Grid Modernization Advisory Group

Whitepaper Series
#1: Investment in Advanced Meter Infrastructure

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ADVANCED METER INFRASTRUCTURE & DISTRIBUTION GRID MODERNIZATION

1 – DESCRIPTION OF ACTION

Advanced metering infrastructure (AMI), sometimes called a foundation for a 'smart grid', is essential for modernization of the distribution grid in New Mexico. AMI allows two-way communication between the utility and the customer's meter, opening up a new realm of capabilities that will allow innovative applications.

AMI technology has been in common use in the energy industry for over a decade and approximately 70% of the 150 million meters in the United States are now AMI.[1] AMI brings to customers benefits of improved electricity reliability, long-term cost savings[2], improved energy efficiency options, and more opportunities for the use of Distributed Energy Resources (DER), such as electric vehicles, rooftop solar and behind-the-meter battery storage. The Grid Modernization Advisory Committee (GMAG) is recommending that **all utilities in New Mexico invest in the implementation of AMI and other smart grid technology with a full suite of capabilities in their territories.** This includes AMI ('smart') meters for all customers of each utility, as well as the advanced features and services that a smart grid can provide, as described below.

A good model for New Mexico to consider for its utilities is the system that Xcel Energy is currently implementing– the Advanced Grid Intelligence and Security (AGIS) system. AGIS provides all the aspects of AMI and full distribution grid modernization that are discussed in this whitepaper. Xcel Energy is currently deploying its AGIS system in Colorado and Minnesota and hopes to bring its experience in deploying this system as an example of a robust and fully integrated modern grid that could be similarly replicated in New Mexico. However, New Mexico has its own unique grid. The state's electric service providers will determine what aspects of the AGIS system best fits the individual utility and the needs of its customers. Thus, the recommendation is to deploy an "AGIS-like system" in New Mexico in an effort to provide an example of an integrated modern grid, but to allow individual utilities discretion on how to modernize their grid. The Xcel AGIS system will be discussed in detail below.

DRIVERS FOR RECOMMENDING AMI

Modernization of the distribution grid with AMI will address three of the four beneficial drivers that have been identified as critical: achieving a clean energy transition; making use of New Mexico's world-class renewables; and the necessity of a modern grid for economic development and increased quality of life.

Achieving a clean energy transition: The New Mexico clean energy transition needs a modernized distribution grid to help decarbonize energy supply and use. The modernized grid needs to facilitate clean energy flow in two directions instead of only from the utility to the customer. It needs to

[1] Estimate based on: https://www.eia.gov/tools/faqs/faq.php?id=108&t=3
[2] Colorado PUC Docket 16A-0588E PUBLIC SERVICE COMPANY OF COLORADO FOR AN ORDER GRANTING A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR DISTRIBUTION GRID ENHANCEMENTS, INCLUDING ADVANCED METERING AND INTEGRATED VOLT-VAR OPTIMIZATION INFRASTRUCTURE, direct testimony of Alice Jackson, Hearing Exhibit 101, August 2nd, 2016.

facilitate innovative rate structures like time-of-use rates. It needs to facilitate energy efficiency, both at the customer location and in the grid itself. It needs to facilitate the use of automated and customer-controlled demand response, to lower peak loads. And it needs to provide higher reliability and resiliency so that customers can depend on the grid for additional needs such as transportation and heating. AMI and a full AGIS-type smart grid system can deliver all of these capabilities.

Making use of New Mexico's world-class renewable resources: The advantages of New Mexico's world-class renewable resources of wind and solar should be available to individual consumers. A modern distribution grid can provide customers with the ability to generate their own energy with rooftop solar. It can also allow customers to take advantage of utility-scale wind and solar more effectively by signaling to the customer when green energy is available and abundant and when it is not, allowing them to make decisions about where their energy is generated. Finally, a modern grid can facilitate the interconnection and delivery of community-based solar projects that customers can subscribe to if they so desire. AMI can help with all of these capabilities.

Supporting economic development, technical progress, and quality of life: A modern grid is essential to providing clean, resilient and secure energy to New Mexicans and the region in order to spur economic development, technical advancements, job opportunities and improvements in the lives of all. As we depend more and more on electricity in our homes, at our work, and for our future, we need it to be more reliable and resilient. AMI accomplishes this by increasing the reliability and resilience of the grid.

OBJECTIVES THAT AMI SUPPORTS

Ten objectives have been identified for grid modernization. AMI with a full AGIS-type smart grid system can address all of them as listed here and described more fully in subsequent sections.

1. **Reliability and Resiliency.** This objective was identified as primary for this action. It is addressed by AMI with a full AGIS-type system through the reduction in the number and duration of faults by alerting the utility of service interruptions and allowing them to more quickly dispatch crews to conduct repairs, or by allowing crews or automated systems to reconfigure the grid, where capable, to restore power to some customers more quickly on the distribution system, and flexibility in meeting peak demands.
2. **Affordability**. AMI has long-term benefits for lowering customer bills through providing information to customers to allow them to reduce energy consumption and energy costs[3]. There are, however, likely to be short term bill increases due to capital costs of adopting AMI that will be addressed below.
3. **Adopt Clean Energy Technologies.** AMI can facilitate more clean distributed generation, the use of new technologies such as distributed energy storage, flexibility in the use of utility-scale clean energy, and overall reduction in energy needs, all of which will advance clean energy technologies.
4. **DER Integration.** AMI can help to increase the hosting capacity of the grid by working with advanced (smart) inverters that are now available for most DER systems, other equipment, and

[3] See complete testimony in Colorado Docket 16A-0588E.

software applications. In addition, AMI can facilitate smart charging of EVs, which will allow more EV load to be accommodated by the grid.

5. **Reduce Carbon Emissions**. AMI will meet this objective by meeting Objectives 3 and 4 above.
6. **System Efficiency.** AMI can provide data to facilitate Volt/VAR optimization that lowers the voltage on the grid, making most loads more efficient. AMI also facilitates energy efficiency and demand response that can make the system more efficient.
7. **Adapt to Increased Load.** AMI can help address increasing loads from EVs, conversion of natural gas heating to electric heating, and other new loads by facilitating smart charging of EVs, load shifting through demand response, and overall load shifting through time of use rates.
8. **Asset Optimization.** AMI can improve asset optimization by utilizing feeders and substations more effectively through the objectives listed in Objectives 4, 6 and 7 above.
9. **Customer Enablement.** AMI will allow more customers to choose specific energy sources, as described in Objectives 3 and 4 above, and have more control of their loads as described in Objectives 4, 6 and 7 above. Modernization of the distribution grid with AMI will respond to three of the four beneficial drivers that have been identified as critical: achieving a clean energy transition; making use of New Mexico's world-class renewables; and the necessity of a modern grid for economic development and increased quality of life. Another customer experience benefit would be pre-pay or flexible payment benefits which have been shown in other states (e.g. SRP in Phoenix) as a hugely popular program for all types of customers.
10. **Operational Market Animation.** If the aggregation of DER becomes feasible technically or economically, AMI could facilitate the coordination of that aggregation and its operational use.

AMI TECHNOLOGY

The heart of a smart grid system is a smart meter at every customer location and a robust communications network that is capable of transmitting data to and from the meters on both a regular and "at will" basis. The brain of a smart grid system is the Advanced Distribution Management System (ADMS), which is a sophisticated software system usually installed on a dedicated computer. Additional software and hardware applications can be added to the basics as described below.

- **AMI Meters.** AMI meters have already been installed on more than 100 million residential, commercial, and industrial customers of utilities in the US.[4] They are standard equipment for most utilities. AMI meters provide the interface between the customer and the utility, establishing the customer's link to a utility communication network. The communication link is bi-directional, allowing the utility to request and receive data from the meter and to communicate with the customer in other ways. The AMI meters collect granular usage data, usually at 15-minute intervals, and generally have the capability to transmit that usage data back to the utility on a regular schedule, and/or on demand. AMI meters also, generally, have the ability to collect voltage information and sometimes other power quality data that can be transmitted back to the utility on request. All of this data collection is automated, requiring no utility personnel to travel to the customer's location. AMI meters also have the capability to interface with Home Area

[4] https://www.eia.gov/tools/faqs/faq.php?id=108&t=3

Network (HAN) devices that are developed and sold by third-party providers to manage multiple home energy devices, such as smart thermostats, smart appliances, smart electric outlets, and other devices. This can potentially include solar photovoltaic (PV) systems and distributed storage that is on site. Older Automatic Meter Reading (AMR) meters require a utility vehicle to drive down each street once per month collecting monthly usage data. Software support for AMR meters is decreasing as utilities are shifting to AMI. To the best of our knowledge, no new AMR meter systems are being installed in the US. All new and replacement systems are AMI.

- **AMI/Smart Grid Communications Network.** To implement AMI and a full smart grid, the utility needs to install a robust communications network within its territory to connect AMI meters and other smart grid equipment to the utility office(s). The communications network must be capable of both transmitting data to customer meters and receiving data from those same meters, on both a regular and on-demand basis. Utilities and their suppliers usually have two levels of this communications network: a short-range communication ability from the customer meter to a nearby collection point, and a longer-range communication link from collection points to utility offices. One problem that some initial AMI systems had was insufficient data handling capacity of the communications network. This limited the amount and frequency of data that could be exchanged between the utility and its customers. Utilities should pay close attention to the bandwidth of their AMI communications systems for the capabilities that the utility is designing for and specify that the systems to be able to accommodate upgradability and interoperability to the extent foreseeable. This should include estimates of signaling to customer regarding smart charging commands, demand response commands, voltage measurements for VVO, information on energy rates and availability of green energy, and other anticipated needs for data communication.

- **Advanced Distribution Management System (ADMS).** ADMS is the software platform that operates the smart grid system. Though AMI will generally have direct linkage to billing systems and other utility "back-office" software systems, ADMS is at the heart of all the advanced features that the smart grid is capable of performing. It is essentially the "operating system" of the smart grid.

- **Reliability Software (FLISR).** FLISR is a software reliability package that is a feature of most smart grid systems. This software package gives the utility the ability to pinpoint outages on the distribution system immediately, rather than waiting for customers to complain.

- **Conservation Voltage Reduction (CVR) software and hardware.** A smart grid system can be augmented with software that will allow voltages to be lowered on the distribution grid, saving around 3% of all energy use on feeders and substations where it is implemented. Additional hardware will also be needed to control Load Tap Changers, capacitor banks, regulators, and grid edge devices. Xcel Energy is implementing this technology in Colorado as part of their AGIS investment. A description of the components they are using can be found at the link below.[5]

[5] See complete testimony in Colorado Docket 16A-0588E.

- **Management of DER.** Distributed Energy Resource System (DERMS) software is another tool that can be added to a smart grid system.

- **Xcel's AGIS technology.** In 2016, Xcel Energy proposed a large investment to modernize their distribution grid in Colorado.[6] The Xcel proposal is a state-of-the-art AMI system, deploying full-function AMI meters to all 1.5 million customers. The communications network that is being implemented is composed of a Field Area Network (FAN) between substations and filed devices. It is composed of wireless technologies that include a mesh network for short distances and a microwave access network for longer distances.[7] The proposal includes basic AMI plus a full smart grid system, including an ADMS, Integrated Volt-VAR Optimization (IVVO), also known as Concentrating Voltage Optimization (CVO), Fault Location Isolation and Service Restoration (FLISR), including Fault Location Prediction (FLP).[8] The Colorado PUC approved Xcel's AGIS investment. Xcel is in the process of installing the system in their service territory.

AMI AND SMART GRID FEATURES

The GMAG is recommending the deployment of a full set of AMI features as described below. Some utilities start out with AMI meters and a basic communication capability from those meters back to their billing system. This type of application has some benefit for customers, allowing alternative rate structures. The Public Service Company of New Mexico (PNM) proposed such a system several years ago, but the state's Public Regulation Commission (PRC) denied pre-approval of cost recovery, causing PNM to withdraw the application. The features listed below have evolved over the past decade as AMI and the capabilities provided by a full smart grid system have matured as products. New features are being invented and developed constantly, so over time, AMI systems can expand to incorporate additional features.

Automated Meter Reading

Historically, customer meters were electro-mechanical devices with a dial that displayed total energy use. A meter reader would walk by each home or office once each month to read the accumulated energy use. The manual reading would then be entered into the utility billing system and a bill sent to the customer. This was an expensive process, employing many people in a very simple yet time-consuming task. The next step in the evolution of meter reading was the AMR meter, which required utility employees to drive down streets once per month to "ping" each meter and get the accumulated usage information sent to a receiver in the truck. This decreased the total workload for utility employees, but still involved a manual, once-per-month process.

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[6] See complete testimony in Colorado Docket 16A-0588E.

[7] Corrected Direct Testimony of Wendall Reimer – Colorado Docket 16A-0588E. Due to a relatively recent FCC rule change, Xcel Energy is currently utilizing public carrier for the backhaul, while also evaluating the potential for a private LTE network to replace the original WiMAX solution.

[8] Corrected Direct Testimony of Chad Nickell – Colorado Docket 16A-0588E.

AMI meters and the AMI system complete the automation of the chain that begins with recording usage data and ends with a customer receiving a bill. AMI meters regularly send usage data through the AMI communications system to the utility billing system. This eliminates the manual processes and allows usage data to be recorded at a much more granular level. 15-minute data is typically recorded by the meters and can be downloaded to the utility at longer intervals. In most AMI systems the usage data can be requested in real time by the utility and sometimes by the customer through a utility portal. The automation of billing services with AMI provides large cost savings[9] that can be passed on to the customer.

Automated Connect and Disconnect

AMI meters and the AMI system allow the utility to perform automated connection of electric service to many homes and offices without physically sending someone to the property. This can speed up new service or resumption of service. AMI can also be used for automated disconnect without sending utility personnel to the property. Having these functions automated saves overall costs for the utility, which are passed on to the customers.[10]

Advanced Rate Structures

As with any commodity, customers of electric utilities respond to price signals. It is important that the rate structure for electricity gives customers price signals that reflect the cost of producing electricity and the carbon intensity of that generation. Many states and utilities are investigating and implementing time-of-use (TOU) rates that incentivize customers to use less energy during peak load hours, shifting use to times when energy is more abundant, cleaner and cheaper. Critical Peak Pricing is another mechanism that can be used to set high prices for energy when peak loads are anticipated. And special prices to incentivize use of EVs can help with smart charging, which will be needed to shift EV charging loads. These rate structures will help reduce carbon intensity by shifting use to times when renewable energy is abundant and spread out load so that expensive grid augments are deferred or eliminated. AMI, with its ability to record energy use on a much more granular level, is necessary to implement these innovative rate structures. With AMI, it may be possible in the future for the utility to send real time price information to customers, along with real time information on when renewable energy is abundant on the grid. This will allow the customer, through automation, to shift energy use in a much more controlled way to help integrate more renewables onto the grid.

Improved Reliability and Resilience

One of the biggest advantages of AMI and a full smart grid system is the improvement in reliability such a system can bring to customers. Historically, utilities have had to wait for customers to call them when they were experiencing an outage as a result of a break or short circuit in a distribution feeder. The utility had no or very limited visibility into the feeders. The majority of customer outages on a distribution grid with above-ground feeders is from a break or short in the feeder caused by wind, tree limbs, animals, ice storms, hurricanes, tornadoes, etc. For example, a windstorm brings down a tree limb

[9] See complete testimony in Colorado Docket 16A-0588E.
[10] See complete testimony in Colorado Docket 16A-0588E.

on a feeder, causing part of a neighborhood to experience a service outage for hours. Before AMI, the utility would start plotting the locations of customers who called about their power being out. Through aggregation of the various calls in an area, the utility could start to make educated assumptions about which component of the distribution feeder was where the fault must have occurred (e.g. service wire, transformer serving multiple houses, upstream fuse, etc.). They could then direct a repair truck to help them locate the fault. With AMI meters to report voltage, the utility can detect and trace voltage problems or outage alarms. The location of outages can be found immediately, and repair crews dispatched without waiting on customer calls to initiate the process. This cuts outage time dramatically. Furthermore, additional supplemental smart grid software products which utilize AMI data can monitor the condition of grid components to anticipate some types of faults such as transformers that may be consistently operating at or above their rated capacity, cutting the number of customer outages.

A report from the U.S. Department of Energy indicates that filed trials by several utilities have shown improvements in reliability from grid automation of 13% to 40% in System Average Interruption Frequency Index ("SAIFI" – the average number of sustained interruptions) and 2% to 43% in System Average Interrupt Duration Index ("SAIDI" – the average number of system outage minutes).[11] These improvements save customers a great deal of money in lost income. Lawrence Berkley National Lab has created an Interruption Cost Estimator ("ICE Calculator") that can be used to estimate the cost savings that benefits customers when the reliability features of AMI are implemented. Using conservative estimates (10% improvements in SAIDI and SAIFI), this estimator calculated that Xcel customers in Colorado would save $370,845,000 over 20 years with implementation of AMI.[12]

A full smart grid system such as AGIS can also contribute to utility resilience plans. Grid resilience is the ability of the grid to survive catastrophic outages caused by natural disasters or human made attacks. One of the ways a grid can survive, or survive in part, catastrophic outages is by reconfiguration. For example, if a long feeder or many feeders to a remote community or housing development is cut off by fire or by another disaster, a utility can reconfigure service to that area using other facilities if they are available. This is accomplished via automated switching that shifts the load to another feeder or even to another substation. The detection of resilience problems and the automated action can be enhanced by the information facilitated by the AMI system.

Advanced Energy Efficiency

Energy efficiency, including both Demand Side Management (DSM) and Demand Response (DR), is key to moving forward towards a low carbon future. Energy efficiency can also directly save money for customers on their bills and can defer and avoid expensive expansion of the energy system. The AMI system can facilitate energy efficiency in the following ways:

- Smart charging of EVs – managing charging times to match with renewable resources or for use during off peak times.

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[11] Reliability Improvements from the Application of Distribution Automation Technologies –Initial Results. Smart Grid Investment Grant Program, Dec. 2012. www.smartgrid.gov

[12] Wilson Answer and Cross-Answer Testimony Colorado 16A-0588E.

- Smart thermostats – managing home heating and cooling to lower peak energy loads, while keeping people comfortable and saving them money.
- Integration with Home Area Networks (HAN) – directly exchanging data between AMI meters and home energy systems.
- Smart appliances – communicating with smart appliances to manage energy usage.
- Real time communication with customers – giving customers information on when green energy is available and when it is not.
- Voltage optimization for energy efficiency – system wide energy savings through voltage conservation when implemented in an AGIS-like smart grid system.

Management of distributed generation and storage (DERMS)

Distributed Energy Resources (DER) include distributed generation (DG), Distributed Energy Storage (DES), EVs, DSM and DR. The interconnection of DG and DES, especially when reaching high penetrations on individual feeders and substations can be a benefit to the grid if managed appropriately, or a potential problem when they are not managed properly. With the advent of advanced inverters, utilities will have the option to communicate with DG and DES to manage their generation and charge/discharge in ways that benefit the grid and also avert problems that high penetrations can cause. Distributed Energy Resource Management Systems (DERMS) have been developed to perform this function.[13] DERMS can be included in an initial overall AMI/ADMS implementation or added at a later time. The GMAG recommends that utilities make the investment in DERMS systems before high penetrations of DG on feeders becomes problematic for the maintenance of reliability and power quality. DERMS should also be considered to provide benefits to the distribution system, as it helps to control peak load and provides potential non-wires solutions through the aggregated management of DER.

2 – CONTEXT AND CURRENT SITUATION

In 2019, electric utilities in the US had deployed about 94.8 million AMI meters, with 88% of these installed at residential customer locations.[14]

Number of AMI installations by sector, 2019

Residential	Commercial	Industrial	Transportation	Total
83,539,594	10,850,886	446,871	1,504	94,838,855

[13] Guidehouse Insights Leaderboard: DERMS Vendors - https://guidehouseinsights.com/reports/guidehouse-insights-leaderboard-derms-vendors ; Siemens DERMS information: https://new.siemens.com/us/en/products/energy/energy-automation-and-smart-grid.html; National Renewable Energy Laboratory, "Coordinating Distributed Energy Resources for Grid Services: A Case Study of Pacific Gas and Electric; NREL/TP-7A40-72108 Nov 2018.
[14] https://www.eia.gov/tools/faqs/faq.php?id=108&t=3

In the area surrounding New Mexico, the following utilities have installed AMI system-wide: Arizona Public Service, Salt River Project, Tucson Electric Power, and Nevada Energy. Xcel Energy is in the process of installing AMI system-wide in Colorado.

In New Mexico, however, none of the investor-owned utilities (IOUs) have implemented AMI for any of their customers. The total customer meters represented are as follows: PNM – 541,639; El Paso Electric Co – 111,450; and Southwestern Public Service Co – 117,768,[15] giving a total meter count for IOUs of 770,857. New Mexico's rural electric cooperatives (cooperatives) have installed a total of 110,052 AMI meters at customer locations out of a total of 207,908 meters, for 53% average AMI coverage. Public utilities in the state have installed 12,364 AMI meters out of a total 77,917 meters, for 16% total coverage. The AMI systems installed in the territories of cooperatives and public utilities are primarily being used to collect usage data for billing purposes, creating significant cost savings from reducing manual meter reading in rural areas. The state as a whole has a total of 122,416 AMI meters out of a total 1,056,682 customer meters for a total AMI coverage of 11.5%, well short of the approximately 70% coverage of the US as a whole.

In Colorado, Xcel Energy applied for approval to modernize their distribution grid with their Advanced Grid Intelligence and Security System (AGIS) in 2017. The proposal included AMI meters at all 1.5 million customer locations, a robust communication system to connect those meters to Xcel's legacy systems, full FLISR capability for improved reliability, an ADMS, and an Integrated Volt VAR Optimization (IVVO) system on two thirds of their full grid.[16] The proposal also included work to ensure grid cybersecurity and the ability to directly interface Home Area Network (HAN) devices with customer AMI meters. The system was shown to have a positive cost-benefit ratio and was approved by the Colorado PUC.[17] Xcel is currently deploying this system in Colorado and has indicated that they will be deploying the same type of system on their grid in Minnesota.[18] They have also indicated an interest in deploying the system in their New Mexico subsidiary, Southwestern Public Service Co.

3 – IMPACTS OF THE ACTION

The deployment of AMI to all customers in each utility in New Mexico would modernize the distribution grids throughout the state. The positive aspects of this modernization have been touched on in preceding paragraphs and are summarized below.

- **Affordability**. Deployment of a full AMI system as described above is a large investment for utilities and their customers. The long-term gains in affordability in terms of benefits versus costs should be calculated by each utility before they make this investment. However, the deployment of almost 100 million AMI meters nationwide argues that utilities and commissions across the country have decided that the benefits outweigh the costs. Customer benefits include: improved reliability, bill savings from advanced energy efficiency measures, bill savings from advanced

[15] All data in this paragraph is from the Baseline Document, Exhibit 22 – Advanced Metering.
[16] See complete testimony in Colorado Docket 16A-0588E.
[17] See complete testimony and Commission Orders in Colorado Docket 16A-0588E.
[18] Xcel Energy Minnesota Proposal. https://www.xcelenergy.com/company/media_room/news_releases/xcel_energy_and_itron_collaborate_to_bring_advanced_technology_to_energy_industry

rate designs, bill savings from system efficiency, and bill savings from reduced billing costs. The specific benefits and costs will be unique to each utility.

- **Reliability.** Deployment of AMI is the largest single investment a utility can make to improve customer reliability. Large gains in SAIDI and SAIFI can be modeled as described above, which provide a monetary value for the reliability improvement. This has been a major selling point for AMI in many states. In addition, some aspects of the value of improved reliability cannot be given a dollar value. One example is service to customers whose medical needs are supported at home by equipment that must have continuous or near-continuous power. The value of lives lost when power is out is incalculable.

- **Resiliency**. AMI can help support resilience by improving automated reconfiguration of the grid. This may require additional investment in additional software systems and hardware such as reclosers and, potentially, additional feeder build out.

- **Security.** Utilities will have far more visibility into their grids with AMI.

- **Other benefits.** Other benefits of AMI include, but are not limited to:
    - Reduced pollution through lower energy use and integration of more renewable energy;
    - Support for improved hosting capacity for distributed generation through providing higher quality data;
    - Customer access to meter data for more granular customer control of energy use; and
    - Additional energy efficiency measures, such as smart charging of EVs, can be more easily accomplished with AMI as a foundational technology.

However, there are some negative impacts resulting from the investment in and deployment of AMI systems such as Xcel's AGIS. The following issues will need to be considered.

- **Affordability**. Grid modernization requires an initial investment that must be paid off over time. Customers will see a short-term bill increase. The short-term increase in bill cost will be mitigated by long term cost savings as discussed above.

- **Reliability.** There are no negative impacts to reliability from AMI investment or deployment.

- **Resiliency.** There are no negative impacts to resiliency from AMI investment or deployment.

- **Other negative impacts**. Other negative impacts of AMI investment or deployment include, but are not limited to:
    - Meter reading jobs will be replaced by automation;
    - There is a risk that utilities will only use AMI for meter reading and will not follow through in making use of its other benefits;

- A small number of customers will oppose AMI, fearing that the utility will have more data on their energy use. This opposition can be mitigated through utility privacy and data security measures, which will need to be reviewed and potentially strengthened; and
- A very few customers are afraid of smart grid technology. A special, increased rate will need to be developed for these customers, enabling them to opt out of smart meters and have their meters read manually.

4 – PREREQUISITES, RISKS, ROADBLOCKS, & ENABLERS

PREREQUISITES

The main prerequisite for the implementation of AMI by New Mexico utilities is to get approval for the relatively large investment from their upper management, their boards of directors, and the PRC (when necessary). The utilities will each need to make a business case for the investment, showing why it is good for the company and for its customers. There are abundant examples of utilities who have done this in other states, such as Xcel Energy in Colorado and Minnesota, NV Energy in Nevada, Arizona Public Service and Salt River Project in Arizona, and many others across the country.

As an additional prerequisite, each utility, before seeking approval for the investment, needs to review, in detail, the full set of AMI and smart grid features and services discussed above and determine how they fit with their customers and budgets. Full implementation may require a stepwise process, with features added over time. However, the recommendation of the GMAG is that all the features and services discussed above should be considered to be part of grid modernization and should be deployed in a timely manner to secure the full set benefits to New Mexico and to all utility customers.

RISKS AND ROADBLOCKS

The risks and roadblocks for implementing AMI and a larger smart grid program include:

- **AMI and smart grid deployment is a relatively large investment for each utility.** We estimate a cost of between $200 and $600 per meter[19], depending on the feature set. The exact amount will need to be evaluated by each utility. The investment is spread over between ten and twenty years in customer rates,[20] increasing customer bills by several dollars per month. This is offset by improvements in reliability and the availability of DSM programs and rate structures that can save customers money. In the short term, customer bills may increase slightly. In the long term, the investment will pay off.[21]

- **There is a small but vocal group of customers who don't want the technology.** In each state where AMI has been proposed, a small but vocal set of customers object to the installation of AMI at their homes. The objections are generally of two types – first, those customers who fear the technology for reasons of electromagnetic radiation and/or fire; and second, customers who

[19] Rough approximation for Xcel of $1.8B and 3.3M customers/3.9M meters is $462/meter (estimates by Xcel for system wide deployment).
[20] PNM cost data from AMI application.
[21] Public Service of Colorado testimony in Colorado Docket 16A-0588E.

fear the utility gaining more granular information about their energy use. There are many scientific and technological responses that can allay these fears.[22] Most state regulatory commissions decide to offer customers an "opt out" rate for AMI that allows them to stay with non-communicating meters or other "manually read" technology for an additional price to cover the cost of labor to read the meter, process the data manually, and pay for any software to sustain that capability for manual reads. Over time, the objections and number of customers willing to pay the extra fee for manual meter reading dwindles.

- **Many utilities only use AMI to provide improvements in customer energy use and billing, without investing in the additional smart grid features described above.** This is a lost opportunity that can be recovered if the communications network is robust enough to handle additional data that will allow the reliability and energy efficiency benefits that are described above.

- In 2016, PNM filed an application with the PRC asking for approval to put an AMI project in a future rate case and be allowed to recover the prudently incurred expenses of such project. **The application was ultimately denied approval for cost recovery by the PRC.** PNM's proposal included remote connect and disconnect, theft detection, and high impedance detector edge analytics as well as the replacement of existing customer meters with AMI meters and the establishment of a communication network that would allow for automated billing. PNM representatives testified to the benefits of TOU rates, energy efficiency, and integration of renewables which would be made possible. Nevertheless, several parties opposed the proposal, and the PRC ultimately denied it.[23] PRC approval of AMI and smart grid deployment cost recovery is necessary for any IOU implementation of these technologies.

- **New communication channels and smart devices can be a security risk**, requiring utilities to consider cybersecurity mitigations as part of system implementation and possibly adding supplemental controls at an additional cost. This issue has been dealt with by utilities across the nation and is being managed by Xcel in its AGIS system in Colorado.

- **Utility Concerns.** Although grid modernization legislation was passed in the 2020 New Mexico Legislative Session (House Bill 233) enabling utilities to recover appropriate costs for grid modernization programs submitted to the NMPRC, this has not yet been tested. It will be important for the utilities to achieve appropriate cost recovery from the commission to provide confidence for all utilities to move forward with the capital investment necessary to modernize their respective grids. An additional utility concern is that the economics of a full smart grid system for utilities in New Mexico may be such that an AGIS like system would need to be implemented over time. There is concern that the recommendation in this white paper may be construed as an "all or nothing" proposal, which is not the case.

[22] Answer and Cross Answer testimony of Ken Wilson, Colorado Docket 16A-0588E.
[23] New Mexico Recommended Decision Case No. 15-00312-UT.

ENABLERS

AMI is the keystone of grid modernization for the distribution grid. New Mexico is currently behind other states in the implementation of AMI. New Mexico should place a priority on the implementation of AMI with the features and services discussed above.

AMI is not a new technology. It is widely available from the largest vendors such as Itron and Siemens.[24] It is well tested and widely deployed.

Reliable electricity is essential for a thriving economy and a well-functioning society. As has been described in detail earlier, AMI can be used to make dramatic improvements in reliability.[25] Customers now demand energy choices, such as the interconnection of distributed generation and solar. AMI and additional and supplemental smart grid systems such as DERMS can be used to increase hosting capacity and manage distributed generation and storage to meet customer needs.

5 – STEPS TO IMPLEMENTATION

The path for implementation of AMI first requires the utilities to decide to make the investment and for the utility commission and/or utility boards to approve that action. The full set of steps to implementation are as follows:

- **Utility preliminary work.** Utilities must research AMI and all associated features, with estimates of costs for implementation on the utility's grid. Utility engineers are no doubt familiar with the technology. There are also AMI vendors and consultants who can help with this process.

- **Utility presentation/filings with PRC and/or utility board of directors**. Each utility must make a case for the investment, looking at costs and benefits and describing the technology that will be deployed.

- **Approval of the investment by the Commission/Board.** Typically, the decision to allow a utility to make an investment in AMI will be done in a proceeding before the Commission. For utilities that are not under Commission regulation, approval will rest with their Board of Directors.

- **Creation and issuance of an RFP for an AMI system with the desired features.** Once approval has been granted for the investment, utilities will send out a Request for Proposal (RFP) to appropriate vendors. The RFP should include full specifications for the desired system.

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[24] ITRON AMI https://www.itron.com/emea/solutions/what-we-enable/ami; "90 Million AMI meters managed with Siemens technology" https://new.siemens.com/global/en/products/energy/energy-automation-and-smart-grid/energyip-meter-data-management.html

[25] As discussed in the reliability section above, pp. 6-7.

- **Deployment and testing.** The utility will then need to select one or more vendors for the project and a contract will be negotiated and signed. The selected vendor(s) then order the equipment and plan the installation. The system is then installed in the field and interfaced with existing utility billing systems and other legacy software as needed. The system must then be fully tested before being turned over to the utility by the vendor(s) for normal use.

Additional technical steps that utilities will need to take include the following:

- Evaluation of ADMS with existing SCADA system integrations[26];
- Evaluation of any SCADA system changes with SCADA fleet (relays, reclosers, cap bank controls);
- Evaluate replacement of legacy devices that may not integrate with SCADA system needs due to legacy protocols or proprietary protocols;
- Understand the interface into DER systems a utility might desire to coordinate with and set a standard (SEP 2.0, WiFi (may have cyber concerns), utility protocols (DNP3, IEC 61850), building control system protocols (Open ADR, BacNet, etc.) for integration and control with the DERMs system; and
- In New Mexico specifically, utilities would have to get some sort of buy in from customers or a regulatory look at whether and what curtailment of inverters looks like for those customers that are either earning renewable energy credits (RECs) or use net metering. This would include not only some limited curtailment, but also balancing with reactive power since reactive power being exported could be reduced if the inverter is not sufficiently sized. In the DERMS control scenario, all of these technologies would be needed to increase hosting capacity.

TIMETABLE FOR IMPLEMENTATION

There are two major steps in getting AMI deployed at a utility. The first step is getting approval for the investment (the first three steps listed above). This can take several years or more. The second step is installation and testing (the last step listed above). This will generally take an additional two years, somewhat dependent on the size of the utility.

MEASUREMENTS OF SUCCESS

Several measures of success are recommended:

1. Percent of customers in New Mexico that have AMI meters;
2. Percent of New Mexico utilities that have implemented basic AMI;
3. Percent of New Mexico utilities that have implemented FLISR or equivalent reliability improvement systems that utilize AMI meters;

[26] Xcel note: Xcel Energy has ADMS functioning in CO and MN, with effort underway to expand functionality across the enterprise.

4. Percent of New Mexico utilities that have implemented Conservation Voltage Optimization (CVO);
5. Scorecard for reliability improvements for each utility.

5 – REFERENCES

Colorado PUC Docket 16A-0588E PUBLIC SERVICE COMPANY OF COLORADO FOR AN ORDER GRANTING A CERTIFICATE OF PUBLIC CONVENIENCE AND NECESSITY FOR DISTRIBUTION GRID ENHANCEMENTS, INCLUDING ADVANCED METERING AND INTEGRATED VOLT-VAR OPTIMIZATION INFRASTRUCTURE.

Guidehouse Insights Leaderboard: DERMS Vendors. https://guidehouseinsights.com/reports/guidehouse-insights-leaderboard-derms-vendors

ITRON AMI. https://www.itron.com/emea/solutions/what-we-enable/ami; "

National Renewable Energy Laboratory. "Coordinating Distributed Energy Resources for Grid Services: A Case Study of Pacific Gas and Electric; NREL/TP-7A40-72108 Nov 2018.

New Mexico Recommended Decision Case No. 15-00312-UT.

Siemens DERMS information: https://new.siemens.com/us/en/products/energy/energy-automation-and-smart-grid.html

Siemens. "90 Million AMI meters managed with Siemens technology" https://new.siemens.com/global/en/products/energy/energy-automation-and-smart-grid/energyip-meter-data-management.html

Xcel Energy Minnesota Proposal. https://www.xcelenergy.com/company/media_room/news_releases/xcel_energy_and_itron_collaborate_to_bring_advanced_technology_to_energy_industry