Appendix B

Electricity Service Provider Interviews

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Summary of Electricity Service Provider Interviews

B.1 Background Concerning the Interviews

To assess the state of smart-grid deployment, metrics were established to measure these attributes. Data collection for the Smart Grid System Report (SGSR) was performed by interviewing 24 selected electricity service providers representing a cross section of the industry. As part of the agreement with interviewees, the results were provided to all participants in a blinded form in advance of delivering the SGSR to Congress.

As the interviews only involved electricity service providers, they emphasize aspects of the electric utility enterprise. Other aspects, particularly those of deployment advances on the demand side, were beyond the scope of these interviews.

B.2 Approach

APQC, a productivity-benchmarking and best-practice research firm, was contracted to develop the questionnaire and conduct the interviews. The interview approach followed a four-step benchmarking methodology – plan, collect, analyze and report.

B.2.1 Plan

Planning of the interviews was a joint effort of the interview team with the following tasks:

- Developing an understanding of project-critical success factors and time constraints, in particular changes since the initial report in 2009
- Update data collection tools (i.e., assessment survey and interview guide) used to conduct interviews for the initial report in 2009
- Selecting types of representative organizations to target for data collection
- Update metrics and indicators to be collected and reported.

B.2.2 Data Collection

Data collection included 24 electricity service providers within the US representing a broad demographic (e.g., coast to coast; small to large; public, private and co-op) and included the following tasks:

- Securing commitment from participating organizations
- Collecting quantitative data from participating organizations
- Conducting follow-on interviews with key personnel to get insights beyond the assessment survey content.

B.2.3 Data Validation and Analysis

Data validation and normalization were performed as necessary, along with high level analysis, to ensure the highest quality and accuracy in comparison. Both blinded raw data and aggregated analysis are provided in this report.

B.2.4 Final Report

This report is the final part of the study project, providing a summary of the study itself to augment the data deliverables mentioned above:

- A list of participating organizations
- Data results
- Partner profiles
- Findings and future projections.

B.3 Metrics

Along with the principal characteristics of a smart grid, the interview team aligned the metrics with the Smart Grid Maturity Model administered by Carnegie Mellon University's Software Engineering Institute. This model establishes a roadmap for a smart grid within an electricity service provider at five levels of maturity. It is used to evaluate an electricity service provider's current state and map future initiatives. The Smart Grid Maturity Model evaluates each electricity service provider against key characteristics in eight domains:

- Strategy, Management and Regulatory
- Organization
- Grid Operations

- Work and Asset Management
- Customer
- Technology
- Value Chain Management
- Societal and Environmental.

The resulting interview form used to collect the data as part of this study can be found in the interview form section presented later in this report.

B.4 Study Partners

The companies that contributed data to this study by participating in the interviews are listed in Table B.1.

Table B.1. Interview Participants

Company	Size (Customers)	Region	Type	Ownership
Ameren Illinois	1.2M	IL	T&D	Investor Owned
Ameren Missouri	1.2M	MO	T&D, Gen	Investor Owned
Centerpoint Energy, Inc.	1.9M	TX	D	Investor Owned
City Of Danville	43K	VA	D, Gen	Municipal
City Of Hudson	7K	OH	D	Municipal
City Of Napoleon	6K	OH	D	Municipal
City Of Westerville	16K	OH	D	Municipal
Coldwater Board Of Public Utilities	7K	MI	D, Gen	Municipal
ComEd	3.2M	IL	T&D	Investor Owned
East Miss EPA	36K	MS	D	Non-profit
Entergy Services, Inc.	2.7M	LA, TX, AK, MS	T&D, Gen	Investor Owned
Ephrata	7K	PA	D	Municipal
Glendale Water and Power	84K	CA	T&D, Gen	Municipal
Omaha Public Power District	43K	NE	T&D	Municipal
Pepco Holdings Inc. Power Delivery	750K	DC, MD	T&D	Investor Owned
Portland General Electric	800K	OR	T&D, Gen	Investor Owned
Progress Energy - Florida	1.6M	FL	T&D	Investor Owned
Progress Energy Carolina	1.5M	NC	T&D	Investor Owned
Salt River Project	932K	AZ	T&D, Gen	State
San Diego Gas & Electric	1.4M	CA	T&D, Gen	Investor Owned
Southern California Edison	13M	CA	T&D, Gen	Investor Owned
Tucson Electric Power	375K	AZ	T&D	Investor Owned
Wadsworth Electric And Communications	13K	OH	D, Gen	Municipal
Wyandotte Municipal Service	12K	MI	D, Gen	Municipal

These companies represent a significant portion of the US as shown in the Figure B.1 and provide a balanced view of both regulated and deregulated electricity service providers as shown in Figure B.2.

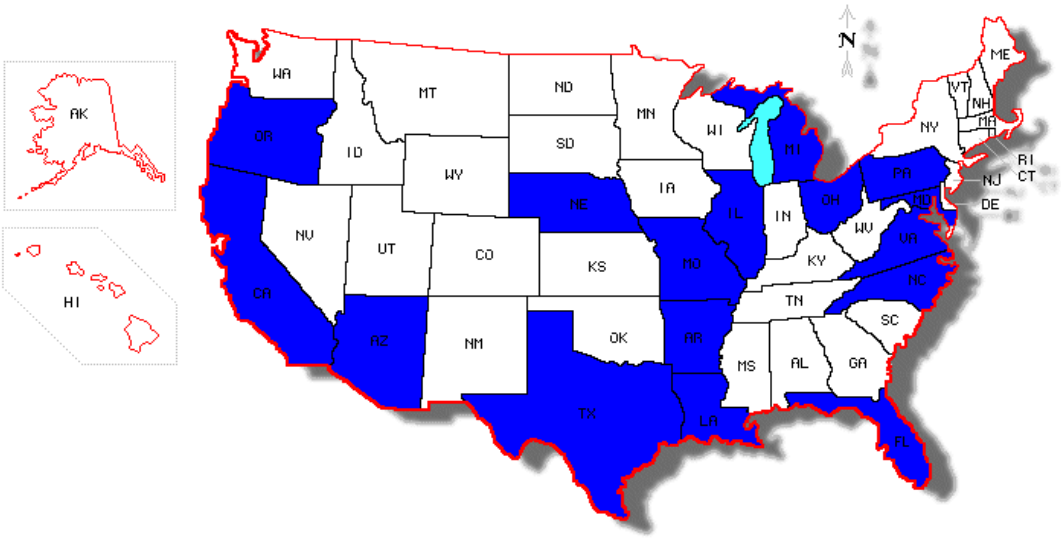

Figure B.1. Coverage of US by Participating Organizations

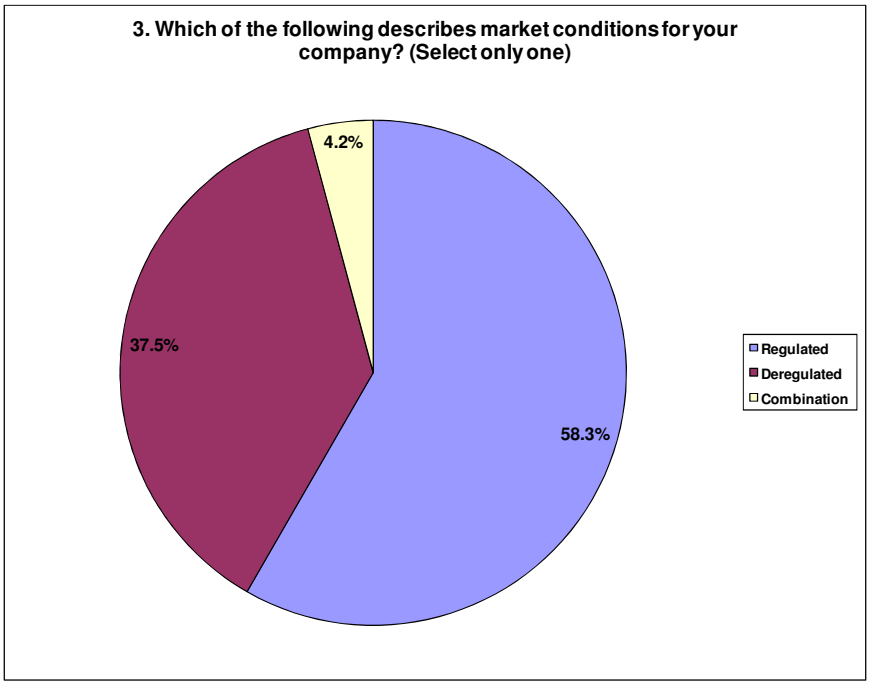

Figure B.2. Market Conditions of Participating Organizations

B.5 Findings

The major insight gained from the data collection efforts is that deployment of smart-grid capabilities among US electric electricity service providers is in its early stages. Most of the characteristics evaluated show low levels of support and penetration into the marketplace.

This does not imply that electricity service providers do not see value in or are not planning these efforts, only that they have not yet moved forward. Some of the key observations are provided here:

- 42 percent of electricity service providers have begun deploying remote load control for customers' high-energy devices
- 58 percent of electricity service providers have customer participation in demand response
- Most electricity service providers, over 62 percent, have not developed capabilities for automated response to pricing signals within a premise
- Deployment of advanced meters has increased significantly since 2008, for both residential and commercial customers (see Table B.2).

Table B.2. Deployment of Advanced Meters

Metric Name	2010				2008			
	Top Performers	Median	Bottom Performers	Count	Top Performers	Median	Bottom Performers	Count
Advanced meters as a % of total meters (residential)	69.9%	14.9%	0.4%	24	0.5%	0.2%	0.0%	14
Advanced meters as a % of total meters (commercial)	50.8%	6.6%	1.5%	15	1.3%	0.2%	0.0%	11
Advanced meters as a % of total meters (industrial)	67.3%	17.4%	5.0%	15	100.0%	13.8%	0.0%	10
Advanced meters as a % of total meters (total)	69.9%	14.9%	0.4%	24	2.8%	0.7%	0.2%	11

There are areas where electricity service providers are moving forward more rapidly; these may indicate either ease of adoption or critical need. Of the electricity service providers interviewed for this report, two-thirds have or are developing programs to shave peak demand (see Figure B.3)

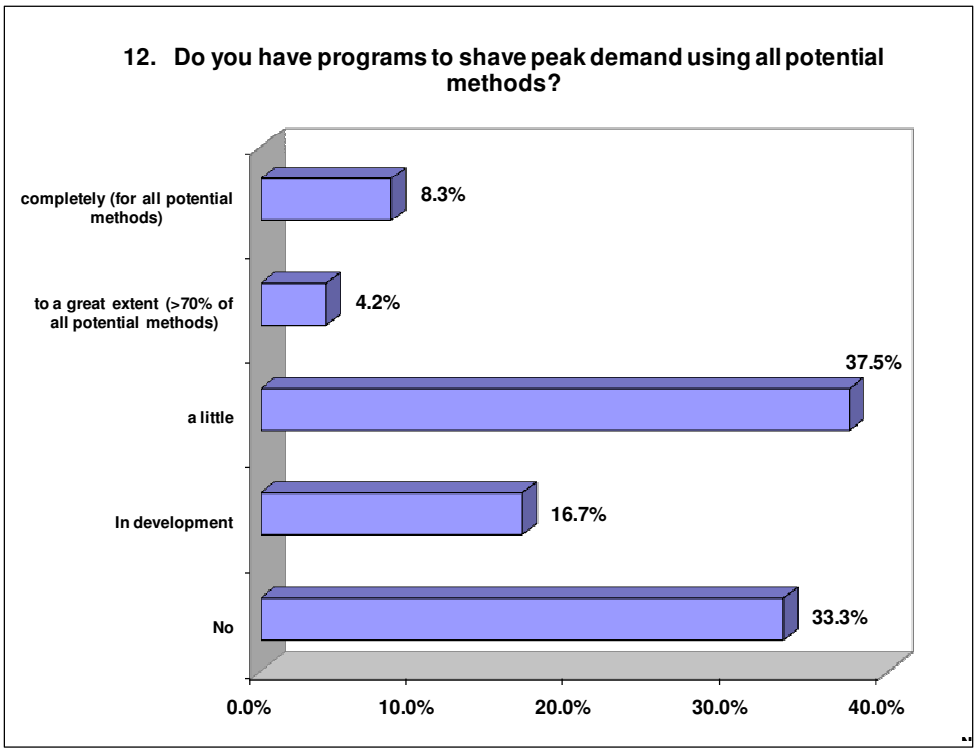

Figure B.3. Programs to Shave Peak Demand

In Figures B4 through B7, Bottom Performer refers to the performance level below which 25 percent of all responses fall (i.e., 25th percentile), Median is the median performance level for all participants in the database (the median reflects the value below and above which there is an equal number of values.), and Top Performer represents the performance level below which 75 percent of all responses fall (i.e., 75th percentile).

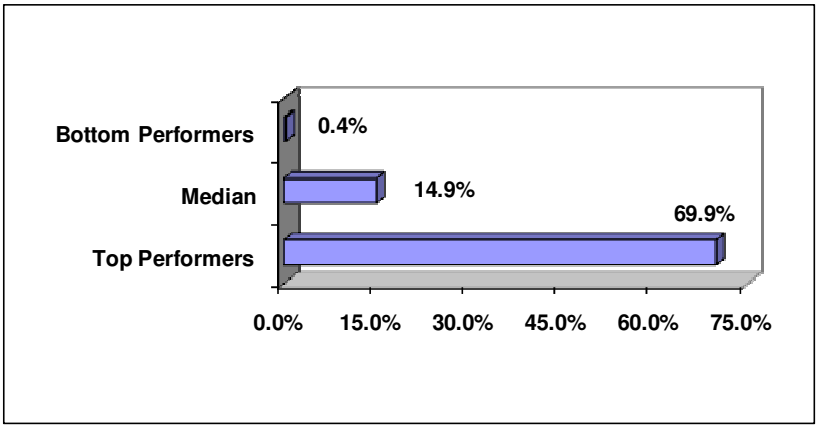

Figure B.4. Advanced Meters as a Percent of Total Meters

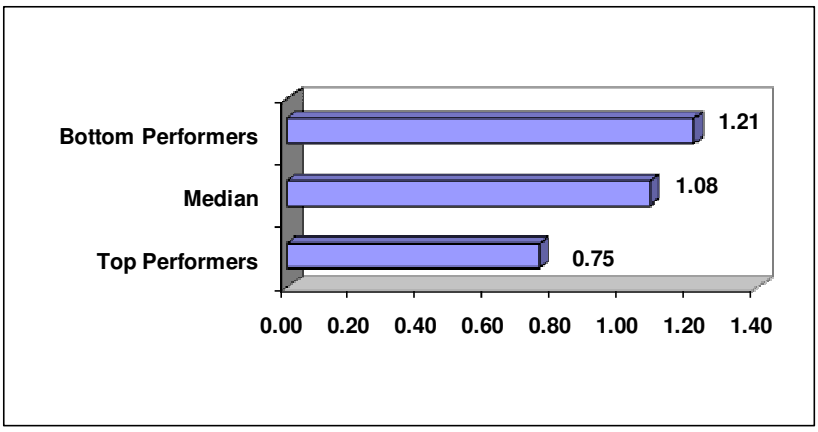

Figure B.5. Actual SAIFI

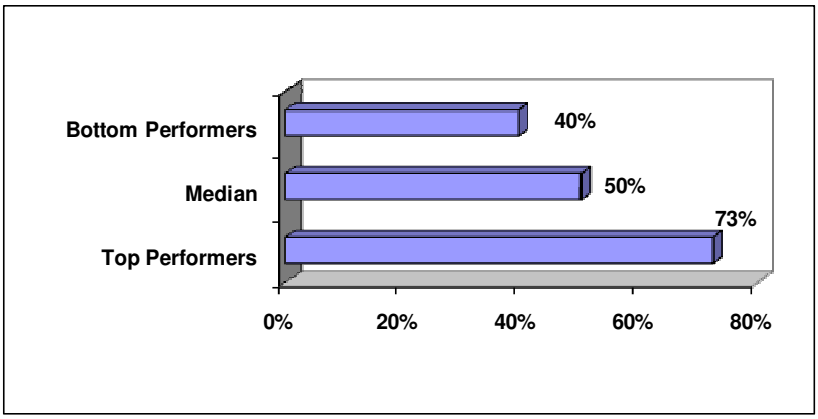

Figure B.6. Percentage of Substations That Are Automated

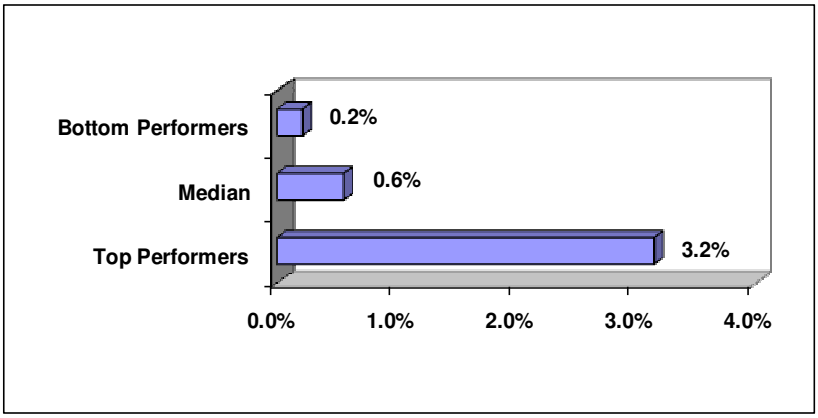

Figure B.7. Percentage of Customer Complaints Related to Power Quality Issues (Excluding Outages)

The full set of results and analysis from the study are provided in the sections that follow. The aggregated responses to both quantitative and qualitative questions are presented.

B.5.1 Interview Questions

The interview form and questions used in the interviews with electricity service providers is presented in the following section. Key terms used in the interview questions are defined below.

- **Industrial customers:** Customers that have factories or are involved in manufacturing; they typically have the highest energy needs. Other customers are residential and commercial
- **Outage detection:** Identification of which circuits are down and the location and possible cause
- **Outage frequency:** Total number of customer interruptions out of the total number of customers over a year; this is the same as SAIFI
- **Regulated/Deregulated:** Supervision of rates, terms and conditions of service, financing, and service areas by a governmental agency; deregulation is the removal or relaxation of regulations or controls
- **Service area (in sq. miles):** The total land area within the scope of operations and control of the electricity service provider
- **Substation Automation:** Substation automation goes beyond traditional SCADA to provide added capability and information that can further improve operations and maintenance, increase system and staff efficiencies, and leverage and defer major capital investments. Applications and data of interest may include remote access to IED/relay configuration ports, waveforms, event data, diagnostic information, video for security or equipment-status assessment, metering, switching, volt/VAR management, and others for maintaining uninterrupted power services to the end users
- **Total customer count:** This is the total number of customers (some may have multiple meters, so it is not the meter count)

B.5.2 Interview Form and Questions

B.5.3 Instructions

To support the 2011 Smart Grid System Report data collection effort, this survey assesses the current status of smart grid development, prospects for its future, and obstacles to progress. Scope includes:

- the prospects of smart grid development including costs and obstacles,
- regulatory or government barriers, and
- regional issues.

Data provided will be blinded and incorporated into APQC's databases and may be used to support APQC's mission as an education and research organization consistent with APQC's Benchmarking Code of Conduct (http://www.apqc.org/PDF/code_of_conduct.pdf). For purposes of identifying participating organizations, your organization's name will be listed as a study participant, as appropriate. In exchange for completing this survey, you'll receive a custom report of survey results. This study is sponsored by Pacific Northwest National Laboratory in association with the Department of Energy.

B.5.4 General Instructions

1. If you do not have the exact number for an answer, please provide a reasonable approximation. If you cannot provide a reasonable approximation, please leave the answer blank.
2. Please direct survey-related questions to sgmm@apqc.org

B.5.5 Contact Information

First Name
Last Name
Title
Company Name (include division if applicable)
Address Line 1
Address Line 2
City
State
Postal Code
Phone
Business Email
Functional Area

B.5.6 Survey Questions

1. Please provide the end date of the 12-month period for which you will be providing data in this survey (e.g., Dec 31, 2009).

2. Please provide the following demographic information:
   a. Percentage of automated substations
   b. Percentage of substations with outage detection
   c. Percentage of circuits with outage detection
   d. Number of electromechanical relays
   e. Number of microprocessor relays
   f. Number of employees

g. Total customer count
   i. Residential
   ii. Commercial and industrial
h. Electric meter count
   i. Residential
      1. Advanced
      2. Total
   ii. Commercial
      1. Advanced
      2. Total
   iii. Industrial
      1. Advanced
      2. Total
i. Megawatts
   i. Megawatt hours of generation served
   ii. Peak demand (Megawatt)
   iii. Level of distributed generation (Megawatt hours)
j. Size of service territory in square miles
k. Number of substations by voltage class
   i. Less than 13kV
   ii. Between 13kV and 35kV
   iii. Greater than 35kV

3. Which of the following best describes your market conditions?
   a. Regulated
   b. Deregulated
   c. Combination (service area includes both)

4. In which industry segments does your organization participate? (select all that apply)
   a. Generation
   b. Transmission
   c. Distribution
   d. Retail

5. Do you have dynamic or supply based price plans (select all that apply)?
   a. None
   b. Critical peak pricing
   c. Time of use
   d. Real-time pricing (on order of min up to hr)

6. For the following, select all that are enabled through the real-time data sharing from smart grid capabilities you have implemented?
   a. New information is flowing across functions and systems
   b. Control analytics has improved cross line of business decision-making
   c. Planning has transitioned from estimation to measurement-based
   d. Distributed intelligence and analytics are now available across functions and systems
   e. Distributed intelligence and analytics are now available externally
   f. Coordinated energy management of generation is available throughout your supply chain

7. What type of regulatory policies (beneficial regulatory treatment for investments made and risk taken) are in place that support smart grid investment by your utility?
   a. None
   b. Mandates (e.g., required installation of advanced meters)
   c. Incentives
   d. Regulatory recovery

8. What percentage of your smart grid investment to date has been recovered through rate recovery?

9. What percentage of your smart grid future investment do you expect to recover through rate recovery?

10. Do you have remote load control of customer high energy devices?
    a. No
    b. In development
    c. a little (< 10% of all customers)
    d. to a great extent (10% - 70% of all customers)
    e. completely (> 70% of all customers)

11. Do you have customer participation in demand/response?
    a. No
    b. In development
    c. a little (< 10% of all customers)
    d. to a great extent (10% - 70% of all customers)
    e. completely (> 70% of all customers)

12. Do you have programs to shave peak demand using all potential methods?
    a. No
    b. In development
    c. a little
    d. to a great extent (>70% of all potential methods)
    e. completely (for all potential methods)

13. What is your capacity for distributed generation as a percentage of total capacity on grid (excludes DG whose operation does not respond to grid conditions and emergency generation capacity)?

14. What is your energy storage capacity as a percentage of total capacity on grid (batteries, flywheels, Thermal, excluding pumped hydro)?

15. What is your non-dispatchable, non-controllable renewable generation as a percentage of total capacity on grid?

16. Do you have automated response to pricing signals for major energy using devices within a premise?
    a. no
    b. in development
    c. a little (10% - 30% of all customers)

d. to a great extent (30% - 80% of all customers)
e. completely (> 80% of all customers)

17. Do you have automated response to frequency signals for energy using devices within a premise?
    a. no
    b. in development
    c. a little (10% - 30% of all customers)
    d. to a great extent (30% - 80% of all customers)
    e. completely (> 80% of all customers)

18. Please provide the following reliability measures
    a. Predicted SAIFI
    b. Actual SAIFI
    c. Predicted SAIDI
    d. Actual SAIDI
    e. Predicted MAIFI
    f. Actual MAIFI

19. How many advanced measurement devices do you have within your grid?
    a. Phasor Measurement Units
    b. Digital Fault Recorders
    c. Other

20. Please provide the following capacity factors?
    a. System average load (MW)
    b. System peak load (MW)
    c. System capacity (MW)

21. What percentage of your lines have dynamic rating capability?

22. What is the percentage of IEDs with communications on your grid?

23. If you have any micro-grids within your distribution system…
    a. How many?
    b. What is their total capacity?
    c. What is their percentage of your summer capacity?

24. What is your percentage of customer complaints related to power quality issues (excluding outages)?

25. Does your organization report NERC-CIP compliance?

26. Have you deployed the following security features? (Select all that apply)
    a. Intrusion detection
    b. Key management systems
    c. Encrypted communications
    d. Firewalls
    e. Others (Please describe)

B.5.7 Interview Results

B.5.7.1 Key Terms

- N: The N value reflects the sample size of a distribution.
- Bottom Performer: This represents the performance level below which 25 percent of all responses fall (i.e., 25th percentile).
- Median: The median performance level for all participants in the database. The median reflects the value below and above which there is an equal number of values.
- Top Performer: This represents the performance level below which 75 percent of all responses fall (i.e., 75th percentile).
- NA: Information is not available.
- Average: The arithmetic mean.
- Weighted average: The calculated value based on a weighting element. Calculation is made by taking a respondent's percentage of total as a weighting element and multiplying that percentage times the company's metric value. The weighted average is the sum of data from all participants that had a metric value.
- All-participants peer group: Reflects all business entities that provided data.

Note: Results in this report are drawn from relatively small sample sizes. Care should be exercised when applying these results to a larger population.

B.5.7.2 Scope

Interviews pertained to the following deployment attributes associated with transmission and distribution network and generation operations:

- IT Penetration
- Communications Network Capabilities
- Costs
- Obstacles

B.5.7.3 Data Originated from the Following Types of Operations

- Transmission & Distribution
- Generation

Table B.3. Summary of Quantitative Data

Metric Name	Average	Weighted Average	Weighting Element	Top Performers	Median	Bottom Performers	Count
Key Performance Indicators							
Advanced meters as a % of total meters (residential)	35.0%	24.0%	residential meters	69.9%	14.9%	0.4%	24
Advanced meters as a % of total meters (commercial)	28.4%	19.4%	commercial meters	50.8%	6.6%	1.5%	15
Advanced meters as a % of total meters (industrial)	35.7%	21.5%	industrial meters	67.3%	17.4%	5.0%	15
Advanced meters as a % of total meters (total)	35.0%	23.6%	total meters	69.9%	14.9%	0.4%	24
Percentage of automated substations	55%	47.7%	total substations	73%	50%	40%	15
Percentage of substations with outage detection	78%	78.2%	total substations	100%	82%	66%	17
Percentage of circuits with outage detection	85%	82.1%	total customers	99%	90%	80%	17
Predicted SAIFI	1.02	0.81	total customers	0.50	1.08	1.49	14
Actual SAIFI	0.98	1.13	total customers	0.75	1.08	1.21	19
Predicted SAIDI	84.5	63.94	total customers	30.0	76.3	121.8	12
Actual SAIDI	96.8	115.32	total customers	55.8	83.4	142.5	18
Predicted MAIFI	2.17	0.23	total customers	1.25	2.50	3.25	3
Actual MAIFI	3.81	1.46	total customers	1.28	1.80	5.77	7
Percentage of smart grid investment to date that has been recovered through rate recovery	28%	23.5%	total customers	62.5%	0.0%	0.0%	9
Percentage of smart grid future investment expected to be recovered through rate recovery	57%	37.3%	total customers	100.0%	100.0%	5.0%	9
Capacity for distributed generation as a percentage of total capacity on grid	25.1%	23.7%	total customers	35.0%	5.0%	0.0%	23
Storage capacity as a percentage of total capacity on grid	0.2%	0.8%	total customers	0.0%	0.0%	0.0%	22
Non-dispatchable renewable generation as a percentage of total capacity on grid	6.6%	4.9%	total customers	5.0%	1.1%	0.0%	9
Percentage of lines that have dynamic rating capability	1.1%	0.6%	total customers	0.0%	0.0%	0.0%	9
Percentage of IEDs with communications on grid	926.0%	44.2%	total customers	50.0%	39.0%	1.0%	9
Percentage of customer complaints related to power quality issues (excluding outages)	1.5%	0.6%	total customers	3.2%	0.6%	0.2%	6
Supporting Indicators							
Residential customers as a % of total customers	87.0%	86.8%	total customers				
Commerical and Industrial customers as a % of total customers	13.0%	13.2%	total customers				
Electromechanical relays as a % of total relays	57.9%	46.4%	total relays				
Microprocessor relays as a % of total relays	42.1%	13.4%	total relays				
Size of Service Territory in square miles per 1000 customers	16.46	11.28	total customers				
Substations by voltage class:							
< 13 kV substations as a % of total substations	22.6%	20.1%	total substations				
>= 13 kV < 35 kV substations as a % of total substations	28.0%	24.6%	total substations				
>= 35 kV substations as a % of total substations	49.4%	55.3%	total substations				

Table B.4. Summary of Qualitative Data

	Count	Frequency Percentage (All Participants)
3. Which of the following best describes your market conditions?		
Regulated	14	58.3%
Deregulated	9	37.5%
Combination	1	4.2%
4. In which industry segments does your organization participate? (select all that apply)		
Generation	14	58.3%
Transmission	19	79.2%
Distribution	22	91.7%
Retail	18	75.0%
5. Do you have dynamic or supply based price plans (select all that apply)?		
None	12	50.0%
Critical peak pricing	0	0.0%
Time of use	12	50.0%
Real-time pricing (on order of min up to hr)	1	4.2%
6. For the following, select all that are enabled through the real-time data sharing from smart grid capabilities you have implemented?		
New information is flowing across functions and systems	15	62.5%
Control analytics has improved cross line of business decision-making	6	25.0%
Planning has transitioned from estimation to measurement-based	4	16.7%
Distributed intelligence and analytics are now available across functions and systems	1	4.2%
Distributed intelligence and analytics are now available externally	0	0.0%
Coordinated energy management of generation is available throughout your supply chain	1	4.2%
7. What type of regulatory policies (beneficial regulatory treatment for investments made and risk taken) are in place that support smart grid investment by your utility?		
None	13	54.2%
Mandates (e.g., required installation of advanced meters)	3	12.5%
Incentives	6	25.0%
Regulatory recovery	8	33.3%
10. Do you have remote load control of customer high energy devices?		
No	6	25.0%
In development	8	33.3%
a little (< 10% of all customers)	8	33.3%
to a great extent (10% - 70% of all customers)	1	4.2%
completely (> 70% of all customers)	1	4.2%
11. Do you have customer participation in demand/response?		
No	4	16.7%
In development	6	25.0%
a little (< 10% of all customers)	12	50.0%
to a great extent (10% - 70% of all customers)	1	4.2%
completely (> 70% of all customers)	1	4.2%
12. Do you have programs to shave peak demand using all potential methods?		
No	8	33.3%
In development	4	16.7%
a little	9	37.5%
to a great extent (>70% of all potential methods)	1	4.2%
completely (for all potential methods)	2	8.3%
16. Do you have automated response to pricing signals for major energy using devices within a premise?		
no	15	62.5%
in development	7	29.2%
a little (10% - 30% of all customers)	2	8.3%
to a great extent (30% - 80% of all customers)	0	0.0%
completely (> 80% of all customers)	0	0.0%

Table B.4. Summary of Qualitative Data (continued)

	Count	Frequency Percentage (All Participants)
17. Do you have automated response to frequency signals for energy using devices within a premise?		
no	17	70.8%
in development	8	33.3%
a little (10% - 30% of all customers)	0	0.0%
to a great extent (30% - 80% of all customers)	0	0.0%
completely (> 80% of all customers)	0	0.0%
25. Does your organization report NERC-CIP compliance?	16	66.7%
26. Have you deployed the following security features? (Select all that apply)		
Intrusion detection	15	62.5%
Key management systems	12	50.0%
Encrypted communications	16	66.7%
Firewalls	22	91.7%
Others (Please describe)	3	12.5%

B.5.7.4 Graphic Summary of Qualitative Information

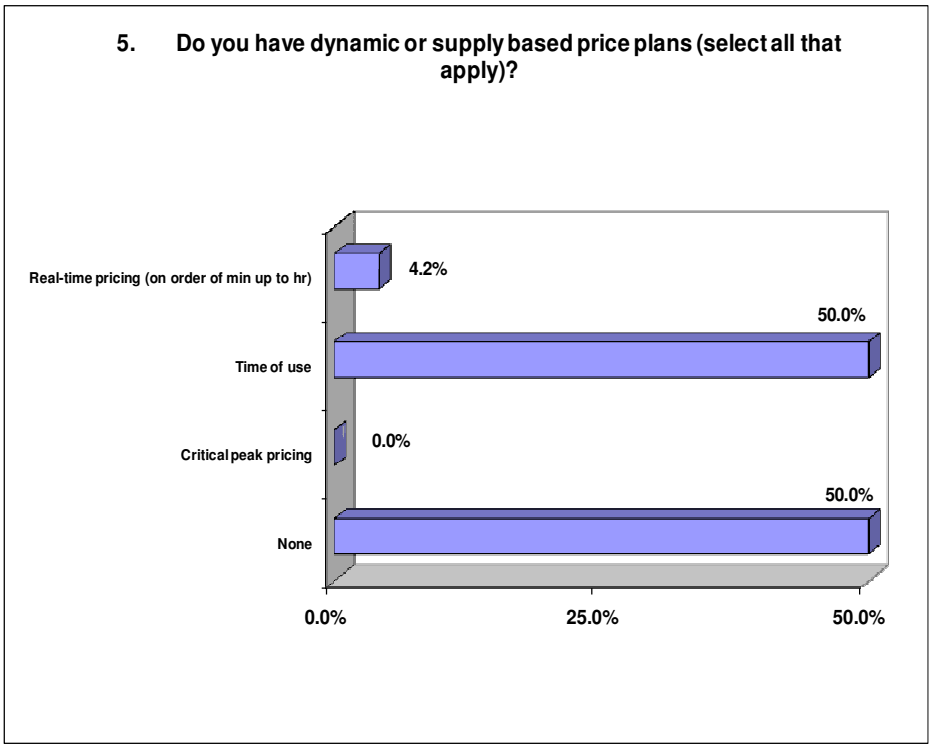

Figure B.8. Percentage of Interviewees with Dynamic or Supply-Based Price Plans

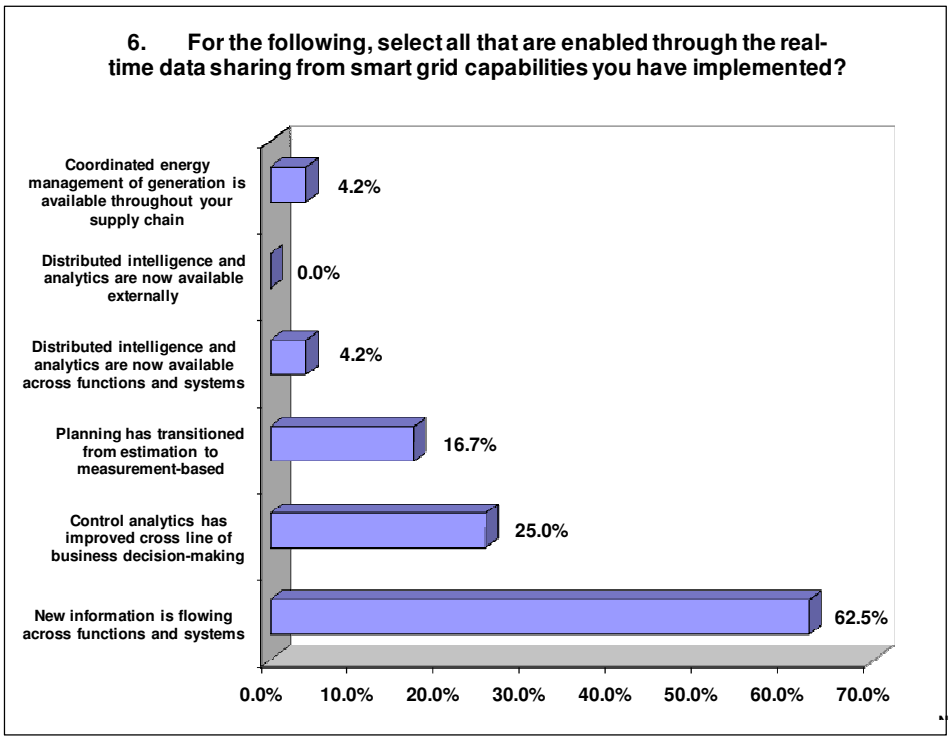

Figure B.9. Smart-Grid Activities Enabled by Smart-Grid Capabilities Implemented

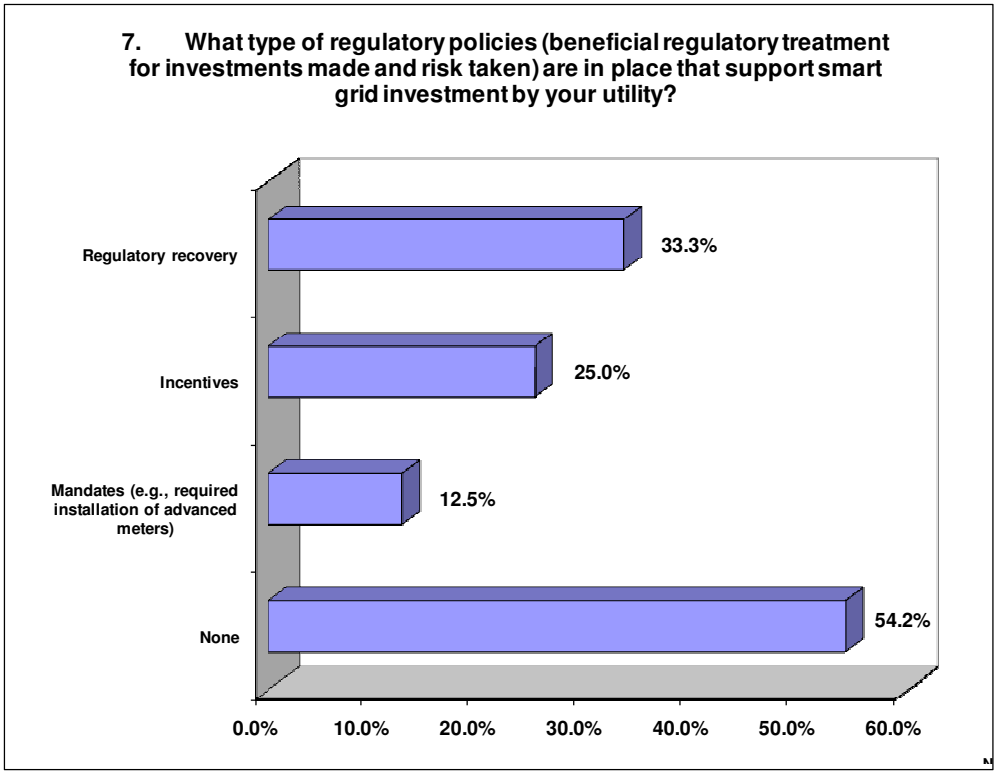

Figure B.10. Types of Regulatory Policies Supporting Smart-Grid Investment

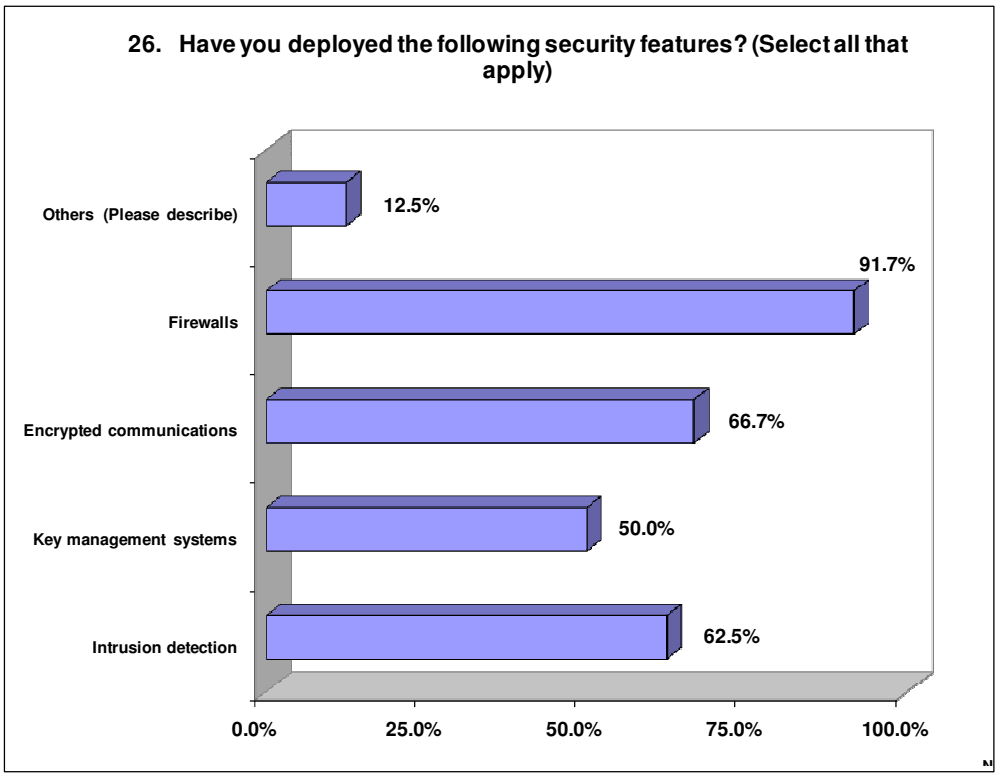

Figure B.11. Types of Security Features Deployed

B.6 Insights for Future Data Collection

An additional objective during the course of the study was to gather insights about the selected metrics and interview questions to support future cycles of data collection and reporting. The key concern from interviewees was the number of different collection and reporting efforts and formats they must support. To this end, more rigorous data would be available through alignment with other DOE smart grid data collection efforts throughout the reporting period. An opportunity also exists to align more closely with the SGMM data set as it is collected throughout the same reporting period. This would provide a broader and richer data set in support of the evaluation and reporting efforts. Both these improvements would need to be coordinated well in advance of initiating the next reporting effort in 2012-2013.