MEMORANDUM
Summary of AMI Customer Benefits Research
Market Research & Policy, Product Strategy & Development
January 2015

INTRODUCTION

Advanced Metering Infrastructure (AMI) deployments offer many **direct benefits** to utilities by increasing electric distribution efficiency, reducing operating costs (such as remote meter reading, remote disconnect / reconnect), facilitating peak load reductions through behavior change programs or rates, and improving revenue capture through smart meter accuracy and theft detection. These direct benefits eventually flow to customers in the form of lower rates.

In addition to these direct benefits, AMI also offers many **indirect benefits** that impact both the customer and to the larger society / community. These indirect benefits are felt by the customer in terms of: greater reliability; increased product offerings and customer choice; enhanced levels of service and communication; opportunities for customers to feel more engaged with their energy use; and potential for savings on their electric bills. These indirect benefits can also impact the greater society and environment through decreases in carbon emissions in direct relation to electricity usage reductions from distribution efficiencies, adoption of dynamic pricing or energy management services, and enabling Plug-In Electric Vehicles (PEV) or renewable generation integration.

Figure 1 below illustrates how direct and indirect benefits have a dynamic relationship that is integrated and reinforcing. This memorandum focuses on the indirect benefits of AMI deployment and the valuable opportunities this deployment would provide for Xcel Energy to strengthen our relationships with our customers given thoughtful and deliberate communication and product development strategies.

Figure 1. AMI Deployment Benefits

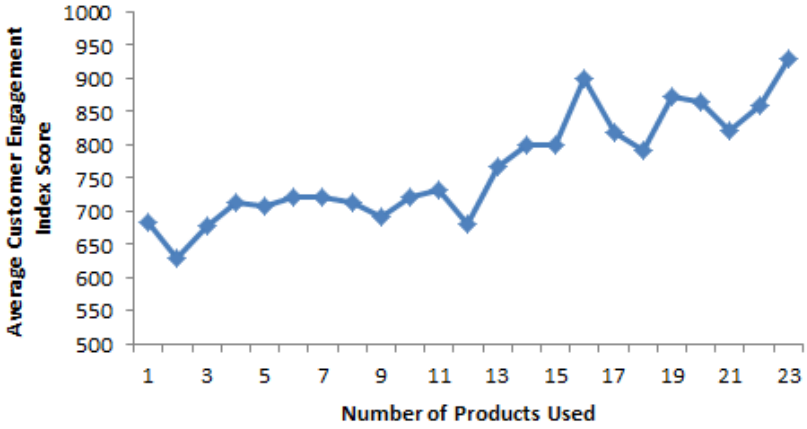
CUSTOMER BENEFITS

Indirect customer benefits fall into four categories: product choice, economic, reliability, and enhanced customer experience and service. Studies have shown that these benefits are important drivers in customer satisfaction and improving utility brand trust.

The Benefit of Product Choice

AMI serves as a dynamic platform that enables many products and services including dynamic pricing (DR, TOU, CPP, and DLC), energy management systems (smart thermostats and EMS), grid ready appliances, renewable energy integration, enabling PEVs and battery storage, energy disaggregation, and prepayment. National studies from JD Power[1] and Market Strategies International[2] have shown that utility customers are more satisfied or more engaged when they have more choices. Figure 1 shows 2015 PSCo data from the Customer Engagement Index. Customers who use more products (and enjoy the benefit of more choices) tend to have higher levels of engagement or satisfaction.

Figure 2. PSCo Products Drive Engagement

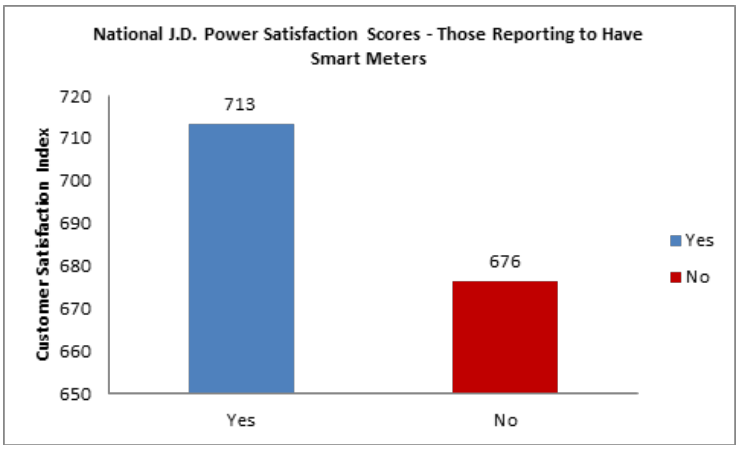


Source: 2015 Xcel Energy Customer Engagement Index

According to an October 2015 article in Fortnightly, "Commonwealth Edison in Chicago reported a rise in customer satisfaction as a result of it's high-touch approach to engaging and educating its customers on smart meters as it rolls them out…"[3] Other utilities, such as Baltimore Gas & Electric, Pepco, and Sacramento Municipal Utility District have had similar customer engagement success stories according to the Smart Grid Collaborative's 2016 Customer Engagement Success Stories Case Studies.[4] Figure 3 shows how national J.D. Power data affirms this hypothesis with customer satisfaction scores that are significantly higher (37 point increase) for those with smart meters.

[1] "2016 Utility Products and Services Study," JD Power McGraw Hill Financial, 2016.
[2] "2015 Customer Engagement Index Study," Market Strategies International, 2015.
[3] Durand, Patty, "Customer Connection," Fortnightly, October 2015.
http://mag.fortnightly.com/iphone/article.php?id=2291463&font=searchResults3
[4] http://smartgridcc.org/sgcc-smart-grid-customer-engagement-case-studies/

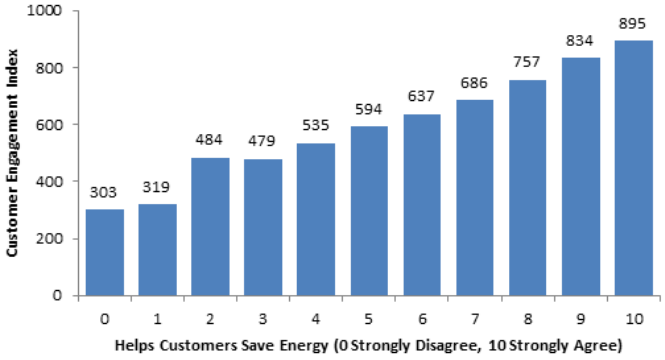
Figure 3. Improved National J.D. Power Satisfaction Scores For Those with Smart Meters



Economic Benefits

Economic benefits are driven by savings achieved through participation in the enhanced and expanded AMI enabled service offerings describes above such as dynamic rate, demand response, or prepayment programs. It is estimated that customers save $13.68 to $23.92 per year from dynamic pricing programs and $7.82 to $19.56 from prepayment programs.[5] Figure 4 shows how customers who believe that Xcel Energy helps them save energy have higher satisfaction scores.

Figure 4. Customer Perception of Xcel "Helping Customers to Save Energy" Leads to Higher Satisfaction



Furthermore, studies have shown that personalized reports from AMI enabled products / services often improve utility DSM program awareness, drive further participation, and ultimately lead to more energy savings measures or behavior changes.[6]

[5] Smart Grid Consumer Collaborative, "*Smart Grid Economic and Environmental Benefits: A Review and Synthesis of Research on Smart Grid Benefits and Costs.*" October 9, 2013.
[6] Navigant Consulting and The National Association of Regulatory Utility Commissioners, "*Value of Customer Data Access: Market Trends, Challenges, and Opportunities."* April 2015.

Reliability Benefits

Many of the direct benefits related to grid reliability that are provided to utilities also benefit customers. These can be attributed to AMI enablement of the following:

- **Volt/VAr Control (IVVC)** which helps to effectively manage voltage and reduce required capacity during peak demand periods
- **Improved outage management** in providing better detection, faster response time, and reduced restoration
- **Fault location and isolation** which helps repair crews find and fix faults faster and isolate impacts

An evaluation of Xcel Energy's SmartGridCity revealed that "Customer Minutes Out" was reduced by over 28,000 minutes annually per feeder that had distribution automations systems installed. Furthermore, power quality complaints were found to have dropped to zero annually after deployment from over 30 complaints on average.[7]

Enhanced Customer Experience and Service

AMI leverages wireless technology to not only help streamline operations but also improve customer experience. Several examples of how AMI can enhance customer service are below:

- **Detailed energy usage data** helps customers better understand their energy usage
- **Remote meter reading** removes the need for onsite manual meter reading and reduces the frequency of customer complaints or perception of "invasion."
- **Prepayment or "pay as you go"** programs can drive reductions in customer call volumes associated with billing and collection.[8]
- **Outages** can be more effectively managed through better detection and faster response and restoration times
- **AMI deployment** can provide a unique opportunity for utilities to interact with each customer and strengthen relationships. This could include engaging with key municipal stakeholders and providing town hall meetings, as well as training AMI installers to view AMI installment as a secondary priority to having a positive interaction with the customer.
- **Detailed customer data** can be leveraged to improve traditional DSM program measurement and verification activity and provide real-time evaluation results. These results can help inform continued program improvement.

SOCIETAL BENEFITS

Indirect societal benefits impact the greater common good and fall into three categories: economic, environmental, and reliability.

Economic Benefits

Access to customer data enables the introduction of new services and products that were previously not feasible. This leads to demands for new types of jobs (e.g., communications engineers, software developers, and customer service professionals) and is also beneficial for suppliers in a competitive market where historical granular data allows for more competitive, lower cost/more targeted offers.

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[7] Xcel Energy, *SmartGridCity™ Demonstration Project Evaluation Summary* (report to the Colorado Public Utilities Commission), December 14, 2011, 85.

[8] Ameren, "*Advanced Metering Infrastructure (AMI) Cost / Benefit Analysis*." June 2012.

Environmental Benefits

Most all AMI benefits described throughout this memorandum lead to some reduction in electricity usage or peak load reduction. These reductions can be directly correlated (and quantified by some studies)[9] with decreases in carbon dioxide emissions. Below are some examples of how AMI drives emissions reductions:

- Benefits that can reduce overall energy usage:
  - IVVC
  - Prepayment
  - Energy management (smart thermostats, EMS)
- Benefits that reduce demand
  - Dynamic pricing (TOU, CPP, DLC, and DR)
  - Energy management (smart thermostats, EMS)
  - Grid-ready appliances
- Remote meter reading and disconnect/reconnect capabilities reduces carbon emissions from vehicle fleets
- Benefits that promote increased reliance on clean energy and reduces carbon emissions
  - Enablement of PEVs
  - Enablement of battery storage
  - Renewable energy integration capabilities

SUMMARY OF RESEARCH:

Benefit	Utility	Customer	Societal	Sources
Integrated Volt/VAr Control (IVVC)	Helps to more effectively manage voltage and can reduce required capacity during peak demand periods, reducing overall usage	Improves power quality.[1] Benefit estimates range from $11.24 to $32.01 per customer per year.[2]	Offers carbon emissions reduction benefits in direct relation to electricity usage reductions. Estimated to be a 372 lb/customer reduction per year.[2]	(1) Xcel Energy, 2011. (2) Smart Grid Consumer Collaborative, 2013.
Remote Meter Reading	Reductions in labor, vehicle, and IT expenses (60% reduction),[1] errors , customer complaints,[2] as well as traffic and safety issues.	Removes any customer perception of invasion.[3] Benefit estimates range from $13.68 to $23.92 per customer per year.[4]	Reduces carbon emissions from vehicles.	(1) Ameren, 2011. (2) Navigant, 2015 (3) Smart Grid Consumer Collaborative, 2013.
Dynamic Pricing: TOU, CPP, DLC, and DR programs	Potential reductions in demand during peak periods.	Allows customers the opportunity to reduce bills by shifting usage. Benefit estimates range from $13.68 to $23.92 per customer per year.[1]	Offers carbon emissions reduction benefits in direct relation to electricity usage reductions. Estimated to be a 110 lb/customer reduction per year.[1]	(1) Smart Grid Consumer Collaborative, 2013.

[9] Smart Grid Consumer Collaborative, "*Smart Grid Economic and Environmental Benefits: A Review and Synthesis of Research on Smart Grid Benefits and Costs*." October 9, 2013.

Benefit	Utility	Customer	Societal	Sources
Prepayment	Prepayment drives reductions in billing, collection (and associated call volume), [1] and interest expenses. [2]	Provides "pay as you go" choice which studies show drive energy reductions. [2] Benefit estimates range from $7.82 to $19.56 per customer per year. [2]	Offers carbon emissions reduction benefits in direct relation to electricity usage reductions. Estimated to be a 76 lb/customer reduction per year. [2]	(1) Ameren, 2011. (2) Smart Grid Consumer Collaborative, 2013.
Remote Dis-connect and Re-connect	Remote dis/re-connect drives reductions in admin costs. It's estimated that 20% of customer/year require this service. [1]	Reduces time required for various customer services transactions[2]		(1) IEE, 2011. (2) Navigant, 2015.
Revenue Assurance	Reduction in losses from metering errors, theft (estimated at 1% of utility revenue), [1,3] and line losses.	Benefit estimate of $3.00 per customer per year. [2]		(1) Ameren, 2011. (2) Smart Grid Consumer Collaborative, 2013. (3) Navigant, 2015.
Customer Energy Management/ Building Automation/ Programmable Thermostat/ Load dissaggregation	Automated DR can be accomplished using EMS or a programmable thermostat and reduce peak demand.[1]	Provides real-time & historical data to customers and the opportunity to shift usage. Energy reduction can range from 5-15%. Adoption rates are estimated to be 20% for res by 2030.[1]	Offers carbon emissions reduction benefits in direct relation to electricity usage reductions.	(1) EPRI, 2011.
Grid-Ready Appliances	Manufactured with DR capabilities built in. Penetration expected to reach 40% by 2030. [1]	Allows customer opportunity to save on bills through on demand reduction.		(1) EPRI, 2011.
Outage Management	Allows for better detection, faster response time, reduced restoration time and cost (reducing unnecessary investigations). 4.5% outage duration reduction[1] Outage restoration spend reduction of 10%.[2]	Benefit estimate of $1.18 per customer per year. [1]		(1) Smart Grid Consumer Collaborative, 2013. (2) Ameren, 2011.

Benefit	Utility	Customer	Societal	Sources
Fault Location and Isolation	Helps repair crews find and fix faults more quickly and isolate impacts. Total reliability improvement of 22.3 min/customer/year[1]	Benefit estimate of $40.14 per customer per year. [2]		(1) Xcel Energy, 2011. (2) Smart Grid Consumer Collaborative, 2013.
Renewable Generation Integration	TOU and energy management systems may help w/ intermittency challenges. Makes DERMS possible to manage customer-sited generation. Allows for Net Metering and obviates the need for a separate meter.	Better integration benefits further adoption/reliability of customer-side renewables. Allows for Net Metering.	Increased renewable adoption reduces use of fossil fuels and carbon emissions.	
Enabling PEVs	By incentivizing customers to shift charging to the night, utilities can reduce G, T&D capacity. [1]	Allow customers realize cost saving by charging at non-peak times at a lower rate. Potential for reverse flow capability. [2]	Increased PEV adoption reduces use of fossil fuels and carbon emissions.	(1) Ameren, 2011. (2) EPRI, 2011.
Safety & Emergency Response	Allow for rapid collaboration with fire departments and other agencies to respond to emergencies. [1]		Increases safety and emergency response for all.	(1) Ameren, 2011.
Electric Energy Storage		Ability to sustain outages. [1] Includes battery systems sited at end use facilities, on the distribution and transmission systems and EV batteries. [2]		(1) EPRI, 2011. (2) Navigant, 2013.
Increased DSM Program Performance	Increased DSM adoption benefits the utility in meeting EE targets and incentives	Personalized reports etc. often improve program awareness and participation. [1]	Increased adoption of EE lead to reduction in energy/emissions.	(1) Navigant, 2015.
New Market Activities			Promotes intro of new services and products that were previously not feasible which leads to new jobs and industries. [1,2]	(1) Navigant, 2015. (2) Ameren, 2011.

Benefit	Utility	Customer	Societal	Sources
Customer Segmentation/ Targeted Marketing	A better understanding of customer profiles/preferences drives cost effectiveness and enables segmentation[1]			(1) Navigant, 2015.
EM&V	Ability to track DSM program results using non-meter customer data (3rd party home devices) which can reduce evaluation costs[1]	Better evaluation leads to better program design/management, thereby benefiting the customer.		(1) Navigant, 2015.
Wide Area Monitoring (WAM)	Allows monitoring of the bulk power system reducing frequency of high-duration, widespread outages from instabilities in the bulk power grid. [1]	Avoidance of economic damages that major outages can be valued in the hundreds of millions of dollars or more. [1]		(1) Navigant, 2015.

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