Executive Summary

The electric power infrastructure is under pressure—continuing growth in demand, the importance of power quality and reliability in a digital society, aging workforce and assets, physical and cyber security of the electric infrastructure, and environmental and cost pressures are all combining to drive the development of a highly automated power delivery system. For most utilities, the first step in this direction will be the implementation of a system that goes well beyond the traditional view of Automated Meter Reading (AMR) to encompass Advanced Metering Infrastructure (AMI) and AMI's close cousin Advanced Metering Management (AMM).

For the past 20 years, the industry has focused considerable resources on automated meter reading (AMR), primarily intended to improve the accuracy and cost of monthly revenue reads. Over the past few years, there has been a clear transition from the classic AMR approach to advanced meter infrastructure (AMI). While receiving reads from the meters is still the largest perceived benefit for the utility, significant benefits can be obtained from the new functionalities provided by technological advance. Today's focus has broadened to a number of related applications leveraging the same technology assets. Dynamic pricing programs, for one, hold great promise for flattening the load curve, but require more sophisticated and granular measurement.

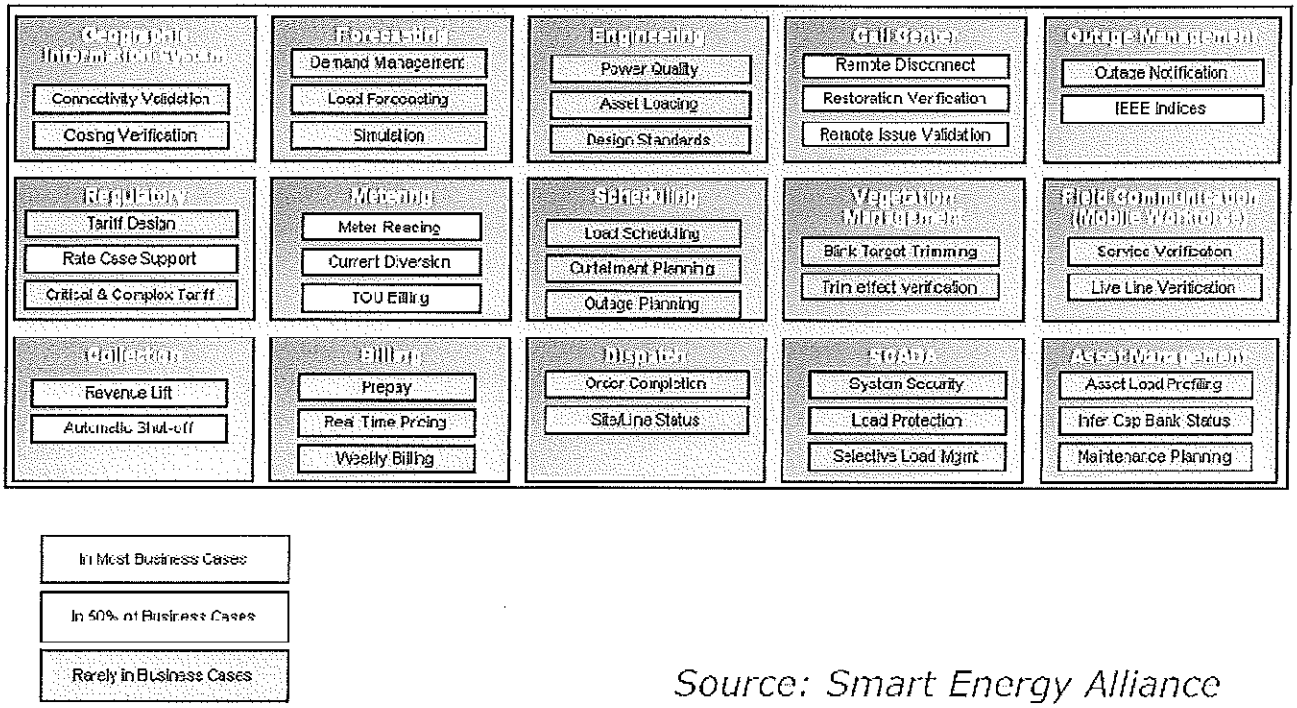
The good news for utilities is that the prospects for new technology have never been brighter. Technology stands poised to transform the physical operation and functional capability of utilities to bring them fully into the digital age. The intelligent grid focuses primarily on the efficient, reliable and safe distribution of

electricity. It's the marriage of the electrical distribution infrastructure, with a communications infrastructure in the form of a number of communication technologies—two-way radio frequency, broadband over power line (BPL), power line carrier, cellular or WiMax—that makes data more readily accessible for operating, maintenance and planning decisions.

Chapter I: AMI Benefits and Applications

Utilities today need to adopt technology that meets more than one need. AMR systems are unlikely to be justified based only on reducing meter-reading costs, and utilities are placing more focus on the combination of possible benefits in customer service, operations, and finance and technology that can be leveraged from investments in AMI

With more than 25 million AMR meters installed, the business cases for AMR/AMI are already diverse, but many examples show that there is business case value in areas other than the classic AMR "feet off the street" rationale. The functionality available to utilities today is much more robust and should be incorporated into the AMI business case, as illustrated below:



Source: Smart Energy Alliance

AMR/AMI and relate Supply Optimization Applications discussed in this report include:

- Asset Management and Usage Forecasting
- Dynamic Pricing
- Tampering and Theft
- Outage Management
- Supply Automation Applications
- Demand Response
- Load Profiling Balancing
- Distribution Network Diagnosis

- Remote Surveillance and Control
- Supply Control and Optimization Applications
- Supply Monitoring, Analysis and Quality Control
- Demand-Side Management (DSM)
- Automated Load Leveling, Shedding and Shifting
- Automatic Capacitor Bank Analysis and Control

Chapter II: The Future of AMI

The market for AMI-related equipment and services is expected to balloon over the coming 5 to 10 years as regulatory pressures converge with decreasing implementations costs.

The creation of a Smart Grid requires the linking of several components: the smart meter, the smart customer, smart utility communications, and a smart network capable of aggregating and making use of the tremendous amount of new data that will be generated.

Developing and adopting open standards for meters, communications, customer premises, and utility applications and data networking will go a long way towards solving many of the thorny implementation issues that utilities face with linking these components. More and better standards in key areas could drive the cost of AMI implementation down further, increasing the benefits to both the customer

and the utility, and create for greater confidence and safety in terms of future upgrades for utilities.

Chapter III: Implementing AMI

For many, Smart-Grid business cases have been a long time in the making, emanating largely from15-20 year efforts to justify the economics of AMR. While the terminology and technology have evolved, AMR is still the anchor benefit in virtually all Smart-Grid analyses; digital meter functionality and the associated communications infrastructure to enable it are the largest two investment costs that utilities must recover in rate base.

Broader Smart-Grid transformations leverage AMI and seek one or more distribution-centric advancements including grid reliability & security, demand response, distributed energy resource integration, distribution automation, energy efficiency and home automation. These advances trigger some incredibly information-intensive innovations that will require thoughtful technology implementation. Meter data management (MDM) and the use of analytics that make sense of the data for humans to use in operations is badly needed, and comprehensive and successful smart grid implementations will need well thought out solutions for these areas.

The intelligent grid focuses primarily on the efficient, reliable and safe distribution of electricity. It's the marriage of the electrical distribution infrastructure, with a communications infrastructure in the form of a number of communication technologies—two-way radio frequency, broadband over power line, power line carrier, cellular or WiMax—that makes data more readily accessible for operating, maintenance and planning decisions. Data from distribution grid devices has always been available, but the problem has been retrieving it and

using it remotely on a wide scale; the needed communications equipment has been prohibitively expensive until now.[1]

Still, wide-scale communication upgrades represent a huge investment (although small compared to investment in new generation capacity), and utilities want to get it right the first time. Technologies are rapidly evolving, and something else even better may emerge in the near future. Utilities considering intelligent grid solutions want to ensure that what they are implementing today will position them for the operating and regulatory environments of 15 to 20 years from now.

Conclusion

Utilities and their regulators must develop a common vision of how AMI will morph to lay the groundwork for the Smart-Grid revolution to come.

The intelligent grid is not the same for every utility, because each one has different circumstances that will result in different solutions. Utilities should prepare by examining plausible scenarios, perhaps in five-year increments, and then extend these scenarios 15 or 20 years out. No method can perfectly predict the future, but utilities can develop a realistic Smart-Grid roadmap by building a flexible and standards-based communications and networking platform, and developing plausible scenarios that leave management with a "no regrets" feeling.

The need for a fair return-on-investment is obvious, and the regulatory dialog should focus on an integrated Smart Grid that accommodates new technologies

[1] Interview with Richard Bertolo, Project Director, Distribution Business Development, Hydro One Networks, Inc.

for both grid and customer functionality. The case for rate recovery that must be agreed upon between utilities and their Public Utility Commissions (PUCs) is more complex than anything that has come before. Utilities should work with commissions to help them understand the need to pursue benefits beyond the obvious metering and distribution business benefits, and should partner with legislators to align the collective stakeholders with the full view of both tangible and social benefits.