

# Smart Metering Deployments: Pitfalls and Perils

*“State Regulators Question Prudence of Boulder’s Smart Grid”*

*“Smart Grid Comes Costly for Households in Germany”*

*“Anti-Meter Fever Strikes Australia Too (Feb. 24, 2010)”*

*“Enraged Power Customers Vent Before Council”*

*“Residents Steamed Over High Electric Bills”*

## Introduction

The envisioned “Smart Grid” includes the digital automation of the power supply system to improve the security, quality, reliability, efficiency, and safety of electric power, as well as to make the system more environmentally friendly. Advanced (i.e., smart) meters and the associated advanced metering systems are an integral part of the Smart Grid. According to the Edison Foundation, 38 states are currently pursuing deployment of smart meters and almost 60 million smart meters are expected to be installed in the next ten years (approximately 47 percent of U.S. households). The worldwide installed base of smart meters is expected to reach 302.5 million by 2015. (Source: Berg Insight Research)

In Texas, the three largest transmission and distribution service providers (TDSPs) began deploying advanced meters and associated systems in late 2008 and early 2009. As of July 2010, these TDSPs have installed more than 1.7 million meters and expect to have approximately 6.5 million meters installed within the next three years.

## Potential Pitfalls and Perils

Advanced meter deployment has met several challenges in the United States and around the world. Concerns have been raised regarding the accuracy of smart meters, as well as responsibility for the costs associated with advanced meter deployments and system development. Other issues include security, privacy, and public-health. However, the overarching concern relates to what impact, if any, the deployment of advanced meters and systems has on customer bills, both in terms of surcharges to recover infrastructure and deployment costs, as well as the accuracy of the monthly electricity consumption charges.

## Texas: At the Leading Edge... of Customer Complaints

In early 2010, customer complaints related to electric bills increased significantly in certain areas in Texas. Much of the media and public attention focused on customers claiming higher electric bills in the months following installation of new advanced meters across Texas. Certain consumer interest groups as well as a number of state legislators called for a moratorium on smart meter deployment, which could potentially have cost the TDSPs and their customers millions of dollars as well as federal grant money. Although advanced meter deployment was not stopped, there was a clear loss of public and consumer confidence in advanced meters.

## Making Sense of It All

Navigant Consulting, Inc. was retained by the Public Utility Commission of Texas (the “Commission”) and the three largest TDSPs in Texas at the request of the Public Utility Commission of Texas to conduct an independent evaluation and investigation into the various questions and concerns raised regarding the deployment of advanced metering systems in the state. Navigant Consulting assembled a team of highly experienced practitioners with broad and deep expertise in investigative consulting, data analytics, business process evaluation and advanced meter system design, and began work on what would become the most comprehensive evaluation of a smart meter deployment undertaken to date.

## Engagement Objectives

The overall objective was to evaluate the accuracy and reliability of advanced meters and metering systems being deployed in Texas to address public concerns and eroding consumer confidence in the use of advanced meters across the state.

A scope of work was designed to address four key questions that needed to be answered in order to meet the overall objective of the evaluation.

1. Is electricity usage accurately measured and recorded by the advanced meters?
2. Is the recorded electricity usage accurately communicated from the advanced meters through the respective TDSP advanced metering systems for use in customer billing?
3. Is recorded electricity usage higher on average for customers with advanced meters in comparison to customers with older electromechanical meters?
4. Are there other potential factors or causes contributing to the observed higher incidence of meter- and billing-related customer complaints?

## Navigant Consulting's Approach

A cross-disciplinary team of more than 40 Navigant Consulting professionals and subcontractors, was created to conduct the evaluation and investigation. Navigant Consulting collaborated with cross-functional teams consisting of metering, billing, customer service and IT personnel from each of the TDSPs to develop a structured and well-defined work plan that could be executed on an expedited schedule and that focused on addressing the aforementioned four key questions. The plan included the following five components:

**Data Collection:** The teams developed an iterative data collection process to identify, collect, evaluate, and analyze information from each of the TDSPs. Information collected included policies, processes, and written procedures related to deployment and operation of the advanced meters and associated systems, as well as electronic customer billing and historical meter accuracy testing records. During the course of the evaluation, the Navigant Consulting team reviewed more than 18,000 pages of hard-copy documents and files and approximately 345 million records (45 gigabytes) of electronic information, including customer billing records for more than 1.5 million customers, as well as historical meter accuracy

test data for more than 1.2 million advanced and electromechanical meters. The Navigant Consulting team also conducted interviews and discussions with more than 60 TDSP personnel responsible for the business processes and controls surrounding the advanced meter deployment and system development, as well as the associated data generated by the advanced meters and systems.

**Accuracy Testing of Advanced Meters:** The teams designed a multifaceted meter testing program to determine if electricity usage is accurately measured and recorded by the advanced meters, as well as to ensure the meters selected for testing were correlated geographically to the customer complaints for high electric bills. The accuracy testing of advanced meters was conducted by independent third-party meter testing services companies under the direction of the Navigant Consulting team. Nearly 5,700 meters were accuracy tested, as follows:

- » 2,400 advanced meters before installation
- » 2,700 advanced meters after installation in a laboratory or meter shop environment
- » More than 500 advanced meters in the field (using portable testing equipment)
- » Side-by-side testing of 75 advanced and 75 electromechanical meters (subjected to load and temperature conditions representative of severe summer and winter conditions experienced in Texas)

The Navigant Consulting team also reviewed historical accuracy testing results for approximately 1.1 million advanced meters and more than 85,000 electromechanical meters.

**Analysis of Customer Complaints:** The teams analyzed a number of customer complaints related to high electric bills, as well as a small number of specific concerns expressed by customers in one of the TDSP's service areas to evaluate whether there was any relationship between the complaints and the deployment of advanced meters and their use in the customer billing process. The Navigant Consulting team evaluated the complaints and concerns in relation to the following factors:

- » Advanced meter deployment
- » Weather

*"I thought that was an amazingly comprehensive study, and I really applaud the work that Navigant did ... because not only did they verify the accuracy of the meters, then they worked with the utilities and the meter companies so they understood when the meter was giving a particular signal back to the home office, what that signal was indicating. ... They went and looked at every consumer complaint – historical consumption record – and were able to show that when that customer had an electro-mechanical meter and cold weather came about, usage spiked, came back down, spiked, came back down."*

PUC TX Chairman Barry Smitherman in an interview with the Texas Tribune on August 12, 2010

- » Historical electricity usage
- » Billing cycles and durations
- » Read type (estimated and actual)
- » Media coverage

In more than 60 instances, the Navigant Consulting team followed up directly with customers to discuss their concerns and gathered additional data, including electric bills and general information related to their residence and electric usage patterns.

**Customer Electric Usage / Billing Analysis:** The teams performed statistical analysis to evaluate whether customers with advanced meters experienced different (i.e., "higher") metered residential kilowatt-hour (kWh) electricity usage than they would have experienced without the advanced meter. Significant variations were analyzed (i.e., regressed) against potential explanatory variables such as heating degree days and cooling degree days, as well as differences in heating source (i.e., gas vs. electric), structure type (i.e., apartments vs. single-family homes), among others, as necessary, to determine if the installation of an advanced meter had any relative impact.

**Evaluation of Advanced Meter Deployment and Data Management Process and Controls:** The teams assessed the processes, written procedures, and controls developed by each TDSP to facilitate the successful deployment and use of advanced meters in their respective service areas, including the following:

- » Advanced meter testing – initial testing and acceptance of advanced meters
- » Advanced meter deployment – physical installation of advanced meters and initial network communication establishment
- » Advanced meter data management – collection, storage, and transfer of data recorded by the meter through advanced meter data systems

The Navigant Consulting team developed process maps that detailed the procedures and control points in place at each of the TDSPs, as well as completed a meter-to-bill analysis and a meter-to-back-end system verification to ensure that electricity consumption information was accurately communicated from the advanced meters through the ad-

vanced meter data systems and ultimately to the customer.

## Navigant Consulting's Findings

The investigation and evaluation were completed in approximately four months and culminated in a report submitted to the Commission. The report addressed each of the four key questions and achieved the overall objective of re-instilling public and consumer confidence in the accuracy and reliability of the advanced meters and associated systems.

**Accuracy Testing of Advanced Meters:** The results of the accuracy testing indicated that the advanced meters accurately measured and recorded electricity usage. 5,625 out of 5,627 meters (or 99.96 percent) tested were found to be accurate by the American National Standards Institute standards of +/- 2 percent. Side-by-side testing, as well as the review of historical accuracy testing results, indicated that the advanced meters were significantly more accurate than the electromechanical meters.

**Analysis of Customer Complaints:** The higher electricity bills observed appeared to be due primarily to significant changes in the weather and electricity usage during the recent severe winter in Texas. The Navigant Consulting team also observed a combination of other factors that may have exacerbated the observed differences in certain customer bills including the length of customer billing cycles, and the use of "estimated" and "manual" meter reads that may not have been reflective of the customer's actual electric usage.

**Electric Usage / Billing Analysis:** The results of the analysis indicated that there was no statistically significant difference between customers with advanced meters and customers with electromechanical meters, that was believed to be attributed to the installation and use of advanced meters.

**Evaluation of Meter Deployment and Data Management Process and Controls:** The processes employed by the TDSPs were generally consistent with one another and sufficient to provide reasonable assurance that each TDSP had the necessary processes and control points to ensure the accuracy and ef-

fective deployment of advanced meters, as well as that the meters were successfully communicating with the respective advanced metering systems.

## The Best Way Forward: How to Avoid the Potential Pitfalls and Perils

The Smart Grid will be ineffective for utilities and consumers unless the key components, including advanced meters and associated systems, are properly developed, deployed, administered, and monitored. During the course of its investigation and evaluation, the Navigant Consulting team observed certain key aspects of advanced metering systems, as well as advanced meters, that require special attention as the world continues to move toward a Smart Grid, including the need to:

- » Develop Robust Processes and Controls – Develop an iterative process to create, test, and refine processes and controls around key areas including advanced meter testing, deployment, and meter data management.
- » Address Communication Issues – Evaluate advanced meters with communication issues (especially advanced meters that suddenly cease to communicate) quickly, as communication issues are typically symptomatic of more serious issues with the advanced meters themselves.
- » Monitor Communication – Evaluate information communicated from the advanced meters including developing a

detailed understanding of the event codes, as well as defining thresholds for further analysis and reporting purposes. Advanced meters will typically communicate an event code, signaling a potential issue if the meter is not performing to acceptable standards.

- » Perform Root-Cause Analysis on Meter Failures – Evaluate the root cause of advanced meter failures, especially where failures seem to be concentrated in a particular advanced meter hardware or firmware version.
- » Evaluate Success and Failure Rates of Firmware Upgrades – Evaluate the success and failure rates for the deployment of firmware upgrades, as meters that are allowed to remain in service for extended periods with old firmware versions are likely more susceptible to potential issues.
- » Establish Cross-Functional Teams to Evaluate Communication Problems and Failures, as Well as to Monitor Error Codes and Success and Failure Rates of Firmware Upgrades – Develop and educate cross-functional teams including representatives from the information technology, metering, billing, and customer service departments to coordinate and evaluate the potential impact of any issues related to advanced meters or the advanced metering system upon meter reliability and accuracy, including billing accuracy.

