Advanced Metering Infrastructure & Utility Applications

Identifying How to Create Value Across the Grid
There are a number of aspects of advanced metering that we can investigate in order to determine what the true potential for electric utilities

- What are the opportunities associated with advanced metering and other automated distribution applications?
- What are the different components that come into play and who are some of the system element providers?
- How can financial analysis help us to determine the viability of differing system solutions?
Monitoring and diagnostic systems can be used to provide power quality and control monitoring applications for different aspects of an electric distribution system

- Factors arising as a result of deregulation means utilities need to measure power characteristics in every sector of the power grid
- Increased monitoring requires additional communications infrastructure
Power monitoring and control applications have capabilities that can be fully automated to maximize efficiency and significantly reduce O&M costs

- The systems alone collect and analyze data that can diagnose and locate problems before they happen
- IEDs (Intelligent Electronic Devices) can be installed to fully automate control systems and receive maximum economic benefits
Communications networks may provide a cost-effective, bi-directional, broadband communications platform capable of delivering real-time data to the utility

- Using a communication platform can eliminate the cost barriers historically associated with the installation of SCADA, AMR and Load Management Systems
  - There are no payments to telephone utilities for installation fees and rights of way
  - The approach eliminates the need for high-cost dedicated landlines or dial-up lines that require toll payments
  - Fixed wireless networks can be very costly to install on an entire network
  - Network capabilities can eliminate charges associated with using cellular systems
- Efficiency can be improved by reducing the number of different architectures that need to be supported and managing all systems on one network
- The utility own the meters and the communications system and not have to rely upon another utility or provider
  - No interruption of data transmission due to downed telephone or cellular systems
  - Maintenance and repairs scheduling is completely controlled by the utility
- Labor and operating costs associated with manual data gathering and analysis could be reduced in a variety of areas:
  - Head count
  - Salaries/Benefits
  - Vehicle Fleet
  - Overhead
- The potential exists to reduce communications latency between devices
There are numerous vendors that offer a variety of automated distribution functions

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Utility Applications Supported</th>
<th>Sample Customers</th>
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</thead>
</table>
| Cannon Technologies | • Demand response  
|                    | • AMR                                           | • TVA                                            |
|                   | • Substation automation                         | • Louisville Gas & Electric                       |
|                   |                                                  | • Kansas City Power & Light                       |
| CES International | • Outage detection                              | • Southern Company                                |
|                   |                                                  | • Baltimore Gas & Electric                        |
|                   |                                                  | • Con Edison                                      |
| DCSI              | • AMR                                           | • PPL                                            |
|                   |                                                  | • Idaho Power                                     |
|                   |                                                  | • Bangor Hydro                                    |
| GE Power Systems  | • Substation Automation                         | • Hydro Québec                                    |
|                   |                                                  | • Scottish & Southern                             |
|                   |                                                  | • PG&E                                           |
One of the more critical areas within the field of automated distribution lies in the emergence of Intelligent Electronic Devices (IEDs)

- IEDs offer the ability to utilize cost-effective and intelligent monitoring systems and services to the electric utility industry for monitoring the health of distribution infrastructure
  - The combination of low cost sensors and communications platforms will enable numerous applications of Distribution Automation
- There are a number of typical functions supported by IEDs:
  - Detection and location of faults
  - Measurement of power quality
  - Identification of grounding and cable insulation issues
  - Detection of power theft
  - Detection of unanticipated loads
  - Confirmation of recloser, sectionalizer and other switch operations
  - Support capacitor-switching algorithms
  - Monitoring disturbed generation
The development of network infrastructure can allow for a better communications platform to enable automated distribution applications

- Test of Underground Sensor Equipment -

Source: GridCom International
Overall, there are a number of different players in the overall value chain:

**Vendors**
- Cooper Power
- S&C Electric
- Kearney

**Applications & Products**
- Reclosers
- SCADA
- Switches

- ABB
- GE
- Itron

- Fisher Pierce
- Lindsey
- Square D
- CHK

- Energy Line
- Fisher Pierce

- Domosys
- Intellon

- Richards
- GE-Harris

- AMR
- Distribution automation

- Fault testing
- Line sensors

- Capacitor banks

- LAN

- Cable joints
- RTUs
AMR systems have been delivering increasing value with lower costs and more robust capabilities

**AMR Project Payback**

- **Past meter prices**
  - $30: 2.9 years
  - $40: 3.9 years
  - $50: 4.9 years
  - $60: 5.9 years
  - $70: 6.9 years
  - $80: 7.8 years
  - $90: 8.8 years
  - $100: 9.8 years

- **Current meter prices**
  - $30: 2.9 years
  - $40: 3.9 years
  - $50: 4.9 years
  - $60: 5.9 years
  - $70: 6.9 years
  - $80: 7.8 years
  - $90: 8.8 years
  - $100: 9.8 years

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Sample smart grid data
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THE SHPIGLER GROUP
STRATEGY MANAGEMENT CONSULTING SERVICES
The concept of supporting a number of distribution applications through one system has been promoted by EPRI.
When choosing a technology partner/vendor, make sure to choose a complete system that supports a number of system priorities.

- Shares a vision of a total solution approach
- Feature an entrepreneurial approach
- Has a utility-centric focus
- Possess proven technology capabilities
It is very common to integrate a number of players from different portions of the overall value chain in supporting distribution technology application delivery.
Each vendor can be “graded” based on the overall fit they bring to the proposed project.

<table>
<thead>
<tr>
<th>Ability to Invest</th>
<th>Vendor A</th>
<th>Vendor B</th>
<th>Vendor C</th>
<th>Vendor D</th>
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<th>Shared Vision</th>
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<th>Utility Focus</th>
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<th>Entrepreneurial</th>
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<th>Technology Capability</th>
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<th>Manufacturing Capability</th>
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For one utility we worked with, we identified six distinct areas of opportunity within the field of “internal utility applications”

- **Automated Distribution**
  - **Automatic Meter Reading (AMR)**: The immediate opportunity lies in the ability to read multiple meters.
  - **Demand Side Management (DSM)**: The “beyond the meter” capability will enable a robust Demand Side Management program to be instituted.
  - **Distribution Transformer Monitoring**: The Current and Voltage measurement will enable Transformer Diagnostics and Failure Prevention.
  - **Outage Notification**: The location of the sensors in the electrical grid provides opportunity to detect outage information.
  - **Customer Service**: Sensors can enable the delivery of enhanced services that can be marketed to the customer base.
  - **Power Quality Monitoring**: The Voltage Sampling Rate in the design will enable Harmonic Distortion Analysis.
A system was developed to support AMR, DSM, outage detection, and other utility applications

<table>
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<th>Utility Functionality</th>
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<tbody>
<tr>
<td>Provides a new electric meter and data collection device</td>
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<tr>
<td>Stores multiple customer energy usage data at a single location point</td>
</tr>
<tr>
<td>Accepts and stores other multi metering data at a single location point (gas and water)</td>
</tr>
<tr>
<td>Enables backhaul of collected data to NOC (Network Operation Center)</td>
</tr>
<tr>
<td>Plurality of ports for utility and communication providers (CATV, DSL, BPL, Home Security, etc.)</td>
</tr>
<tr>
<td>Enables two way interactive communication between the device, the consumer, service providers, data handlers, and the utilities</td>
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<tr>
<td>Enables “grid-smart” applications (distribution portal)</td>
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<tr>
<td>Empowers consumers to “Smart Home” technology (consumer portal)</td>
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The overall electric applications revenue opportunity for the total system offers significant value.

Revenue - Electric Applications

- Customer Services
- Monitoring
- Remote Meter Management
- DSM
- Metering

Revenue data for 2006 to 2015 is presented in the chart above.
Metering is projected to yield the largest immediate potential benefit of all of the electric applications

- Read-to-bill benefits are heavily loaded up front as deployments lead to immediate cash flow benefits
- Meanwhile, pure AMR benefits and corrections of faulty billing increase as more meters are brought on-net

**Key Assumptions**

- 2006 electric meters: 1,837,193
- Annual growth: 2.4%
- AMR value: $0.53
- Faulty meter rate: 1.5%
- Slow:fast meter rate: 9:1
- Net loss for slow meters: 15%
- Average annual bill: $844
- Read-to-bill benefit: $5.47
- Unregulated benefit rate: 75%
A demand side management program could yield over $7 million in annual benefit once the entire network is equipped

- The primary measure of DSM program performance is the TRC (Total Resource Cost) of Energy Savings
- The TRC is expressed in units of Cents/kWh so that it can be directly compared to a utility’s avoided cost in order to determine the cost-effectiveness of the DSM program

### Key Assumptions

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<thead>
<tr>
<th></th>
<th>Value</th>
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<tbody>
<tr>
<td>Energy savings/meter</td>
<td>135 kWhr</td>
</tr>
<tr>
<td>Total resource cost</td>
<td>$.032</td>
</tr>
<tr>
<td>Unregulated benefit rate</td>
<td>75%</td>
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</table>
Off cycle reads can result in significantly higher costs that normal monthly reads

- The deployment is projected to last five years, after which point approximately one million dollars is returned in value per year

**Key Assumptions**

- Off cycle reads/year: 7%
- Off cycle meter read: $10.00
- Unregulated benefit rate: 75%
Implementation of the system devices can support more efficient operation of distribution transformer monitoring

- Remote troubleshooting can reduce labor required for in-person visits
- Furthermore, efficiency in dispatching in the event of a transformer failure can be increased as well

### Key Assumptions

- Customer troubles/year: 8.3%
- Hours per trouble call: 1.5
- Labor rate: $60.00
- Trouble visit reduction: 75%
- Calls involving OT: 25%
- Failure rate per meter: .013%
- Hours per failure: 4.0
- Dispatching efficiency gain: 10%
Customer services like surge protection and electrician services can easily be supported by a deployment of a total system solution

- The high margin nature of the business supports immediate cash flow generation

**Key Assumptions**

<table>
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<th>Assumption</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surge penetration</td>
<td>1.3%</td>
</tr>
<tr>
<td>Surge monthly fee</td>
<td>$7.99</td>
</tr>
<tr>
<td>Surge net margin</td>
<td>95%</td>
</tr>
<tr>
<td>Electrician sales rate</td>
<td>25%</td>
</tr>
<tr>
<td>Customer charge</td>
<td>$500</td>
</tr>
<tr>
<td>Electrician margin</td>
<td>82%</td>
</tr>
</tbody>
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**Customer Services Benefits**

- Surge Suppression
- Electrician Services

Sample smart grid data
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Going forward, the next steps will be to identify how to proceed with a metering and automated distribution strategy

- Confirm management interest in utility applications – and the nature of the interest
- Build the business case to support a viable strategy
- Begin discussions with technology vendors to evaluate technology fit
- Initiate tests of technology options
- Customize analysis of opportunity for your community
- Identify partnerships with key operators – ISPs, CLECs, network integrators – and negotiate terms and roles
- Project manage the deployment of the network

There may exist an opportunity for cities to work together to jointly evaluate the potential of these kinds of system approaches