



Los Alamos Department of Public Utilities (DPU)

AMI Study – Update September 2018



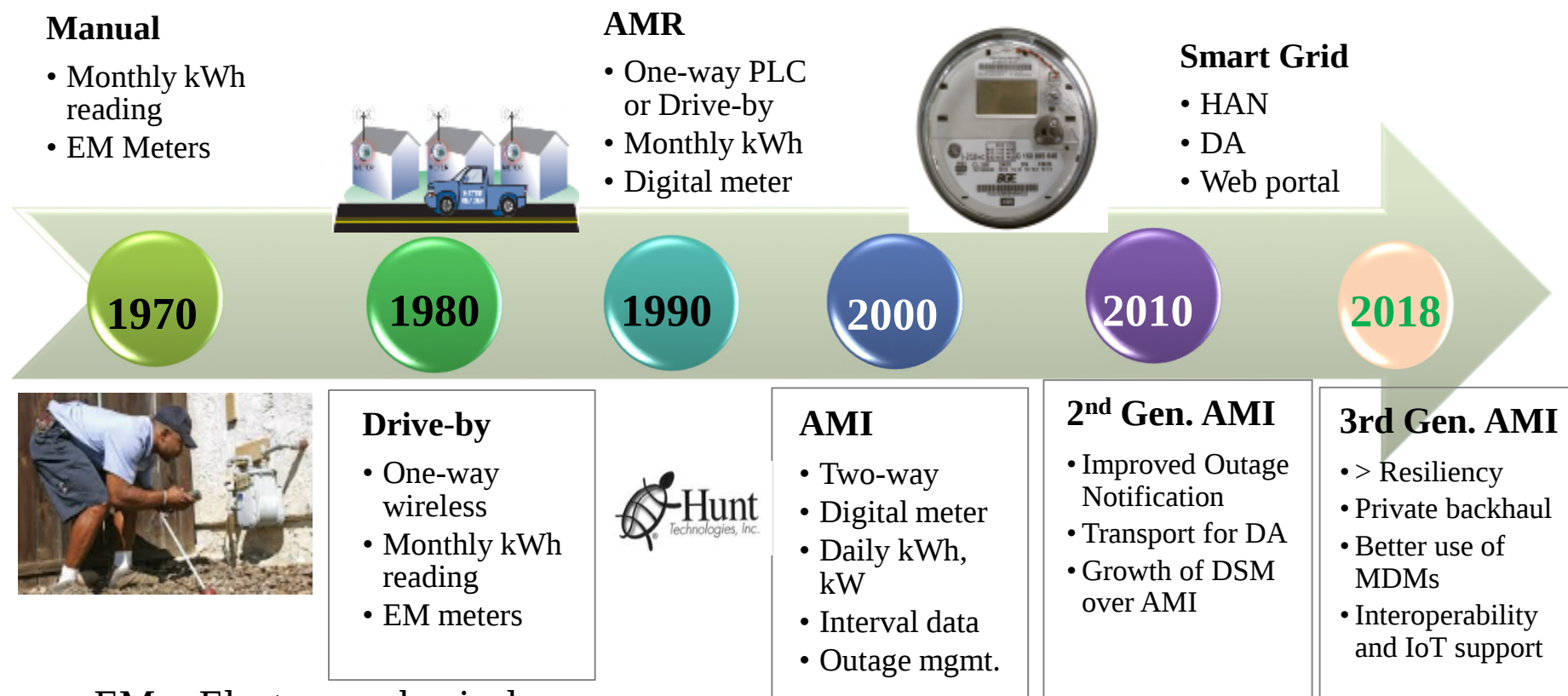
EXPERIENCED ■ INDEPENDENT ■ RESPECTED

Meeting Agenda

1. Introduction to AMI
2. AMI Technology Considerations
3. AMI Benefits Overview
 1. Billing and Customers
 2. Outages
 3. Field Time Reduction and Safety
 4. Additional Services/Programs
4. AMI Cost, Benefits, and Break Even

Introduction

Meter Reading Technology Evolution



EM = Electro-mechanical

AMR = Automated Meter Reading

DA = Distribution Automation

DSM = Demand Side Management

AMI = Advanced Metering Infrastructure

HAN = Home Area Network

IoT = Internet of Things

AMI Benefits: Overview

Potential Benefits of AMI Overview

- Among other uses, an AMI network enables the efficient and effective transport of information from the field into the office for various systems. In general, areas of improvement exist for:
 - Billing and Reporting
 - Customer Support, Services and Information
 - Outage & Restoration
 - Overall Safety Improvement
 - Additional Programs – Demand Response, Distribution Automation, Street Light Controls, Internet of Things (IoT), etc.

Potential Benefits of AMI (Continued)

- Water Leak Detection
 - Assist with pressure management and help determine possible leaks which are of value to the customer
- Reduce water costs and wasted resources
 - Ability to monitor/manage water supply and distribution
- Further monitor the water distribution system for issues or problems; increase reliability and more effectively troubleshoot issues
- Potential remote disconnect/reconnect options
 - Alerts and events to also identify potential theft
- Eliminate bill estimating and provide more clarity

Potential Benefits of AMI (Continued)

- Voltage Monitoring
(Min, max, average)
- Transformer Loading Analysis
- Number of customers out of power
- Current demand savings from load control (kW)
- Outage Index Reporting (*SAIDI, SAIFI, MAIFI*) at multiple levels
- Cumulative outage hours
(*MTD/YTD*)
- Demand Response
(Conservation Voltage Reduction, Peak Reduction, Etc.)
- General line loss analysis
- Power quality investigation
- Number of blinks, sags, etc.
(over time specified)
- Peak condition tracking
- Power factor by circuit or time of day
- Pattern detection (Algorithm to detect patterns in voltage, demand, blinks, etc.)
- System efficiency by circuit
- Remote Disconnect/Reconnect

Potential Customer Benefits

- Accuracy – fewer read errors
- Fewer estimates
- Less intrusion
- Billing date flexibility
- Better customer bill understanding/education
- Rate stability/Flexibility/Avoided rate increases
- Increased efficiency, load management, Internet of Things (IoT)
- Improved Power quality
- Faster outage restoration
- Demand Response savings for the customer
- More detailed information available immediately
- Expanded service to attract new businesses and residents
- More options for customers in need (example: pre-paid metering)

AMI Benefits: Billing and Customers

Potential Benefits of AMI (Continued)

Billing and the use of complex rates:

- Time of Use (TOU)
- Critical Peak Pricing
- Net-Metering
- Pre-paid Metering
- Move-in/Move-out/Final Readings
- Alerts/Events
 - Flag suspected theft
 - Usage - when there should be zero or no-usage
 - Tilt notification – indicates meter tampering or removal from base
- Non-Pay Disconnect and Reconnect (see safety)
 - Well established for Electric, but starting to see an offering for the Water service as well

Existing CIS/UB Support

- Many CIS/UB systems on the market today are geared towards Utilities with AMI.
 - Numerous features, reporting functions, and applications are optimized around larger data sets
 - Some of the features used in the billing system which are enabled by having AMI:
 - Complex billing rates
 - Customer efficiency programs
 - On-demand/Move-in/Move-Out/Final readings directly from the CIS (without needing access directly to the AMI system)
 - Rate optimization and comparison
 - Better use of data for reporting

Improved Detail with Meter Intervals

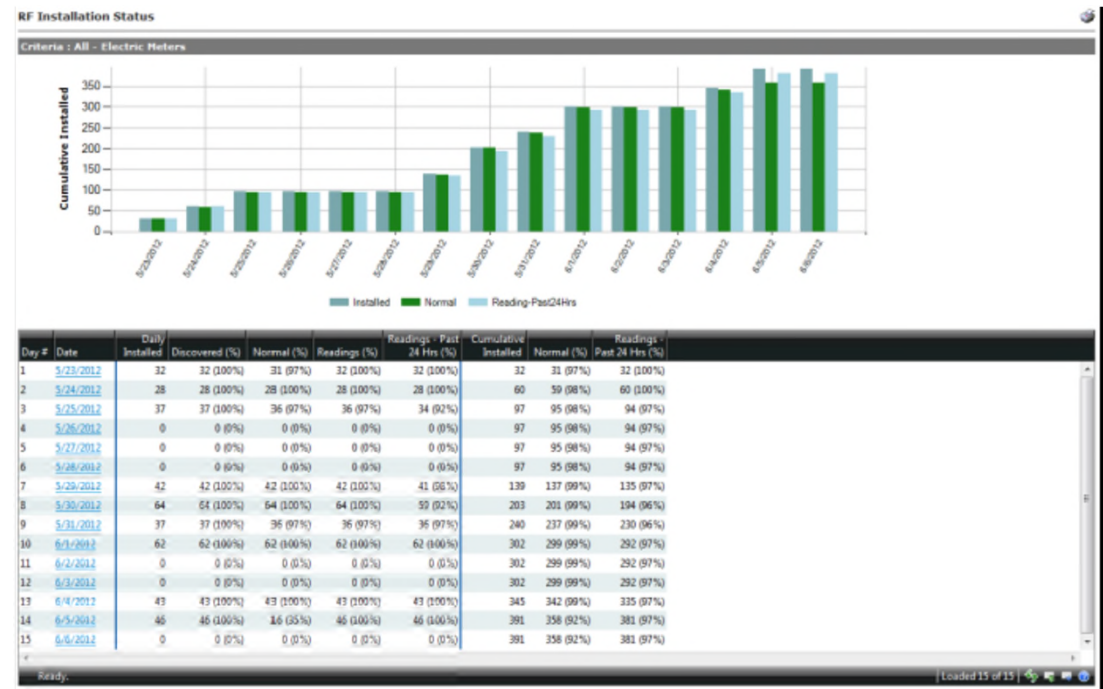
- **Interval Reading**
 - Flexible interval readings can be provided (5 min., 15 min., 1 hour, etc.)
 - Flexible interval reporting times. Timing and frequency can typically be adjusted from the office
 - Measure effectiveness of load management programs (intervals from electric and direct load control switches)
- More Data
 - kWh hourly readings
 - kW
 - Power Factor
 - Voltage min/max
 - Voltage profile
 - Load profile
 - Alarms/Events

Market Competitiveness

- Marketing to attract new businesses and residents starts with highlighting the area's strengths:
 - Provide modernized customer data services and proactive responses to issues
 - Leak detect
 - Outage and restoration responses
 - Alerts (broken/burst pipe or hot socket)
 - Street/Security/Playground Light Controls
 - Competitive and flexible billing rates
 - Internet of Things, Commercial Energy Efficiency, Net-Metering, and other potential programs
 - Quick response and low impact to customers in resolving issues (Ex. high bill complaints)

AMI Sample Reports and Capabilities

- **Endpoint Report:** for scheduled reads with demand resets; provides a list of all endpoints scheduled for reset and the current status of the reset. Filtered by user-defined addressing group
- **Daily Read Status Report:** tracks the readings success rates of all meters in the field each day, in addition to a breakdown by collector
- **Billing Progress Report:** shows list of meters that do not show billing data for certain X-day billing window
- **Meter Exception Reports:** monitor condition of endpoints by tracking whether endpoint is logging, has ever logged, or logs or counts intermittently



AMI Sample Reports and Capabilities

- **Service History Reports:** customer information reports to assist with customer service inquiries. Can indicate customer usage and temperature data
- **Usage Report:** displays electric consumption (time of use) data provided by AMI devices; also can be displayed in the MDMS
- **Overall Electricity Usage Report:** shows total energy consumption data across customers
- **Outage Tracker:** augments the power restoration process by tracking status of customer outages and restorations and approximate elapsed time of outage
- **Meter Change-Out Report:** generates listing of meter change-outs
- **Meter History Viewer:** shows data collected from meter for diagnostic purposes

AMI Sample Reports and Capabilities

- **Virtual Disconnect Report:** identifies consumption at locations where zero usage or minimal usage is expected.
- **User Activity and Management Audit:** tracks user activity including user creation, modifications, and lockouts.
- **Endpoint Configuration Audit:** tracks when endpoints are brought into the system, removed, configured and deployed.
- **Load Management/Demand Response:** LM control area dashboard and asset availability. LM audit reports.
- **Inventoried Devices:** lists devices that do not have an installation date assigned.

Audit Reports

Report Selection

Report Type: Daily Activity Report

Device Criteria

☒ All
☐ Collector
☐ Meter

User Criteria

☒ All
☐ User

Date Range

☒ Quick Select: Past 24 Hours
☐ Start Date: End Date:

Report List:

- Daily Activity Report
- Collector Archived
- Collector Settings Change
- Critical Commands
- Endpoint Configuration
- Group Configuration
- Import Operations
- Login Failures: Invalid Password
- Login Failures: Invalid UserName
- Meter Readings Quality Changed
- Organization Settings Change
- Process Settings Change
- Security
- System Settings Change
- User Account Management
- User Roles Management
- User Sessions

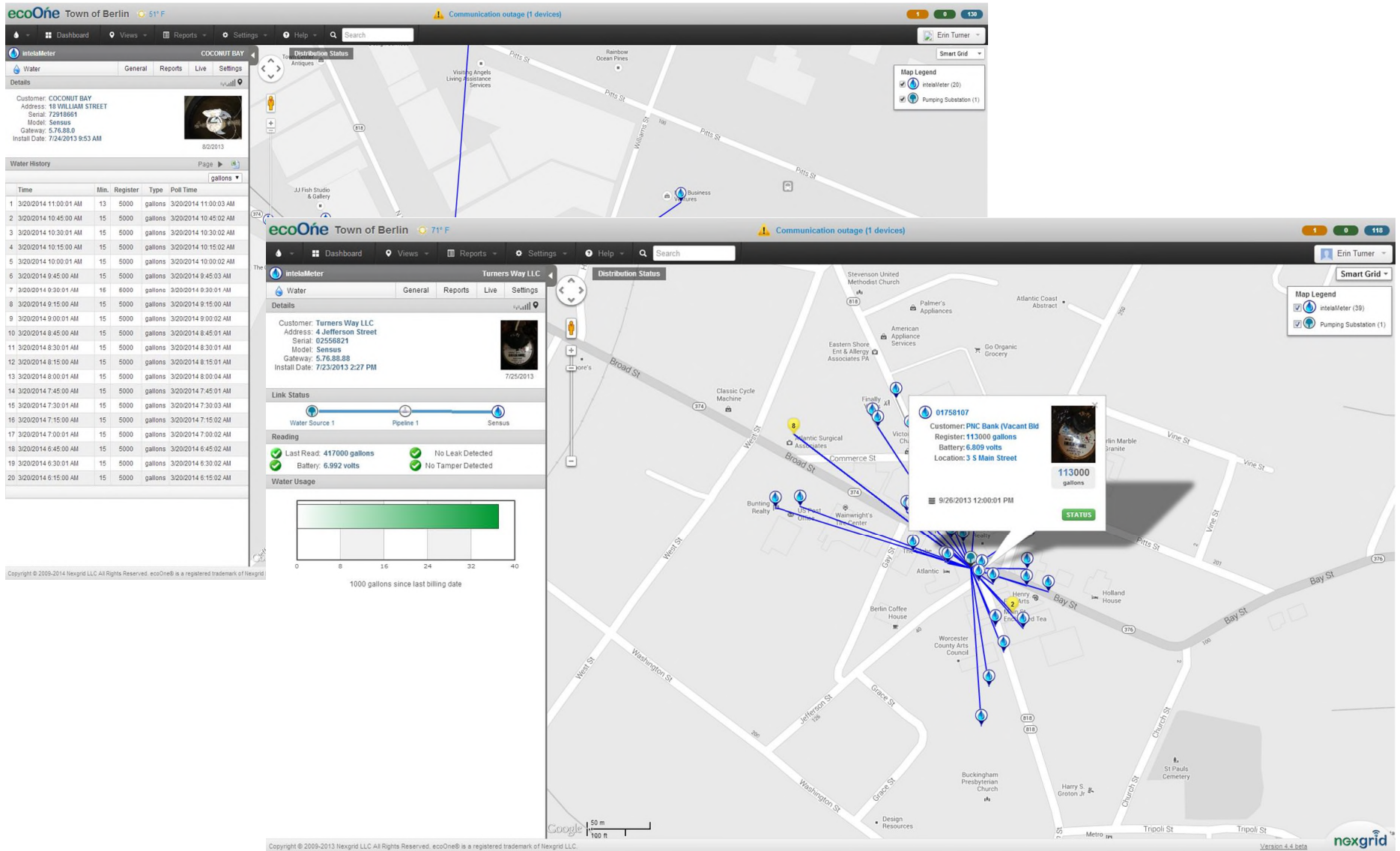
Interval Data Screen Samples (Customer Facing)



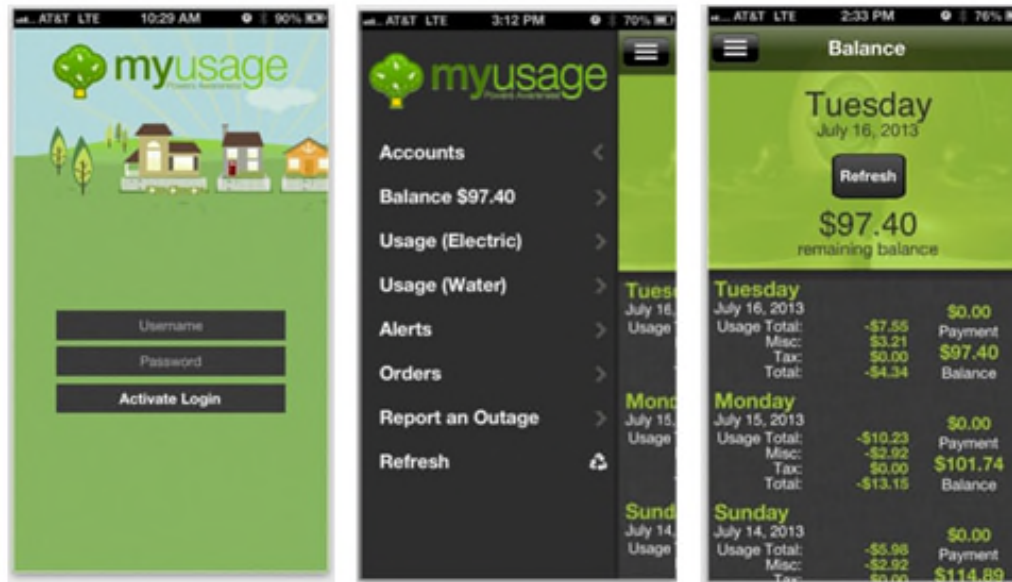
Interval Data Screen Samples (Customer Facing)



Meter Data and Connection View



Metering Subscriber (Pre-Pay) Screen Samples



Water Leak Detect Example

The screenshot displays the EATON AMI Water Leak Report interface. The top navigation bar includes the EATON logo and tabs for AMI, Demand Response, Volt/Var, Assets, Tools, and Admin. The main content area shows a 'Water Leak Report' with a message indicating 2 water leaks identified. Below this is a table of water leaks with columns for Device Name, Meter Number, Device Type, Leak Rate, and Customer Info. A pop-up window titled 'Account Info' is overlaid on the right, showing customer and service location details.

Water Leaks Table:

Device Name	Meter Number	Device Type	Leak Rate	Customer Info
*100099 RF Water Commercial	100099	RFW-Meter	3.000 gal/hr	View Details
*100104 RF Water	100104	RFW-Meter	2.000 gal/hr	View Details

Account Info Pop-up:

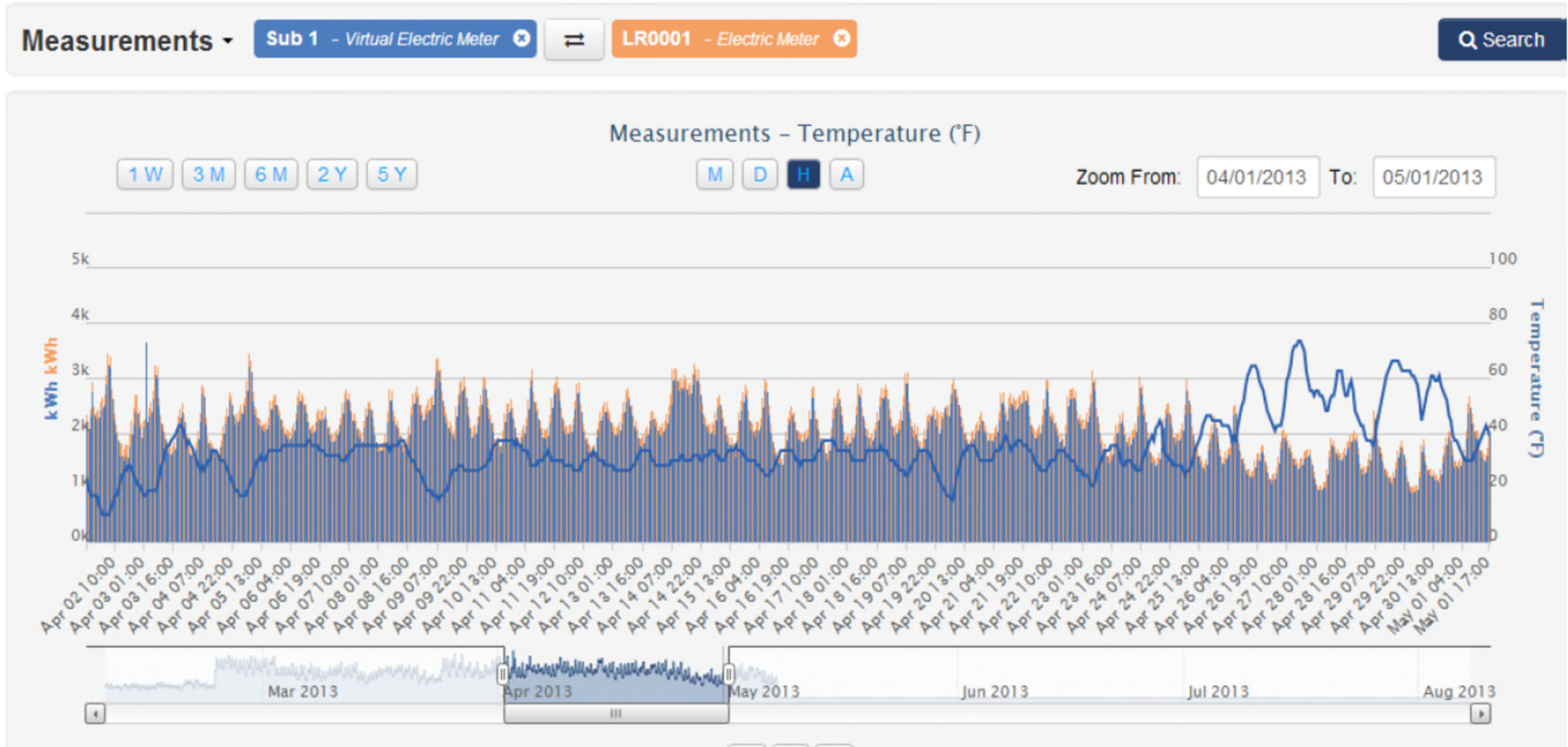
Customer Information

Name: Pat L Smith
 DBA Name: Wild Blue Yonder
 Address:
 Phone:
 Email:

Service Location

Service Location: 101000002
 Customer Number: 479
 Account Number: 47900
 Site Number: S123-55XXXG
 Map Location: 090-285-002A
 Address:

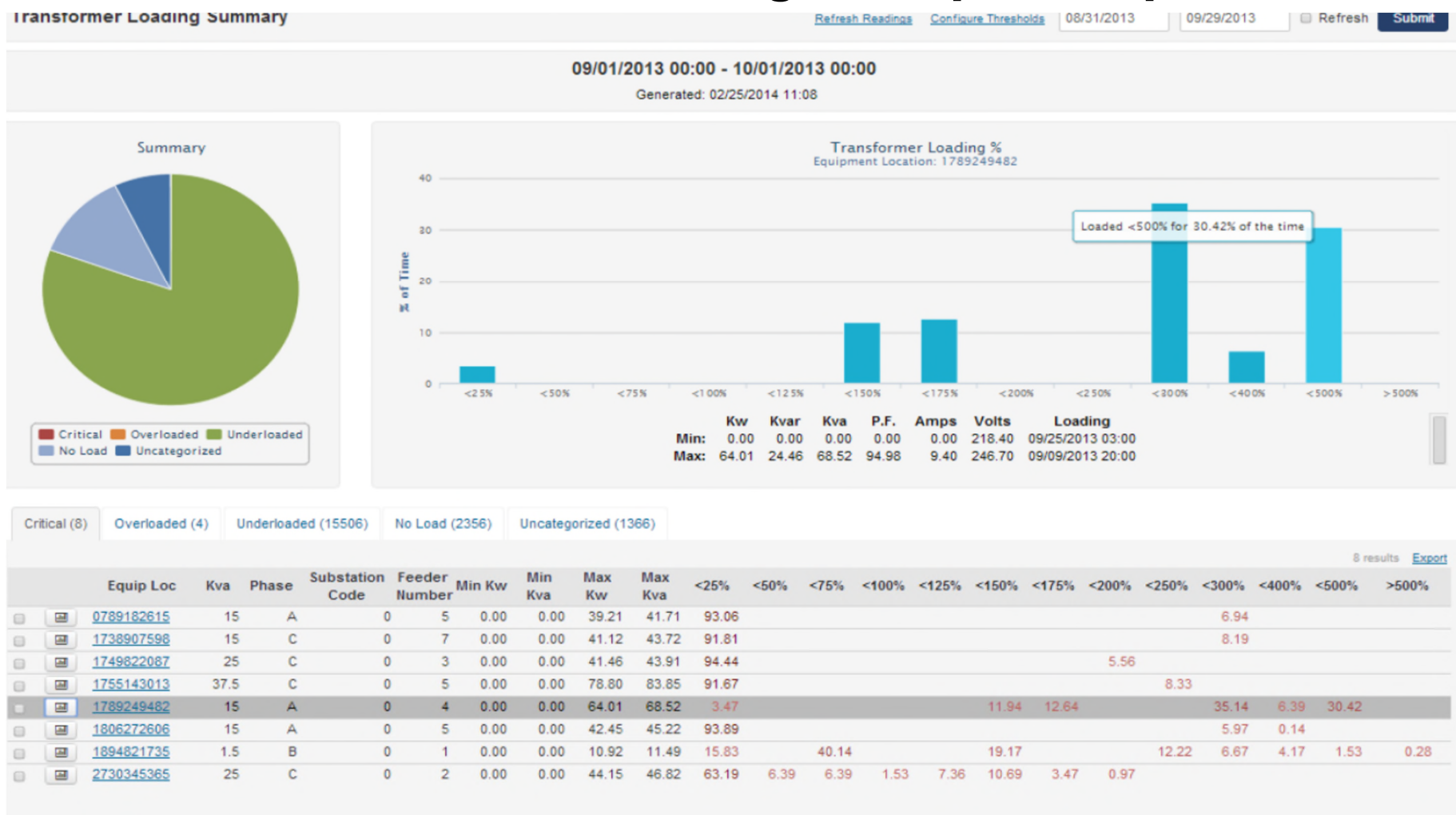
Line Loss Reporting: Substation Revenue Meter to All Meters Served by Substation



Reducing line loss could become a huge benefit. Just making small improvements can lead to a significant gain in revenue. Being fair to all customers is also very important.

An MDMS may be needed (some analysis is included in AMI systems now)

Transformer Sizing: Sample Graph



An MDMS may be needed (some analysis is included in AMI systems now)

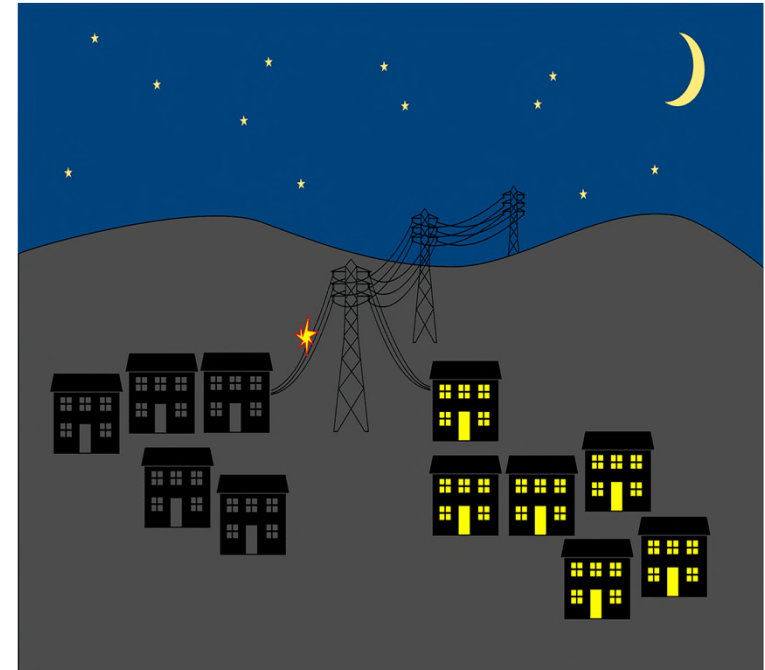
AMI Benefits: Outages

Outage Management Over AMI

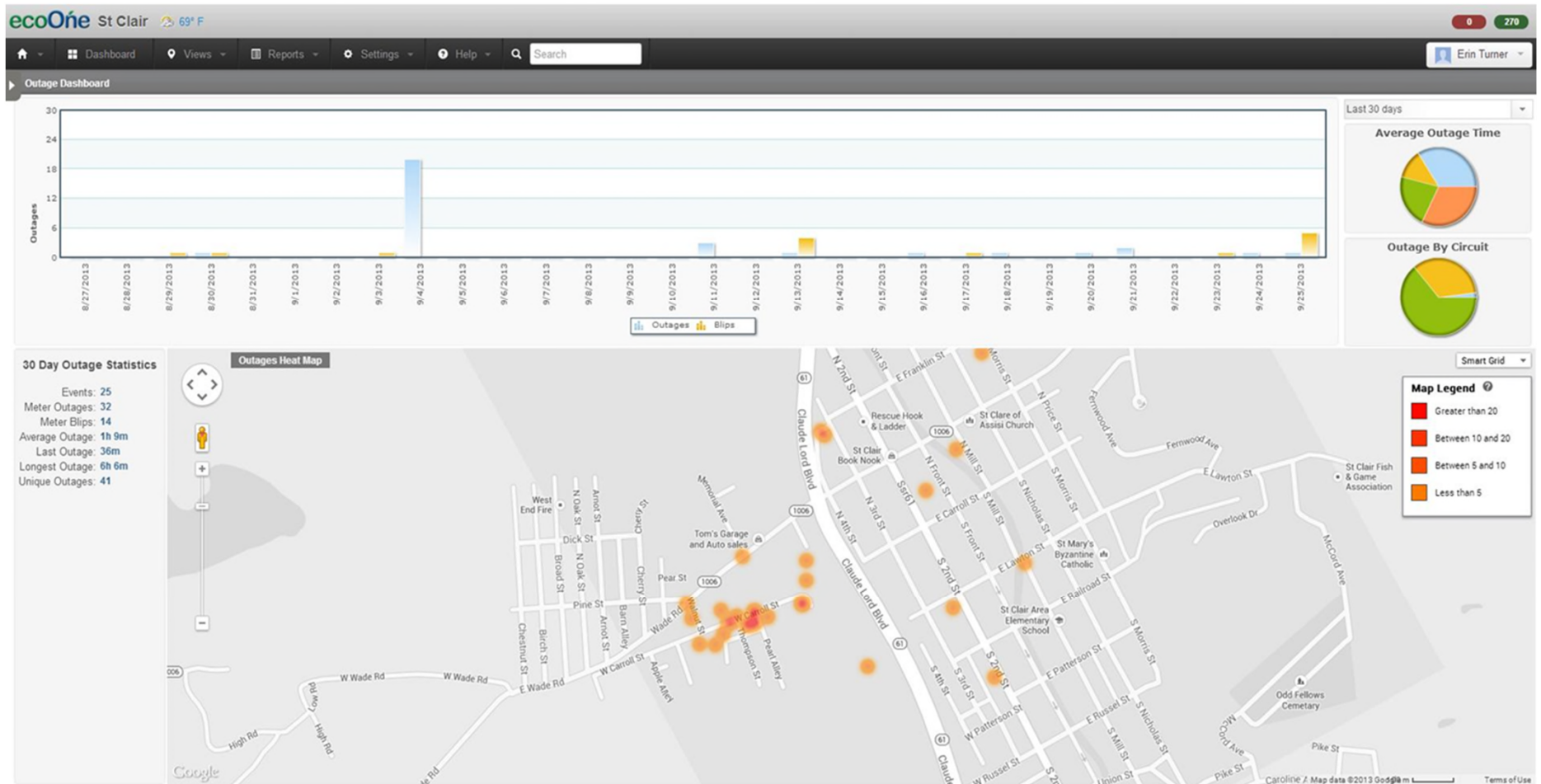
- When power is lost at a meter, the AMI system will send a message when the outage occurs to the AMI software system indicating power is out.
 - It can take about 5 to 30 seconds depending on the AMI vendor and the number of simultaneous meters that are out, to deliver the message to the system.
- The AMI system could be integrated with a GIS Mapping system and an Outage Management System.
- Views indicating the map locations where outages exist (red dots for outages and green dots for power-on locations) are available
- When power is restored, the red dot turns green.

Improve Outage Notification

- **Proactive Outage Message**
 - Accuracy of knowing which strategic and critical asset locations have a sustained outage
 - Restoration messages from those same accounts when the power is back on, in some cases, before the crew even leaves the area
 - Better customer service; in some cases providing a message with an estimated restoral time rather than a generic outage message
 - Understanding the scale of an outage (single or system wide)
 - Knowing if a customer has lost power before they even need to call in, proactive responses



Improve Outage Notification



Blink and Outage Correlation for Energy Theft

- **What is it used for?**
 - Reports that assess the correlation between blinks and outages can be used to identify and mitigate energy theft.
 - When meter tampering occurs by disconnecting the socket, the AMI system can report an outage. This tool can be used when theft is believed to be occurring at a given meter location.
- **Why report it?**
 - By identifying and taking subsequent measures to avoid energy theft, the utility can avoid revenue losses.

AMI Benefits: Field Time Reduction and Safety

Increased Safety – Reduced Field Effort

- **Remote Disconnect and Reconnect**
 - Disconnect and reconnect power from the office vs. a manual cut-off
 - Could be used as an emergency load reduction effort
- **Eliminate Meter Readers**
- **Reduced Truck Rolls**
 - Final/Move-in/Move-Outs
 - Verifies
 - High bill complaints
 - Reduced meter replacements
 - “No Light Calls”
- **Identify Bad Equipment and Code Violations**
 - Identify overheating meters
 - Information and details are powerful

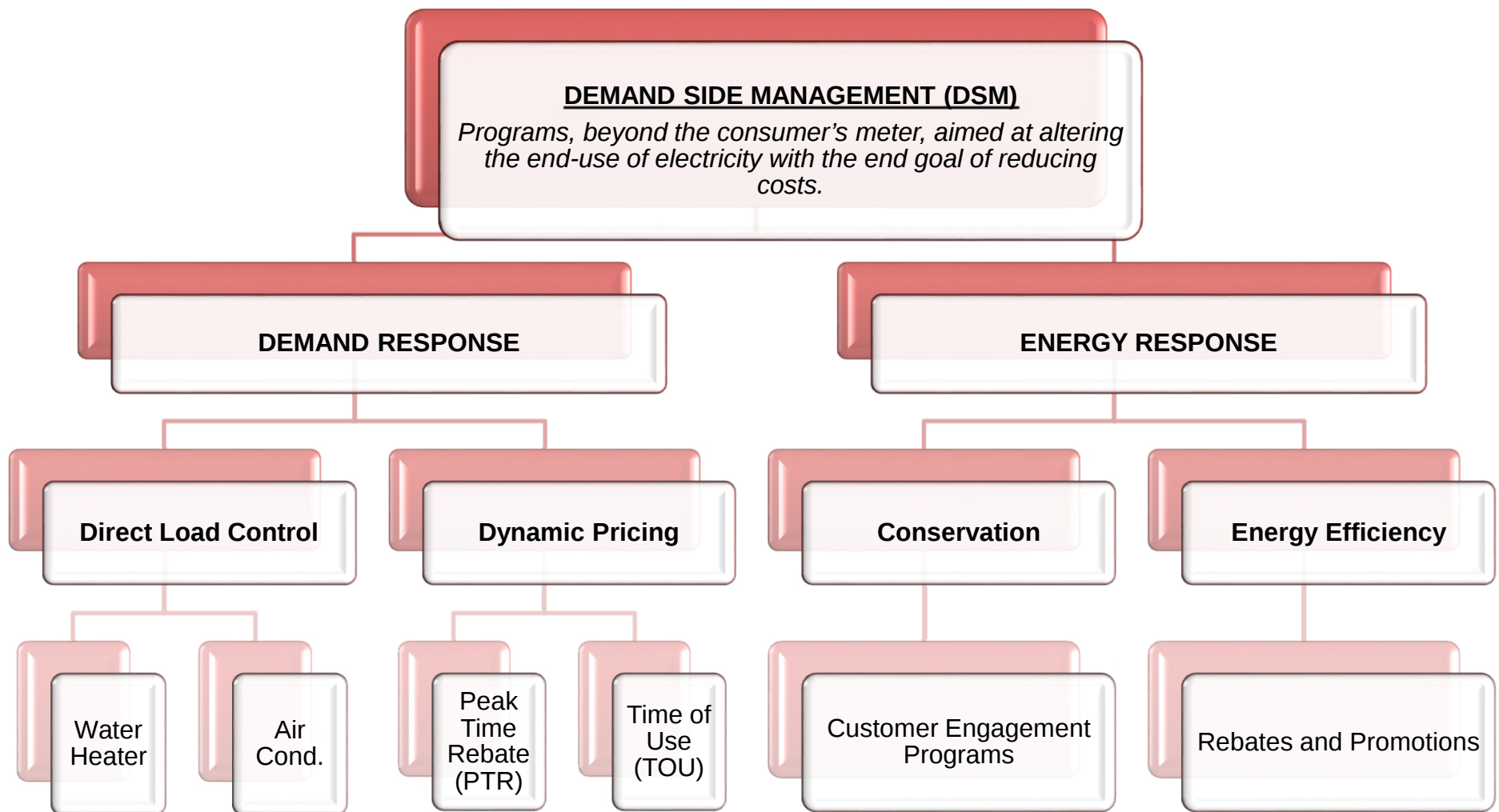


AMI Benefits: Additional Services/Programs

Demand Response

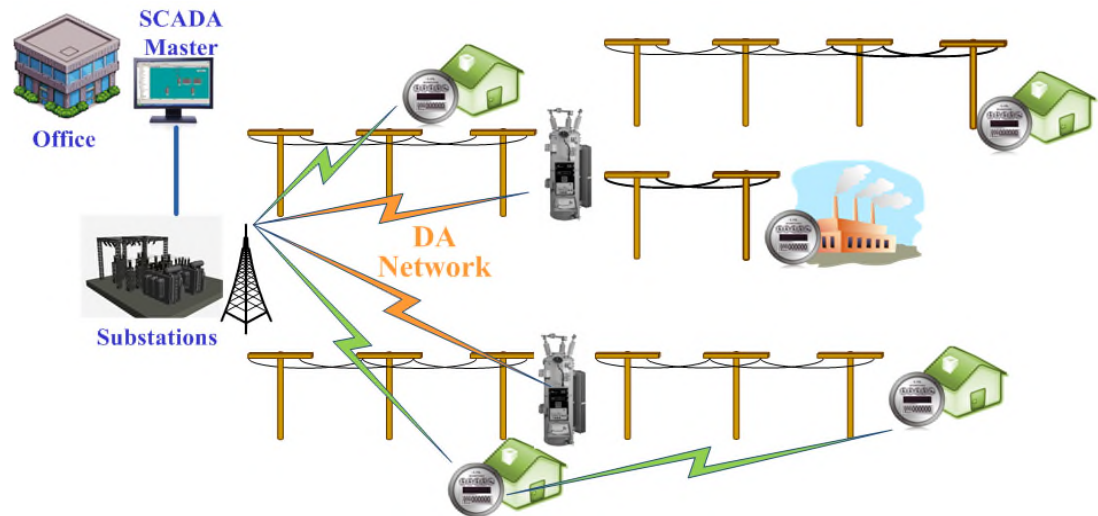
- AMI also opens up opportunities for demand response programs:
 - This can help lower the overall system peak when pricing is high and shift the load when demand charges are lower
 - Depending on peak demand charges, demand response programs can have a very large return on investment
 - AMI can also help introduce dynamic pricing programs and increase the options for members to participate in peak load reduction
 - Peak demand reduction and Conservation Voltage Reduction programs have the potential to save the Utility costly demand charges, but consideration on how to run these programs are key to success

Demand Side Management Overview



Voltage Control Program

- Substation automation forms basis for voltage control
 - Benefits
 - Coincident peak price reduction
 - Energy reduction
 - Components of a voltage control program
 - Regulation (substation and feeder)
 - Measurement (meters and regulators)
 - Control (SCADA or integrated Volt/VAR application)
 - Considerations
 - Seasonal / daily load
 - Metering latency
 - Dynamic network
 - Existing Comms



Distribution Automation (DA) Considerations

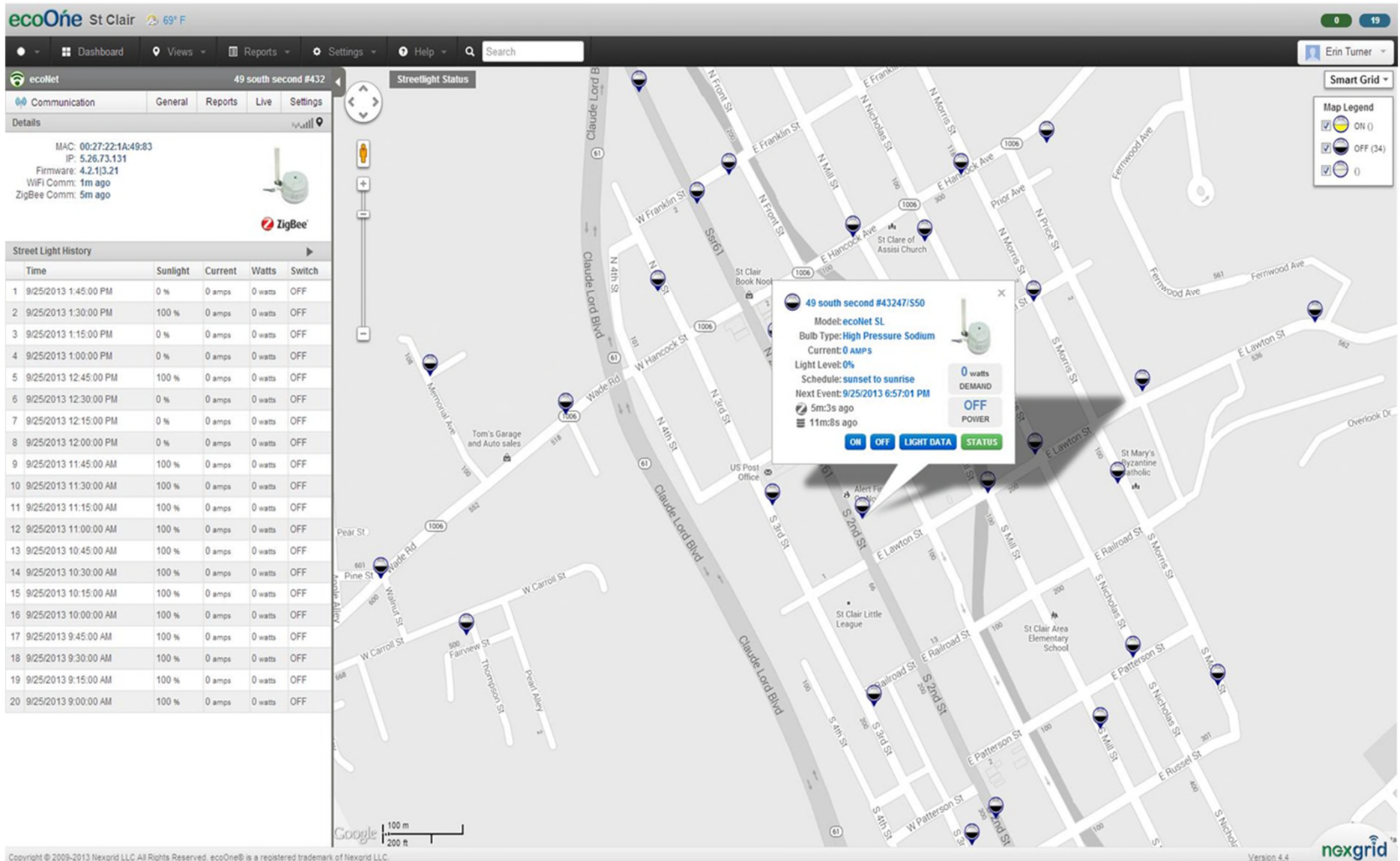
- Every utility has valuable assets
 - **IEDs:** Relays, regulator controls, meters.
 - **Communications:**
 - o **Fiber (partial) deployment:** Communities with existing or pending fiber programs
 - o **Wireless assets:** Including towers
 - **Other systems that can be integrated with SCADA:**
 - o Automated metering (AMI/AMR)
 - o Outage management system (OMS)
 - o Geographic information system (GIS)

Maximize the benefit of what you have toward the programs you need. In areas where latency is tolerable, AMI is a good choice, but a direct communications path is a better option when available.

Street Light Controls

- Many AMI vendors support photo cell adaptors
 - Monitors the light itself
 - Provides remote control and configuration
 - Schedules (automatically adjust for different needs; like a holiday parade or ball game)
 - Lumen output
 - Pattern flashing
 - Send in Alerts/Events
 - Failure to turn On/Off
 - Burn time

Street Light Control and Monitoring



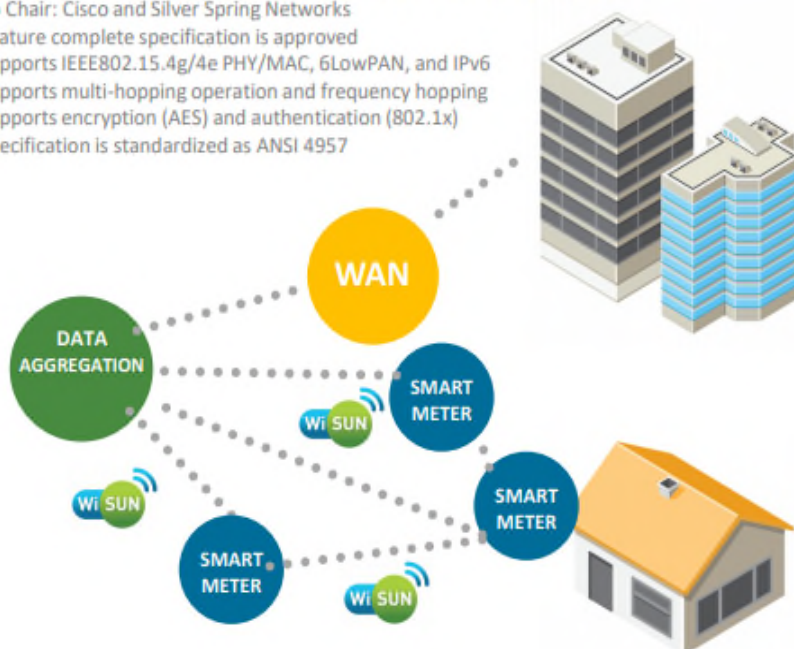
Home Area Network Solutions

Profile Specifications for Smart Utility Applications



FIELD AREA NETWORK (FAN) WORKING GROUP

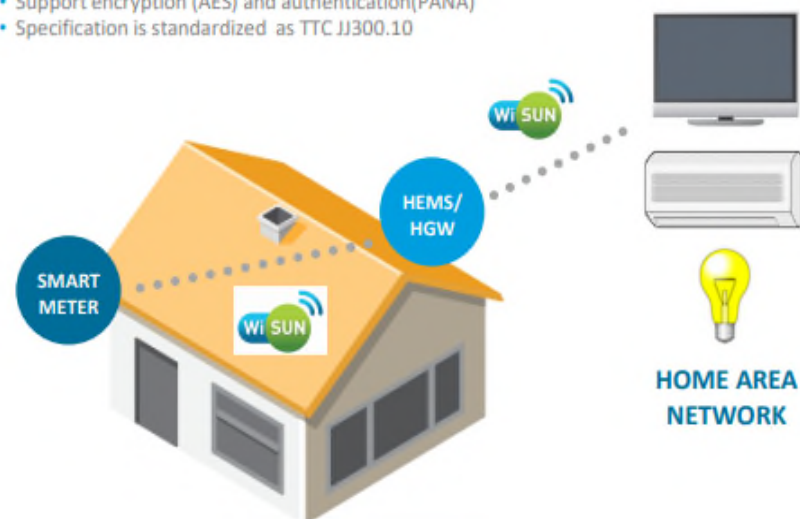
- Co Chair: Cisco and Silver Spring Networks
- Feature complete specification is approved
- Supports IEEE802.15.4g/4e PHY/MAC, 6LowPAN, and IPv6
- Supports multi-hopping operation and frequency hopping
- Supports encryption (AES) and authentication (802.1x)
- Specification is standardized as ANSI 4957



FAN: Communication Between Smart Meters and Distribution Automation

HOME AREA NETWORK (HAN) WORKING GROUP

- Chair: NICT, Technical Editor: Toshiba
- Specification is approved (Wi-SUN profile for ECHONET Lite)
- Support IEEE802.15.4g/4e PHY/MAC, 6LowPAN, and IPv6
- Support encryption (AES) and authentication (PANA)
- Specification is standardized as TTC JJ300.10



TEPCO B-ROUTE: Communication Between Smart Meters and HEMS

HAN: Communication between HEMS controller and HAN device

AMI Budgetary Cost

Potential Benefit Categories (economic and non-economic)

- Reduction in manual meter reading costs (Off-Cycle, On-Cycle, Move-in/Move-Out, and need for staff)
 - Need for Overtime (reduction potential)
 - Disconnect and Reconnects
 - Avoided meter replacement and present meter reading costs
 - Meter accuracy improvement
 - Theft monitoring and alert
 - Water Leak Detect
 - Conservation Voltage Reduction and other demand response programs
 - Overall system maintenance, power quality and reporting improvements, and more automated meter to cash process
 - Safety
-
- Note: For the following assumptions, it was projected out over 15 years

Benefit Assumptions

- **Meter Readings – On-Cycle**
 - This is based on the cost (\$1.12) to read each meter manually
 - Benefit average over 15 years of **\$29K** per year
- **Reduction in Connects/Disconnects/Off-Cycle Readings**
 - This is based off of the average number of connects and disconnects per year (for non-pay and for request)
 - The percent of the AMI system deployed
 - The cost per trip (\$156.00)
 - Minus the reconnect and disconnect fee (\$25)
 - The estimated percent in reduction of manual connects/disconnects (95%)
 - The cost to manually read a meter outside of the normal cycle or missed reading (Move-in/Move-Out, re-reads, etc.)
 - The estimated percent reduction in the number of off-cycle readings (99%) at \$22.77 per read
 - Benefit average over 15 years of **\$75.5K** per year
- **Manual Meter Read Force Reduction**
 - Reduced need for manual reads on the system (95% - assume small percent of meters needing a manual read)
 - The percent of the AMI system deployed
 - Assumed annual employment cost of \$75K per year
 - Benefit average over 15 years of **\$200K** per year

Benefit Assumptions

- **Avoided Meter Replacement & Current System Costs**
 - The cost to currently replace a failed meter (Electric, Water, or Gas)
 - The average number of meters replaced per year (E:50, W:300, G:50)
 - Current cost for present meter reading system
 - The percentage of the new AMI system deployed
 - Benefit average over 15 years of **\$100K** per year
- **Theft Protection & Water Loss Reduction**
 - The current total revenue
 - The current estimated amount of theft
 - The current estimated amount of water loss
 - The percentage of the new AMI system deployed
 - Benefit average over 15 years of **\$35K** per year
- **Meter Accuracy Savings**
 - Current percentage of mechanical meters (75%)
 - Estimated current meter accuracy (98%) vs estimated new meter accuracy (99.9%)
 - The percentage of the AMI system deployed
 - Benefit average is **\$94K** per year

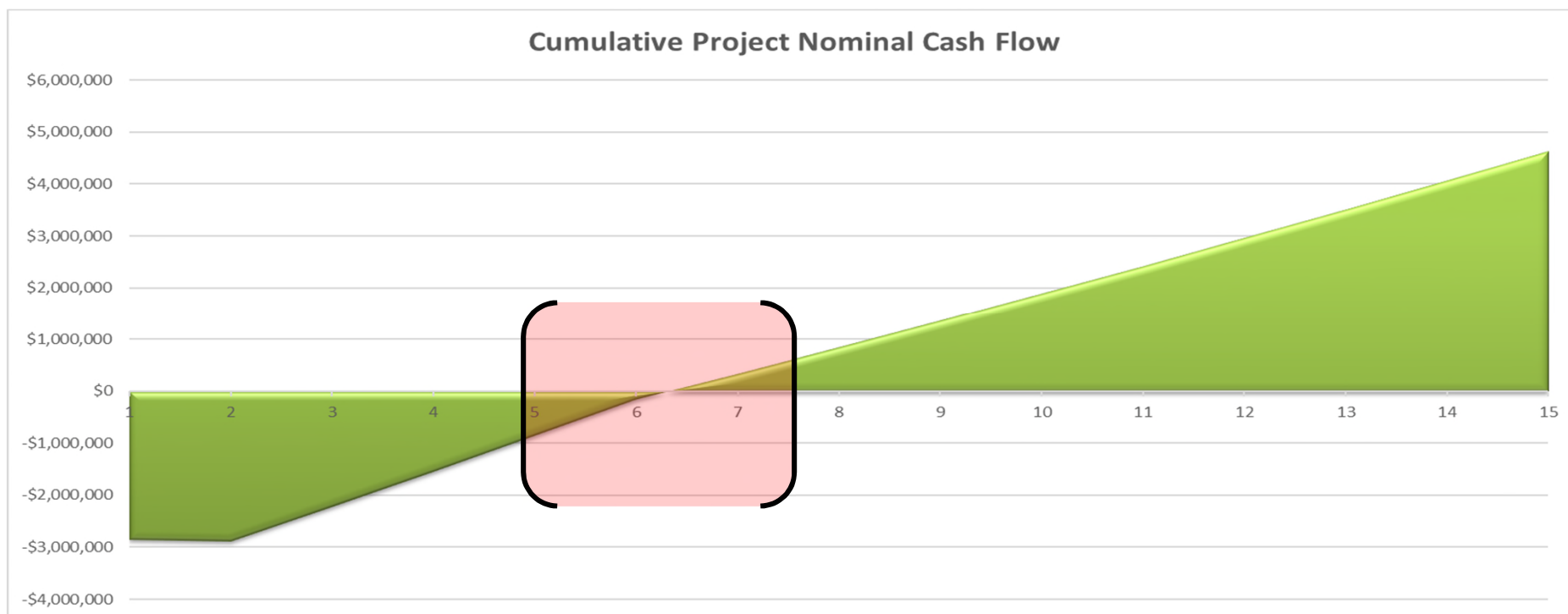
Benefit Assumptions

- High Bill and Estimate Call Savings
 - The average number of high bill complaints and estimate calls (240)
 - The average cost for these calls (\$22.77)
 - The estimated percentage of calls reduced (95%)
 - The percentage of the AMI system deployed
 - Benefit average of **\$16.5K** per year
- Outage Management – No Light Calls
 - The average number of calls for ‘no lights’ (65)
 - The average cost to send a crew and truck (\$156.00)
 - Percentage found to be customer side issue (10%)
 - The estimated reduction percentage in sending a crew (99%)
 - The percentage of the AMI system deployed
 - Benefit average of **\$4.5K** per year

Estimated AMI Benefits (Cost Savings)

Benefit Category	15 Yr PV	Benefit per Meter	% of Total Benefit
Avoided Meter Replacement and Present Meter Reading System Costs	\$ 1,501,000	\$ 61.05	18%
Meter Accuracy Savings	\$ 1,407,000	\$ 57.19	17%
Reduction in Connects/Disconnects/Off-cycle Read Costs	\$ 1,133,000	\$ 46.08	14%
Meter Reading Savings - On-Cycle	\$ 437,000	\$ 17.75	5%
Water Loss Reduction	\$ 337,000	\$ 13.69	4%
High Bill and Estimate Call Savings & Works Comp Reduction	\$ 248,000	\$ 10.10	3%
Theft Protection	\$ 189,000	\$ 7.68	2%
Outage Management (No lights calls, crew optimization)	\$ 62,000	\$ 2.51	1%
Manual Meter Read Force Reduction	\$ 3,001,000	\$ 122.02	36%
Cash flow - reduced short term interest	\$ 0	\$ -	0%
Benefits Total	\$ 8,315,000	\$ 338.07	100%

Potential ROI



- Variations occur in many estimated areas:
 - Current Meter reading costs
 - # of Disconnects/reconnects per year
 - Implementation of Demand Response/CVR
 - Off-Cycle Readings, Investigations, Etc.
- The expected return or breakeven may occur after **year 5** and before **year 7**

Total Cost Breakdown Total

#	Category	AMI
1	AMI Infrastructure	\$ 90,177
2	AMI Software, Servers, and Internal Support	\$ 109,078
3	Meters and Modules	\$ 3,994,638
4	Installation and Project Management	\$ 325,185
5	Test Equipment and AMI Tools	\$ 19,637
6	MDMS Costs	\$ 320,000
Total Initial Deployment Cost		\$ 4,858,715
7	Annual Software License Fees and Support – Year 1 – 7	\$ 699,727
Total Cost of Ownership		\$ 5,558,442

Summary

- AMI enhances the ability of systems to better predict, report, and supply information
 - More data = better decisions
 - Field Safety and investigation (“no lights”, outage & restoration)
 - Equipment and system failures (water leaks or hot sockets)
 - Flexible rates and customer programs
 - Better billing and customer engagement practices
 - High bill complaints
 - Less intrusive
 - CIS enhancements/needs, programs, and options to better suit the customer
 - AMI is becoming the commonplace in communities and is providing the opportunity to offer services to a more data and convenience focused audience
- AMI has the potential to open up new services and opportunity within the community