters in the 2010 Survey as the 2008 Survey, the modeled growth rates were not overly influenced by these massive individual increases. Additionally, we capped the modeled growth factor at 10 percent change for meter and customer counts, since these do not vary significantly between comparison survey years. In most cases the modeled growth in meters and customers for the size classes between 2008 and 2010 Surveys was between one and five percent. There was no imputation for non-responding entities with missing values in the comparison fields in the 2008 Survey.

The statistical regression model-adjusted imputation approach controls against self-selection bias by having past entity-level values – adjusted for growth trends - account for the meters and customers of non-responding entities rather than relying on assumed relationships between responding and non-responding entities and a reference size value. There is, however, the chance that the regression coefficient is biased towards the entities used in the regression, but the coefficients by design change the meter and customer counts from their respective 2008 Survey counts by no more than 10 percent.

The general extrapolation approach for the demand response section of the 2010 Survey was consistent with the approach used for the meter and customer counts in the AMI section described above. The entity-level comparison survey field values come from the 2008 Survey or EIA-861. The 2008 EIA-861 contains customer class-level potential and actual peak load reduction from both time-based and incentive-based programs. We again use the 2008 Survey as in the AMI section, for the "other" customer class balance group, and for customer counts and peak load reduction by specific program type.

As with the meter and customer counts, we fit the demand response survey item regressions on 2008-2010 paired entity-level survey data, and resulted in factors yielding between half and double the 2008 values. However, whereas total meters and customers were limited to a 10 percent statistical model-based adjustment to the 2008 values, we did not restrict the factors for demand response fields in this manner. This is because it may be reasonable for the MW for potential peak load reduction to have increased by more than 10 percent between survey years.

## Results

The 2010 Survey included some modifications to the instrument that resulted in some entities changing how they responded in previous FERC Surveys. These modifications included changes to the definition for AMI technology and changes to the number of demand response programs and how respondents categorize their answer regarding multiple classifications to a single demand response program. The new AMI definition is now consistent with the definition used by the Energy Information Administration (EIA). The specific definition is as follows:

> **"*Advanced Meters***: Meters that measure and record usage data at hourly intervals or more frequently, and provide usage data to both consumers and energy companies at least once daily. Data are used for billing and other purposes. Advanced meters include basic hourly interval meters, meters with one-way communication, and real-time meters with built-in two-way communication capable of recording and transmitting instantaneous data."

The new definition language requiring "usage data to both consumers and energy companies at least once daily" adds a level of functionality few utilities are now providing to customers. For at least three respondents, the new language prompted them to reclassify their advanced meters to non-advanced. The most significant change came from the utility serving Jacksonville, FL where they reduced their previously reported advanced meters from nearly 400,000 to zero.

The 2010 survey now includes an expanded list of fifteen demand response classifications, an increase from 12 program types used in 2006 and 2008. The 2010 survey also include altered[4] definitions for some program classifications versus definitions in 2008. The new program types and definitions conform to those in use by NERC's Demand Response Data Task Force to collect demand response program information for its Demand Response Availability Data System (DADS). Common terminology will allow comparison with the DADS data. Table 2 lists program classifications included in the 2010 Survey instrument[5].

[4] The changes in number and definition of program types may have caused respondents to reclassify programs from the 2008 Survey to be consistent with the 2010 Survey. Unlike the 2008 Survey, where respondents could choose multiple program classifications for a single program, the 2010 Survey forced the selection of a single program classification for each program reported.

[5] Definitions for each program type are in the glossary located in Appendix C of the 2010 Demand Response and Advance Metering Staff Report.

| 2010 Survey Program Classifications | Change from Previous Surveys |
|---|---|
| Direct Load Control | |
| Interruptible Load | |
| Critical Peak Pricing with Control | New program classification |
| Load as Capacity Resource | |
| Spinning Reserves | Previously included in Ancillary Services classification |
| Non-Spinning Reserves | Previously included in Ancillary Services classification |
| Emergency Demand Response | |
| Regulation Service | Previously included in Ancillary Services classification |
| Demand Bidding and Buyback | |
| Time-of-Use Pricing | |
| Critical Peak Pricing | |
| Real-Time Pricing | |
| Peak Time Rebate | |
| System Peak Response Transmission Tariff | New program classification |
| Other | |

**Table 2: Classification of Demand Response Program Types in 2010 Survey**

Following are key results from the report:

## AMI Highlights

- There was a rapid increase of AMI deployments starting in 2006 with less than 1 percent penetration nationally, increasing to 4.7 percent in 2008 and now at 8.7 percent from the 2010 survey. While the survey did not collect data on reasons for the trends, there are some known factors that may have influenced the rate of growth between periods. During the period between 2005 and 2007 AMI technology development moved towards a standard system, reducing the level of risk of adopting premature technology. This may have encouraged utilities to initiate deployment. With the promise of additional funds from ARRA for Smart Grid investments starting in 2007 and 2009, entities may have moved forward with existing plans to deploy AMI projects. Although penetration in all regions remains below 20 percent, some regions are growing at a robust rate. WECC, MRO, TRE and SPP regions saw increases in AMI penetration mainly driven by residential deployments. Following pilot programs and early ramp-up, these regions are now in mass market scale-up and may continue to see robust growth over the next few years. WECC saw AMI penetration increased six-fold from 2007 to 2009; MRO had a four-fold increase during the same period.
- Most states had less than 1 percent AMI penetration in 2005 with a few exceptions such as AR, AL and ID. Most states penetrations increased but still remained under 10 percent by 2007; again with a few exceptions such as PA, ID and AR. By 2009, nearly fourteen states had AMI penetration rates of 10 percent or higher, with the highest growth in penetration occurring in the west. AZ, OR, and ID all have penetration rates of about 25 percent or higher. Table 3 presents AMI penetration by States from 2007, 2008 and 2010 surveys.

| | 2006 | | | 2008 | | | 2010 | | |
|---|---|---|---|---|---|---|---|---|---|
| State | AMI meters | Total meters | Penetration | AMI meters | Total meters | Penetration | AMI meters | Total meters | Penetration |
| AZ | 5,521 | 2,783,083 | 0.2% | 96,727 | 2,810,224 | 3.4% | 847,177 | 2,915,712 | 29.1% |
| OR | 2,960 | 1,821,710 | 0.2% | 39,797 | 1,890,423 | 2.1% | 478,897 | 1,896,717 | 25.2% |
| ID | 29,062 | 739,199 | 3.9% | 105,933 | 769,963 | 13.8% | 198,370 | 803,576 | 24.7% |
| PA | 18,200 | 6,053,110 | 0.3% | 1,443,285 | 6,036,064 | 23.9% | 1,493,201 | 6,152,994 | 24.3% |
| WI | 19,882 | 2,983,075 | 0.7% | 117,577 | 3,039,830 | 3.9% | 757,688 | 3,418,498 | 22.2% |
| CA | 40,153 | 14,253,873 | 0.3% | 170,896 | 14,595,958 | 1.2% | 2,475,896 | 14,837,434 | 16.7% |
| MO | 8,986 | 3,087,821 | 0.3% | 204,498 | 3,098,055 | 6.6% | 506,416 | 3,072,893 | 16.5% |
| SC | 19,655 | 2,007,339 | 1.0% | 114,619 | 2,373,047 | 4.8% | 312,894 | 2,445,044 | 12.8% |
| GA | 73,312 | 4,404,447 | 1.7% | 342,772 | 4,537,717 | 7.6% | 514,403 | 4,401,623 | 11.7% |
| TX | 28,200 | 10,195,134 | 0.3% | 868,204 | 10,870,895 | 8.0% | 1,284,179 | 11,013,153 | 11.7% |
| KY | 27,501 | 2,225,485 | 1.2% | 105,460 | 2,161,142 | 4.9% | 273,663 | 2,523,833 | 10.8% |
| OK | 60,273 | 2,024,592 | 3.0% | 161,795 | 1,875,325 | 8.6% | 215,462 | 2,028,522 | 10.6% |
| ND | 29 | 367,776 | 0.0% | 33,336 | 375,473 | 8.9% | 42,875 | 445,164 | 9.6% |
| SD | 7 | 484,728 | 0.0% | 41,191 | 475,477 | 8.7% | 41,122 | 432,632 | 9.5% |
| TN | 426 | 3,165,211 | 0.0% | 60,385 | 3,160,551 | 1.9% | 252,341 | 2,761,758 | 9.1% |
| VT | 1 | 331,161 | 0.0% | 20,755 | 375,202 | 5.5% | 31,293 | 379,139 | 8.3% |
| NC | 29,411 | 4,681,178 | 0.6% | 143,093 | 4,771,479 | 3.0% | 385,884 | 4,847,336 | 8.0% |
| MS | 82 | 1,015,493 | 0.0% | 3 | 1,454,275 | 0.0% | 97,344 | 1,511,958 | 6.4% |
| MI | 31,254 | 4,877,345 | 0.6% | 73,948 | 5,311,570 | 1.4% | 269,933 | 4,865,396 | 5.5% |
| NM | 1 | 875,393 | 0.0% | 20,776 | 904,861 | 2.3% | 54,250 | 1,015,058 | 5.3% |
| AL | 89,702 | 2,738,519 | 3.3% | 139,972 | 2,774,764 | 5.0% | 127,092 | 2,467,741 | 5.2% |
| FL | 8,479 | 9,679,565 | 0.1% | 765,406 | 9,591,363 | 8.0% | 490,150 | 9,644,617 | 5.1% |
| VA | 5,016 | 3,412,011 | 0.1% | 6,448 | 3,965,584 | 0.2% | 175478 | 3,663,525 | 4.8% |
| WY | 0 | 272,033 | 0.0% | 12,268 | 318,282 | 3.9% | 14,437 | 303,272 | 4.8% |
| MT | 162 | 529,135 | 0.0% | 8,979 | 549,136 | 1.6% | 27,470 | 577,745 | 4.8% |
| IL | 43,043 | 5,510,470 | 0.8% | 112,410 | 5,701,533 | 2.0% | 286,568 | 6,099,158 | 4.7% |
| CO | 39,274 | 2,263,873 | 1.7% | 39,873 | 2,246,184 | 1.8% | 111,330 | 2,403,001 | 4.6% |
| OH | 1,958 | 6,307,050 | 0.0% | 28,042 | 5,544,353 | 0.5% | 289,970 | 6,290,618 | 4.6% |
| IN | 13,137 | 3,217,359 | 0.4% | 61,551 | 3,115,205 | 2.0% | 148,129 | 3,355,485 | 4.4% |
| KS | 18,913 | 1,430,953 | 1.3% | 61,423 | 1,426,832 | 4.3% | 62,626 | 1,467,092 | 4.3% |
| MN | 11,780 | 2,537,414 | 0.5% | 37,071 | 2,542,113 | 1.5% | 108,232 | 2,602,360 | 4.2% |
| WA | 477 | 3,061,233 | 0.0% | 69,377 | 2,987,355 | 2.3% | 128,857 | 3,298,781 | 3.9% |
| IA | 110 | 1,591,985 | 0.0% | 46,407 | 1,714,774 | 2.7% | 58,092 | 1,576,475 | 3.7% |
| ME | 716 | 773,164 | 0.1% | 426 | 780,748 | 0.1% | 20,315 | 796,691 | 2.5% |
| LA | 44 | 1,037,355 | 0.0% | 44,103 | 2,186,249 | 2.0% | 53,848 | 2,245,066 | 2.4% |
| DE | 16 | 421,331 | 0.0% | 0 | 438,020 | 0.0% | 10,433 | 455,926 | 2.3% |
| HI | 45 | 465,314 | 0.0% | 6,550 | 405,228 | 1.6% | 8,713 | 411,232 | 2.1% |
| NV | 17 | 1,193,873 | 0.0% | 10,835 | 1,292,331 | 0.8% | 24,378 | 1,255,950 | 1.9% |
| NE | 1,520 | 937,148 | 0.2% | 8,630 | 970,774 | 0.9% | 19,290 | 999,353 | 1.9% |
| UT | 1 | 1,036,605 | 0.0% | 37 | 1,056,718 | 0.0% | 20,046 | 1,083,069 | 1.9% |
| AK | 6 | 305,949 | 0.0% | 18 | 315,419 | 0.0% | 3,835 | 316,289 | 1.2% |
| AR | 75,118 | 1,494,383 | 5.0% | 168,466 | 1,488,124 | 11.3% | 14,578 | 1,529,065 | 1.0% |
| WV | 17 | 1,234,035 | 0.0% | 10 | 1,183,513 | 0.0% | 7,039 | 1,033,802 | 0.7% |
| MA | 6,940 | 3,244,778 | 0.2% | 3,907 | 3,077,679 | 0.1% | 20,831 | 3,150,098 | 0.7% |
| NJ | 25,222 | 3,884,140 | 0.6% | 9,866 | 3,900,716 | 0.3% | 25,744 | 3,953,683 | 0.7% |
| RI | 398 | 480,275 | 0.1% | 148 | 480,135 | 0.0% | 2,381 | 506,379 | 0.5% |
| NY | 3,071 | 7,906,309 | 0.0% | 12,778 | 7,811,335 | 0.2% | 28,664 | 9,313,776 | 0.3% |
| MD | 130 | 1,972,886 | 0.0% | 8 | 1,938,948 | 0.0% | 4,189 | 2,483,628 | 0.2% |
| CT | 3,862 | 1,580,365 | 0.2% | 5,838 | 1,600,768 | 0.4% | 1,967 | 1,625,758 | 0.1% |
| NH | 306 | 759,514 | 0.0% | 260 | 763,683 | 0.0% | 391 | 755,770 | 0.1% |
| DC | 0 | 809,412 | 0.0% | 1,348 | 809,412 | 0.2% | 2 | 275,554 | 0.0% |

## TABLE 3 - ESTIMATED PENETRATION OF ADVANCED METERING BY STATE IN 2006, 2008 AND 2010

- Consistent with previous periods, electric cooperatives and political subdivisions (public power districts, water and power agencies, etc.) have the highest penetration of advanced meters with nearly 25 and 20 percent respectively. These entities also have the fastest growth rate compared to IOUs and municipalities.

**Demand Response Highlights**

- In 2010 more than 500 entities reported offering demand response programs in the United States. The total *reported* (derived from respondents only) peak potential from demand response program continued to increase year-over-year. Reported potential increased 79 percent between 2006 and 2008; and increased 42 percent from 2008 to 2010. The total reported peak potential is 53,063 MW.
- Much of the growth comes from the wholesale market participants where potential demand response increased from12, 656 MW in 2008 to 22,884 in 2010. The increase occurred primarily with RTOs where reported potential demand response increased from 9,060 MW in 2008 to 20,533 MW in 2010. Much of the increase stems from forward capacity markets in ISO NE and PJM attracting significant DR interest. Together, wholesale, commercial and industrial customers make up over 80 percent of demand response programs. Figure 2 presents reported peak DR load reductions by customer class in 2006, 2008 and 2010.

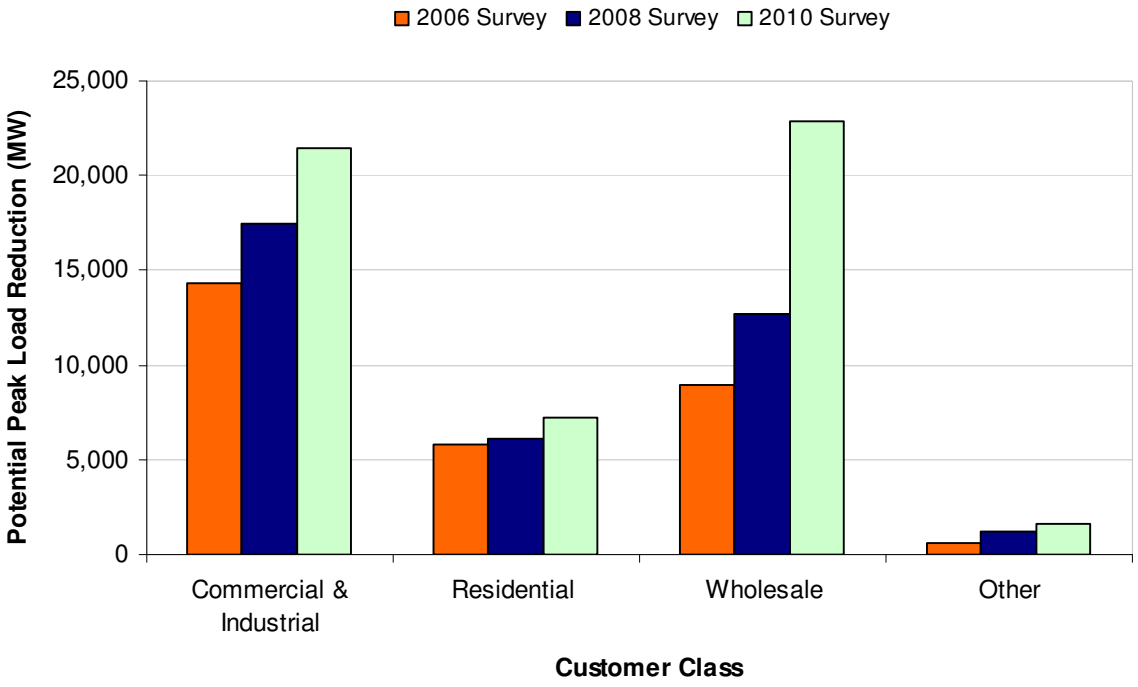


**FIGURE 2 - REPORTED POTENTIAL PEAK LOAD REDUCTION BY CUSTOMER CLASS IN 2006, 2008, AND 2010 FERC SURVEYS (MW)**

- The total *estimated* (includes estimates for non-responders) from potential demand response resource contribution from all U.S. demand response programs is more than 58,000 megawatts (MW), or about 7.6 percent of U.S. peak demand. This represents a jump of about 17,000 MW from the 2008 Survey. The regions with the largest estimated demand response resources are Midwest and Mid-Atlantic, the Upper Midwest, and the Southeast.
- Most demand response resources are delivered via nonresidential programs that bring higher per-participant peak load reductions, these include; emergency response, interruptible load, and load as capacity resource. Together with direct load control (residential program) these programs generate 79 percent of the demand resources nationally. In 2008, direct load control programs rank first in terms

of reported peak potential; it ranked third in 2010. Time-based rate programs make up barely 10 percent of total peak potential.

- The regions with the most demand response resources in terms of reported peak potential were RFC, MRO, and NPCC. These regions reflect the substantial wholesale demand response capacity of the RTOs in their regions. FRCC region has the largest residential direct load control program. Only Alaska and Montana did not have some type of demand response or time-based rate program.
- While RTOs tend to favor incentive-based demand response programs aimed at the large commercial and industrial and wholesale customers; IOUs and cooperatives favor pricing programs such as interruptible/curtailment rates, time-of-use rates, and real-time pricing programs since these are offerings available for retail customers. However, the reported number of entities offering real-time pricing in 2010 is inconsistent with the number of entities reporting in 2008 and 2006[6].

In addition to the survey results, the 2010 Assessment report also provides updated narratives on key issues the industry is addressing regarding advanced meter technology developments, and demand response activities to address several regulatory barriers are ongoing. For AMI these include: 1) development of National Institute of Standards and Technology (NIST) Smart Grid Interoperability Standards that will establish protocols and model standards for information management to achieve interoperability of smart grid devices and systems; 2) status report from DOE regarding security of AMI information. For demand response ongoing activities to address regulatory barriers include; 1) state policy changes to reduce financial impacts of demand response on utilities, state and industry efforts to improve and standardize baseline demand methods and cost-effectiveness analyses, coordination of federal and state policies, development of open, interoperable smart grid standards, and the reduction of barriers to demand response participation in wholesale markets.

## Conclusions

The survey and analysis yielded a very robust dataset in Microsoft Access or Excel allowing evaluators to query saturation and penetration of advanced metering, incentive and time-base rate demand response programs by customer class, entity type, state, NERC region and national levels. Even with some inconsistencies in data collection across the study years, evaluators can compare survey results from period to period. Evaluators can track the changes in advanced meter penetration in parallel with demand response resources and monitor the growth in capacity associated with the enabling technology.

[6] A methodology change in the 2010 Survey may have contributed to these apparent declines. See discussion in the "Analysis Approach" section 22-23, 2010 Assessment of Demand Response and Advanced Metering.

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