Report on Savings Realized Through the Use of Smart Meters

Pursuant to 30 V.S.A. § 2811(c)

Submitted to:

Senate Committee on Finance
Senate Committee on Natural Resources and Energy
House Committee on Commerce and Economic Development
House Committee on Natural Resources and Energy

Department of Public Service
March 8, 2016

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I. Introduction

30 V.S.A.§ 2811(c) directs the Department of Public Service to prepare and publish a report on the savings realized through the use of smart meters, as well as the occurrence of any breaches to a company's cyber-security infrastructure.[1] This report is submitted in fulfilment of that mandate. As of September 30, 2015, utilities with advanced metering infrastructure (AMI) have spent a cumulative $129,089,617 and have realized $26,999,097 in measured operational and energy savings. There have been no known breaches of any utility's cyber-security infrastructure to date; however, two utilities reported non-critical incidents.

A. Executive Summary

In Vermont, smart meter is defined in statute and is distinguished by whether the meter is wireless or wired.[2] A wired meter is an advanced metering infrastructure device using a fixed wire for two-way communication between the device and an electric company.[3] A wireless smart meter is an advanced metering infrastructure device using radio or other wireless means for two-way communication between the device and an electric company.[4]

The U.S. Department of Energy defines advanced metering infrastructure (AMI) as an integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers. Customer systems include in-home displays, home area networks, energy management systems, and other customer-side-of-the-meter equipment that enable smart grid functions in residential, commercial, and industrial facilities.[5] This report uses the term AMI to describe the smart meter programs in use by Vermont utilities.[6] AMI networks are promoted for their ability to help electric providers decrease costs, and enable greater participation from consumers in energy efficiency and conservation efforts. This report is intended to inform the Legislature and the public on savings realized through the use of smart meters.

As of September 30, 2015, participating utilities spent a cumulative total of $129,089,617 to implement their AMI plans, and realized $26,999,097 in measured operational and energy savings. These figures cover periods from inception of each utility's AMI system through September 30, 2015. AMI capital spending was 83% of total AMI spending. This consisted of $107.6 million in capital expenditures for AMI meters which includes AMI meters, spare parts, test equipment, line, & station improvements. Participating utilities spent $21.5 million on operational activities. This accounted for 17% of total AMI spending. Operational expenses include grid automation, meter installations, maintenance, customer records, AMI program management, and contingencies.

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[1] *See 30 V.S.A. § 2811 (c): The reports shall be based on electric company data requested by and provided to the Commissioner of Public Service and shall be in a form and in a manner the Commissioner deems necessary to accomplish the purposes of this subsection.*

[2] 30 V.S.A. § 2811 (a) (1)

[3] 30 V.S.A. § 2811 (a) (2)

[4] 30 V.S.A. § 2811 (a) (3)

[5] https://www.smartgrid.gov/recovery_act/deployment_status/sdgp_ami_systems.html

[6] GMP's SmartPower program includes initiatives that go beyond the standard AMI definition, such as distribution automation. However, for purposes of this report, the SmartPower program is considered synonymous with AMI.

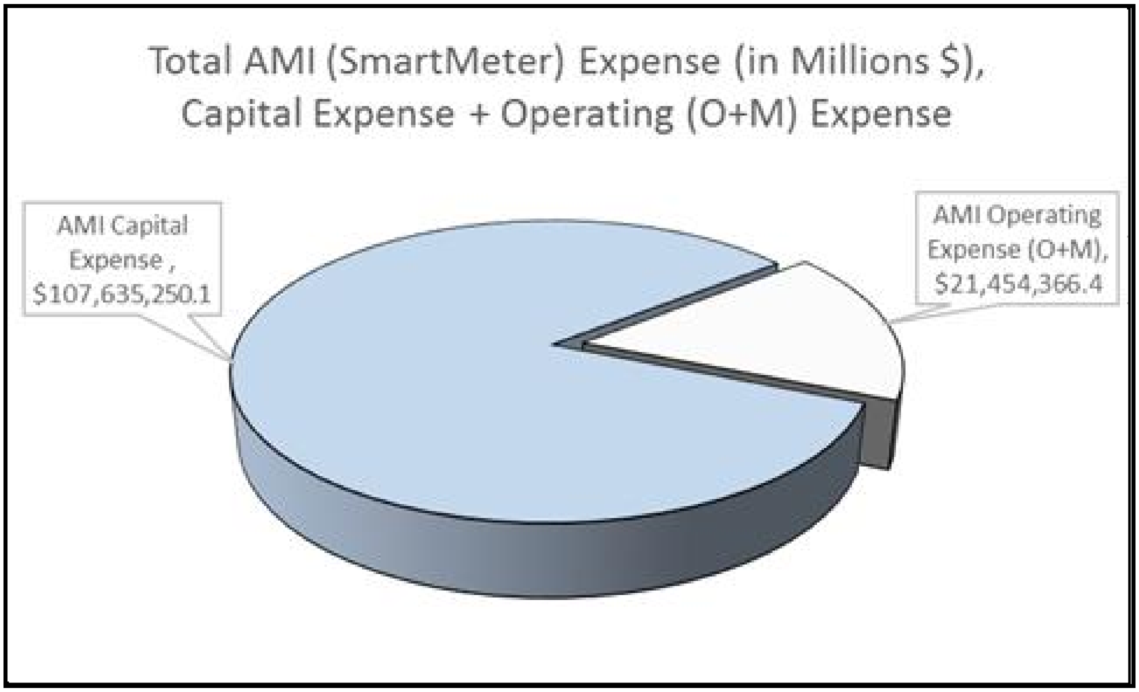
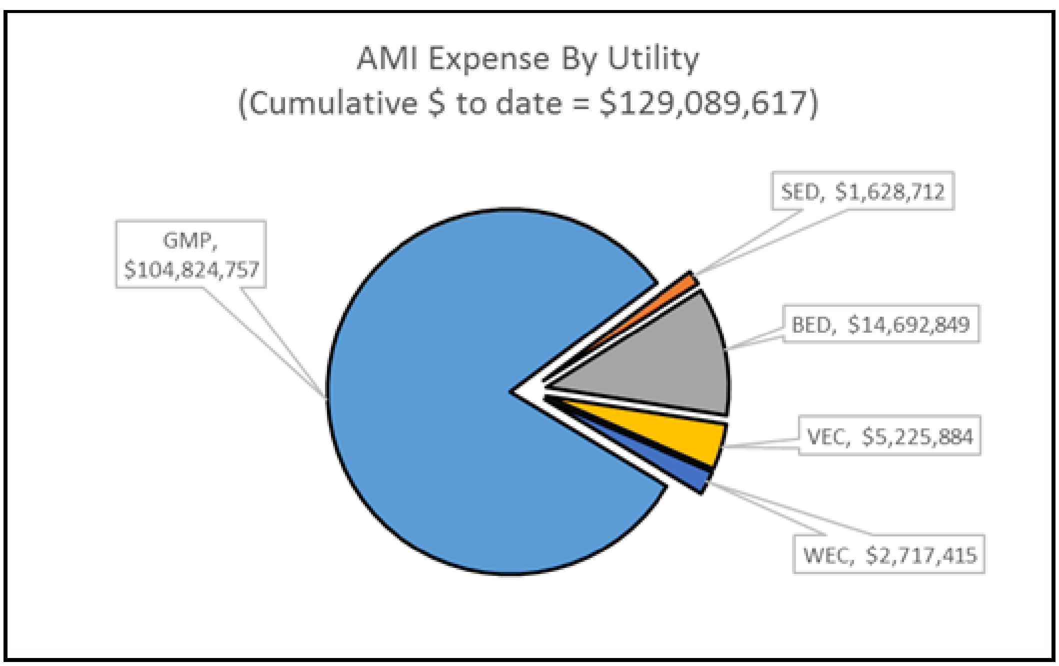


Figure 1

Figures 2 and 3 depict the costs and savings by utility. GMP accounted for 81% of total AMI expenses, Burlington Electric (BED) 11.4%, VEC 4%, WEC 2.1%, Stowe Electric (SED) 1.3%.



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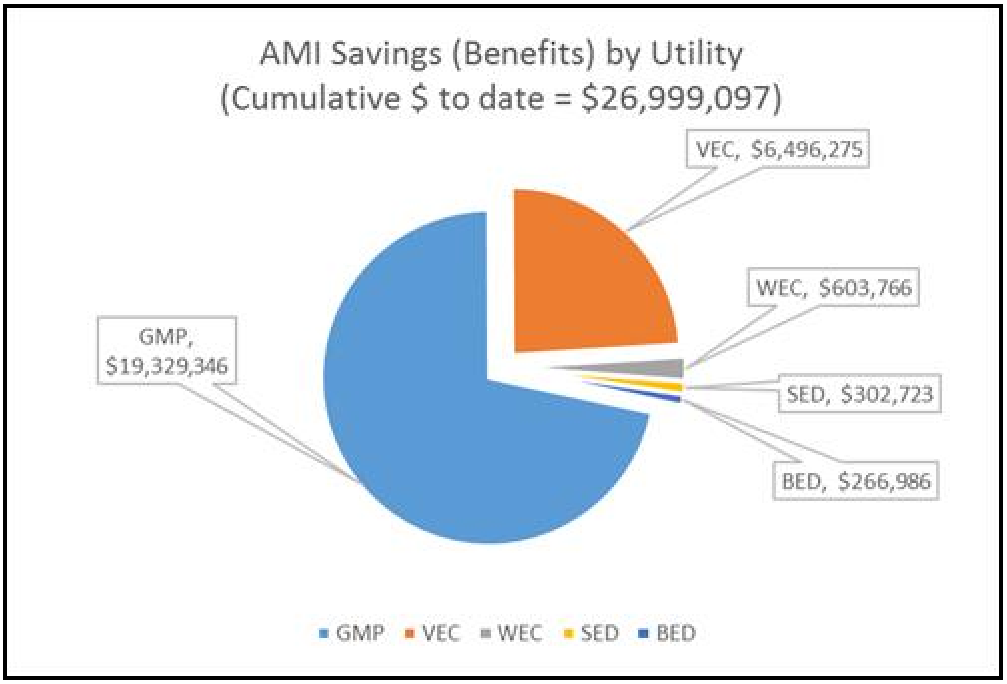

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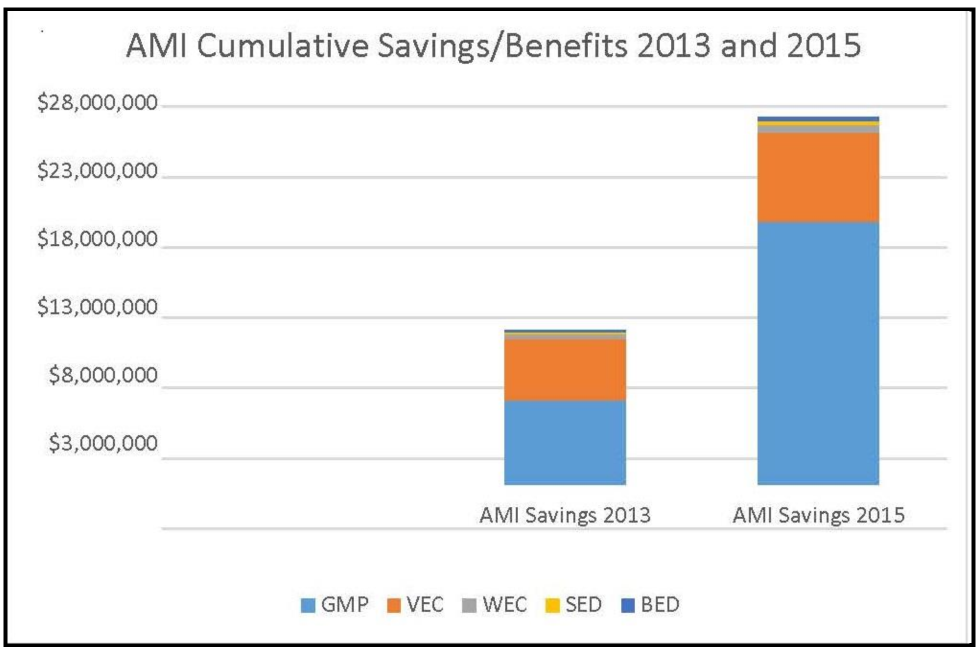
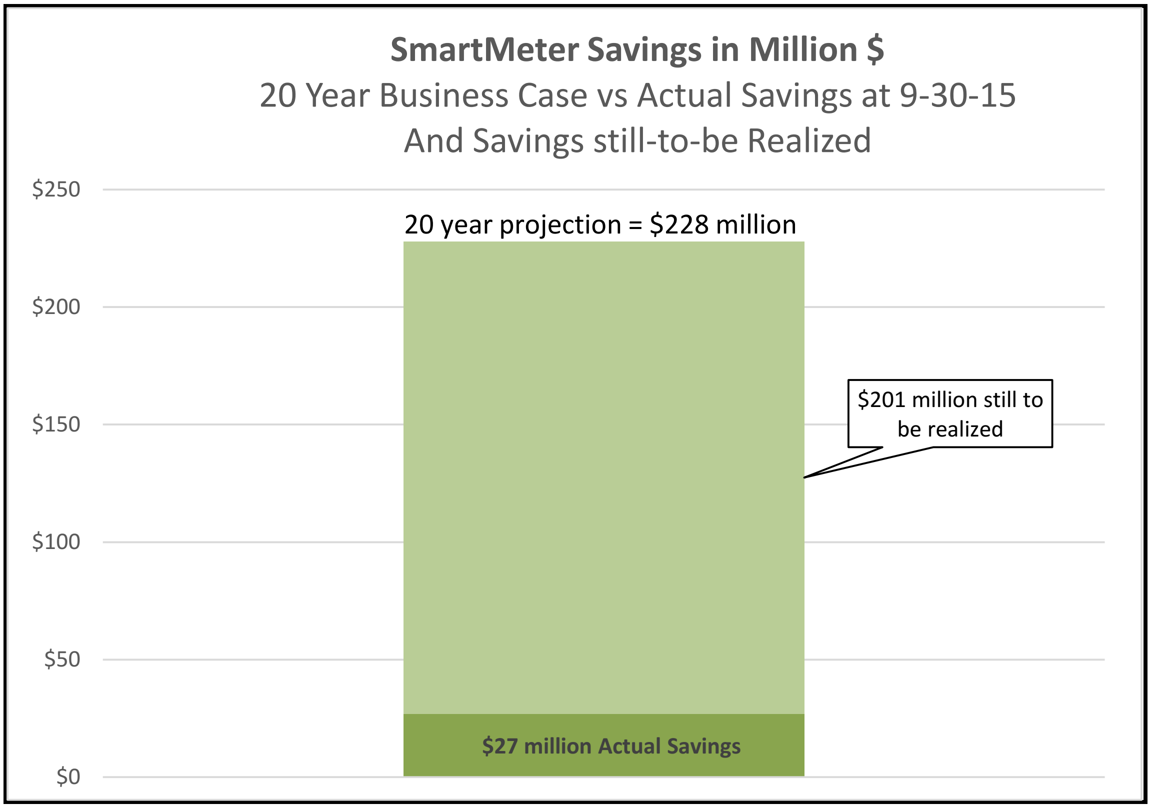


Figure 4

Initial AMI business Plans expected to realize 20 year total customer savings of $228 million. Actual cumulative savings (benefits) as of September 30, 2015 total $27.0 million.



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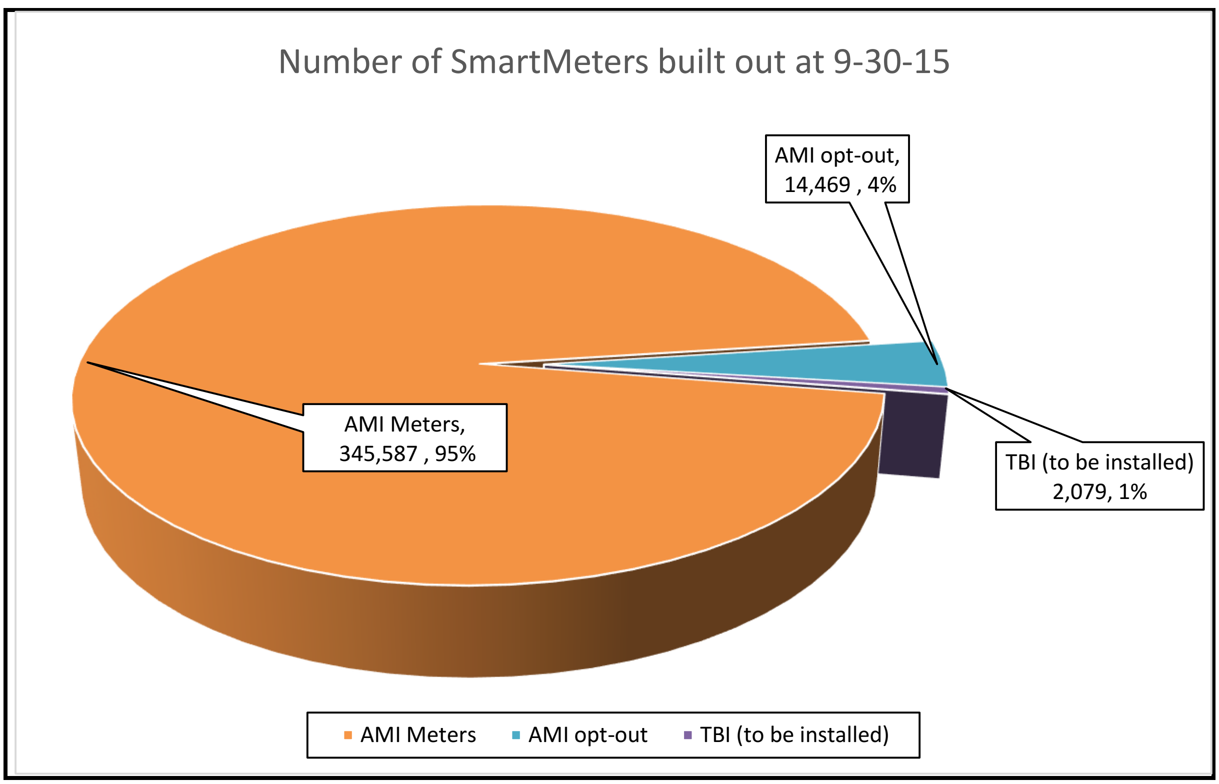

Figure 6

B. Procedural History of this Report

The Legislature authorized the Department of Public Service to request any information from the utilities necessary for completion of this report. The Department sought and received data from Burlington Electric Department (BED), Green Mountain Power (GMP)[7], Stowe Electric Department (SED), Vermont Electric Cooperative (VEC), and Washington Electric Cooperative (WEC).

The Department, in conjunction with Green Mountain Power Company and the former Central Vermont Public Service Company, initially developed the Measurement and Verification (M&V) template to capture information necessary for monitoring progress of the GMP and CVPS AMI implementation approved by the Public Service Board in dockets 7704 and 7612. The M&V template was based on a report required by the U.S. Department of Energy to report expenditures of federal grant money from the America Recovery and Reinvestment Act of 2009 (ARRA), which was awarded to the State of Vermont as the Smart Grid Investment Grant (SGIG).[8] The template compares a utility's business plan for AMI implementation with actual expenditures. The Department concluded that the template would be a useful method for obtaining the data necessary for this report.

In general, the methodology employed by each utility to collect this information consisted of using the existing reporting practices and processes of each utility's financial systems to record, classify and summarize the cost and savings information included herein. The internal controls associated with those financial reporting processes are audited annually to ensure that the reported financial information is accurate. In preparing this report the Department relied upon those reporting processes and internal controls to ensure the integrity of the financial data.

II. Actual Costs

Actual costs are the total capital expenditures and operating expenses actually incurred or spent from a program's inception through September 30, 2015. Capital expenditures are comprised of customer accounts and distribution expenses. Customer accounts expenses include master station computers, software, multi-speak interfaces, AMI interfaces. Distribution expenses include meters, spare parts, test equipment, substation equipment, DSL connectivity routers, phone systems, Auto Fault Recovery, Var Volt Optimization, RF Fault Indicators, and Interactive Voice Response (IVR). Operational expenditures are comprised of Administration and General (A&G), depreciation, and distribution expenses. Distribution expenses include expenses related to advertising, customer accounts, and customer installation.

In 2013, participating utilities reported AMI expenses totaling $97.5 million, and AMI savings of $11.4 million. This resulted in $ .12 of benefits (savings) per $1 of AMI spending. By 2015, utility smart meter cumulative spending was $129 million, and cumulative savings were $27 million. This resulted in $ .21 of benefits (savings) per $1 of AMI spending.

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[7] GMP's submission to the Department includes data from Central Vermont Power Supply (CVPS), with which GMP merged in 2012. The data set included pre-merger CVPS data.

[8] In October 2009, Vermont's electric utilities were awarded approximately $69 million in American Recovery and Reinvestment Act (ARRA) funds through Smart Grid Investment Grants (SGIG) to deploy smart grid technology.

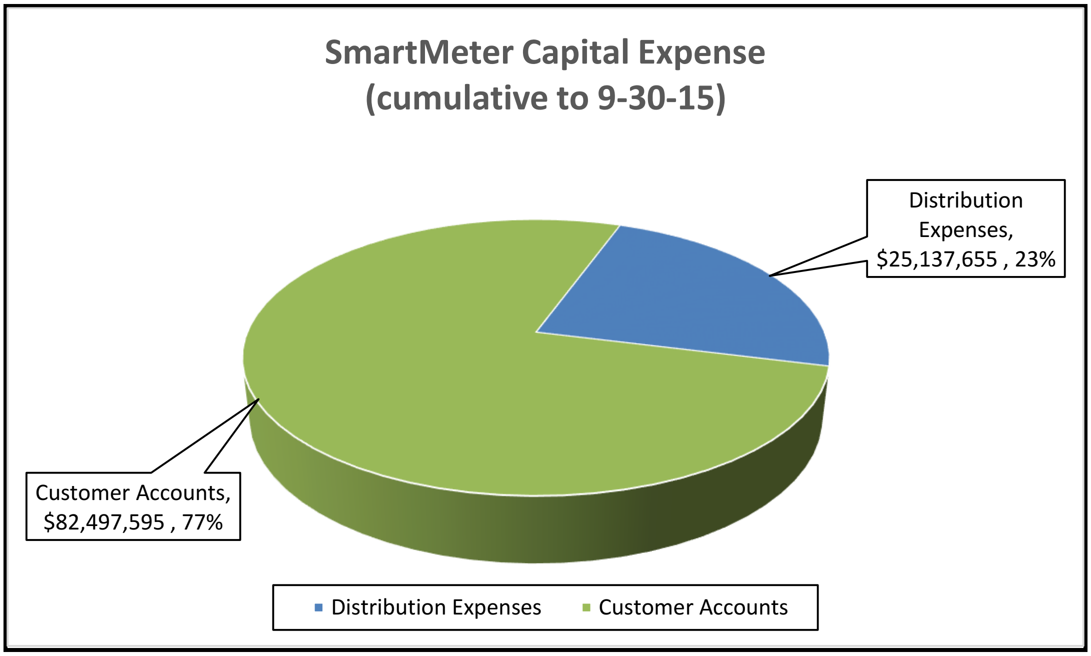


Figure 7

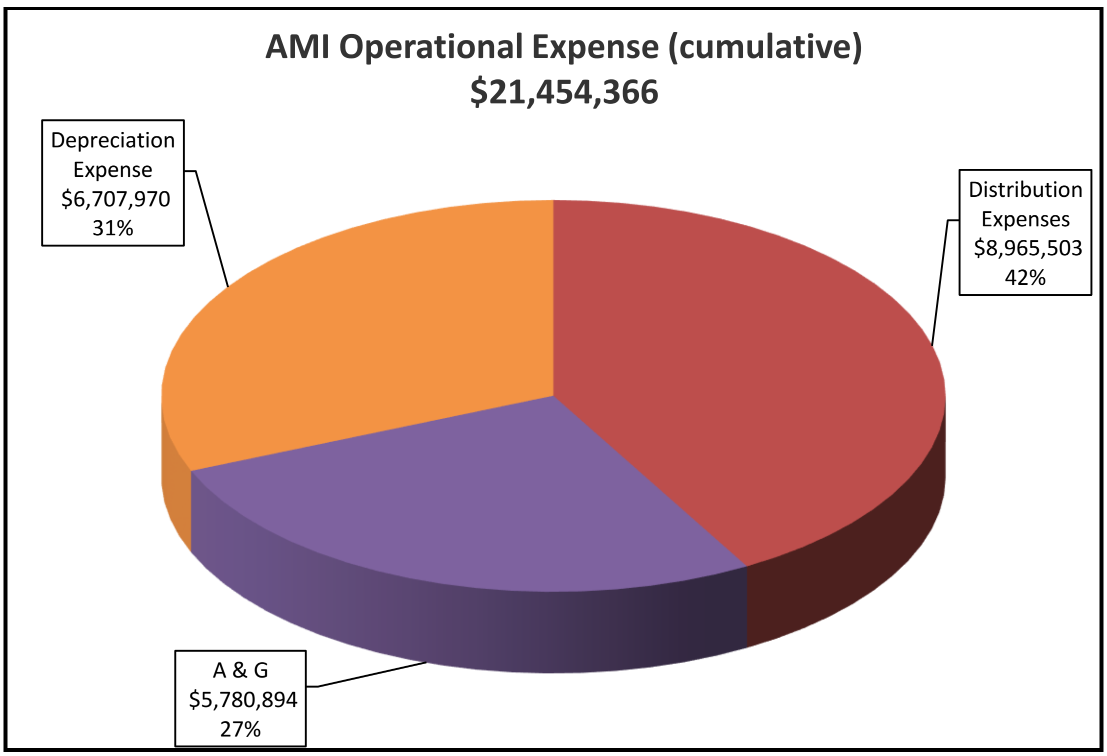


Figure 8

II. AMI Financial Plans

Each utility developed an AMI business case that included a 20 to 25 year financial plan with a forecast of its expenditures and the expected savings that would be realized. The forecasted expenditures included capital expenditures (acquisitions and installation costs), ongoing operation and maintenance (O&M) expenses, and costs of establishing dynamic pricing, smart grid enabled rate design and demand management programs. The financial plan also included a contingency amount that varied by utility, as did the planning period covered by the forecast, ranging from 20 to 25 years. For GMP South (former CVPS territory), the cumulative financial plan is based on the August 2011 update to the 2007/8 business case that was provided to the PSD as part of the 2012 base rate filing. For VEC, the financial plan data includes the expenditure of its own funds before and after the receipt of the Federal ARRA funding in 2009. As of September 30, 2015, **99.9%** of the total planned financial outlays for all participating utilities were spent: $129,089,617 spent vs $129,275,379 planned.

III. Savings Realized Through the Use of Smart Meters

Operational and Energy Savings

The M&V template captures data for three types of savings: operational savings, energy savings, and societal benefits. Operational and energy savings are considered quantifiable in financial terms and are savings derived from new capabilities that allow utilities to more efficiently manage and operate the distribution grid. Energy savings are cost reductions attributable to improved energy management. As of September 30, 2015, savings realized have been primarily operational, with 53% attributed to meter reading expense savings.

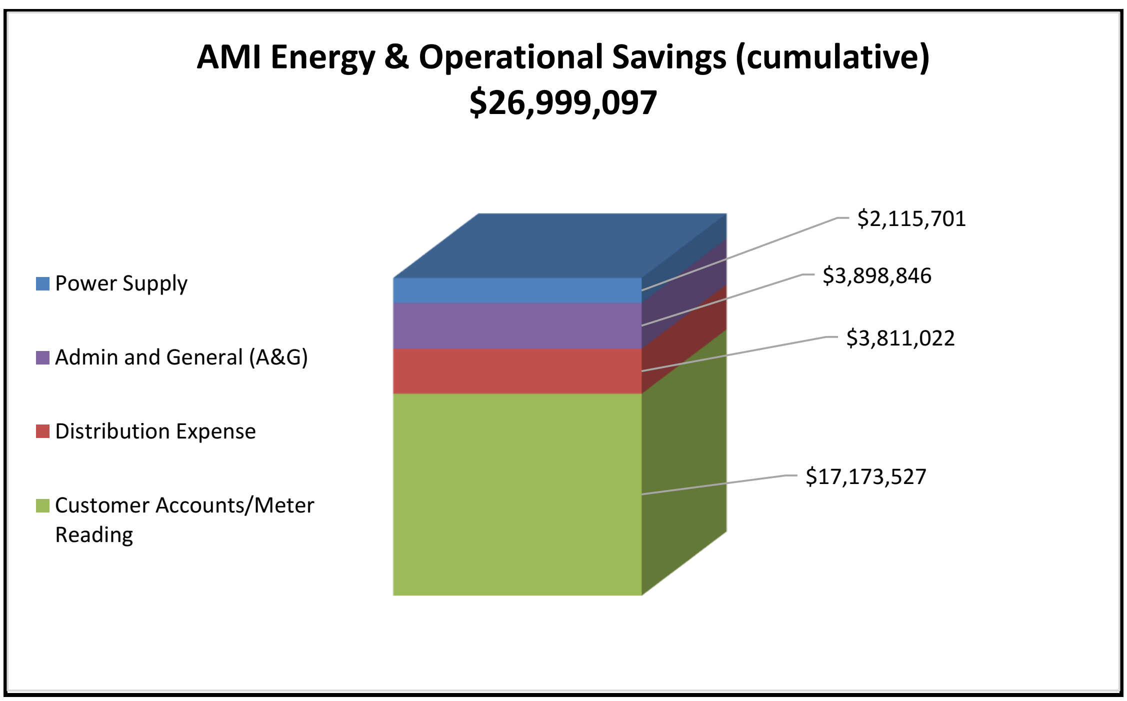


Figure 9

Initial AMI implementation plans estimated total program savings of $228.33 million over 20 to 25 years, with $23 million in savings expected by September 30, 2015. As of that date, utilities reported actual operational and energy savings of $27 million, exceeding plan projections by 17%.

Societal Benefits

Societal benefits are not measured in financial terms and are considered qualitative only. Examples of societal benefits are reductions in pollution emissions and improved outage management that can be reasonably attributed to AMI implementation. Benefits cited by utilities in the 2014 Smart Meter report as well as in responses submitted for this 2016 Smart Meter report include:

Commercial and industrial customer outage cost reduction: Utilities estimate that enhanced outage management capabilities associated with AMI should result in shorter outages for utility customers. Shorter outages will mean a decrease in related production and output losses for Commercial and Industrial customers. The value of this increased productivity is considered a societal benefit.

Carbon reduction: Carbon emission reductions result from fewer trips to customer premises due to the utilities' ability to provide remote support (meter reading, service switch, voltage reading, etc.) over the AMI network. As a result, there are greenhouse gas emissions reductions from both avoided meter reading truck rolls, and avoided service calls during wide spread outages, trouble calls during working hours, and after hour trouble call truck rolls.

Decreased energy costs: Another potential societal benefit of smart meters is lower wholesale energy costs due through demand management. Vermont's enhanced Demand Response program helps reduce load during peak and high demand periods. This in turn can have a price lowering effect on wholesale prices. With the use of AMI interval data, residential and small commercial customers can now participate in demand management programs that help reduce or stabilize the price of wholesale energy for the entire New England pool during peak demand hours.

Customer conservation associated with AMI web presentment: AMI implementation plans assume that the more customers know about and understand their electricity use, the more likely they are to conserve energy. This includes conservation and change in usage patterns assuming that time-of-use pricing becomes available. Web presentment of hourly data for individual customers should cause customers to conserve electricity (avoided power costs) and shift their usage (reduce power costs) to off-peak hours.

IV. AMI Cost and Savings Summaries by Utility

The following graphs provide utility-specific summaries of AMI costs and savings as to date, followed by management narrative submitted by each utility.

UTILITY: GREEN MOUNTAIN POWER

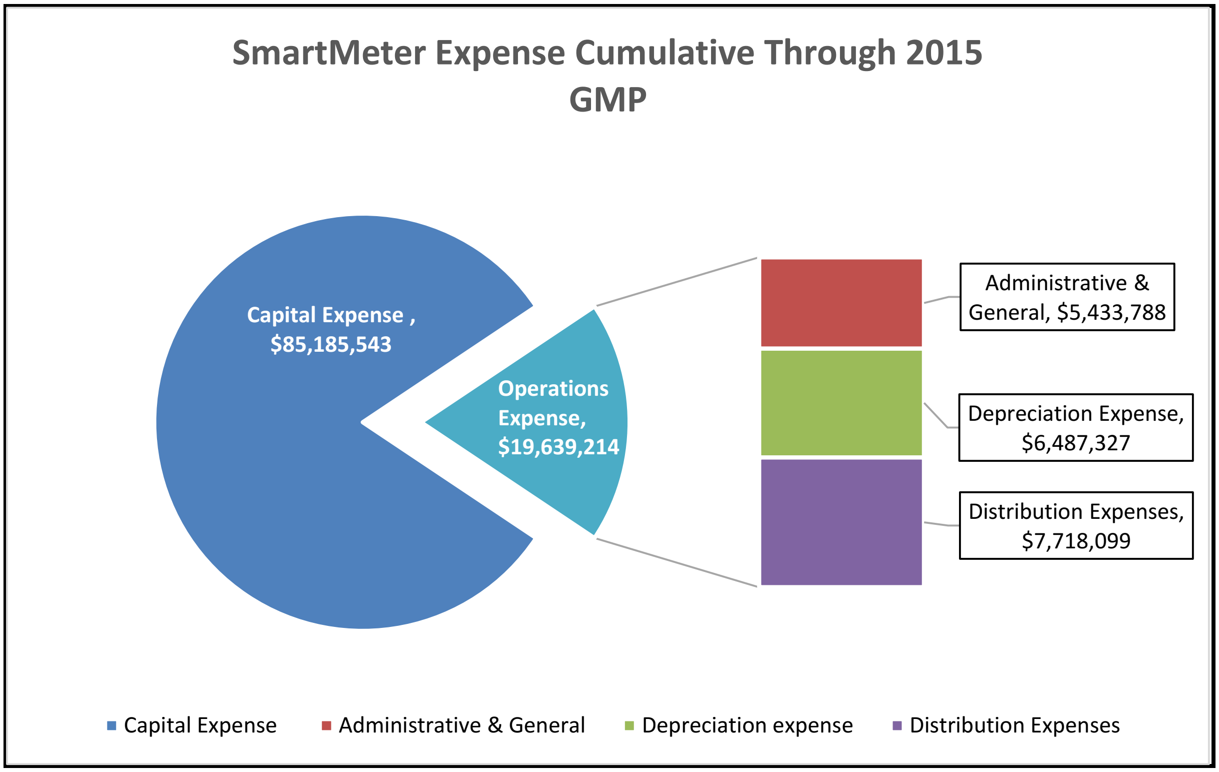
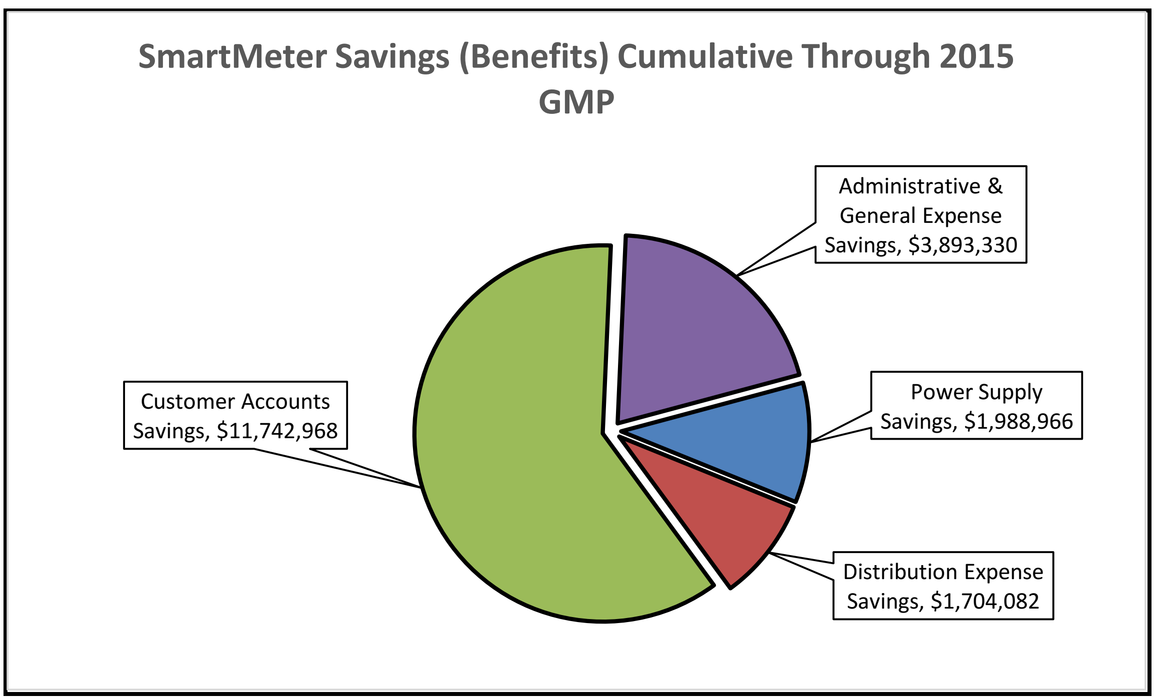


Figure 10



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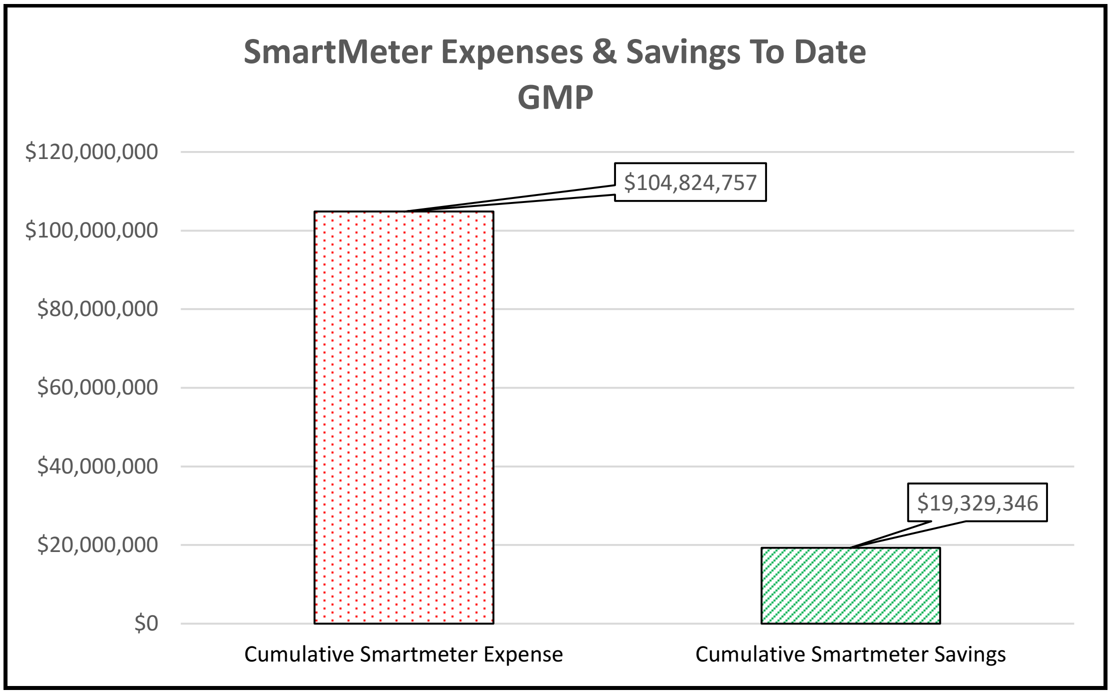


Figure 12

GMP MANAGEMENT NARRATIVE

GMP's SmartGrid program has delivered clear benefits to both customers and our internal operational quality and cost. Our customers are seeing their energy usage data in levels of detail and accessibility never presented before. We see evidence of this each week in our call center when customers engage with our customer service representatives to discuss what they are seeing in their energy usage data and learning about their energy usage patterns as a result of the accessibility of the information. Our customers are becoming more engaged in their understanding of energy usage and its impacts which is a good thing. During power outages, our AMI system is allowing us to confirm outages and restorations via meter pings which saves times and customer interruptions and we have incorporated text alerts into our service options so customers can stay updated on the status of an outage without having call GMP or check a website. Finally, because of the cost savings that SmartGrid has delivered we have been able to pass those savings along to customer in the form of lower rates. Internally, SmartGrid has caused our workforce to develop new skills, processes and collaboration as we operate a more connected operation each day. We're finding new connections and opportunities to reduce cost and improve quality as we gain more experience with these technologies.

UTILITY: BURLINGTON ELECTRIC DEPARTMENT

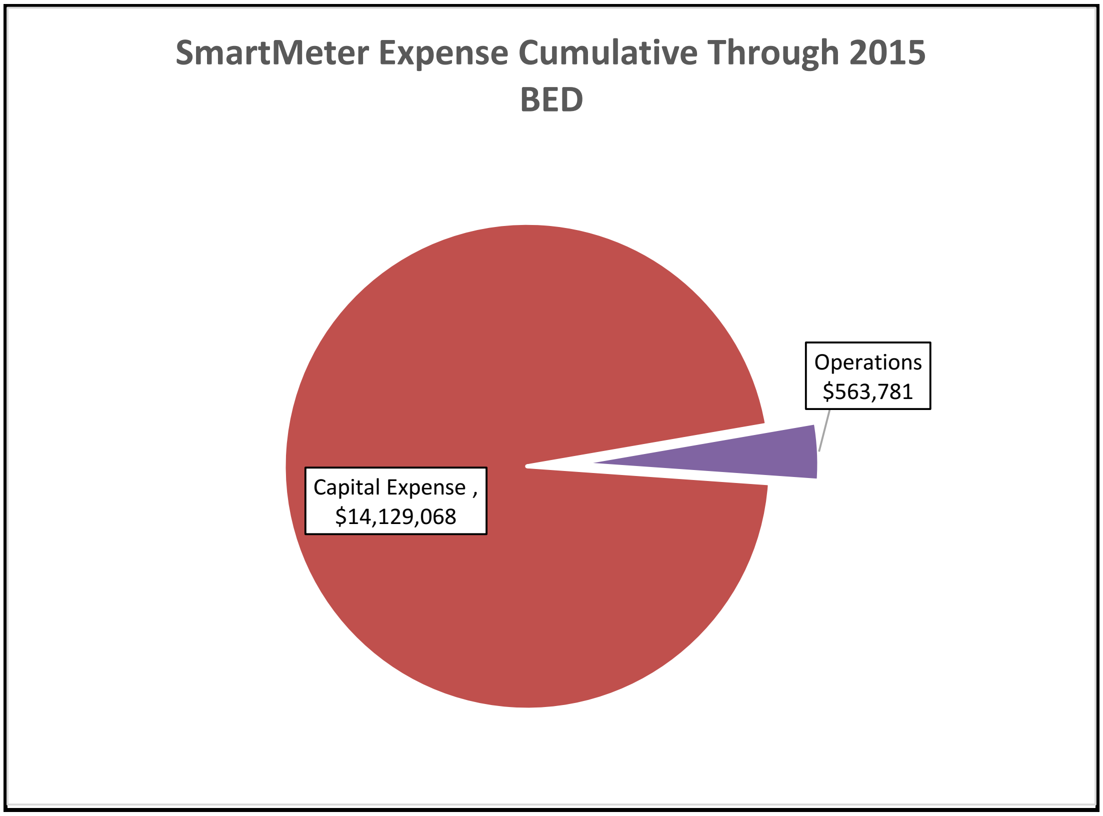


Figure 13

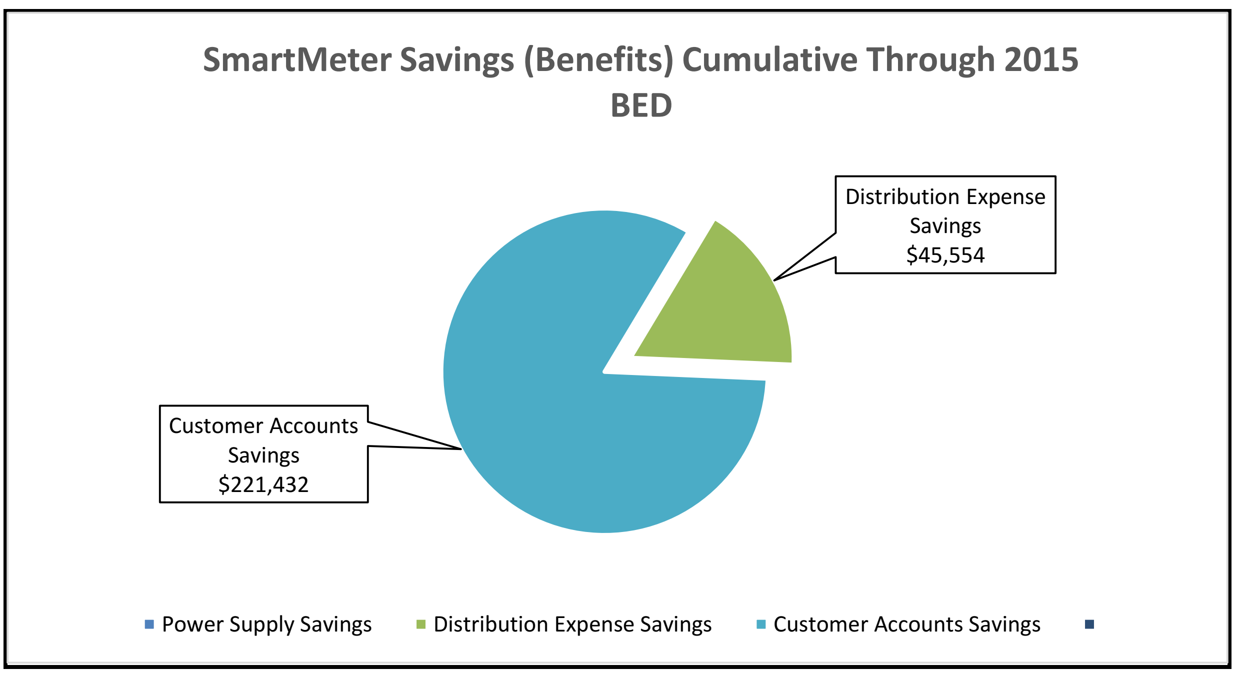


Figure 14

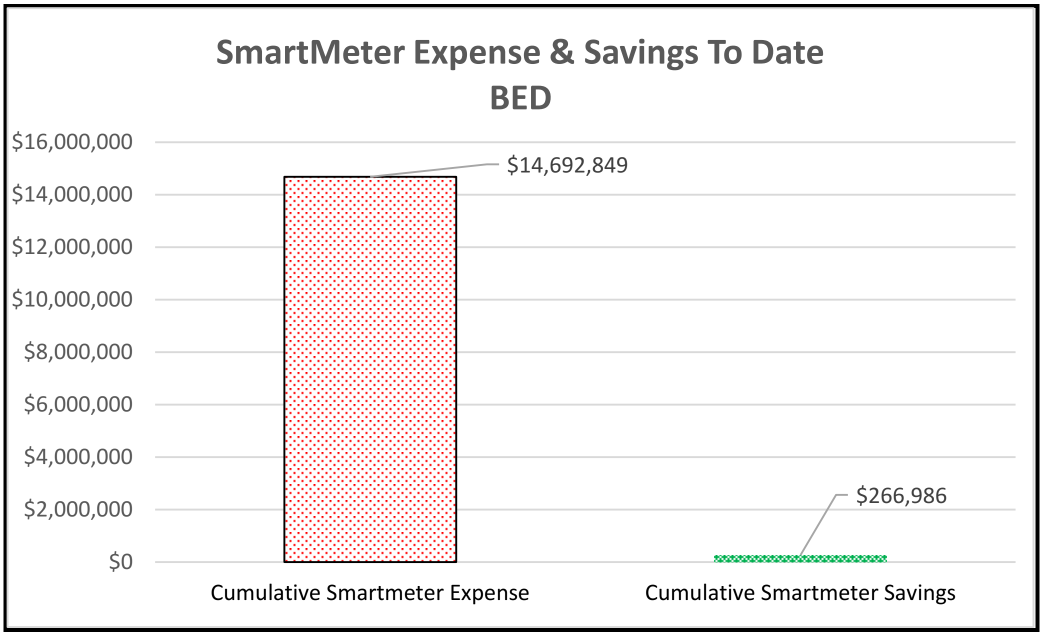
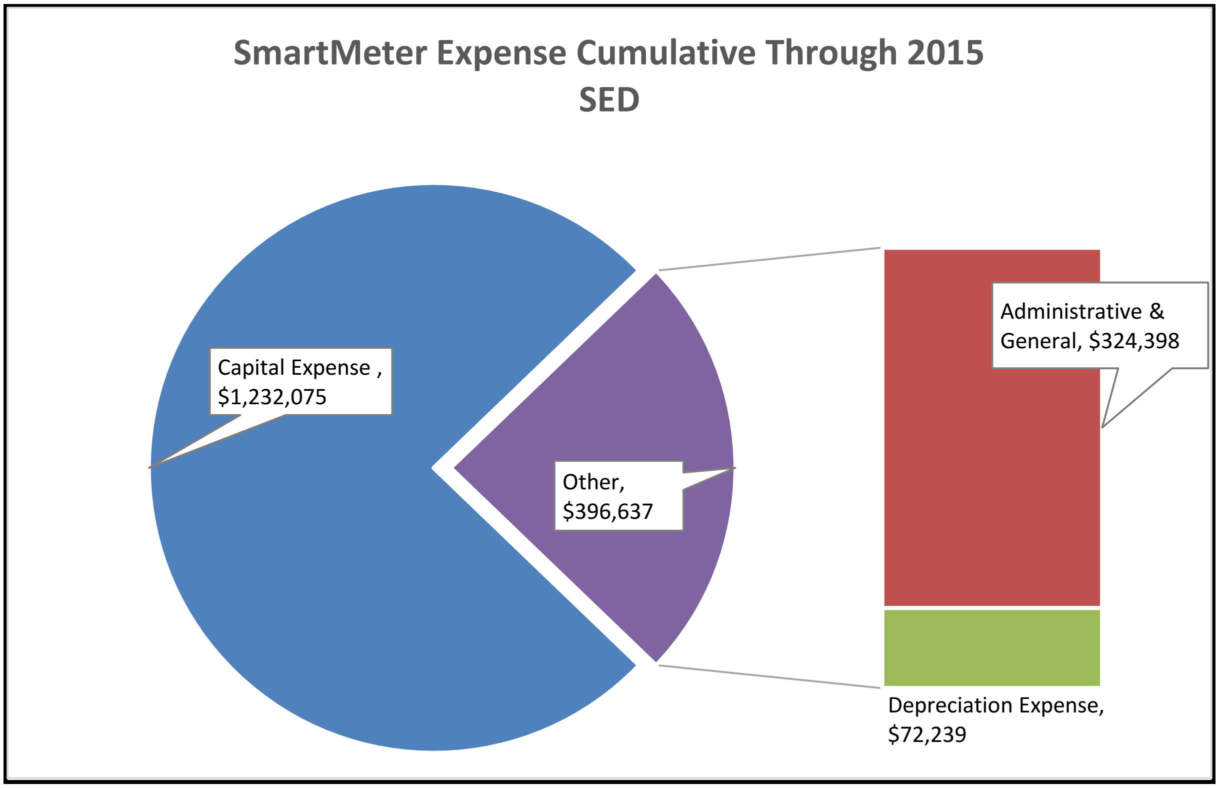


Figure 15

BED MANAGEMENT NARRATIVE

AMI benefits have accrued in areas not anticipated when the program began. Significant cost reductions have occurred related to the disconnection/connection of meters, and in the reduction of truck trips for initial/final reads for customers entering/leavings the system. Customers have received more insight into energy use, and BED staff has been able to leverage the data in answering high bill complaints and evaluating energy efficiency offerings. Because the technology was cutting edge when installed with ARRA funds BED has experienced significant difficulty expanding use of data into analytics. This has been a major focus in FY16 and will be again in FY17 with much broader customer offerings occurring during that period. The infrastructure presently in place has been (and will continue to) acting as a foundation for further programs. These systems will be indispensable as BED continues its transition to "Utility 2.0" where services are based more heavily based on distributed resources.

UTILITY: STOWE ELECTRIC DEPARTMENT



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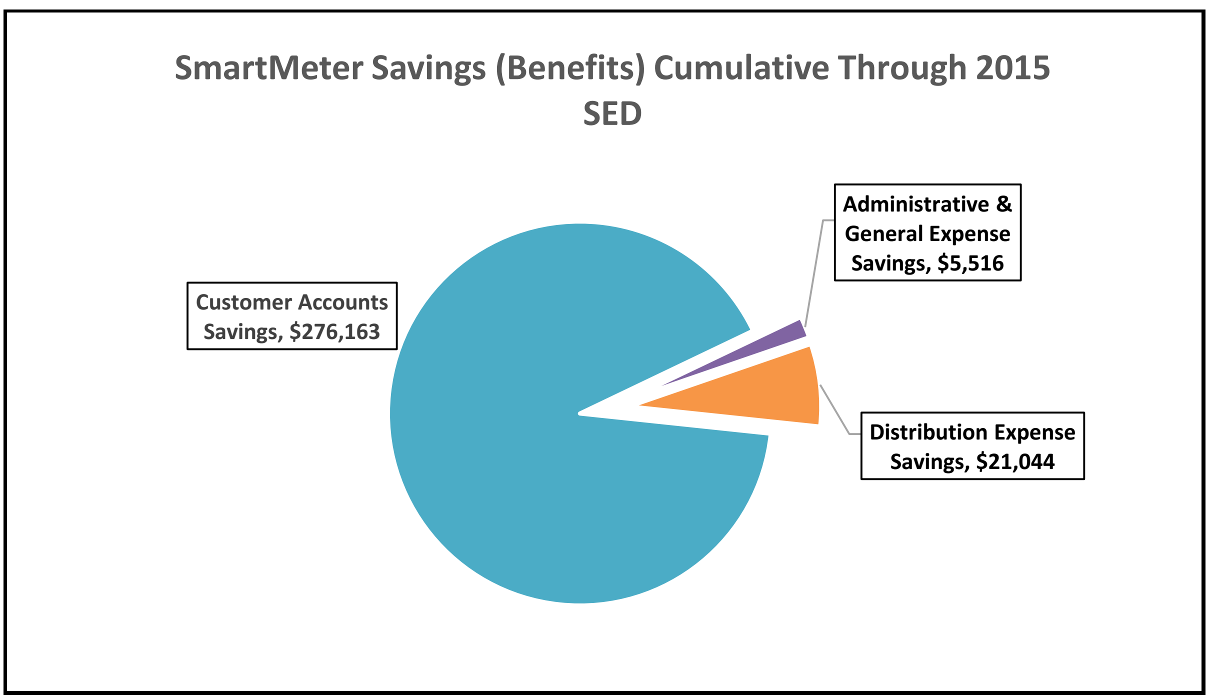


Figure 17

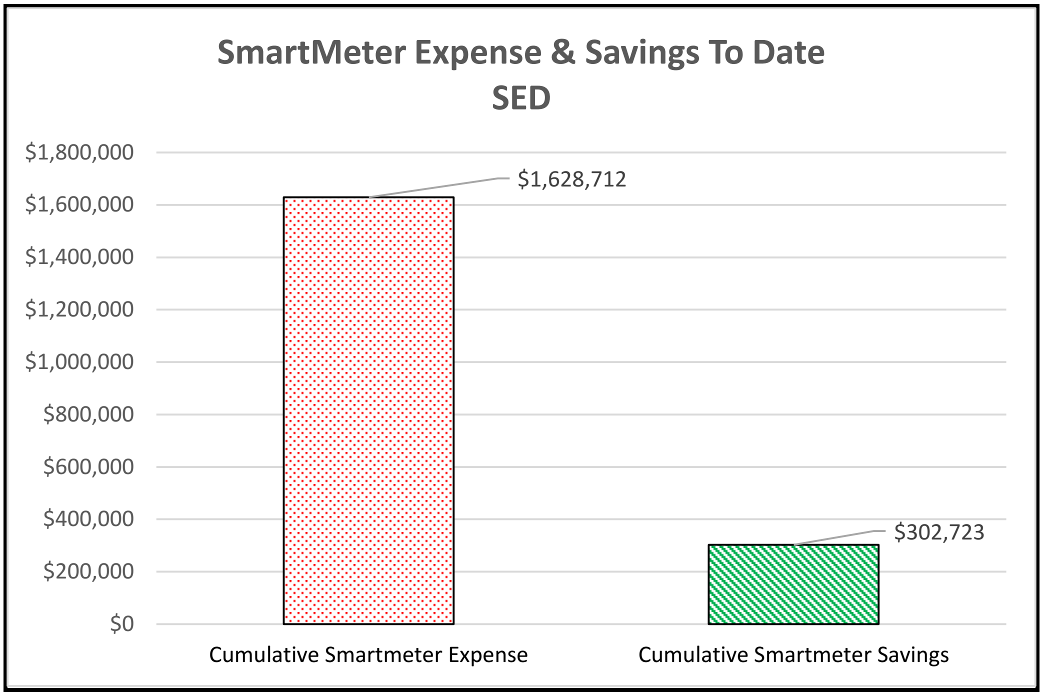


Figure 18

SED MANAGEMENT NARRATIVE

In October 2015, SED implemented a new rate design based upon a fully allocated cost of service study ("ACOSS") which used a year's worth of Stowe's smart meter data. SED believes that it is the first distribution utility in the state of Vermont to develop allocators for an ACOSS using the interval data made available by a fully implemented AMI system. Utilizing this granular data has facilitated the development of allocators that are the closest possible reflection of the true costs of service for each rate class and distribute the costs as equitably as possible among those rates. The load study found SED could simplify its tariffs by collapsing commercial rate classes while still adhering to traditional rate principles. The elimination of the residential demand rate was supported by the load studies which showed very similar consumption patterns from demand and non-demand residential customers. In all, 163 residential customers were taken off of the residential demand rate and transferred to the standard residential rate. This eliminated the need to transfer ratepayers off or onto the demand rate and will also save our former demand ratepayers money on their monthly bills while still equitably allocating the cost of providing electric service. The measure also effectively eliminated the need to spend administrative resources to handle ratepayer questions and complaints associated with the demand rate. The interval data was also essential to the development of Stowe's new residential Time-of-use rate with a Critical Peak Pricing component ("TOU/CPP"). As designed, a residential ratepayer receiving service from SED and with average consumption habits could see bill savings by either shifting their usage to different times of day or conserving during high-priced periods. The same ratepayer with average consumption habits who does not alter their usage after signing up for the rate will likely see little to no change to the annual cost of their electric bills. Customer access to interval data is crucial to the implementation of the new TOU/CPP rate. The launch of the web presentment module at the end of 2014 was a crucial first step toward helping customers unlock the benefits of a fully deployed AMI system. Expanding ratepayer access to usage information is understood as critical in understanding the potential value of measures they can take to reduce their electric consumption and the related costs.

UTILITY: VERMONT ELECTRIC COOP

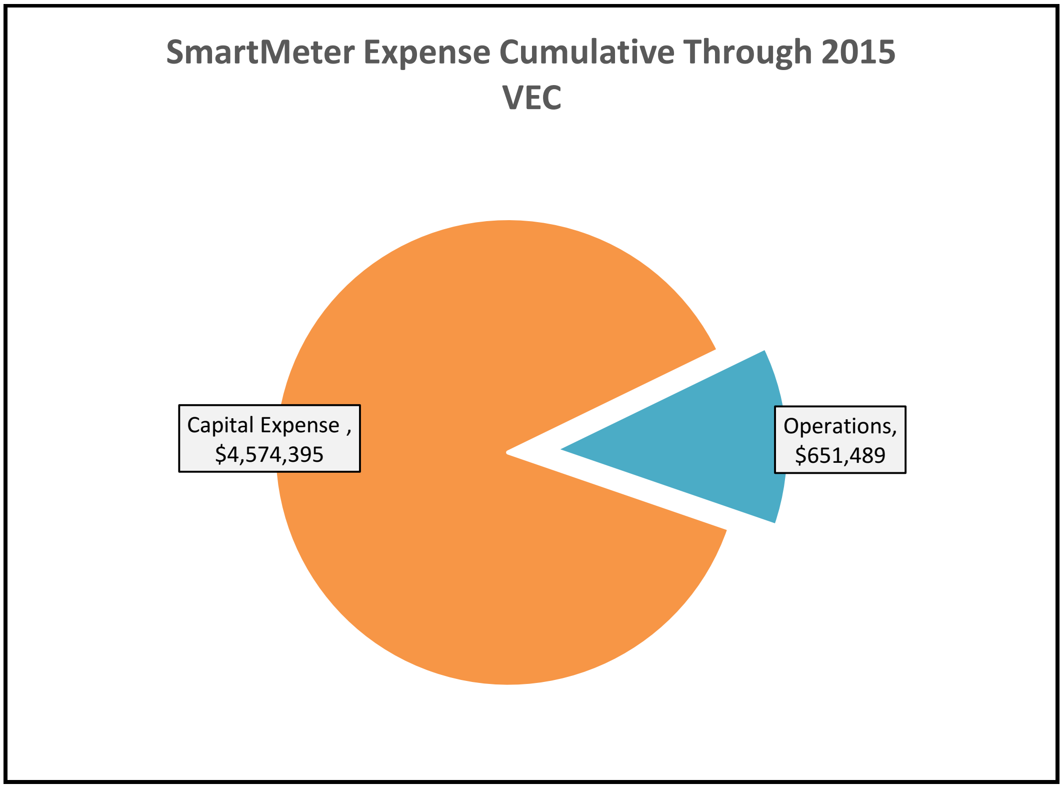
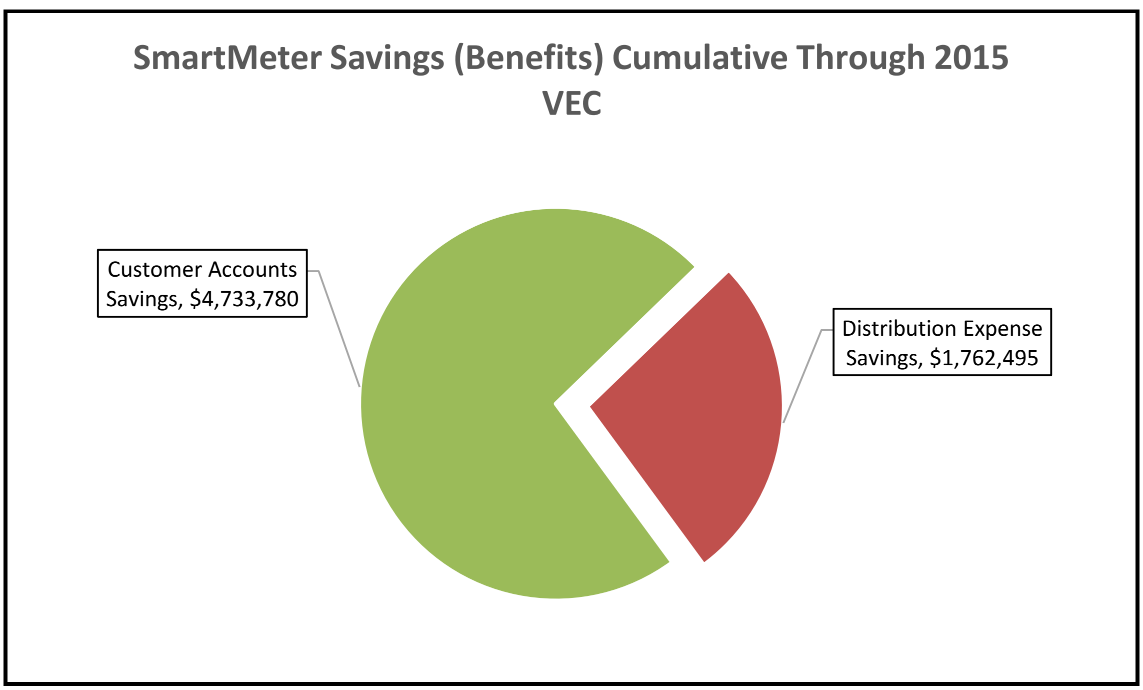


Figure 19



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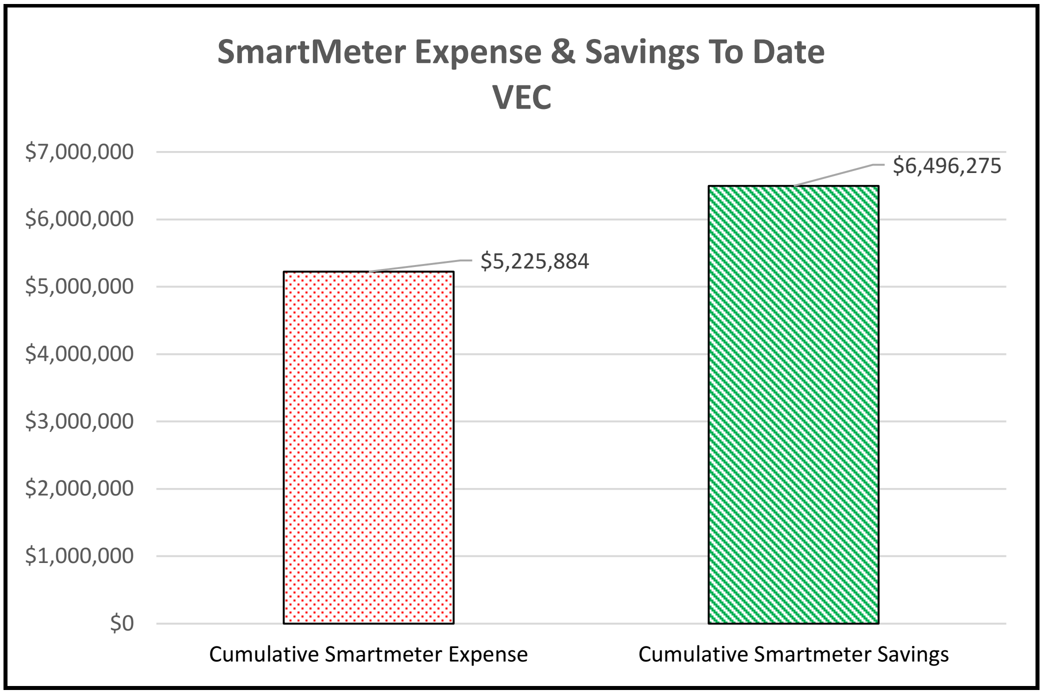
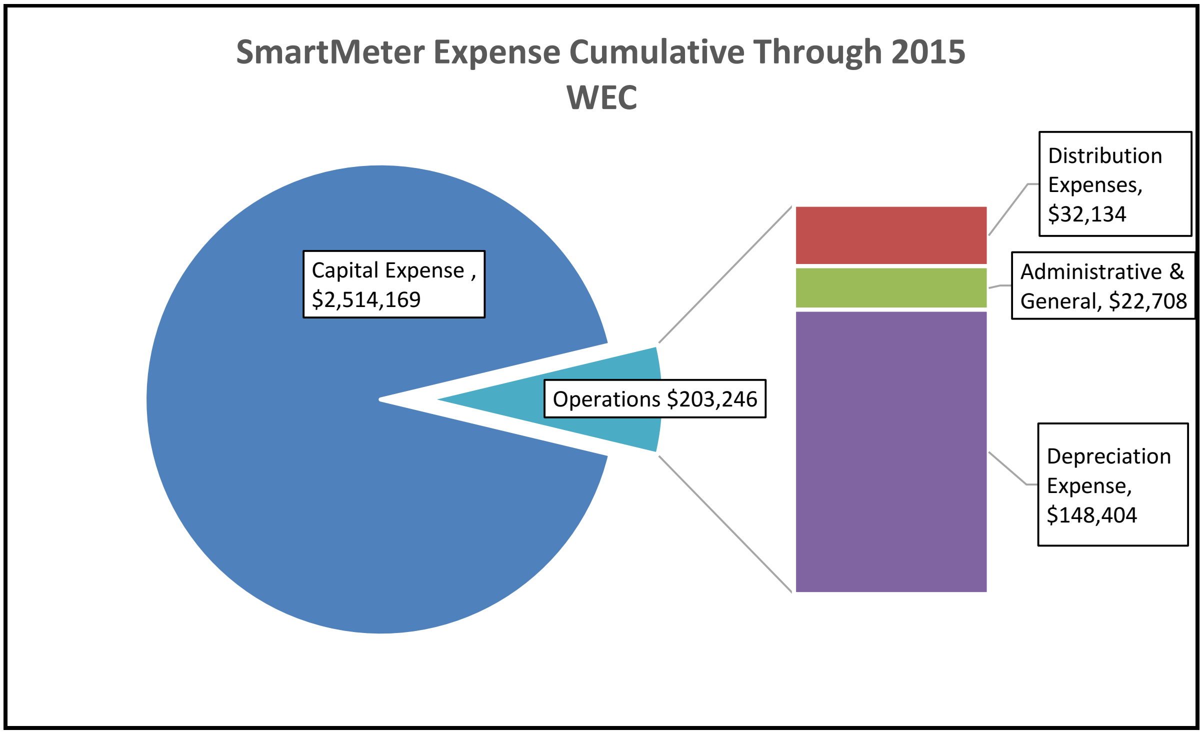


Figure 21

VEC MANAGEMENT NARRATIVE

The primary motivation for installing smart meters was to reduce meter reading costs and at the same time improve outage performance. We have conducted an analysis of clearly quantifiable costs and benefits associated with AMI meter implementation. On the cost side, we focused on labor and installation costs, meter procurement costs, and IT and other procurement (i.e, IT equipment to automate substations). On the savings side, we considered reductions in meter staff and associated fleet costs and savings due to the reduced need for line workers to patrol lines to locate outages (assumed to be two "truck rolls" per day). To date, our savings have exceeded our costs. We expect to continue to see savings over the life of these meters. In addition to the savings that we can clearly quantify, VEC has also realized savings that are more difficult to isolate and attribute to smart meters, but are none the less real. First, the installation of smart meters combined with an outage management system has resulted in decreasing our outage frequency. Regarding CAIDI and SAIDI, VEC can directly attribute reductions in outage duration due to AMI infrastructure, specifically due to VEC's ability to predict outage locations and expedite restoration. Reductions in SAIFI are harder to tie to AMI infrastructure, since outages happen for a variety of reasons unrelated to meter type. While the improved outage performance is due to many different factors (including capital improvements, vegetation management and other system improvements), our AMI meter implementation certainly contributed by improving our outage management. In addition, as noted above, by reducing the number of truck rolls needed for outage restoration, we are able to re-deploy those workers in performing proactive maintenance which also improves the outage indexes. In addition to the benefits already cited, the two-way meter infrastructure has become a very important tool for improving member satisfaction.

UTILITY: WASHINGTON ELECTRIC COOP



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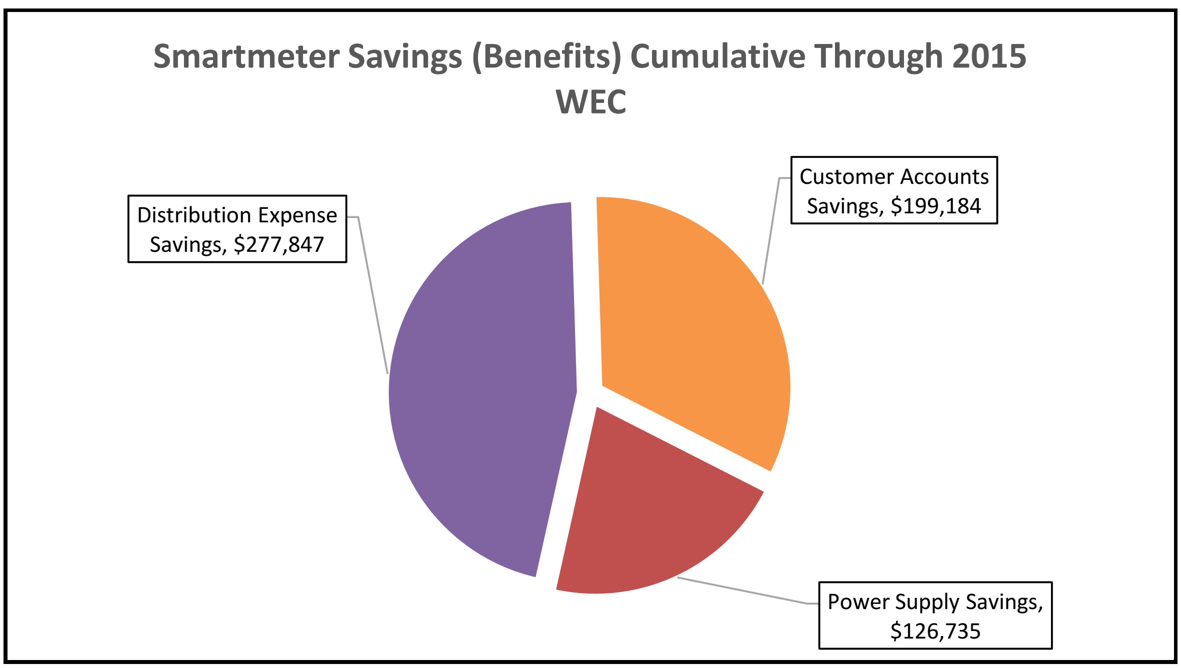

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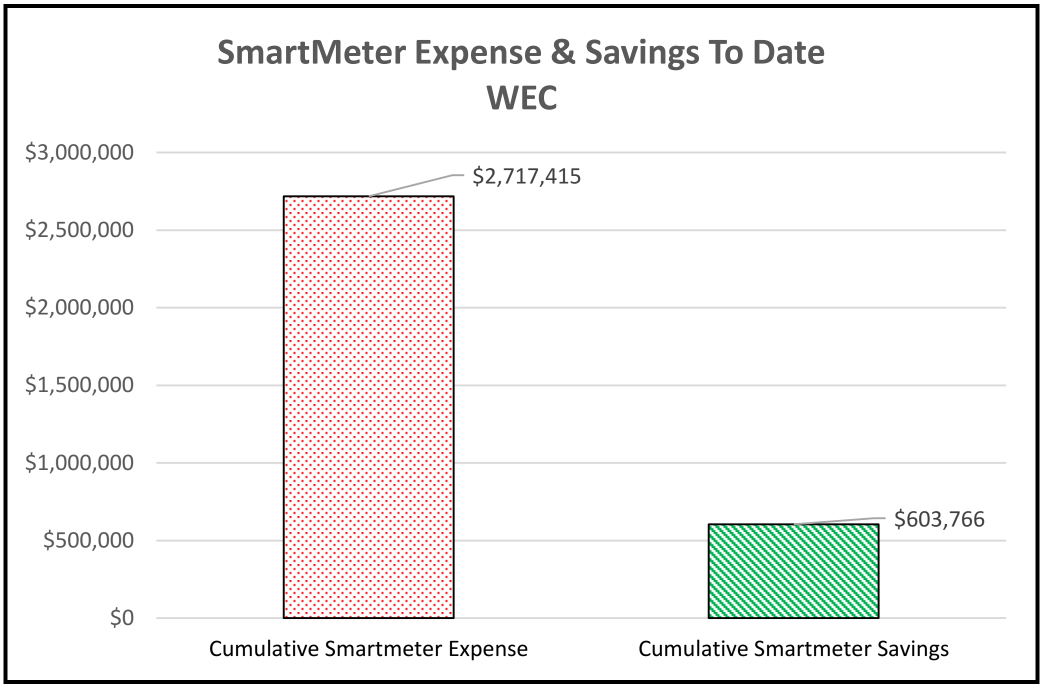

Figure 24

WEC MANAGEMENT NARRATIVE

Customer Information System (CIS): Member services are now able to directly assist members with actual daily usage, and begin to troubleshoot voltage or outage issues. AMI enables reduced cost of operation, expands the overall capacity of all WEC employees to more accurately respond. Operations: Diagnostics of fault location/cause is the primary benefit of AMI infrastructure during outages. Engineering: similar to benefits utilized by Member Services, to allow rapid identification of both individual and wide spread outage conditions.

V. Cyber Security

30 V.S.A. § 2811(c) directs the Department to brief the Legislature on "the occurrence of any breaches to a company's cyber security infrastructure." The Department has interpreted this language to mean security events affecting a utility company's AMI network. According to the responses from all five participating utilities, there have been no known breaches of any of the AMI networks' security. However, GMP and VEC reported minor, non-AMI related instances of negative occurrences relating to Information Technology, as described below.

Green Mountain Power

GMP has an enterprise security program in place that includes protection, detection, change management, verification and vulnerability testing. In addition, GMP works closely with State and Federal agencies to help identify potential cyber-security risks and to fortify GMP infrastructures and practices. Security assessments of critical IT systems are conducted regularly to identify potential vulnerabilities and remediate as needed. As security threats are constantly evolving, GMP is continuing its effort both internally and in collaboration with its security partners to protect customer information and the smart grid infrastructure from potential threats. GMP has not experienced any intrusions into its AMI system during the past year. The company has experienced a normal amount of minor security incidents involving malware exploits on employee desktops and laptops but these were non-critical in nature and were quickly detected and removed without compromising company or customer data.

Vermont Electric Cooperative

In 2015 our DNS vendor was subject to DDoS (Distributed Denial of Service) attack, which interrupted the systems which rely on DNS for couple of hours. VEC continues to review cyber security risks, to improve processes, to collaborate with other parties in evaluating and implementing new technologies. More specifically, cybersecurity is included in VEC's strategic planning with specific strategies and Key Performance Indicators (KPIs) including for cybersecurity enhancement. VEC has begun using the "Cybersecurity Capability Maturity Model" (C2M2) which was developed by Department of Energy. In VEC's view, C2M2 provides a long-term framework which will allow VEC to constantly monitor and improve cybersecurity posture. VEC is also working on integrating NIST Cybersecurity Framework (Executive Order 13636) with C2M2. As to technology enhancement affecting cyber-security, VEC finished sectionalizing internal network with internal firewalls. This created an additional layer of protection for malware potentially injected into internal network. Internal firewalls further the concept of "zero trust network" which is already use by larger companies. In addition, VEC continues to monitor its internal network with very sophisticated SIEM (Security and Event Management). Due to the complexity of this system, full implementation will take couple of years; however, VEC we already sees significant benefits with early warnings for potential risks. Using mobile devices (smartphones, tablets) creates great opportunity but also bring some risks. To protect the VEC system, we implemented MDM (Mobile Devices Management) which controls data flow, for example by allowing us to erase data if a device if lost.

VEC continues to collaborate with other electric cooperatives through the National Rural Electric Cooperative Association (NRECA). VEC's IT manager is a member of Cybersecurity Advisory Group at NRECA. One of the benefits of this collaboration has been the opportunity to test for free certain appliances for deep packet inspection. VEC worked with the National Cybersecurity Assessment and Technical Services Team (NCATS) under the Department of Homeland Security. NCATS provide us external penetration services with weekly reports. This service allows us to mitigate some risks and is provided to us for free. VEC participated in cyber security meeting organized by Vermont Division of Emergency Management and Homeland Security. Finally, VEC participate in planning of the following exercises:

- August 2014 – VT Communication TTX – DHS HQ and Vermont Emergency Management and Homeland Security
- October 2015 – SCADA system hacked TTX – Vermont EM&HS, DPS, VT electric utilities
- July 2016 – Vigilant Guard – Communication and SCADA TXX, VT National Guard, Vermont EM&HS (VEC is the only electric utility in Vermont who is directly involved in planning and participating in Vigilant Guard).

VI. Conclusion

As of September 30, 2015, participating utilities expended virtually 100% of planned financial outlays and reported associated operational and energy savings from smart meters and AMI infrastructure of $27 million – exceeding expectations by 17%. These utilities plan to recover costs and realize additional savings during the remainder of the planned 20 to 25 year period.