INDEPENDENT REPORT

# Analysis of AMI Deployment Plan, Technology Choice and Client Benefits

## Hydro Quebec AMI System
## File R-3770-2011

Submitted By:

**Valutech Solutions Inc.**

December 7, 2011

For

GRAME

And

The Quebec Energy Board

# Table of Contents

# 1.0 Mandate

Valutech Solutions Inc. (Valutech) has been engaged by GRAME to provide an expert report in connection with Docket R-3770-2011 Remote Meter Reading Project (LAD). This report must comply in all respects with the authorization and subsequent rulings of the Quebec Energy Board with regard to the areas of inquiry approved by the Board.

**Part I. Analysis of pilot projects results as described in Hydro Quebec's Application for Authorization dated June 30, 2011:**

- Evaluate the results of preparatory work and pilot projects associated with the LAD Project
- Determine the missing elements in the selection of preparatory work and pilot projects and identify them
- Assess if, according to the progress of the preparatory work and the preliminary results of pilot projects, the timing is appropriate to proceed with Phase 1 deployment

Energy Board authorization for Part I. was provided in D-2011-145 and D-2-11-124 as follows:

**D-2011-145 states :**

- [13] *Concerning the pilot projects, the Board reiterates its decision D-2011-124. The Board identified the issues relevant to the study of this project under section 73 of the Act, including whether the project is justified in relation to the objectives. In this context, the Board considered that how the project is likely to meet the objectives can be discussed or questioned. Such questioning may be related to pilot projects if it were shown that they are inconclusive with regard to the achievement of objectives. So do not unduly restrict the discussion in this regard and let the experts decide, if necessary*. 1.

**D-2011-124 objectives:**

[36] *According to the file of the Distributor, the Project's objectives are threefold:*

*• the sustainability of the park meters;*

*• achieving efficiency gains from automating the reading of the consumer, as well as the interruption and return to service remote;*

*• the possibility of technological change can possibly offer new services to customers and to develop measures of network management. "[Emphasis added]*

[1] D-2011-145, par. 13, and D-2011-124, par. 37 à 39

## Part II. Analysis of the technology choices made by Hydro Quebec for the LAD Project:

Analyze Hydro Quebec's technology selection and determine if it will offer the potential to support future new client services such as demand side management, electric transportation ,dynamic pricing and electric vehicles, and will appropriately integrate data sources and facilitate the development of intelligent networks.

When evaluating the technical choices, the Energy Board has provided guidance concerning the scope of the technical analysis in D-2011-145 and D-2011-124 as follows:

- D-2011-145 [11]. *The Energy Board said to the GRAME to revaluate the mandate of its expert within the framework established in Decision D-2011-124. The Board will assess the relevance of the expertise by referring to the analytical framework set by the decision and its probative value in relation to the experience of the expert.*

- D-2011-145 [12]. *Thus, the modification of the project is not something that the board is studying as part of this application under section 73. The Board invites the GRAME to reread the paragraph 28 of Decision D-2011-124.*

- D-2011-124. [28] *Request for information must first be relevance to the alleged request of the Distributor. As for question and reports (so the expert's report) must be relevant to the project under consideration. This is not the first time that the board must remember that it is studying the project of the Distributor, not a hypothetical project or alternative one.*

## Part III. Economic and financial analysis of the LAD Project:

Conduct an economic and financial analysis of the technology selected to determine if Hydro Quebec's choice is advantageous and optimal for its clients from a financial point of view. Consider the potential for the AMI network, telecommunications services and new generation meters to provide future new client services and support new measures of network management.[2]

With regard to Hydro Quebec's Request for Authorization to proceed with Phase 1 deployment, in line with the goal of providing options for demand management, the elements that are within the scope of this analysis include paragraphs 19 a, 19 b and 19 c[3].

- "*The acquisition and integration of the front-end data acquisition system and the meter data management system to Hydro-Québec, as well as the requests for proposals for the acquisition*

[2] D-2011-124, par. 37

[3] R-3770-2011, Request for authorization project reading distance - Phase 1 by Hydro-Québec Distribution, B-002, par. 19 a, b and c.

*and installation of meters of new generation, collectors and routers (telecommunications equipment) and telecommunications services* "[4](B-0002, par. 19 a);

- The demand for "*completion of the development of the AMI IT, including the development of communication links with the service provider responsible for the installation of meters, the development of the remote disconnect/reconnect function and the establishment of a metering operations center, prior to the deployment of the meters of new generation of the project LAD, all during the period 2010-2012* "[5](B-0002, par. 19 b);

- "*The replacement of 1.7 million meters in the greater Montreal area [...], as well as the acquisition and installation of the required routers and collectors, all during the period 2012-2013.*» (B-0002, par. 19 c[6]);

This portion of the mandate was authorized by the Board for part I of the mandate and includes D-2011-145, par. 14 and D-2011-124 par. 37

**D-2011-145 states:**

- [14] *On the other hand, the economic analysis of the new features is clearly excluded from this request.*

**D-2011-124 states:**

- [37] *In regard to the third objective [the possibility of technological change can possibly offer new services to customers and to develop measures of network management], the board intends to hold the debate in the possibility [emphasis in the Régie's decision] that the equipments of the Project LAD - that is to say the smart metering and the TI and IMA - can evolve into new services to customers and new measures of network management.*

- [38] *That said, it should not be confused (i) the possibility that the technologies implemented by the Distributor under the project can evolve into new features and (ii) economic analysis and authorization, as part of future projects, for these other features.*

- [39] *In this application, the Board does not consider future projects but the project. So there is a mix between practical to do what needs to be discussed in phase 1 or which may be later. In this regard, the Board must take into account that this request is for the first phase of a project planned in three phases and that some effects of the first phase of the project could later become inevitable.* "

[4] R-3770-2011, Request for authorization project reading distance - Phase 1 by Hydro-Québec Distribution, B-002, par. 19 a
[5] R-3770-2011, Request for authorization project reading distance - Phase 1 by Hydro-Québec Distribution, B-002, par. 19 b
[6] R-3770-2011, Request for authorization project reading distance - Phase 1 by Hydro-Québec Distribution, B-002, par. 19 c

# 2.0 Executive Summary

On June 30, 2011, Hydro Quebec submitted an application to the Quebec Energy Board, requesting authorization to proceed with Phase I implementation of its Remote Meter Reading Project (LAD), as described in Docket R-3770-2011, and to recover the costs incurred during the project's preparation period as previously established in Decisions D- 2010-022 and D-2010-078 respectively.

In connection with this filing, Valutech Solutions Inc., hereinafter Valutech, was engaged by GRAME to apply its expertise to evaluate the Hydro Quebec plan, technology and customer benefits that would be realized if this project were to go forward, and to submit an independent report describing its findings.

More specifically, Valutech was asked to review the available record in this Docket and address the following areas:

- Evaluate the results of the preparatory work and pilot deployment efforts to date to determine if the pilot deployment results are sufficient to justify moving ahead with LAD;

- Evaluate the technology selected by Hydro Quebec within the framework of the Quebec Energy Board (QEB) guidelines, considering its adequacy and potential for future benefits rather than a comparison with other alternatives;

- Provide an economic and financial analysis of the selected technology based on the available information, but without including financial analysis of any new features that are not specifically included in the LAD plan.

In preparing this report, Valutech has examined available documents provided by GRAME as approved by the Quebec Energy Board, as well as other publicly available documents and materials on Advanced Metering Infrastructure (AMI), meter data management systems (MDMS) and smart metering generally. In addition, we have examined available material on the Landis+Gyr Gridstream wireless mesh AMI System, and to a lesser degree on Hydro Quebec's MDMS provider EnergyICT since that system has already been implemented. We have also consulted HQ's WiMAX RFP Section F Specifications to determine if there is a reasonable opportunity to leverage the two systems for efficiency purposes.

Valutech has examined the available material, including Hydro Quebec's authorization request in Docket R-3770-2011 to receive authorization to move ahead with Phase 1 deployment, and has made recommendations and reached certain conclusions and opinions that are discussed in this report. Hydro Quebec lists the following project objectives for the LAD project in Document 1 of its June 30, 2011 filing:

- Ensuring the durability of its embedded meters

- Obtaining efficiency improvements through LAD from improved meter reading functions and remote disconnecting of electric service

- Creating a potential to offer new client services in the future such as detection of power failures and demand management

We have examined each of these three categories to determine if based on available documents the overall LAD plan appears to achieve its objectives, and if in our view approval of the current request for authorization to go forward with Phase 1 implementation is considered appropriate and warranted at this time.

# 3.0 Background

On May 25, 2011, Hydro Quebec (HQ) announced that it had signed a contract with Landis+Gyr for the acquisition of its Gridstream wireless Advanced Metering Infrastructure (AMI) system. Installation of the new system would begin with a series of pilots involving approximately 27,000 meters to develop new processes test the new technology. If the pilots were successful, HQ would proceed to full deployment in 3 separate phases over a 5 year period from 2012-2017. The pilot projects, which began in June 2010, would involve the installation or monitoring of approximately 6,000 smart meters in Boucherville, 19,000 meters in Villeray Montreal and 2,000 meters in the municipality of Memphremagog.

In its press release, Hydro Quebec touted the many benefits that its clients would receive from AMI, such as reducing operating costs, elimination of estimated bills, outage detection, remote disconnect/reconnect of service and personal energy management.[7] In addition, the utility claimed that the new system would save over $300 million throughout its 20 year life. HQ further stated that Landis+Gyr would establish a Centre of Excellence, which would initially employ up to 75 people, to promote the benefits of smart meter and smart grid implementation.

In June 2011, Rogers Communications announced that it has been selected by HQ to provide network communications for the Landis+Gyr Gridstream wireless mesh network. Under this agreement, Rogers will provide backhaul data connections from HQ's data center to an estimated 600 smart meter collectors dispersed throughout the HQ service area.

With the Rogers announcement, HQ has identified most of the providers of the major components of its smart meter system[8]. At this time, HQ has apparently not made a formal announcement concerning the selection of the meter installation contractor, although it is believed that Capgemini Quebec will be the installation contract manager.

While Hydro Quebec continues to deploy meters and pursue its three pilot projects, it has applied to the Quebec Energy Board for authorization to proceed with Phase 1 of its full system implementation plan. The first of 3 phases, Phase 1 would begin in June 2012 and the project would continue through all phases until its completion in 2017. Each phase must be approved separately by the Energy Board.

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[7] See Hydro Quebec Press Release "Hydro-Quebec announces rollout of advanced metering infrastructure" dated May 25, 2011.

[8] Rogers Communications Press Release: "Rogers Communications to Provide M2M for Hydro Quebec" dated June 20, 2011.

## 3.1 Project Cost

Hydro Quebec filed a request with the Quebec Energy Board on June 30, 2011 to proceed with Phase 1 implementation. In its June 30 filing, HQ stated that the entire project would cost a total of $997 million, including preparatory costs, and would produce savings of $300 million over 20 years with long term annual savings of $81 million. Included in this cost are $42 million in preparatory costs and $82 million that would be spent to set up the AMI system IT infrastructure. This amount would apparently be spent prior to the June 2012 start of full system deployment. Also included in the project total are $157 million in operating costs, including $30 million for consultant fees for project management and other related services.

## 3.2 Preparatory Costs

Beginning in June 2010, HQ commenced the early stages of AMI system deployment by requesting the creation of an expense account in filing 3723-2010 to account for project related expenditures as it defined its business processes, initiated the pilot deployments, acquired a meter data management system and set up its Meter Operations Center. This preparatory work, which was projected to cost $42 million, would be completed by June 2012 when Hydro Quebec would see the complete results of the pilot performance and have all necessary system interfaces designed, built and tested.

Hydro Quebec subsequently selected Ericsson to be the project manager and system integrator for its meter data management system (MDMS)[9]. Ericsson selected EnergyICT headquartered in Kortrijk Belgium as the MDMS provider and is responsible for implementing the MDMS software, and integrating it with the AMI solution and HQ's SAP client billing system. This effort was included in the $42 million preparatory cots.

Preparatory costs will also include the installation of the 19,000 pilot meters in Montreal by an outside contractor to verify the contractor's meter change out process and integrate its meter change out system with HQ's back end billing system. At this time, the installation contractor selected by HQ to work with Capgemini has not been announced.

# 4.0 Advanced Metering Infrastructure Overview

This section provides an overview of Automated Meter Reading (AMI) technologies and the associated functional capabilities and implementation benefits. The information included in this overview will provide a general context within which to view the Hydro Quebec proposed AMI system and provide background for the analysis and opinions which are discussed in the subsequent sections of this report.

[9] December 16, 2010 press release: "Ericsson selected as prime integrator by Hydro Quebec".

AMI system implementation creates an associated expectation of receiving both utility and client benefits that can justify the cost of installation. Valutech will therefore provide a discussion of typical benefits achieved from AMI for context in evaluating Hydro Quebec's proposed AMI system and implementation plans.

## 4.1 AMR vs. AMI: Technology Differences

The term automated meter reading (AMR) was originally used to describe any meter reading system which enabled a utility to collect monthly billing data without physically reading the meter. This encompassed a wide variety of meter reading technologies including mobile, pedestrian, wireless, power line and phone-based systems. More recently, the term Advanced Metering Infrastructure (AMI) has emerged to describe automated meter reading systems that go beyond simply obtaining a monthly meter reading. These systems can supply more frequent meter interval data and provide near real-time, two-way communications with the meter and other distributed network devices.

AMR system technologies have evolved over the years, but are typically classified into two general categories: mobile systems (including pedestrian systems) that provide a monthly billing read, and one-way fixed network systems that are capable of obtaining daily reads without two way communications. The more advanced AMI systems are typically comprised of different technology components which are integrated to create a two-way, fixed network path between the meter and the utility's central office.

AMI system components include an advanced meter or meter/module combination (often called a "smart meter"), a hierarchical or peer-to-peer communications network that is capable of delivering meter data and alarms in near real time, and a suite of application software residing at the data center that manages customer read schedules, reads meters and transfers the meter interval data into a meter data management application or a meter data repository.

The primary purpose and benefit of installing a mobile or one-way AMR system is the elimination of the expense associated with maintaining a large, manual meter reading work force. Operational savings associated with AMR deployments include labor, supervision, vehicles, and reduced claims and insurance costs due to decreased injury and accident rates. Residual benefits associated with the deployment of AMR systems include increased customer satisfaction associated with the elimination of estimated meter reads, the elimination of missed reads, the reduction of billing errors and the ability to read indoor meters without entering the premises. Societal benefits are generally limited to reduced vehicle emissions through fleet reductions. These benefits can be significant, but in many cases don't outweigh the cost of implementing the system. As a result, many utilities have historically not been able to justify the implementation of AMR systems just on the meter reader savings alone.

Recently, however, a convergence of internal and external events and drivers has forced regulators and utility managers to seriously consider the implementation of AMI. Employee labor and benefit costs continue to escalate and the expense associated with maintaining a manual meter reading workforce is becoming prohibitive. On the other hand, smart meter and communications technology costs have moderated, making the deployment of advanced metering and communications technologies more feasible.

Energy costs, energy supply shortages, and electric transmission constraints are forcing regulators and utilities to look for innovative ways to control peak load growth, alter demand patterns, and defer the need for new capacity. And awareness of, and concern over, the environmental impact associated with the development of new generation, transmission and distribution facilities and associated increases in emissions have become mainstream political and social issues.

Consequently, while the cost of implementing AMI has not decreased significantly, the overall cost/benefit ratio has improved and the sizable investment in these systems has begun to appear prudent and justified when the additional company, client and societal benefits associated with the implementation of AMI are considered. When implemented effectively, AMI can be a pivotal, enterprise-level data source and communications network that produces efficiencies in customer service, customer billing, meter reading, distribution operations and other areas. In fact, many experts now consider the implementation of an AMI system to be a fundamental building block of the “smart grid”.

Utilities in North America have responded differently to the challenges and benefits associated with installing AMI. In some cases, they have provided limited solutions for their larger commercial and industrial customers and a small number of time-of-use meters. Others have opted for larger scale deployments to residential, commercial and industrial customers.

## 4.2 AMI System Components

A typical AMI network consists of several different components, including the smart meter, a communications link consisting of towers, collectors, routers or meter take off points, network management software, and in many cases a meter data management system (MDMS) application to handle the large volumes of interval data provided by the system.

The AMI network management software is an essential component that performs several important functions including the management of the AMI communications network, scheduling and collection of meter reads and coordination of routine customer and meter data changes to ensure that all meters are read. In order to support the large volumes of meter interval data and facilitate business intelligence, most utilities, including Hydro Quebec, are now implementing an MDMS along with the implementation of their AMI system.

MDMS software serves as a repository for meter interval data and as an interface with other system applications such as the company’s Customer Information System (including billing), outage management, geospatial information systems (GIS) and enterprise asset management applications. Business reports and analytical programs can make use of the data that is stored in the MDMS. Utilities that operate in areas where retail competition has been implemented or those that are considering some form of dynamic pricing structure such as time-of-use (TOU), critical peak pricing, or demand response programs, often employ an additional software application to manage the large number of client switching transactions associated with competitive retail energy activity.

Figure 1 below provides a general AMI components overview and typical network topology. It also introduces new terms involving a Local Area Network (LAN) and Wide Area Network (WAN) that provide the communications links between the meters and the utility's central office.

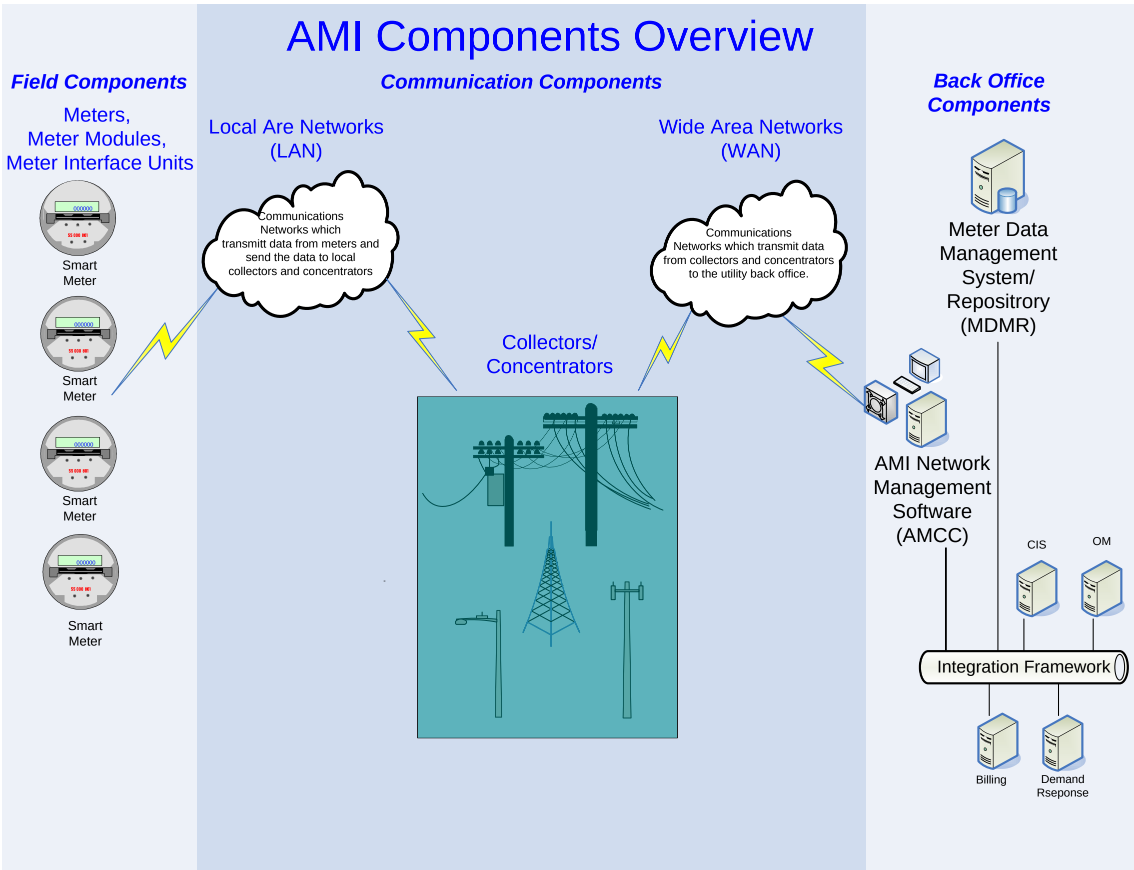


Figure 1 - AMI System Components Overview

### 4.2.1 Smart Meters

AMI system implementation requires a utility to install solid state smart meters to support time differentiated rates and to manage demand response programs that rely on interval metering to confirm that load shedding has taken place. Most of the major meter manufacturers now offer residential as well as commercial solid state meters that provide a number of applications and are capable of more accurate energy measurement under full and light load conditions.

Many of the more advanced AMI systems on the market today work in conjunction with smart meters to store and forward interval-based consumption quantities needed for time of use rates. In addition, most solid state meters are capable of generating outage and tamper alarms, and can provide power quality data that increases system reliability and improves customer satisfaction. A drawback, however, is the relatively shorter expected life of solid state meters which most manufacturers claim to be 15-20 years.

In some more advanced versions of the smart meters, functions such as net metering and home energy management (HAN) are supported, and their advanced functions become an important component of a utility's overall smart grid strategy. Hydro Quebec's smart meters will apparently come equipped with ZigBee functionality which can support HAN deployment in the future.

#### 4.2.2 Functionality

Standard smart meters are comprised of 2 components, the metrology and the communications board or module. These components combine to record and store data and information and communicate with the Local Area Network (LAN). Smart meters can generally be grouped into three separate categories: basic, advanced, and highly advanced based upon the functionality they provide:

Basic smart meter functionality typically includes the ability to:

- Record monthly kilowatt hour usage
- Record monthly kilowatt demand
- Provide TOU data

Advanced smart meter functionality typically includes the ability to:

- Record interval (daily, hourly, or sub hourly) usage and demand data
- Provide outage notification
- Provide tamper notification
- Provide voltage alarms

Highly advanced smart meter functionality typically includes the ability to:

- Be IP addressable
- Remotely disconnect the service
- Interface with a home area network
- Be remotely programmed

Regardless of the functionality provided, the meter can be set up to communicate with one or two way local area networks depending on the infrastructure being deployed. The basic functionality combined with one way communications provides traditional AMR capability and can often support the ability to implement time of use rates. Two way communications combined with advanced functionality can provide the capability for on demand reads, enable remote disconnect/reconnect for collections, "move ins" and "move outs" , detect outages and tampering, monitor out of range voltage conditions and support hourly pricing and demand management programs.

Highly advanced functionality is currently the objective of most utilities that are looking to get the most functionality from their AMI system investments. The remote disconnect feature, an important stated benefit of the Hydro Quebec system, involves the installation of additional disconnect hardware inside the meter. IP addressability is becoming more popular but not yet considered a standard advanced function. And the ability to interface with a Home Area Network (HAN) through ZigBee wireless communications is becoming a standard function, and is more frequently being included within the under glass meter configuration if a utility intends to offer clients critical peak pricing or similar time based utility rates that involve use of programmable thermostats and in-home energy displays.

#### 4.2.3 Obsolescence and Upgradeability

As previously mentioned, the useful life of most advanced meters is generally considered to be 15 to 20 years. Advanced smart meters are typically remotely programmable, and many changes such as converting the meter to a time of use rate can be enabled through the remote programming. Some additional functions, including updates to the ZigBee Smart Energy Profile protocol, could also be handled through remote firmware upgrades if sufficient internal memory is available. The cost to remotely program a meter from the central office is insignificant if a meter is equipped for it, but if a meter needs to be replaced in the field to add new functionality such as remote disconnect or ZigBee at a later date, a significant cost would result.

Recent improvements in meter design and increases in memory are making it much easier to manage changes in meter settings and rates from a central location without the need to visit the meter in the field. However, the link between the meter and the specific AMI LAN being used is often unique, and cannot be readily switched over to another system without replacing the meter. As a general rule, a utility should be able to upgrade smart meters remotely over the AMI network to migrate to a newly released version of its AMI system software, but switching to a different AMI vendor's LAN technology would not be possible in most cases.

## 4.3 Communications & Network Equipment

AMI systems generally employ fixed communications networks (fixed networks) that are capable of reading an advanced meter several times per day and can deliver meter data, including outage and tamper alarms, in near real time from the meter to the utility data center. The fixed network is the backbone of the AMI system and typically uses one of several different network architectures that are comprised of smart meters, data collectors or towers, routers and data collection software located in the utility operations center. Common communication architectures include hierarchical systems, star and mesh networks, and power line carrier systems using a variety of methods such as fiber optic, satellite, telephone and wireless Ethernet for data backhaul to the operations center.

In hierarchical networks, data collectors or concentrators are typically used and reside on poles, in substations or on other facilities to become the link between the meters and the network management and data collection software. Other systems use a more flattened architecture that involves peer-to-peer communications to a data concentrator, or "take out point", that delivers the data to the operations center over several different transmission schemes including telephone, cellular, satellite or other communications medium such as fiber optic cable.

The type of communications methodology and the capabilities of the meter ultimately determine whether the system would be classified as a "one way" or "two way" system for the purpose of utility to client customer data exchange. Maintaining a two way system is typically a greater communications challenge that requires more network equipment and bandwidth, and therefore greater cost, to maintain an acceptable level of network reliability. Nevertheless the benefits of two-way communications for advanced features such as supporting demand response, performing on request reads and implementing remote disconnect functions often outweigh the additional expense.

Figure 2 below provides a graphic visualization of four AMI systems that use different communications architectures.

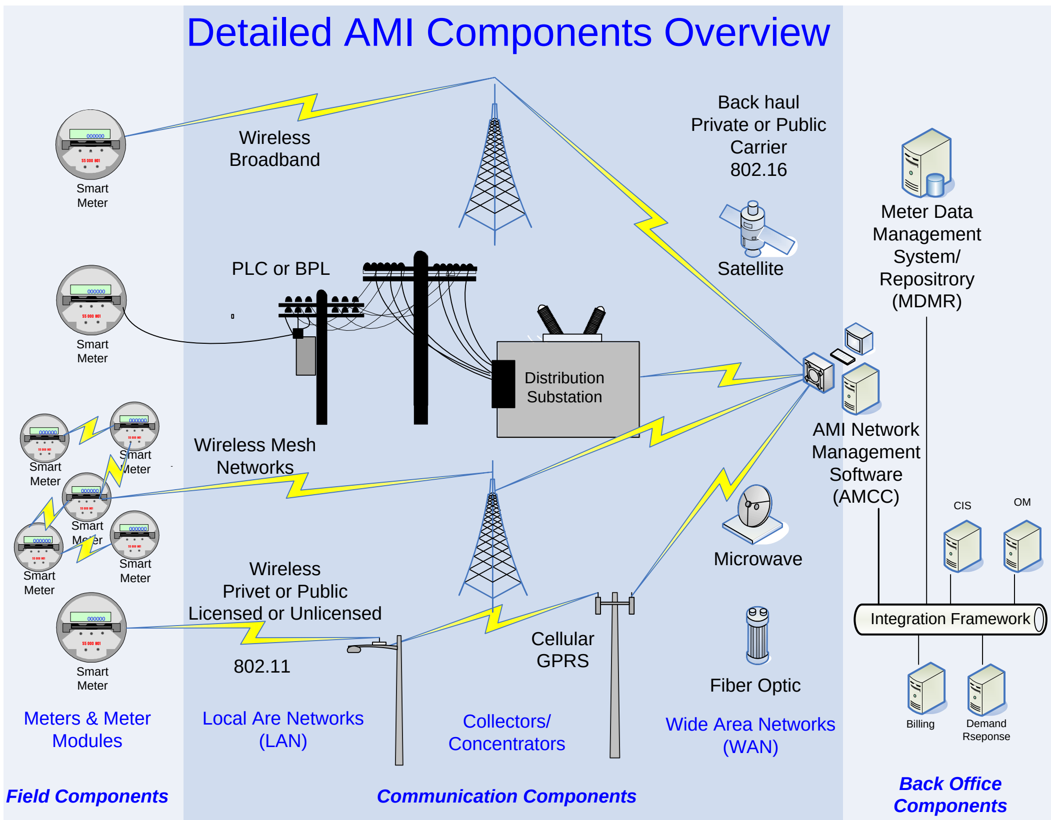


Figure 2 - Typical AMI Network Architectures

### 4.3.1 Radio Frequency (RF) Networks

RF systems typically use one of three common communication modes: (1) one-way communications in which receivers capture transmissions that are being sent regularly and automatically from the meters; (2) one-way with alert in which receivers “waken” meters causing them to transmit their information for a period of time before “going back to sleep”: and (3) full two way systems where a communications dialog can transpire between the meter and the collector or tower when specific information is requested from the operations center. Because remote disconnect functionality is required by Hydro Quebec and can only be accomplished through the use of a full two way solution, further discussion will focus on these types of system technologies.

Decreasing costs and advances in encryption technology that allow multiple devices to share common frequencies have made radio frequency (RF) the most popular technology for AMR. Different radio-based AMI products operate on either licensed or unlicensed frequencies. A licensed frequency typically permits the use of a specific frequency in a given area and normally permits a higher power signal, which enables greater distance between the transmitter and receiver units. Unlicensed RF systems operate under greater government imposed frequency and power level constraints. Moreover, since the same band is shared by other applications (cordless telephones, garage door openers, security systems, medical monitoring, etc.), specialized modulation and encryption techniques are incorporated into most unlicensed systems to minimize interference.

The most common topologies for RF-based AMI systems involve either hierarchical point-to-point or peer-to-peer communications. Point to point systems typically use pole top or tower-based collectors to store and forward data back to the data center, whereas peer-to-peer networks will frequently use a wireless mesh technology that routes data through other meter endpoints before reaching a collector take out point. In both cases, the Wide Area Network (WAN) portion of the system can use telephone, cellular or other public sources such as satellite, licensed frequencies, fiber or private radio networks to backhaul the data from the collector to the data center.

### 4.3.2 Hybrid Architectures

For utilities that operate over a wide range of geographies and demographics a single AMI technology or communications architecture may not be economic to deploy even when economies of scale and standardization are factored into the analysis. As a result many utilities are opting for Hybrid options where various architectures are deployed in portions of their service territory with different geographic and demographic characteristics.

One hybrid option may include using mesh or point-to-point RF architectures in densely populated urban areas and using power line carrier technology in low density urban or agricultural areas. Hydro Quebec is proposing a hybrid WAN option using cellular and satellite technologies for the data backhaul, but it is quite possible that these options are not available or sufficiently reliable in the remote areas of HQ's service territory. Hydro Quebec has noted in its responses to questions, however, that Rogers Communications has accepted responsibility for providing a 100% WAN backhaul solution for the required coverage area.[10]

Critical to the success of hybrid systems is the ability to incorporate a single meter data management system that can interface with several data collection systems and provide a single integration point with the CIS (SAP for Hydro Quebec) and other operations applications.

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[10] Valutech Solutions requested, but was not given access to Hydro Quebec's contract with Rogers Communications to independently verify this contractual coverage requirement. However, HQ noted in its responses to questions that Rogers would accept responsibility for 100% coverage. See Response No. 1 to GRAME, HQD-4, doc 5, page 17.

## 4.4 Communications Obsolescence

### 4.4.1 Local Area Networks

The Local Area Network (LAN) is a critical component of the AMI system and can be very costly to replace. A change out of LAN technology typically requires a corresponding change in the meter. As a result the LAN technology must be selected in a manner that addresses both the current and potential future requirements of the AMI system. Implementing a solution which has too much built in latency or insufficient band width for future applications should be avoided. The additional cost of implementing a technology which has a longer projected useful life can be a good investment if it can save millions of dollars by avoiding early replacement.

### 4.4.2 Wide Area Networks

Wide Area networks for AMI systems typically contain fewer “backhaul” components than Local Area Networks and can usually work with multiple LAN networks. Many AMI networks use multiple backhaul technologies (fiber, satellite, cellular, etc). As a result, shifts in WAN technologies are not as critical to avoid as shifts in LAN technology, as long as the data collectors and routers being installed have dual transport capability[11]. Nevertheless, implementing WANs with sufficient bandwidth and reliability remains a critical design criterion, since system performance is highly dependent on end-to-end connectivity, availability and capacity.

Systems with too much transport latency, for example, will degrade the performance of the AMI system to provide near real time on request reads, outage detection and other time sensitive AMI features. GRAME has requested that HQ provide the results of any studies it has completed to calculate network latency, which has a direct bearing on the number of network collectors and routers that will be required. At the time of report completion, this information has not been provided.[12]

## 4.5 MDMS and System Integration

Meter Data Management System (MDMS) software applications reside between the AMI network data collection system and the customer Information System (CIS). MDMS processes and stores meter reading and other AMI data for use with billing, GIS, outage management, asset management, load research and other applications. Depending on the functional design and the type of billing system being used, MDMS may be called on to calculate the utility rate billing determinants, validate, edit and estimate interval data, and provide the energy usage data to bill time of use, critical peak pricing, interruptible service and other complex rates. The combination of the utility’s CIS system and the Meter

[11] Valutech Solutions has not seen the HQ contract with Landis+Gyr, and it is not known if the agreement requires Landis+Gyr to provide this dual transport capability in its collectors.

[12] Reference: Responses from Hydro-Québec distribution to the request for information no. 1 from GRAME, HQD-4, document 5, page 25, Demand No. 54.

Data Management application is used to handle billing of all time-differentiated rate structures including the handling of client switching functions required to support retail competition and the subsequent energy usage and cost reconcilement process.

The implementation of a Meter Data Management System is often, but not always, timed to take place near the beginning of an AMI system implementation in order to establish initial interfaces with the utility's billing and outage management functions, and prepare to manage the large volumes of customer meter change data that will result. In hybrid AMI solutions, multiple interfaces with the company's billing and customer information systems may be required and an early MDMS implementation is recommended to test the various AMI solution interfaces. The MDMS can also perform data cleansing functions and prepare interval data for billing by performing Validation, Editing, and Estimating (VEE) of the data on a daily basis after it has been received by the AMI system.

For illustration purposes, Figure 3 below provides a graphic depiction of an AMI system with an MDMS solution that is integrated as part of a smart metering AMI initiative.

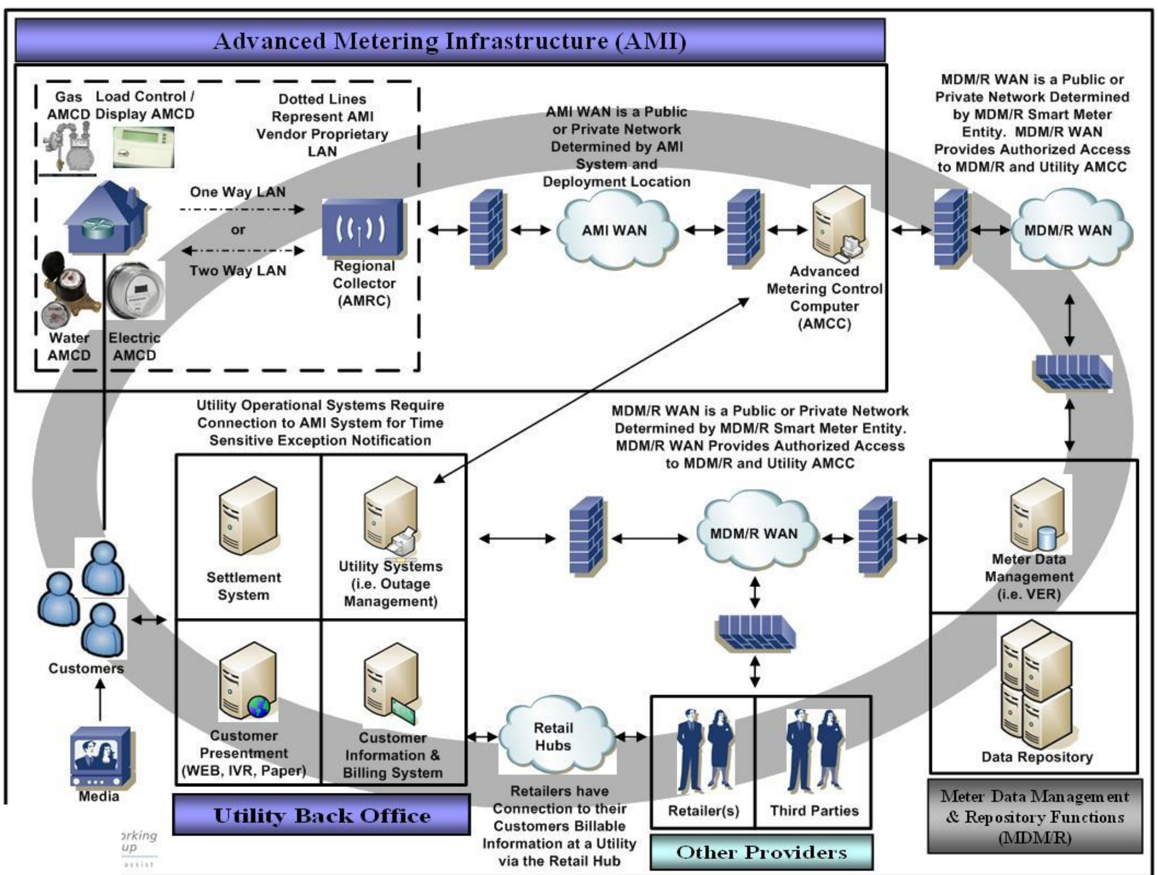


Figure 3 - Meter Data Mgmt System

Many of the important features of AMI rely on the successful collection and manipulation of meter data and alarms within the MDMS. In order to gain the operational efficiencies envisioned through AMI, utilities must provide efficient data transfer from the MDM to their other utility applications such as GIS, outage management and enterprise asset management.

### 4.5.1 MDMS Functionality

The following functions are generally supported by a typical MDMS application:

- Meter data account management
- Integration with AMI vendors
- Multi-utility support (gas, electric, water)
- Multi-channel support (kwh, kw, kvar)
- Support for different interval lengths
- Validation, Editing, and Estimation (VEE)
- Aggregation
- Complex billing capability
- Real-time pricing
- Support for de-regulated markets
- Meter asset management capabilities
- Distribution Asset Optimization
- Support for Demand Response programs
- Outage and Restoration Support
- Meter Event Processing
- Support for meter control (e.g. On Demand Reads, Connect / Disconnect)
- Web based customer portal support

### 4.5.2 Obsolescence

Overall, the MDMS is typically less expensive than the AMI system. However, software upgrades or replacement can be very expensive if it is not planned for when developing the architecture and designing the system. Designing and implementing a system which contains components that are easily upgraded is critical. This extends to developing the interfaces in a way that does not require recoding every time a significant application change is made.

If a Hybrid AMI solution is implemented, multiple interfaces will be required to the MDM System to accommodate the different AMI systems that are deployed. The approach to building the interfaces may involve use of a utility's common architecture model that can be used by any of the AMI systems that are implemented. The meter data management system hardware components will become obsolete and difficult to maintain and their eventual replacement must be planned for and built into the economic evaluation models. That being said, the initial MDMS should have a significant useful life matching the longevity of other enterprise software applications.

### 4.5.3 Interface Requirements

Typically, utilities experience challenges with the integration of their AMI, MDMS and CIS systems. Shortcomings in the integration of these systems will limit functionality and could prevent a utility from receiving the full benefits and capabilities of their systems. For example, typical design standards for larger utilities provide for the activation of most advanced features, such as on demand reads, remote disconnects, off cycle billing functions and client rate changes in a manner to be initiated by client service representatives through their CIS systems.

In order to achieve this optimum level of integration, Hydro Quebec must successfully integrate its Landis+Gyr AMI System, EnergyICT MDMS and SAP client billing system at a level of performance that permits the initiation of these advanced AMI features through SAP. HQ has indicated in its authorization request and responses to questions that only partial integration capability has been achieved to date.

Another important integration requirement is the interface of an AMI vendor or installation contractor's automated meter change out service order system with the utility's CIS system. The use of an automated meter change system is almost always required when high volume change out schedules are anticipated. HQ's planned meter installation schedule anticipates a meter replacement volume of approximately 80,000 meters per month, which will necessitate the use of this type of automated change out process. Valutech Solutions cannot independently verify whether such a system is planned or will be implemented and tested during the pilot program.

Utilities generally also need to synchronize their systems from one common client database. Routine changes in the client population, account and service point data all must be frequently updated in all related systems in order for the read and billing processes to occur without incident. Most client changes will be initiated in the CIS system and must then be similarly reflected in the MDMS and AMI systems.

## 4.6 AMI Benefits

When considering the implementation of an AMI system, utilities should examine the full range of benefits that can come from the deployment of AMI technology. In addition to achieving improved operating efficiencies and billing accuracy from AMI, utilities should be most interested in the client and societal benefits that can be gained from the deployment an AMI system with a fixed communication network. This section provides an overview of the utility, client and societal benefits associated with AMI deployments.

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### 4.6.1 Operational Benefits

Substantial benefits can accrue to the operating utility when a properly designed and deployed AMI system is implemented. For purposes of this discussion AMI benefits which automate the utility meter reading process, improve operations, or provide other revenue collection improvements are classified as utility benefits.

#### 4.6.1.1 Meter Reading Cost Savings

AMI enables a reduction in manual resources required to support meter reading processes and the increased flexibility of meter reading, billing, and call center processes. In addition to the savings that can be achieved through the elimination of manual meter reading, a significant benefit is typically realized from achieving reductions in field services staff for shut offs, call center personnel, meter services technicians, billing analysts and other support personnel.

#### 4.6.1.2 Operating Efficiency

Planning, designing and capacity monitoring are accomplished more efficiently with AMI. Substation and circuit loading can be more precisely monitored for system planning purposes to improve system reliability. Meter operations, outage management, power quality and other functions can be more effectively managed.

Significant operating efficiencies can be achieved through the implementation of the outage management benefits of AMI. Utilities often realize an improvement in their ability to respond to customer outages through more rapid notification of outage conditions and through a more thorough outage restoration process. More accurate and timely outage and restoration information generally enables line workers and trouble shooters to locate problems and make repairs more rapidly.

#### 4.6.1.3 Revenue Recovery

More accurate metering, reduction in energy diversion, improved collection functions, reduction in estimated bills, disputes and write-offs are all achievable through the implementation of an AMI solution. Flexible billing options improve cash flow and support load management functions. In part through the installation of new smart meters, the utility can expect to record energy usage more accurately and to recover lost revenue resulting from slow meters and energy diversion. New meters should eliminate lost revenue from unrecorded energy supplied to customers under light load and full load conditions. Energy theft conditions will be detected much more quickly and can be documented for appropriate follow up action.

### 4.6.2 Client Benefits

The implementation of an AMI solution provides the utility's clients with improved service, reduced billing errors and complaints, faster service, a greater variety of billing and rate choices, new services, and greater client choice. Client benefits are often over looked because they are difficult to quantify, but many experts feel that they result in the most important benefits of AMI deployments. The list below summarizes the more significant advantages of AMI deployment for clients:

- Flexible bill due dates
- Generates high-value data for use in time-of-use rates
- Extensive load profiling and data storage functions
- Reduced outage duration and provides utility notification.
- Interval reads support load management, load aggregation, off system energy purchases

- Reduced property damage from onsite visits
- Net metering functions offer energy cost reduction opportunities
- Value-added services from Internet access to data
- Low voltage detection avoids equipment damage

The implementation of an AMI solution can significantly reduce estimated bills, for example, which in turn will reduce client complaints, disputes and inquiries. Utilities have experienced significant reductions in complaints from the issuance of high bills that were previously caused by missed or incorrect reads, as meter access problems are significantly reduced. Clients can have power turned on and final bills issued in a more expeditious manner through AMI, and the availability of daily readings can permit the company to offer flexible due dates for clients on fixed incomes.

Clients should also see improvements in service reliability through timelier outage notification and improvements in power quality. Advanced metering devices can record low voltage conditions and other power quality problems that can adversely affect client equipment. Reductions in outage times will have a positive effect on client satisfaction.

Another significant client benefit is the ability to offer clients a broader choice of energy supply services through innovative rate structures and demand response programs that can encourage more efficient energy consumption. AMI systems can support a variety of rates that provide real choice to clients, and can provide the monitoring functions that reward them for participating in load curtailment programs.

### 4.6.3 Societal Benefits

The implementation of AMI provides societal benefits both in terms of the services it provides and through the enablement of programs which may defer new generation and transmission requirements. Advanced AMI and smart metering systems help minimize the cost of energy, support distributed generation and net metering functions, and permit utilities to implement load control and various load shifting demand response programs that improve system load factor and help defer the construction of new facilities.

AMI has the smallest ecological or environmental impact when compared to any generation alternative and provides a basis for dialogue with all external stakeholders around the establishment of a viable conservation culture. Among the societal benefits engendered through use of AMI are a general lower cost to provide electric service and greater choices in the clients' ability to monitor their own energy use to become more energy efficient and to have tradeoffs between the cost and time of energy use. AMI smart meters can support net metering and distributed generation, and thereby encourage the use of energy supply from non-traditional sources. Reduction in new generation facilities reduces industry cost of capital and frees up human and capital resources for other uses. More detailed discussions of the conservation and energy efficiency and environmental benefits of AMI deployment are provided below.

#### 4.6.3.1 Energy and Demand Response Benefits

AMI provides energy savings benefits through distribution asset optimization and indirectly enables Demand Side Management (DSM) initiatives such as Time of Use (TOU) and Critical Peak Pricing (CPP) rate structures. A full scale demand response program predicated on the implementation of various rate incentives including time differentiated rates cannot be effectively implemented without the implementation of the smart metering capabilities of AMI. The full benefits of demand response cannot be achieved unless clients are given sufficient incentives and the company is able to implement new rates that encourage load shifting, curtailment and other features that must be verified through AMI.

#### 4.6.3.2 Environmental Benefits

AMI's enhancement of conservation-focused initiatives has direct and obvious environmental benefits. As a primary enabler of conservation benefits, the ecological footprint of AMI is insignificant when compared with the alternative of procuring new energy supplies. The implementation of demand response programs can help to defer construction of new generation, transmission and substation facilities that avoids adding additional pollutants and takes up valuable land resources. The elimination of manual meter reading, field and metering services functions will remove a significant number of vehicles from operation, which reduces automotive emissions. Net metering functions support the proliferation of green energy sources by promoting wind and solar energy, and enabling industrial co-generation clients to place excess power into the energy grid.

#### 4.6.3.3 Other Societal Benefits

In addition to the obvious energy efficiency and environmental benefits discussed above, AMI deployments provide additional, secondary societal benefits including:

- Reduced health and disability costs resulting from the elimination of field oriented activities that are subjected to higher than normal levels of injuries and accidents
- Outage management functions supported by AMI help to shorten outage conditions and restore power more rapidly during adverse weather conditions
- Reduction in energy theft and diversion conditions reduces unaccounted for energy loss that is passed along in the higher cost of energy to other clients

## 4.7 Typical Utility Benefits Portfolio

Many of the utility benefits of AMI provide either bottom line savings in utility operating and maintenance costs, or add increased revenue from elimination of slow meters, energy diversion, reduced line losses and other sources. These benefits are typically quantified and included in the utility's cost-benefit analysis. Hydro Quebec is apparently not including these same hard dollar savings in its project authorization request calculations, or is not crediting them to offset its figures for operating charges during the 5 year deployment period through 2017[13]. The 2009 Accenture study referenced in HQ's authorization request identifies many of these benefits, and Valutech believes that the Accenture

[13] Hydro Quebec, in its LAD Project authorization request, HQD-1, doc 1 dated June 30, 2011, provides Table 4 on page 34, and lists the major categories of operating costs it is including for capital cost purposes. However, there are no offsetting credits applied for the various other utility benefits, including manual meter reading savings, discussed in this report.

identified benefits should be quantified and credited against the amount of additional operating charges forecasted for the project.[14]

### 4.7.1 Meter Reading Savings

The most obvious benefit of implementing AMI is the elimination of manual meter reading expenses. Hydro Quebec will derive significant savings from elimination of manual meter reading. An additional benefit of eliminating manual meter reading is a reduction in the number of vehicles used for meter reading related purposes. Labour and transportation expenses including the cost of fuel are typically the most unpredictable costs associated with meter reading, and will likely experience a significant amount of cost escalation over the coming years.

### 4.7.2 Field Client Services

Since the AMI system implemented by Hydro Quebec should be capable of obtaining daily readings from all clients based on the published 99.4% read performance, a significant reduction in the number of field services personnel should be achieved as turn on and turn off readings become automated. A high percentage of field work in this category involves obtaining missed meter readings, and turning on and off customer services for cancelled and new accounts. For some utilities, a physical shut off is required for cancellations, which takes even more time. AMI network services that produce daily reads can accomplish this function without the need for field visits, thereby bringing about a significant reduction in the number of personnel and vehicles used for this purpose.

### 4.7.3 Call Center Benefits

Elimination of estimated meter readings will eliminate estimated bills and require fewer check readings, billing inquiries and adjustments. Call-in readings will no longer be required, and less time will be needed on the part of call center personnel to resolve high bill complaints. AMI will identify malfunctioning meters and higher than expected usage before problems can be extended to the point where customer satisfaction is adversely affected. The additional information provided through AMI will enable customer service representatives to become much more knowledgeable and proficient in the resolution of customer inquiries. A modest reduction in the number of client service representatives is normally experienced through implementation of AMI.

### 4.7.4 Accruals & Adjustments

A significant but indirect AMI benefit is a reduction in billing dept resources needed to investigate billing problems and process adjustments. Daily reads from AMI eliminate the need for calculation of estimated bills caused by building access issues, service contract disputes, back dated cancellations and turn ons. Keypunch errors and unusual usage patterns are eliminated or quickly detected by AMI, reducing the need for many of the more difficult billing problems that can occur, and which often take significant clerical time to resolve.

[14] Reference: B-0006, HQD-1, Document 1, Pages 13 and 18; Source: Accenture 2009.

### 4.7.5 Outage Response

As discussed previously, AMI can help to improve outage response efficiency by reducing the time spent to locate instances of downed secondary wires, which improves client satisfaction by reducing outage time. AMI generated outage alarms can help to focus restoration response efforts on targeted areas, and restoration alarms produced by many AMI systems can reduce the need for client call backs to verify restoration status.

### 4.7.6 Collections/Write-offs

The impact of AMI on collections is a positive one based on the elimination of estimated reads and reduction in multi-month bills caused by failure to gain access to indoor meters. Most collection efforts center around a regimented mailing, posting and shut-off process which is affected by missed reads. Failure to adhere to a rigid collections process leads to increased billing write-offs. Many utilities anticipate that a measurable reduction in bad debt write-offs can be achieved through implementation of AMI.

### 4.7.7 Energy Diversion

Most utility companies believe that energy diversion is a significant problem that causes lost revenue and leads to higher utility bills for others. Many AMI solutions produce tamper alarms that can warn the utility of potential theft of service situations that should be investigated. Utilities believe that these savings are real, but due to insufficient data an estimate of the potential revenue savings are difficult to predict.

#### 4.7.8 Meter Registration Accuracy

Studies show that electromechanical meters will begin to run slow with aging. The AMI plans under consideration by Hydro Quebec envision replacement of all residential meters with smart meters that measure light and full loads accurately and produce fewer losses. While utilities believe that such losses are not insignificant, it is not known if Hydro Quebec has recognized these savings in its AMI business case.

### 4.7.9 Load Research

AMI will significantly improve Hydro Quebec's' ability to perform effective load research needed to design new time differentiated rates and implement demand response programs, which will benefit clients who shift energy usage to off peak periods. Analysis of load shapes by client rate will assist them in performing hedging and energy reconcilement functions that improve market efficiency.

### 4.7.10 Cash Flow Improvements

Elimination of estimated meter readings and accelerating bill due dates can produce increased customer satisfaction and potentially improve cash flow. Modest cash flow improvements can also be realized through increased issuance of summary bills and various other bill timing issues. No estimate has been developed for the potential benefits of AMI on improved cash flow.

In its own study of client benefits which was supported by Accenture, many of these same benefits were identified as having a positive impact on Hydro Quebec's business case[15]. Valutech was not given access to this business case to verify that these benefits have been monetized and will be passed on to its customers.

The following chart was presented in Hydro Quebec's request for approval to begin Phase I[16]:

**Accenture Study- AMI Benefits 2009**

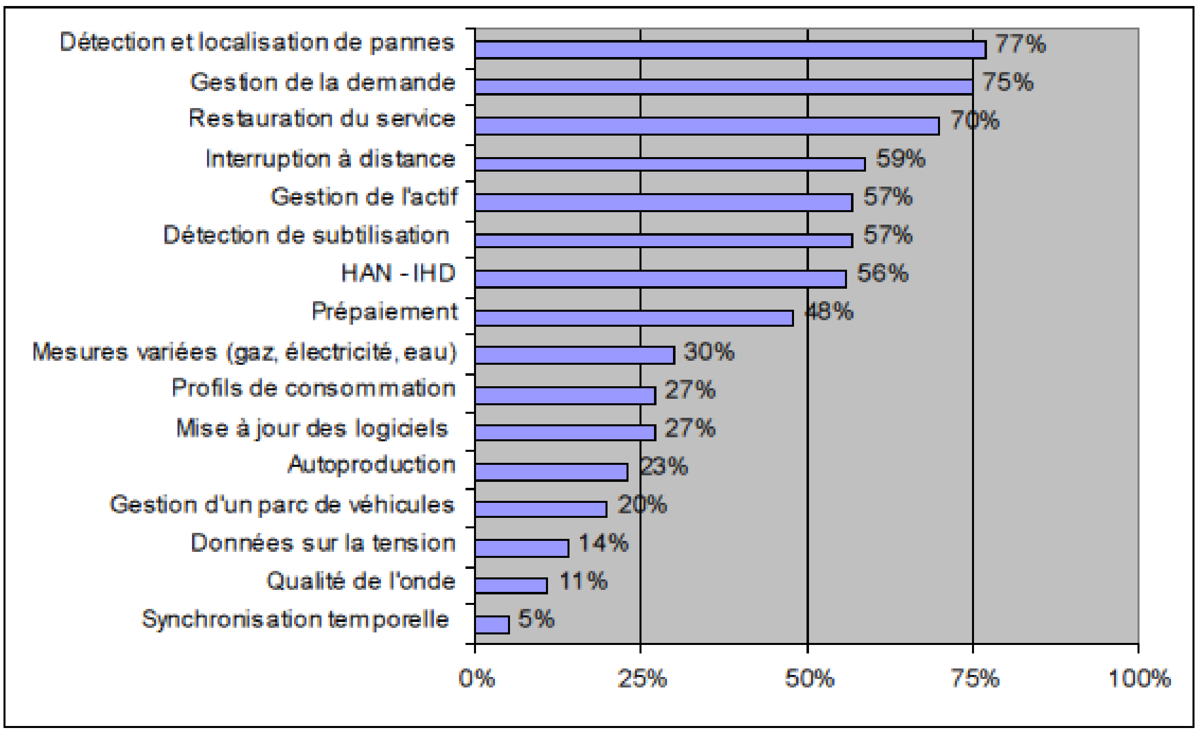


Figure 4 – Accenture Identified Benefits

Many of the above benefits are supported by the new AMI and MDMS technologies implemented by Hydro Quebec, and would further leverage the value of the installed systems if they were implemented. Hydro Quebec should present the Energy Board with a definitive plan to implement many of these

[15] Reference: B-0006, HQD-1, Document 1, pages 13 and 18, Source: Accenture 2009.

[16] See Hydro Quebec document HQD-1, Document 1 dated June 30, 2011, page 18.

benefits during Phase 1, to quantify their business value and then pass the resulting savings on to its clients.

## 5.0 Pilot Project Objectives and Results

Beginning with preparatory work in February 2010, Hydro Quebec's pilot projects commenced in June 2010 with an intention to accomplish a number of specific goals: (1) Integrate and test the ability of installed smart meters to collect consumption data; (2) select an AMI vendor and establish connectivity from meter to central office using that vendor's network technology; (3) implement the MDMS and integrate it successfully with Hydro Quebec's SAP billing system; (4) develop a full deployment implementation plan; (5) establish the necessary new business processes including mass change out of meters; and (6) prepare the human resources transition plan.

Valutech's mandate for review of the pilot program as approved by the Energy Board included the following:

- ✓ Evaluate the results of preparatory work and pilot; projects associated with the LAD Project;
- ✓ Determine the missing elements in the selection of preparatory work and pilot projects and identify them;
- ✓ Assess if, according to the progress of the preparatory work and the preliminary results of pilot projects, the timing is appropriate to proceed with Phase 1 deployment;

Based on the timing of this report, approximately 16 months of the 24 month pilot period from June 2010 to May 2012 has expired. It is therefore possible that some, but not all, of the pilot objectives have been achieved at this time. Hydro Quebec has stated that the pilot projects will "test the feasibility of the selected AMI solution"[17]. Since the selection of Landis+Gyr was announced only recently in May 2011, it is not likely that a field test network could be fully deployed and operational at this point, even though Hydro Quebec has stated that the end-to-end solution would be available for testing by September 2011 in the 2nd pilot area.

A site propagation study is typically required to establish the precise locations of the collectors and routers to achieve optimum read performance. Selection of locations in both rural and suburban areas would involve separate studies and network footprints since the meter densities of these areas would be quite different. Client meters must be selected for change out to new smart meters in a manner that is able to create a mesh network and demonstrate that contract read performance can be achieved.

[17] Hydro Quebec authorization request HQD-1, document 1 dated June 30, 2011, page 24.

Hydro Quebec's application states that "the ratio between the number of meters, routers and collectors will also be confirmed" during the pilot process[18]. Since the performance of the pilot and resulting equipment ratios could have significant implications on the final number of collectors and routers that will be required, and hence the final project cost, Hydro Quebec cannot finalize its cost to the Energy Board before an updated cost estimate has been completed for the entire service area based on the pilot results.

In order to establish a test bed for the new Landis+Gyr network, Hydro Quebec proposes to install 800 residential smart meters in rural and suburban locations. Other meters already in place, such as the 2,600 meters installed in the first pilot area, may be of an older meter design that may not be compatible with the new Landis+Gyr Gridstream technology. And it is not clear if the 17,500 meters currently being read for commercial accounts, possibly using the Itron MV-90 system, will be transferred over to the new network. It therefore appears from the available material that Hydro Quebec intends to evaluate network read performance based on a relatively small meter population of only 800 new residential smart meters.

**Availability of Documents**

In connection with this study, Valutech requested copies of the Landis+Gyr, Rogers Communications and Ericsson proposals and contracts, and all project plans and status reports issued by Quebec Hydro and Landis+Gyr related to the pilot deployment. We also requested copies of the business case and financial model used to calculate return on investment (ROI) and cash flow requirements. These requests were denied by the Quebec Energy Board. It is therefore not possible to determine if Hydro Quebec remains on schedule to begin Phase 1 deployment by May 2012, or if the Landis+Gyr AMI system is meeting all required pilot objectives and read performance criteria with absolute certainty. Valutech will make some informed judgments, however, with the documents at hand.

Typical read performance criteria that are generally found in AMI network contracts for residential smart meters are as follows:

### *Typical System Performance Requirements*

- ***Recorded kilowatt-hours*** (Consumption)
    - ***Per billing cycle***: 99.8% of all billing cycle consumption data for 99.5% of all available meters by 8:00 AM of the billing day.
    - ***Daily***: 99.5% of all consumption data for 98.5% of all available meters in the service area by 8:00 AM of the following day.
    - ***Hourly***: 99.5% of all hourly interval data for 90% of the available meter population by 8:00 AM of the next day.

[18] HQD-1, doc 1 dated June 30, 2011, page 25.

Hydro Quebec's stated performance threshold of 99.4% for daily reads appears to be reasonable, though it does not mention the size of the sample meter population that is being read, or if all of these meters are being read using the Landis+Gyr technology. If only a small number of meters is included, the results may not be statistically significant to establish that this performance level will be achieved for all 3.75 million meters in the Hydro Quebec service area. The 2nd pilot project started in June 2011, and the authorization request was filed on June 30, 2011, so it is not likely that many meters had been installed as of this date to verify read performance.

Valutech requested a copy of the Hydro Quebec contract with Landis+Gyr for this study to determine if the contract performance requirements were sufficiently detailed and stringent. Since this request was not granted, it is therefore not possible to determine if Hydro Quebec's pilot performance objectives are sufficient, and if Hydro Quebec should be permitted to proceed with full Phase 1 deployment.

**Third Pilot Project**

Hydro Quebec has stated that a third pilot project area would commence in August 2011 and last until May 2012 for 19,000 smart meters to be installed by an outside service provider. A major objective of this third pilot is "to demonstrate the overall performance of the AMI in an urban zone…".[19] Since this quantity of meters is a majority of the pilot meters to be installed overall, it is difficult to see how the actual network performance can be confirmed before this 3rd pilot deployment is concluded.

As mentioned above, it appears that the final quantity of collectors and routers needed for the entire LAD project will be estimated based on the number that must be installed to meet the performance criteria in the pilot locations. It is therefore not possible to determine with sufficient precision the total number of collectors and routers, and hence the final project cost, before the pilot deployment and testing phase have been concluded.

In addition to the capital cost of the collectors and routers, the annual recurring operating cost for telecommunications services will increase with each additional collector required by the Landis+Gyr network to achieve the specified level of performance. Therefore, the Rogers Communications portion of the project operating costs could potentially be much higher if the number of collectors increases significantly.

## 5.1 Analysis of Pilot Project Objectives

Valutech has examined the pilot objectives within the limitations of the mandate and documents made available. The objectives fall into three general categories: Verify that the technology works, update the business processes and prepare for Phase 1 implementation. Upon completion of our review, we make the following observations concerning the above six (6) restated objectives outlined in Section 4.2 of Hydro Quebec's project authorization request:

[19] Hydro Quebec authorization request, HQD-1, doc 1 dated June 30, 2011, page 25.

## *(1) Integrate and test the ability of installed smart meters to collect consumption data*

While Hydro Quebec does state that it is receiving consumption data from the MDMS for billing purposes, the consistency and accuracy of this data cannot be independently verified. It is not known how many meters are being read through the MDMS to SAP interface, or if all of the current client rates are supported. At this time, it does not appear that MDMS provider EnergyICT has been certified by the SAP Lighthouse Council for integration with SAP.

Based on the announced May 25, 2011 contract signing date with Landis+Gyr, it is questionable if EnergyICT and Landis+Gyr could have proceeded with integration to the point where full end-to-end processing of revenue quality billing data has yet been achieved. This step would involve scheduling and reading consumption data at the meter, passing it through the installed pilot network and data collection software and interface to the EnergyICT MDMS, and then passing the billing readings to SAP using the MDUS interface protocol developed by SAP. In a response to Energy Board questions, HQ stated that only a partial integration would be performed as of November 2011.[20]

A further important step is to integrate other required interfaces to Hydro Quebec's systems, such as a meter change service order interface for high volume processing of meter changes and a data synchronization interface, which are needed to update customer and meter records and process meter changes to billing during the time of deployment and normal operation. These interfaces are typically built and tested during the pilot deployment period. Without access to Hydro Quebec's project plans and status reports, it is not possible to determine if this effort is taking place.

## *(2) select an AMI vendor and establish connectivity from meter to central office using that vendor's network technology*

With the May 25, 2011 announcement of the Landis+Gyr contract signing, it is apparent that the AMI vendor has selected. It is not clear, however, from the information provided if end-to-end connectivity has been established at this point using Landis+Gyr's Gridstream technology.

As discussed above, the third pilot area is designed to demonstrate the performance of the AMI system in an urban zone using smart meters installed by the outside installation service provider. Since an outside service provider has not yet been announced, it is doubtful that this pilot objective has been achieved for the urban area. It is possible, however, that the 800 meters installed for the first pilot by utility personnel may have been connected in some manner.

An important objective of most AMI pilots is to confirm the network read performance and arrive at a precise number of towers, data concentrators, collectors, routers or other network equipment that will be required to meet the project's contract read performance levels in all phases and implement other required AMI system features and functionality. An insufficient number of data collectors and routers,

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[20] GRAME Request For Information no 1, dated September 28, 2011, page3 of 16.

for example, will affect system bandwidth and diminish the speed of data transmission, which can adversely affect some AMI system features such as performing on request reads and receiving outage alarms.

If Hydro Quebec has underestimated the required number of collectors and routers in its contract with Landis+Gyr and its project estimate, the project could be exposed to significant cost increases later to pay for additional network equipment and installations, and also to cover increased operating costs for additional Rogers wireless communications connections to the additional network collectors.

## *(3) implement the MDMS and integrate it successfully with Hydro Quebec's SAP billing system*

Hydro Quebec states in its filing that it has successfully integrated the EnergyICT MDMS with its billing system[21]. The full extent of this integration is not clear since EnergyICT has not yet been Lighthouse Council certified for SAP, and additional testing may be required to demonstrate that it can pass all required billing determinants to SAP and perform essential validation, editing and estimating (VEE) functions. It is not known if all current rates are supported. And as mentioned previously, HQ has stated in its responses that only a partial integration has taken place as of November 2011.

In addition, as mentioned above, a data synchronization interface, and possibly a meter change out service order interface, would normally be required before large scale smart meter deployment efforts can begin. Typically, the selected outside installation service provider will supply its own meter change out service order system, which must be integrated with MDMS or the CIS system before high volume meter change outs can begin to take place. Since the installation contractor has not yet been identified, it is not likely that a meter change out system has been implemented to date unless Capgemini is providing this system.

Without access to Hydro Quebec's project status reports and vendor contract documents, Valutech cannot confirm that this work has been completed, or has even been sufficiently considered in the overall project plan.

## *(4) develop a full deployment implementation plan*

Based on material provided in the filing, it appears that Hydro Quebec has selected reasonable timetables for its pilot and full system deployments. A 24 month pilot period is normally sufficient time to complete all preliminary tasks and prepare the utility for changes to its internal processes. The five (5) year period for full deployment using multiple phases is a reasonable approach that strikes a balance between the internal stress of running multiple systems (two billing processes, for example) and maintaining the efficiency of deployment.

A major deficiency in Hydro Quebec's authorization request is, in our view, the absence of any detailed discussion or planning for implementation of significant utility and client benefits during the early years

[21] See HQD-1, doc 1 dated June 30, 2011, page 25.

of deployment. HQ's authorization request suggests that no real effort will be made to implement any benefits during the 5 year deployment period beyond automated meter reading, remote disconnect for collections and possibly monthly billing if all three phases are completed. HQ should not wait for 5 years to pass before implementing AMI supported utility and client benefits identified in this report, and included in the2009 Accenture study, that can be implemented during Phase 1.[22]

Typically, utilities deploying AMI will develop a more detailed meter deployment plan that addresses a number of important factors such as route scheduling, meter densities, installation sequence and a host of other factors intended to capture benefits at the earliest possible time. Based on the estimated change out completion rate, an appropriately sized contractor work force must be established to support the utility's projected deployment schedule and achieve the project milestones. A large number of inside meters (as found in the Montreal area, for example) typically creates the need for a significant number of revisits and client appointment scheduling to gain access, and consequently requires a proportionately larger number of meter installers to maintain the project installation schedule. If this number is underestimated, a significant cost overrun could result, or schedule slippage could occur.

Valutech has not been given access to Hydro Quebec's detailed Implementation Plan to assess its overall completeness. Hydro Quebec's June 30, 2011 application, and more specifically, its response to the original set of questions, discuss some key project milestones such as project start and end dates, monthly meter installation rate and deployment phases, but does not provide any insight into the meter reading routes or planned installation sequence beyond identifying the general pilot areas.[23] The filing includes a general meter deployment plan as defined by the various phases, but does not provide any detail concerning the numbers and locations of data collectors and routers that will be required in each phase to read the meters over the AMI network.

## *(5) establish the necessary new business processes including mass change out of meters*

Hydro Quebec lists as a major objective of the pilot period an intent to establish the business processes and information systems that will be needed to implement and operate the new AMI system[24]. In its first response to questions, Hydro Quebec states that as of June 30, 2011, only one year into the two year pilot period, its "main assumptions" have been confirmed, that "the technology is adequate and functional", and that its "level of understanding" is sufficient to warrant going forward with Phase 1 of the full project[25]. Based on the available information and known contract award dates, Valutech does not agree with this conclusion.

Valutech requested but was denied access to Hydro Quebec's project status reports and other related project documents such as the Landis+Gyr contract, the installation contractor Request For Proposal,

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[22] Reference: B-0006, HQD-1, Document 1, Page 13 et 18, Source: Accenture 2009

[23] HQD-1, doc1 dated June 30, 2011, pages 7,8,24 and 30; HDQ-2, doc 1 dated Sept. 9, 2-11, page 33.

[24] HDQ-1, doc 1 dated June 30, 2011, pages 23,24.

[25] Initial Response to the Authority's Request For Information, HQD-2, doc 1 dated Sept. 9, 2011, page 13.

and other documents which might have shed some additional light on the pilot phase's overall objectives and expectations. Since the Landis+Gyr contract was not signed until May, 2011, it is not likely that sufficient network installations had taken place by the June 30, 2011 filing date to complete a network and mesh deployment that is sufficient to verify 99.4% network read performance through an end-to-end installation of meters, network and head end software.

An important objective of pilot AMI deployments is to design, build and test all system interfaces. Hydro Quebec must install the Landis+Gyr Gridstream software with its Command Center operating platform, integrate the Landis+Gyr system with HQ's EnergyICT meter data management software, and integrate EnergyICT with the SAP billing system. Since EnergyICT is not known to be an SAP Lighthouse Council certified vendor for the SAP MDUS data protocol, or to have developed this interface elsewhere, this effort may take somewhat longer than the defined pilot period to achieve. Simply completing a partial integration to pass current billing data does not accomplish the more difficult tasks of interfacing with SAP's Enhancement Pack 5 to provide the advanced AMI functions.

Another major pilot objective is to design and implement the new business systems that must be built around the changes to meter reading and meter change out processes. For example, once the Phase I deployment begins, Hydro Quebec must begin to bill clients using readings from the AMI network while still continuing to support the existing meter reading process. This means that the billing system must operate separate billing processes for both manual (current system) and automated reads.

HQ will also need to implement a robust automated meter change out service order process, as previously discussed, that is capable of generating and processing meter change service orders on a high volume basis using efficient hand held computers and scanning devices. Since Hydro Quebec intends to replace 80,000 meters per month, this process must be well designed and tested to ensure that it can support a continuing high volume of meter changes. Quite often, the outside installation contractor provides its own system and hand held computers for this purpose, which must then be integrated with the utility's CIS system. The effort to establish this automated process cannot begin until the installation contractor has been selected by Hydro Quebec.

## *(6) prepare the human resources transition plan*

Hydro Quebec appears to have prepared a human resources transition plan that is capable of reducing the meter reading and collections shut off personnel in an orderly manner. The number of people designated for reassignment appears to be reasonable, although the attrition part of the plan seems to be heavily reliant on a high number of retirements.

Required staffing reductions for AMI projects are typically not linear, that is they are not exactly proportional from beginning to end to coincide with the percentage of meters that have been automated. During the early periods of deployment, the utility will experience a learning curve that will be less efficient than in later stages of the deployment plan. Subsequently in the final stages, the automation cleanup effort will be more disbursed with a random nature that is less efficient, requiring more meter readers to cross routes to read a smaller number of meters. The final reduction will vary in large part based on the number of inside and hard to reach meters that remain, and is partly a product of the route planning process developed in the Project Implementation Plan.

## 5.2 Observations

Valutech's observations concerning the pilot program objectives are based on the available material provided by the Quebec Energy Board, including the Hydro Quebec Application for Authorization to Proceed with AMI deployment and the HQ responses to the requests for information. Without receipt of pilot project status reports, contract milestone dates and schedule updates, the exact status of pilot project activities cannot be precisely determined. However, our experience with AMI deployment combined with the available documentation lead us to the following general conclusions.

***A. In our opinion given the timing of the Landis+Gyr and installation contractor contracts, the 24 month timeline for preparatory work and pilot deployment does not appear to be sufficient to verify network performance and ensure an efficient AMI system deployment.***

While a 24 month pilot period is typically sufficient to complete all preliminary requirements and validate technical assumptions, it is not usually adequate to include the time needed to request vendor proposals, conduct the vendor selection process and negotiate contracts. It is normally expected that a significant portion of the pilot period is devoted to pilot deployment monitoring and evaluation of results before a decision is made to move forward with mass deployment. The Hydro Quebec preparatory work and pilot deployment periods do not appear to provide sufficient operating time to deploy an adequate pilot network, monitor the results and revise the pricing and cash flow calculations accordingly.

1. The May 25, 2011 contract signing with Landis+Gyr, which occurred just one month before the Hydro Quebec application was submitted to the Quebec Energy Board, would typically take time to implement; to specify, order and receive smart meters and network equipment, finalize propagation studies to pinpoint collector and router locations, conduct planning workshops and train utility personnel. These tasks must be accomplished before pilot network installations can begin.

2. Based on Valutech's experience, it does not seem likely that first article (QC approved) meters could be specified, delivered and tested, and then a larger shipment of production meters ordered, delivered and installed much before the end of the 2011. Similarly, the network collectors must be specified, ordered and configured properly in the factory to accommodate Rogers Communications wireless cellular backhaul or satellite communications based on the results of the propagation study. The Rogers contract was signed in June 2011.[26]

3. As of the approximate date of this report, Hydro Quebec has not yet announced the selection of an installation contractor for the smart meters. HQ's responses to information requests state that the pilot results confirm that "the assumptions concerning the installation are realistic". Yet another part of the response states that a requirement of the pilot is to confirm that HQ will

[26] See Rogers Communications press release dated June 20, 2011, announcing that it will provide service to connect Hydro Quebec's central office with the Landis+Gyr data collectors.

test its installation assumptions “including installation assigned to an outside installer”. These responses appear to be in contradictory.

4. In order to increase deployment scale from a small volume pilot smart meter installation to high volume full deployment (80,000 smart meters per month), an automated meter change out service order system is normally required, which must be integrated with the billing system for the purpose of downloading designated meters for replacement. There is no evidence that this type of system, which is often provided by the installation contractor, has been installed at this time. It is not likely that Hydro Quebec could move to a full deployment scenario without installing and testing this system to ensure that client billing will not be affected by the meter change out process.

5. No information is available concerning the status of system integration efforts between the Landis+Gyr, EnergyICT and SAP systems. While it appears that Ericsson was selected by Hydro Quebec in December 2010 to perform the EnergyICT-to-SAP interface[27], only a partial integration has been completed to date. As mentioned previously, it does not yet appear that EnergyICT has been certified for SAP’s Enhancement Pack 5, which contains the AMI system adapters needed for required remote disconnect functions initiated from SAP.

6. Hydro Quebec states that it bases the proper operation of the network on a “proof of concept” approach in an environment that is “similar to the Distributor’s”. This suggests that HQ has not yet installed significant portions of the Landis+Gyr network with Rogers Communications backhaul in the designated pilot locations to confirm adequate network performance. Under such a minimalist scenario, it is not likely that Hydro Quebec can verify that a 99.4% read rate and sufficient network bandwidth will be provided, or that data transmission speed (network latency) will be adequate to support near real time features such as remote disconnect/reconnect, outage detection and on request reads at the current project cost. In addition, bandwidth inadequacies can jeopardize the future performance of outage management, load control and Home Area Network applications (energy displays, programmable thermostats, etc.) that could be provided in connection with advanced smart grid functions.

### *B. In Valutech’s opinion, the pilot objectives and results identified to date in Hydro Quebec’s authorization request are not sufficient to validate the anticipated project cost.*

We believe an important objective of any AMI system pilot project should be to confirm the initial assumptions concerning project cost. It is not clear how this will be accomplished if Quebec Energy Board approval for the $440 million Phase 1 cost is granted prior to completion of the deployment of smart meters in the 3 pilot areas.

[27] Ericsson press release “Ericsson selected as prime integrator by Hydro Quebec” dated December 16, 2010.

1. Hydro Quebec has stated in its application that a principle reason for conducting separate pilot projects is to test the AMI system in urban, suburban and industrial zones.[28] If approval is granted based only on a proof of concept, the results of the pilot program deployments in these separate areas will not yet be known so that results can be reflected in the Phase 1 and full system deployments.

2. Hydro Quebec's approach to validation of the network technology through a proof of concept, does not address the scalability and bandwidth issues as mentioned above. The proof of concept approach is not adequate to verify the number of collectors and routers that will ultimately be required to provide adequate full system bandwidth. A significant variation in the number of collectors and routers could significantly increase project cost.

3. As discussed previously, the Hydro Quebec filing indicates that a system daily read performance level of 99.4% is required to meet the project specifications. If this read performance level is not achieved system wide, additional collectors and routers would be needed to bring the read performance up to specifications. According to HQ, the 2nd pilot is designed to verify the ratio of meters, routers and collectors, and therefore should be permitted to run its course before a final pricing determination is made. Any additional network devices required to achieve the 99.4% standard would come at additional cost.

4. Since an installation contractor has not been announced at the time of this report, it is not yet possible to compare the contract installation pricing with the estimated costs that were used to arrive at the $997 million total project estimate, and then to validate the contractor's actual performance levels against expectations. Once the 19,000 contractor installations have been completed in the 3rd pilot, Hydro Quebec will have a better understanding of the contractor's installation performance capabilities and the turn back percentage for the meters located inside buildings. Hydro Quebec indicates that over 90% of the residential meters in Phase 1 will be performed by the outside service provider and that 35% of the meters are located inside buildings, which creates a significant potential for cost overruns.

## 5.3 Recommendations

It is evident from review of the available material and our own experience that some important objectives of the preparatory work and pilot projects had not yet been achieved at the time the Project Authorization Request, and likely won't be within the 24 month pilot deployment period. As mentioned above, the timing of vendor contracts suggests that some important steps, such as completion of network deployment efforts in all pilot areas, AMI IT preparations and network performance verification have not yet progressed to the point where Valutech can confidently say that the project technology, cost and schedule could be validated by the end of the pilot period.

[28] Hydro Quebec Application for Approval HQD-1, doc 1 dated June 30, 2011, pages 24 and 25.

We believe that Hydro Quebec's use of a proof of concept approach to confirm network performance is not sufficient to demonstrate satisfactory network reliability and is at odds with its stated reasons for conducting the pilot projects in 3 separate locations. For example, HQ states in it authorization request that deploying meters in clusters is necessary to enable the system's mesh technology to work properly, to read the meters remotely and to justify replacing electro-mechanical meters that have not yet expired[29]. However, it is requesting authorization from the Quebec Energy Board to move forward with Phase 1, a $440 million commitment, based only on the initial proof of concept.

Another important objective of the pilot projects is to confirm that the new AMI system will be capable of operating at a full system daily read performance rate of 99.4%. This level of read performance cannot be verified through a proof of concept approach. Later unplanned increases in the number of collectors and routers needed to achieve this read rate system wide could produce significantly higher project costs during the three (3) mass deployment phases after Energy Board authorization has already been provided.

There is little evidence from the authorization request and responses to questions that Hydro Quebec intends to revise its cost projections based on the preparatory and pilot program results. Since the time of the initial filing, June 30, 2011, the selection of an installation contractor will have been made, and the contracted cost to complete the meter installations will be more precisely known. Upon completion of the 3rd pilot, the installation contractor will have installed nearly 19,000 meters and the contractor's installation rate will be better known, as well as the success rate of gaining access to the inside meters and the resulting turn back percentage. A revised project estimate should be prepared and submitted to the Energy Board prior to receiving Board approval to move forward with Phase I deployment.

Collectively, this information will enable Hydro Quebec to update its meter installation cost assumptions and provide a revised meter installation estimate. And a more precise count of the number of collectors and routers based on the completed pilots will also be known, which will enable HQ to adjust its projected network cost for any increases in the cost for network hardware, equipment installations and annual Rogers Communications costs for cellular and satellite communications to the collectors.

Upon consideration of all of these matters, Valutech recommends the following:

1. Hydro Quebec should complete all three pilot projects by the planned June 2012 completion date, and then extend the pilot program by an additional 6-12 months to evaluate results and monitor network performance. This will provide additional time to evaluate the overall performance of the network and mesh technologies, and to assess the capabilities of Rogers Communications to reliably backhaul data using both cellular and satellite technology options.

2. A comprehensive program of end-to-end testing should be conducted during the extended 6-12 month period using the completed pilot areas to verify that both the Landis+Gyr and Elster smart meters are being read properly over a common mesh network. This testing should confirm that a daily read performance rate of 99.4% is being achieved for the pilot populations,

[29] See Responses to Initial Request for Information, HQD-2, doc 1, question 1.4, page 5.

and that the ratio of network collectors, routers and meters is appropriate to provide sufficient read performance and bandwidth for current and future functions system wide.

3. An evaluation of the Landis+Gyr Gridstream/ EnergyICT MDMS/ SAP billing system interfaces should be conducted by Hydro Quebec to ensure that these interfaces are working and updating the client data properly, and can support initial and future AMI system functions including all current client rates. The remote disconnect/reconnect feature, and move out/in read requests should be capable of being initiated by customer service representatives through the SAP billing system. All AMI IT work should be completed, including the installation of the meter installation contractor's meter change out system with SAP.

4. Hydro Quebec should use the extended 6-12 month period to validate network and contractor installation performance metrics based on the pilot period results and revise the total project cost estimate accordingly. Changes in actual installation labor rates, quantities of network collectors and routers, annual communication costs, project management and system integration costs, etc. should be reflected in the revised project cost, and any resulting impact on expected network performance should be highlighted and fully explained.

5. The results of this additional, in-depth analysis, including a revised project cost estimate, should be submitted to the Quebec Energy Board in a detailed report for review before authorization to proceed with Phase 1 is granted.

# 6.0 Analysis of Technology Choice

Valutech Solutions was asked to analyze Hydro Quebec's technology selection, and to determine if this technology could be used to provide future services to its clients. Services such as demand side management (demand response), support for electric vehicles, time based pricing and implementation of future smart grid applications were specifically noted as being of potential interest to clients. The Valutech mandate was to look specifically at Hydro Quebec's choice of smart meters and AMI system technology, and to determine if it would be adequate to provide planned as well as future services. It is not an objective of this report to discuss other alternative AMI vendors, or to compare Landis+Gyr technology with similar AMI system technologies.

**Availability of Material**

In order to evaluate the technology selection, Valutech requested copies of Hydro Quebec's AMI system Request For Proposal as well as copies of all vendor proposals received for this project. This request was not approved by the Quebec Energy Board. Large utility AMI projects would normally attract most of the major AMI system vendors if they were given an opportunity to bid. Valutech was not given access to the vendor bid list to determine if a large group of potential bidders was included. It is typical that, for AMI projects of this size, the utility project team will conduct an extensive, detailed review of all project proposals, and then evaluate the proposals based on use of a detailed scoring system that would rank the proposals by technical solution, client benefits and cost. A summary of the evaluation results and a written recommendation would then normally be prepared by the project team for review by higher management. In this case, it would likely have been prepared by or included the participation of HQ's project management consultant Accenture. Valutech has not been provided any results of the vendor proposal evaluations, costs or the recommendations to higher management made by the Hydro Quebec project team or Accenture. Our analysis is therefore limited to information provided in the authorization request, responses to questions and publicly available information, and we will not make any judgment concerning the adequacy of the process or the prudency of the final selection.

## 6.1 Landis+Gyr Technology

According to published reports, Landis+Gyr (L&G) is a $1.6 billion company with operations in over 30 countries. Currently owned by an investor group, the company is being purchased by Toshiba for US$2.3 billion.[30] Landis+Gyr has brought together the technologies of CellNet Data Systems, Hunt Technologies, Ampy and a relationship with Ecologic Analytics meter data management software into one company that, along with its meters, provides end-to-end AMI solutions using power line carrier and RF solutions, as well as providing pre-paid metering.

With nearly 25 million meters installed or under contract at more than 500 utilities, L&G has become one of the largest AMI solution providers in the world. Some of the largest utilities in the U.S., including Xcel Energy, PECO and Oncor (considered by many its most advanced deployment and nearest to the Hydro Quebec technology) are using Landis+Gyr technology. Table 1 below provides a recent listing of some of the major Landis+Gyr utility installations in the U.S.:

| Customer | Under Contract | Installed Electric | Installed Gas | Installed Water | Installed Total |
|---|---|---|---|---|---|
| Kansas City Power & Light | 493,572 | 491,951 | | | 491,951 |
| Ameren UE | 1,430,000 | 1,271,493 | 144,390 | | 1,415,883 |
| Ameren Illinois | 1,033,249 | 191,000 | 101,000 | | 292,000 |
| Xcel Energy (NSP) | 2,200,000 | 1,140,000 | 354,000 | | 1,494,000 |
| Puget Sound Energy | 1,800,553 | 1,065,792 | 734,761 | | 1,800,553 |
| Cuiver River EMC | 26,759 | 26,759 | | | 26,759 |
| Boone EMC | 18,944 | 18,944 | | | 18,944 |
| Indianapolis Power & Light | 489,000 | 489,000 | | | 489,000 |
| United Illuminating | 325,500 | 325,500 | | | 325,500 |
| City of Barberton | 11,800 | | | 11,800 | 11,800 |
| PECO | 2,221,238 | 1,728,895 | 492,343 | | 2,221,238 |
| Pittsburgh Water | 83,000 | | | 83,000 | 83,000 |
| Hendricks Power | 15,000 | 15,000 | | | 15,000 |
| Kansas Gas Service | 160,347 | | 159,997 | | 159,997 |
| WE Energies | 1,519,230 | 775,641 | 600,560 | | 1,376,201 |
| Jacksonville Electric Authority | 709,802 | 421,541 | | 288,261 | 709,802 |
| Austin Energy | 361,000 | 127,000 | | | 127,000 |
| Colorado Springs | 520,000 | 49,720 | 43,984 | 22,533 | 116,237 |
| Laclede Gas | 650,000 | | 640,000 | | 640,000 |
| Water One | 12,759 | | | 12,601 | 12,601 |
| Southern Connecticut Gas | 1,129 | | 923 | | 923 |
| City of Seattle | 2,600 | 540 | | 45 | 585 |
| City of Geneseo | 6,581 | 3,336 | | | 3,336 |
| **Total Under Contract** | **14,092,063** | | | | 0 |
| **Total Installed** | | **8,142,112** | **3,271,958** | **418,240** | **11,832,310** |

Table 1 – Major Landis+Gyr Installations

30 Landis+Gyr press release "Landis+Gyr to be acquired by Toshiba for US$2.3 Billion" dated May 19, 2011.

### 6.1.1 Landis+Gyr's Gridstream Network

Landis+Gyr has combined its Hunt and CellNet networks with its UtiliNet radio system to create a branded product line called Gridstream. The Gridstream network is a fixed-wireless mesh technology that can communicate with electric, water and gas meters over a two way communications backbone built around its UtiliNet radio technology. Meter data coming from Focus AX meters is transmitted over the two way Gridstream mesh network to a series of collectors that are typically located on utility poles, towers or at utility substations[31]. From these locations, data is backhauled over fiber, cellular or other communications media[32] to a utility's Meter Operations Center (MOC).

Landis+Gyr's Gridstream network is an accumulation of different technologies and upgrades derived from the various AMI systems it received through the acquisitions of CellNet and Hunt, along with its own advancements in metering technology from the widely known L&G meter product lines. The UtiliNet technology, for example, has been used for many years in SCADA and distribution automation markets along with some early gas meter installations. Though initially rather expensive, the UtiliNet mesh radios have been re-designed and can fit a smaller version under glass into an advanced solid state electric meter.

Landis+Gyr has upgraded their network architecture from the old CellNet one way bubble up technology to a peer-to-peer mesh configuration that is capable of two way communications between the head end software and the meter. It is not known if they have developed a corresponding signal propagation methodology that is sufficiently capable of estimating the precise number of collectors and routers that will be needed for the Hydro Quebec service area. An abundance of caution is recommended when determining the number of network devices that will be needed, and Valutech has recommended that the pilot deployment period be extended for 6-12 months to better assess the network's coverage and bandwidth capabilities and equipment requirements. The Gridstream software to be installed at Hydro Quebec will likely be a version of the Command Center software that is presently in use at Oncor[33].

It is possible that other network operations devices such as capacitors, fault indicators, reclosers and switches will be able to communicate over the network for distribution automation purposes in the future using Gridstream DA. In 2009, L&G and Corporate Systems Engineering announced a two way load control solution for use over the Gridstream network. (See Figure 5 below for a diagram of the Gridstream network).

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[31] The Focus AX meter also has a version called the E-350 Focus AX-SD which includes a service disconnect feature for remote disconnect/reconnect functions. This version will be purchased by Hydro Quebec.

[32] Landis+Gyr recently signed a deal with CalAmp which has access to satellite backhaul, but it is not known if L&G has a satellite data transmission solution at this point.

[33] Landis+Gyr has recently announced a deployment of similar technology at Nashville Electric, Nashville, Tennessee. This deployment will have a particular focus on demand response and distribution automation applications, which could be added later at Hydro Quebec if sufficient bandwidth is provided.

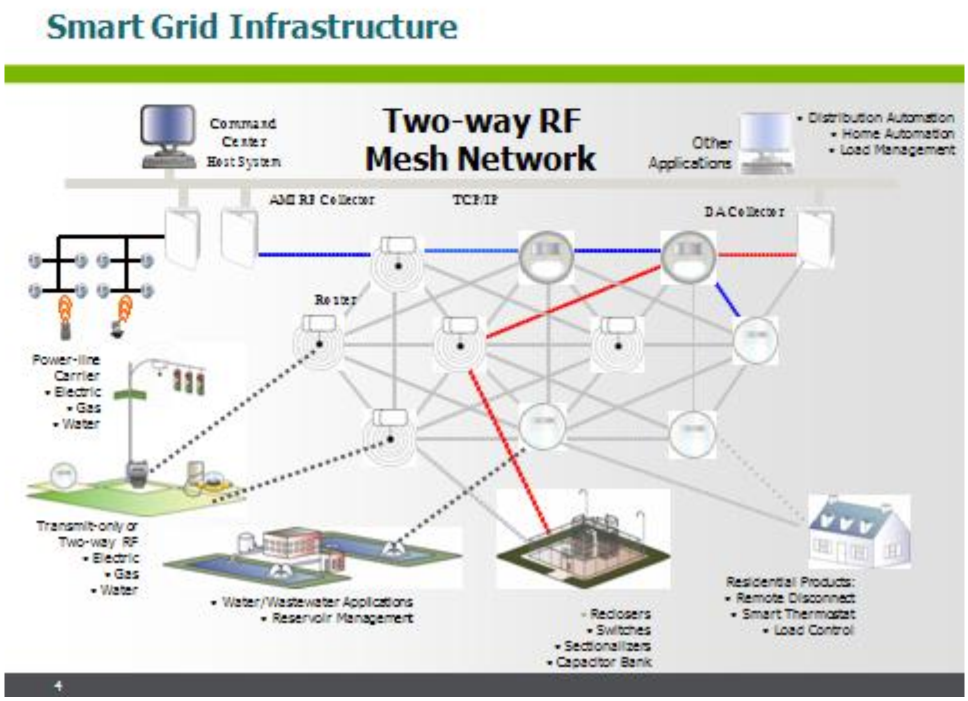


Figure 5 – Gridstream Network

### 6.1.2 Key Network Components

- **The UtiliNet radios under glass.** These devices form a two way wireless peer-to-peer network radio system using the unlicensed 902-928 MHz frequency band that has been deployed for years for various AMI and distribution automation applications. Using the mesh technology, these radios can route their communications in many different directions back to a network collector.

- **Network collectors.** These devices are typically located at a utility tower or substation and convert the network data to a secure wired or wireless WAN network. The collectors communicate with meters or routers to receive the meter data and then forward it on to the Meter Operations Center. The collectors are designed to handle a high volume of meter data coming from the network routers.

- **Network routers.** The Gridstream network employs a large number of routers, particularly in rural areas, to provide the Local Area Network (LAN) connection between meters and collectors. The number of routers deployed will affect the network bandwidth and throughput speed.

- **Two-way electric meters.** Gridstream communicates over the network using several different meter options with two way communications. Communication is provided via the unlicensed 902-928 MHz frequency band. L&G's E-350 Focus AX-SD meter provides two way communications and includes a ZigBee chip for HAN operations as well as the remote disconnect device. Other meters, such as the GE I-210+ and the Elster A3 are currently available. (See Figure 6 for the Focus AX meter specifications).

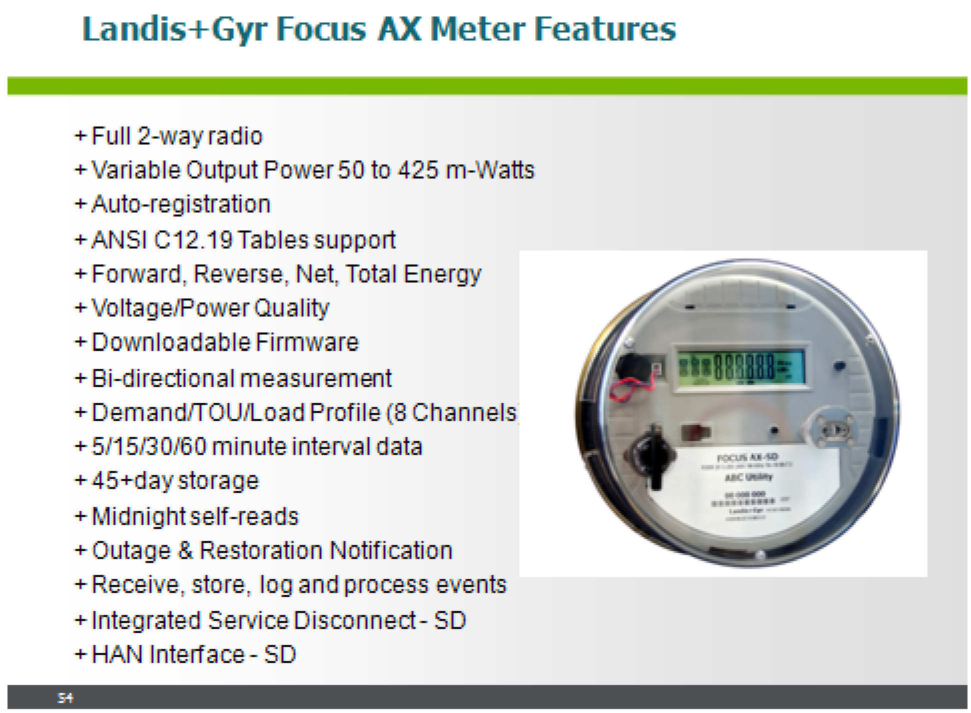


Figure 6 – Focus AX Specifications

- **Head end software.** Traditionally, L&G has offered a hosted software solution that was located at their Distribution Operations Center (DOC) in Kansas City. However, a growing number of utilities are choosing to run their own head end system on site. As a result, L&G has begun adapting the Command Center software as the preferred solution for on-site operation and control of the Gridstream network. This option has apparently been selected by Hydro Quebec.

### 6.1.3 Network Architecture

The Gridstream network typically supports daily readings for all meters and provides on-request reads as needed for billing and customer service. When equipped with E-350 Focus AX-SD meters, Gridstream also supports remote disconnect functions. The network is peer-to-peer self healing if sufficient collectors and routers are located nearby to permit a rerouting of the meter data. The Gridstream electric meter module is remotely programmable and demand and load profile settings can be reconfigured in the meter.

Landis+Gyr can provide trained personnel with software tools available to survey and install the network devices in a manner that achieves required network performance. Detailed site signal propagation studies should be performed to determine the precise number of collectors and routers that will be required. Collectors are typically mounted on towers or utility poles, and the collectors work best if mounted at higher locations such as roof tops or towers. Gridstream provides power outage notification through the Focus AX meter. Cellular and Ethernet over fiber optic technology can be used for backhaul, as well as some other proprietary solutions. It is not clear if a satellite connection is available at this time for data backhaul, based on review of the Gridstream RF Phase IV Collector specification.

### 6.1.4 Head End/Data Center Options

Traditionally, Landis+Gyr has operated its systems from a remote data center, and has passed data files back to the utility for billing purposes. Under this arrangement, utilities typically pay a specific fee for daily or monthly billing reads. More recently, and with the re-branding of the system into Gridstream, L&G is adapting its Command Center software for on-site use under a one-time license fee. Utilities would have the option to purchase meter data that is provided through the DOC or to license the Command Center software for on-site operations.

Command Center runs on a Microsoft.NET platform in a Windows environment using SQL Server or Oracle for database management. The network maintains an always on IP connection with the Command Center software. Interfaces use XML or standard file formats, with Web Services provided over HTTP. Gridstream is also MultiSpeak compliant (See Figure 7 below for a sample screen).

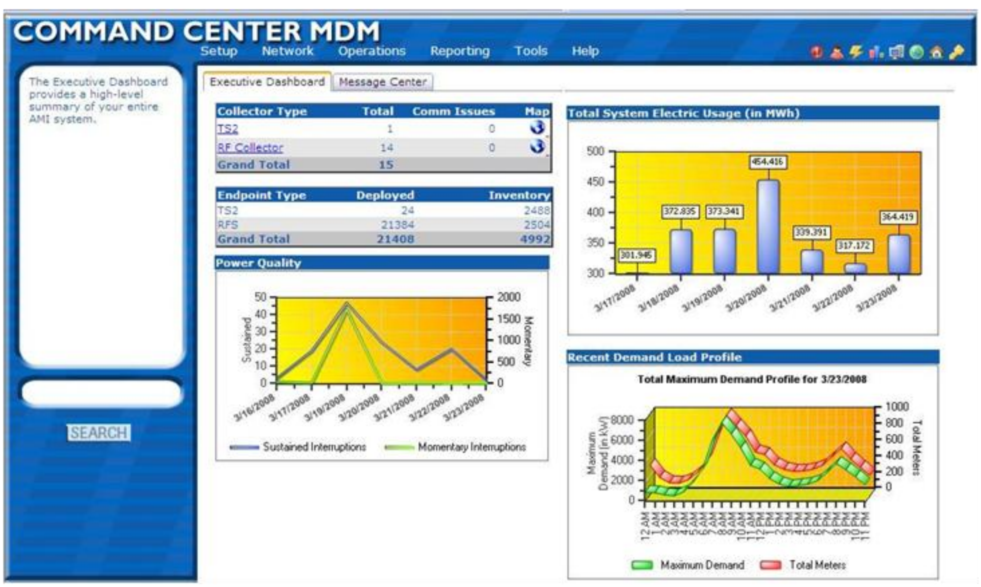


Figure 7 – Command Center

It appears that Hydro Quebec is using SAP for billing[34], and that billing data coming from Gridstream will pass through the EnergyICT meter data management system, and then through an interface between

[34] See HQ Authorization Request, HQD-1, doc 1 dated June 30, 2011, page 22.

EnergyICT and SAP. Valutech is not aware of any utility AMI system implementation that is currently using the combination of Landis+Gyr Gridstream two way communications for AMI, EnergyICT for MDM and SAP for billing advanced utility rates such as time-of-use in North America at this time.

As mentioned previously, at the time of this report EnergyICT is apparently not yet certified on SAP Enhancement Pack 5 using the Meter Data Unification System (MDUS) protocol developed for integration purposes by SAP's Lighthouse Council. Advanced network functions such as remote disconnect/reconnect initiated from SAP are generally required to pass through the MDUS interface using the AMI connector furnished with EHP5. Hydro Quebec has not publicly provided any details concerning its methodology for implementing advanced functions such as remote disconnect/reconnect, on request reads, move in/out billing reads and demand resets, which are typically activated by utility client representatives through SAP. As a result, Valutech cannot assess HQ's integration strategy or the results achieved to date, to provide the remote disconnect/reconnect feature required in Phase 1 deployment.

The Gridstream system and smart meters will likely be phased in while retaining the current billing process, and Hydro Quebec will need to operate and maintain two billing system interfaces (current manual system plus new network interface) during the 5 year rollout period. Based on HQ's plan to implement only monthly billing, move in/out readings and remote disconnect functions during the first 5 years, the full capabilities of the Landis+Gyr AMI system will be significantly underutilized during this period. Valutech recommends in this report that a thorough benefits reassessment be completed and a Utility/Client Benefits Plan be developed to more fully utilize the AMI network assets.

Valutech is not aware of any specific plans for Hydro Quebec to implement advanced network functionality such as outage management, tamper detection, demand response, load control, load research or home energy management functions that can be supported through an AMI system, and which significantly increase the return on the capital investment (although ZigBee communications is included in the meter). The EnergyICT MDM software does not appear to have a client web portal available at this time for client access to energy usage, so it is not clear how HQ could provide client access to daily energy usage data.

### 6.1.5 Home Area Network/Home Energy Management

Landis+Gyr offers a HAN solution that requires a ZigBee interface, and Hydro Quebec has apparently included the ZigBee functionality in the meter that is being purchased. L&G sometime ago announced tentative arrangements with Comverge and Control4 to integrate their control technologies. In 2009 they announced a product developed with Corporate Systems Engineering that offers a two way verifiable load control application that can control multiple loads at a single location. This product offering could be available to support various demand response and load control programs.

L&G's Command Center software could support management of HAN devices, i.e. it is believed to be capable of providing device commissioning and registration over the Gridstream network. It does not appear to provide any specific HAN application software for load management purposes, but could plan to interface with other third party Load Control Management System providers to manage pricing signals and load control events over the Gridstream network.

Landis+Gyr can also operate load control and HAN devices such as programmable thermostat controls and in-home energy displays over the Gridstream network. Implementation of time differentiated rates, including critical peak or real time pricing, typically requires two way communications to the meter as well as the ability to send out pricing signals to these types of devices. From our discussions with various industry sources, it appears that L&G may have started supporting some of these devices at Oncor this year. Oncor's clients can now monitor their energy usage online using the Smart Meter Texas client web portal.

## 6.2 Landis+Gyr's Market Position

Recent analysis of AMI implementation suggests that utilities are no longer seeking only a low cost network meter reading solution, but are instead focusing on full system solutions that can support a wide range of advanced functions that leverage the high cost of AMI. While AMI continues to provide the foundation for the "smart grid" as the enabling technology for advanced smart grid functions, other utility and client benefits are becoming important drivers of these systems as utilities attempt to improve distribution reliability, contain costs and better enable clients to manage their energy use.

In the U.S., federal funding in 2009 for the Department of Energy's Smart Grid Investment Grant program provided over US$3.4 billion in federal grants for smart grid projects that went well beyond AMI, and encouraged advanced technologies for distribution automation, substation automation, outage management and demand response. The market for AMI systems is expected to grow even larger as its core AMI communications technology expands into various other smart grid areas such as remote circuit switching, outage management, transformer monitoring and capacitor controls. UtiliPoint International projects that the market for smart grid systems will grow in North America from a $9 billion market in 2009 to as much as $24 billion annually by 2015[35].

The AMI companies whose technologies are readily adaptable to these additional applications stand to be the long term winners in this rapidly expanding market. AMI companies whose technologies are based on open standards are better positioned to form strategic relationships with other vendors in related industries, and to leverage their AMI communications networks to spread the cost over a larger number of utility business units and applications. With the acquisitions of CellNet Data Systems and Hunt Technologies in 2006, Landis+Gyr was strategically positioned in 2009 to compete in the market for AMI systems when the Hydro Quebec project was being planned.

Figure 8 below shows the general market position of Landis+Gyr for smart meters in 2009, the last complete year prior to the HQ vendor inquiries. This information reflects cumulative shipments back to

[35] UtiliPoint International, "Paving the Road to Smart Grid Success: Enhancing the Focus on Smart Customer Communications, July 13, 2010, page 4.

2004, the first year in which this data became available[36]. The Landis+Gyr shipments also include devices sold for its Hunt Technologies power line carrier system.

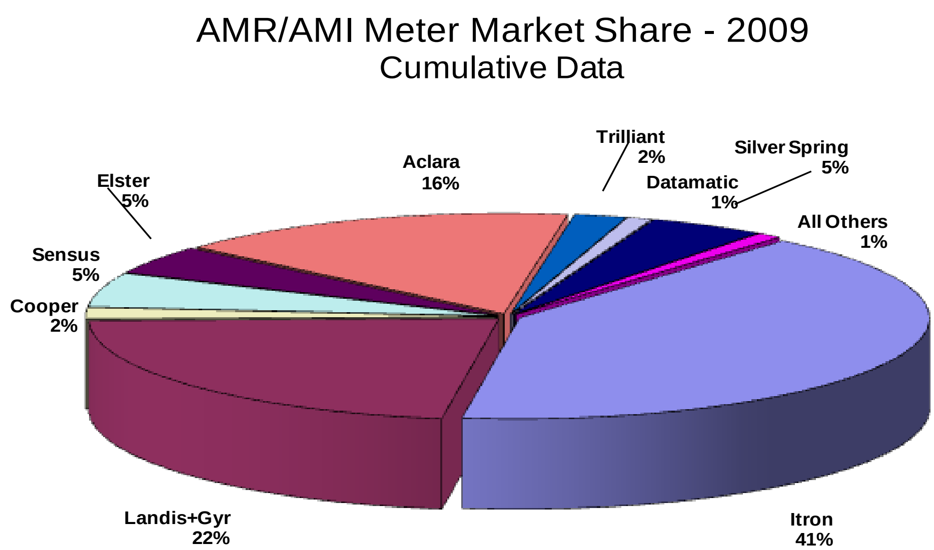


Figure 8 – AMR/AMI Meter Market Share

While Itron was the leader in meter shipments in 2009, many of their devices sold were for mobile and pedestrian systems[37]. Aclara, the number 3 provider in terms of units shipped for the electric market consisted primarily of units sold in connection with its TWACS power line carrier technology.

Perhaps a better way to look at the 2009 data is by way of the number of AMR/AMI systems sold. In 2009, a number of smaller AMI providers were selling systems into the market using other manufacturers' meters. This accounts for the larger percentage in the All Other category. Itron continued to be the top provider of systems including its mobile and pedestrian systems[38].

[36] Data provided courtesy of the Scott Report: AMR/AMI Deployments in North America, 2009.

[37] Note that AMR is an acronym for Automated Meter Reading, the standard term used prior to AMI which included mobile and pedestrian systems.

[38] Again, many thanks to Howard Scott of the Scott Report for providing the 2009 data.

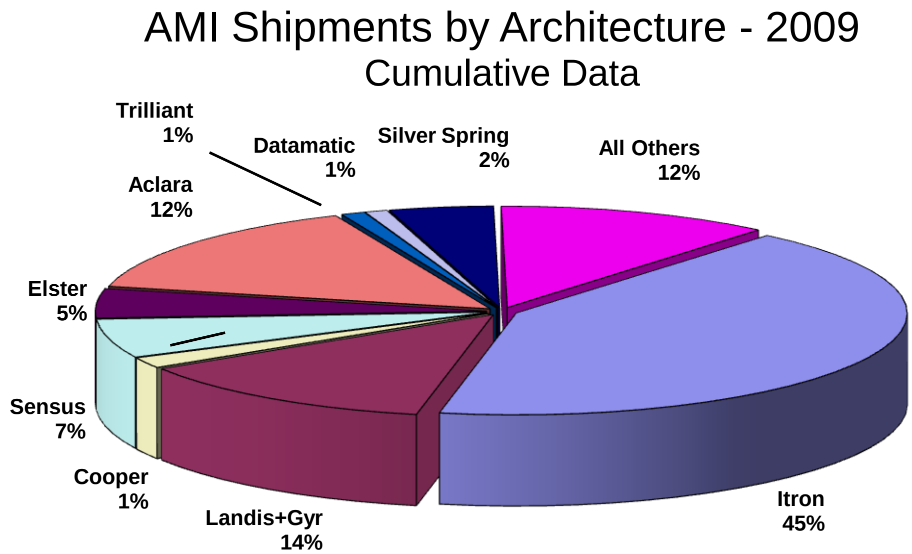


Figure 9 – AMI Architecture Market Share

By either of these standards, Landis+Gyr was a solid number two supplier in the number of meters and AMI systems shipped in 2009, and was considered a leading provider of AMI technology solutions. With the purchase of CellNet Data Systems, Landis+Gyr acquired a company that has been engaged in wireless network AMI technology for over 20 years. CellNet's systems are installed in a number of large investor owned utilities in the U.S., such as Excelon, Xcel Energy and Kansas City Power & Light. Nashville Electric Service is the most recent utility (October 2011) that has announced its intentions to implement Gridstream for AMI, demand response and distribution automation functions.[39]

Landis+Gyr's acquisition of CellNet and Hunt Technologies integrated the metering, software and network technologies of all three companies to produce a company that subsequently developed its Gridstream network solution which is gaining increased use in North America. A major benefit of this acquisition is the availability to provide both an AMI network and the required smart meters through one corporate entity, which helps to ensure that a smooth integration of these technologies is maintained in the future.

## 6.3 Comparison of AMI Capabilities

Valutech has attempted to examine the current Landis+Gyr technology and compare it with what are considered to be general characteristics of other AMI systems that are available today. It is important to note that AMI is a very dynamic technology in a competitive market environment that has been undergoing much change. Advances in metering technology and software applications are commonplace, and AMI network solutions are constantly adapting to these changes. The industry is

[39] See Utility Press Release: "Nashville Electric Service Selects Landis+Gyr for smart Grid Roll-out; Gridstream Network Will Support advanced Metering, Demand Response and Distribution Automation Projects", dated October 17, 2011.

also continuing to upgrade its network security and data transmission standards to comply with the growing number of security risks.

In addition, environmental issues are increasingly driving the need to reduce electricity use and moderate peak utility system capacity. The introduction of the home energy management market, though recent, is already expanding into other areas of smart appliances and electric vehicle charging. These functions are creating growing demands on AMI systems to provide greater network bandwidth and data throughput.

In the few short years since Ontario Province moved to smart metering and competitive pricing of energy markets, use of ZigBee enabled metering based on the Smart Energy Profile standard has gained widespread acceptance and is gradually becoming the de facto standard for home energy management systems. Hydro Quebec appears to have included ZigBee in its network specifications, though there is no evidence that it intends to implement a HAN system any time soon.

### 6.3.1 Features Comparison

Following is a table of typical AMI system features along with a general comparison with Landis+Gyr's known Gridstream capabilities. As noted above, L&G is periodically updating its network capabilities, and future versions of Gridstream may include additional features that are not indicated on this table:

| Category | Typical AMI Network Functionality | Landis+Gyr Functionality (Combined with MDMS) |
|---|---|---|
| 1. Standard Meter Reading Services | | |
| Daily Reads | X | X |
| Billing Reads | X | X |
| Move in/Move out Reads | X | X |
| 2. Additional Network Reads | | |
| On request Reads | X | X |
| Time-of-Use Reads | X | X |
| Hourly Reads | X | X |
| 15 Minute Reads | X | X |
| Meter Totalization Functions | X | X |
| Net Metering | X | |
| Pre-paid Metering | | X |
| 3. Outage/Voltage Alarms | X | X |
| Outage/Restoration Detection | X | X |
| Meter Voltage Monitoring | X | X |
| 4. Tamper Detection/Diversion | | |
| Tamper Alarms | X | X |
| 5. Network Load Monitoring | | |
| Transformer/circuit load monitoring | | |

| Category | Typical AMI Network Functionality | Landis+Gyr Functionality (Combined with MDMS) |
|---|---|---|
| Network Simultaneous Reads | | |
| Meter load profiling | X | X |
| 6. Energy/Load Management | | |
| ZigBee Meter Protocol | X | X |
| Res. A/C & Water Heater Control | X | |
| Commercial Load Shedding | | |
| Supports Programmable Thermostats | X | X |
| In-home Energy Displays | | X |
| Provides Client Web Portal | X | |
| Supports Electric Vehicle Recharging | X | X |
| 7. Disconnect Functions | | |
| Remote (Hard) Disconnect | X | X |
| Soft Disconnect | X | X |
| 8. Misc. Requirements | | |
| Open Standard Interfaces | X | X |
| Remote Firmware Upgrades | X | X |
| Web Services- Customer Data | X | X |
| Report Generator- Customer Data | X | |
| Data Validation/Editing/Est. Functions | | X |
| Security Protection- Sys. & Client Data | X | X |
| Multiple Meter Options | X | X |

Table 2 – Typical AMI Features[40]

### 6.3.2 Technology Assessment

At the top of the priority list, utilities have a fundamental business requirement to maintain existing functions such as timely and accurate client billing, processing electric service turn ons and turn offs, detecting energy diversion and responding to client inquiries. The Landis+Gyr system clearly supports this standard.

As the above chart shows, the system can also perform or support a second level of additional functions that would fall into a more advanced category of features such as outage detection, remote disconnect, voltage monitoring and on request reads. These features generally rely on a near real time communications infrastructure with low latency and sufficient data throughput to accommodate

[40] There is no industry standard list of AMI features that is characteristic of all AMI systems. Valutech has attempted to provide a composite listing of the more common features for comparison with the Landis+Gyr system. As mentioned previously, Landis+Gyr, as with other AMI system providers, continues to upgrade its technology, and this chart may not reflect the newest features, or features on the company's technology roadmap.

periodic high volumes of data traffic (such as in storm conditions). While the Landis+Gyr Gridstream network can support these features, it is not clear if the network design standard is sufficient to provide the required speed and throughput. Moreover, it is doubtful that Hydro Quebec's pilot program is sufficiently robust to validate this functionality since a nearly complete network deployment is recommended to verify the system bandwidth and throughput.

A third category of network functions generally falls into the energy management/load control area, and typically requires an integration with the utility's Customer Information System (CIS), other third party systems and software, and occasionally even an outside energy supplier, to accomplish. Home Area Networks (HAN) and Load Control Management Systems (LCMS) are examples of systems that typically use the AMI network but require third party software to manage the large number of load control devices, send pricing signals over the AMI network and monitor and report on load shedding events. These types of systems can be managed within the utility's own environment or hosted by an outside service provider, but are not usually installed as part of the core AMI system functionality.

Hydro Quebec's AMI system appears to be capable of supporting load management functions over the AMI network, though there is insufficient information available to determine if the Landis+Gyr Gridstream/EnergyICT/ SAP, interfaces are sufficiently developed to support these functions in the near term. Implementing HAN or LCMS systems would require additional interfaces and data synchronization requirements that would take some time to develop, but HQ's choice of L&G and Elster meters does support future implementation based on the ZigBee approach to energy management device communications. The Gridstream data collection software must also be capable of supporting HAN/LCMS related device management and pricing signal functions that are necessary to operate programmable thermostats and send pricing signals to in-home energy displays.

Valutech requested but was not granted access to the contract and network design information needed to determine if sufficient bandwidth has been designed into the AMI network to support advanced functions such as outage detection and home energy management. LAN network bandwidth can be added at a later time, at additional expense, it if is determined that insufficient data speed and throughput are available to support the much higher amount of data traffic that would exist over the LAN as these features are added in the future. However, the Hydro Quebec/Landis+Gyr contract and network specifications should normally identify the features, such as outage detection, tamper alerts, etc., that are supported and specify the anticipated response times (latency) that are expected from the purchased network.

Of more concern, however, is the ability of the Wide Area Network (WAN), consisting of Rogers cellular and satellite communications, to provide sufficient service quality in terms of availability, reliability and speed of data transmission to support near real time delivery of outage alarms and pricing signals between client locations and the Meter Operations Center. Since other alternatives, such as fiber optic network and WiMAX, are not expected to be available in the more rural regions of the service area, cellular and satellite WAN communications will be expected to provide the timely backhaul of the near real time data.

A fourth level of functionality is associated with power distribution network management functions that include distribution automation, substation automation and voltage control. Utilities today are increasingly looking to manage distribution network circuit switching operations, and maintain Volt/VAR control through capacitor bank switching functions over their AMI network. In this area, Landis+Gyr has announced some new capabilities that will be implemented by utilities such as Nashville Electric and Alliant Energy in the near future. These functions can help utilities to improve distribution network efficiency, delay costly capacity upgrades and increase overall network reliability. Landis+Gyr's Gridstream DA network would make use of some existing AMI network components but requires additional equipment that could be added later at the time of implementation. Nashville Electric and Alliant Energy[41] have selected the Gridstream network to provide these advanced network automation functions for their service areas.

In Valutech's opinion, it is reasonable to conclude that the Landis+Gyr Gridstream product, when its functionality is compared to the wide range of core and advanced AMI technology capabilities available in the industry today, is among the leading AMI providers of smart grid functions. The Landis+Gyr UtiliNet radio has been in production for many years and is functioning at utilities across North America to support capacitor bank and Supervisory Control and Data Acquisition (SCADA) functions. However, it is not known if an L&G Gridstream DA software application exists that is being used by a utility in a full production environment at this point.

## 6.4 Client Benefits

Perhaps the most disappointing aspect of the Hydro Quebec project is the lack of attention given to the importance of client benefits that can be achieved in the near term through AMI. Hydro Quebec, in its authorization request filing, has focused almost entirely on a few operational benefits and savings, and has provided only a brief mention of client impacts or benefits, which they have generally listed as follows:

- Eliminate estimated bills
- Transition to monthly billing
- Potential for using remote disconnect/reconnect feature for move in/move out clients
- Improved bill accuracy
- Eliminates the need to gain access to client properties
- A general benefit from reducing HQ's vehicle fleet
- A possible future potential for reduced outage time

With the exception of remote disconnect functions and outage detection, the above features can typically be provided using only a level 1 base network functionality as described in Section 5.3. Hydro Quebec has discussed the potential for implementing additional, more advanced features such as outage management as a general objective, but has not included any specific plans or commitments in its current authorization request.

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[41] Note Smartgrid Times press release: "Landis+Gyr Enables Alliant Energy's Volt/VAR Management Project to Improve Energy Efficiency and Distribution System Performance", October 2011.

A review of the overall project schedule provided to Valutech reveals that it provides no insight into the timing of any specific project benefits[42], though it shows mass deployment efforts for the 3 phases continuing through 2017. In our view, client benefits should be provided for each phase as it is completed and the L&G network demonstrates it is capable of providing the necessary read performance needed to receive utility acceptance. Adding demand response and other client benefits should not be delayed until 2017 or beyond, when the project is officially completed. If implemented as currently planned, or if the Energy Board does not authorize future phases, some client benefits may never be achieved and the AMI system would be significantly underutilized.

### 6.4.1 Demand Response Benefits

An increasing number of utilities have begun implementing voluntary demand response programs designed to encourage client participation in a reduction in peak energy usage. Demand response programs are designed to be cost effective and environmentally responsible methods of reducing client energy costs while at the same time helping a utility to avoid the need for costly off system energy purchases during periods of peak system demand.

AMI systems support these types of programs by providing the advanced metering needed for time-of-use and critical peak pricing rates, and the communications infrastructure needed to transmit pricing signals and other program data to participating clients. By adjusting the time of energy use, clients can take advantage of cheaper off peak energy rates to save money, and in the process create a closer utility-client relationship that benefits both parties.

Load Control Management Systems and Home Area Networks are ancillary systems installed by utilities to leverage their AMI system capabilities and provide a range of demand response opportunities for clients. They require close interaction with other associated systems including the AMI and meter data management systems, the Customer Information System (SAP for Hydro Quebec), and in some cases third parties such as energy suppliers and regional transmission organizations. External pricing signals may be generated by these parties that must pass through the AMI system to cycle an air conditioner, adjust a programmable thermostat or alert the client to a critical peak pricing period.

Some general characteristics of Load Control Management Systems (LCMS) and Home Area Networks (HAN) are as follows:

- Provide a set of HAN devices such as programmable thermostats and in-home energy displays to be used for monitoring and control of energy use for residential and small commercial customers
- Provide back office load control/load management software for overall management, provisioning and activation of in-home devices, air conditioner cycling and water heater disconnects

[42] See Hydro Quebec's responses to 2nd set of questions, HQD-3, doc 2.1, Attachment B, dated October 14, 2011.

- Make use of a two way AMI communications system based on integration of ZigBee, HomePlug, Z Wave or WiFi supported AMI systems including interfaces with CIS and meter data management systems
- Include control functions for HAN device management, control operations, grouping and addressing, pricing signals and event management
- Provide data management functions that collect data and validate information used for load control/load management operations
- Include event management software applications that analyze and aggregate load management data to evaluate the performance of load control, critical peak pricing and other demand response events to meet utility peak reduction requirements
- The LCMS will be able to perform load control functions such as cycling air conditioners and disabling electric water heaters and pool pumps
- Include HAN and LCMS device provisioning capabilities for clients to engage in the participation in various programs
- Include a client web portal so that the HAN can provide energy usage information to a client through a gateway or integration with the utility's AMI and meter data management systems

The Landis+Gyr AMI system is capable of providing the AMI network communications link necessary through use of ZigBee to support these types of demand response programs if a sufficient number of collectors and routers have been included so that sufficient bandwidth is provided in the network design. However, there is no evidence that Hydro Quebec is pursuing demand response implementation anytime soon, or has developed the necessary interfaces with SAP to support these types of programs. Valutech does not believe that the pilot programs, as currently constructed, are adequate to verify that sufficient bandwidth has been provided system wide for these types of programs.

### 6.4.2 Other Client Benefits

AMI implementation can provide Hydro Quebec's clients with improved service, reduced billing errors and complaints, faster service, a greater variety of billing and rate choices, new services, and greater client choice. Client benefits are often over looked because they are difficult to quantify, but many experts feel that they result in the most important benefits of AMI deployments. The list below summarizes some of the more significant examples of client benefits:

- *Daily reads permit offering of flexible bill due dates*
- *Monthly bills are more predictable for family budgets*
- *Estimated bills are virtually eliminated*
- *Consolidated bills can be issued for clients with multiple accounts*
- *Retirees can select their bill due dates based on timing of monthly payments*
- *Generates on and off peak usage data for use in time-of-use rates*
- *Smart meters can record time based usage for electric vehicle charging*
- *Extensive load profiling provides clients with information on their usage patterns*

- *Snow birds can be notified by email if a power outage occurs at their primary residence*
- *Family of clients on life support equipment can be notified if a power outage occurs*
- *Rapid utility outage response from network outage detection shortens client power outages*
- *Interval reads support billing for cheaper off system energy purchases*
- *HAN based energy displays and programmable thermostats produce reductions in client usage*
- *Reduced property damage from onsite visits by utility personnel*
- *Net metering functions offer energy cost reduction opportunities*
- *AMI and MDM enabled client web portals provide clients with timely access to usage*
- *AMI network low voltage alarms detect voltage problems that avoid equipment damage*
- *Future HAN applications such as appliance failure and medical alerts may be implemented*

The implementation of an AMI solution can significantly reduce estimated bills, for example, which in turn will reduce client complaints, disputes and inquiries. Utilities have experienced significant reductions in client high bill complaints caused by missed or incorrect reads, as meter access problems are significantly reduced. These types of problems are significantly greater when multi-month bills are issued, and when, as in Hydro Quebec's case, a significant percentage of inside meters exists. The availability of daily readings for all client accounts can permit the utility to offer flexible due dates for customers on fixed incomes.

Clients should also see improvements in service reliability through timelier outage notification and improvements in power quality. Advanced metering devices can record low voltage conditions and other power quality problems that can adversely affect customer equipment. And reductions in outage times will have a positive effect on customer satisfaction.

Another significant client benefit is the potential to offer clients a broader choice of energy supply services through innovative rate structures and demand response programs that can encourage more efficient energy consumption. AMI systems can support a variety of rates that provide a real choice to customers, and can provide the monitoring functions that reward them for participating in load curtailment programs.

From our review of the Hydro Quebec authorization request, there is not much evidence that HQ intends to offer these types of services to clients at any time in the near future. The relatively long 5 year deployment time suggests a level of indifference to the current client needs, since during this period the focus will be almost entirely on capturing operational savings from eliminating manual meter readings and remote disconnecting meters. It appears that little consideration is being given to improving client satisfaction in certain areas.

We believe that the Landis+Gyr network, when integrated with EnergyICT and the SAP billing system, could be fully capable of generating many of these client services during Phase1, and there is no need to delay offering benefits to clients with smart meters until all phases are completed. Some benefits, such as outage detection, require sufficient bandwidth as discussed previously in greater detail. However, many require only modifications to SAP or other enterprise systems that are well within HQ's capabilities to implement. The Energy Board should therefore condition any authorization to move forward with Phase 1 on HQ's submittal of a Utility/Client Benefits Plan to provide these AMI supported services before approval of Phase 2.

## 6.5 Observations

Valutech Solutions is familiar with virtually all AMI technologies on the market today. Based on the available material provided by Hydro Quebec in its authorization request, and Valutech's own industry knowledge and experience, we have examined the basic elements of the proposed Landis+Gyr technology solution to attempt to determine if reasonable and appropriate decisions were made concerning an AMI system selection. Since Hydro Quebec's Request for Proposal and AMI network specification have not been provided, our review largely involves a comparison of known L&G functionality with typical AMI system capabilities.

Valutech has requested, but has not been provided, access to the Hydro Quebec business case, the Landis+Gyr technical proposal and the final contract terms negotiated between the parties. It is therefore not possible to review or confirm some key contract requirements and performance metrics, such as network design standards, contracted quantities of collectors and routers and network outage and remote disconnect response times. It is also not possible to know the level of integration that has taken place at the time of this report between EnergyICT and SAP, or to determine if the full L&G capability for advanced functions will be integrated with SAP.

We also requested, but were not provided, copies of all bid documents from other AMI system suppliers. Since no bid documents from associated technology proposals and pricing were provided, Valutech cannot provide any specific judgments concerning tradeoffs that may have been made between different technologies and pricing options, or determine if any such tradeoffs were reasonable under the specific circumstances.

Based on the limited availability of project specific material, and using industry knowledge and experience we are making the following observations:

***A. In our opinion, the selection of Landis+Gyr to provide Hydro Quebec's AMI system was a reasonable outcome based on the stated objectives and available industry options at the time of vendor selection.***

1. The Landis+Gyr AMI system provides a favorable comparison between its available features and general industry characteristics as reflected on the technology chart in Section 5.3.1. While no technology road map was provided, L&G has a history of providing periodic technology upgrades and maintaining a high level of technical proficiency.

2. An examination of AMI system market positioning and product delivery statistics in 2009, the last complete year before the vendor selection process began, reveals that Landis+Gyr was a market leader and had delivered meters and AMI systems second only to Itron in terms of

market volume. It was therefore reasonable to believe that L&G could deliver a full featured AMI system at the time of selection.

3. As a manufacturer of smart meters in addition to AMI network systems, Landis+Gyr is capable of delivering an end-to-end technology solution that includes meters, communications network and head end data collection software. This approach reduces risk and makes one vendor responsible for all network components and interoperability.

4. With large deployments already started or completed at major utilities such as Xcel Energy, Exelon, Colorado Springs Utilities and Kansas City Power & Light, L&G has demonstrated a large deployment competency that provides significant confidence it can manage Hydro Quebec's 3.75 million meter deployment.

5. Hydro Quebec's stated current AMI objectives, not including any hypothetical or alternative objectives that cannot be considered in this study, are very modest and appear to be well within the capabilities of the Landis+Gyr system.

By any reasonable standard, the Landis+Gyr Gridstream network appears to be capable of meeting the technical requirements as stated in HQ's authorization request. Given the limited information provided, however, Valutech cannot determine if the AMI system as contracted is sufficient to satisfy any specific performance levels or standards.

### *B. In Valutech's opinion, the Landis+Gyr AMI system is capable of supporting future services for demand response, time based energy pricing and electric vehicle charging if sufficient bandwidth, modifications and upgrades are provided.*

1. Landis+Gyr's E350 Focus AX-SD advanced new generation smart meters are capable of recording energy usage at designated intervals to support time based rates. These meters will permit the introduction of time-of-use rates and include the ZigBee Smart Energy Profile communications needed to pass pricing signals for critical peak pricing.

2. Most demand response programs today involve installation of programmable thermostats, in home energy displays and load control devices for cycling air conditioners and controlling electric water heaters, and typically use a third party software application for management and control of these functions. It appears that L&G's network interface capabilities are sufficient to permit a real time interface with these types of HAN and LCMS systems.

3. The Landis+Gyr network, with ZigBee installed in the meter, appears capable of communicating with programmable thermostats and in-home energy displays. In addition, L&G is now offering its own ecoMeter product for in-home energy monitoring.

4. For more advanced smart grid applications, Landis+Gyr has developed a Gridstream DA application that appears to be capable of managing some circuit switching functions, capacitor bank controls and other smart grid devices. However, it is likely that different collectors would

be required which would add to the overall project cost if these smart grid functions were implemented in the future.

5. Electric vehicle charging is not considered a core AMI system function, but does require time-of-use metering capabilities to record discounted energy usage during off peak charging periods. The L&G network should be able to provide the metering for 3rd party suppliers of these systems and support an appropriate off peak rate for vehicle charging purposes.

***C. In Valutech's opinion, from the stated objectives, Hydro Quebec has not made a sufficient commitment to providing client benefits or improving client satisfaction.***

1. Hydro Quebec's stated client benefits are very general, and no specific timeline has been provided for implementation of any new benefits before the 2017 completion of phase 3 deployment. The project schedule provided in the responses to questions fails to provide any client benefit milestones.

2. Hydro Quebec claims that the AMI system will produce $300 million in operating savings over the life of the system[43]. Yet there does not appear to be any flow through of these savings to the clients. We believe these operating savings should be returned to the clients or used to implement many of the above listed client benefits.

3. Delaying implementation of demand response and other client benefits until 2017 would place Quebec residents at a disadvantage over other provinces that are currently implementing AMI. Hydro Quebec should fully utilize the new smart meters by providing demand response opportunities for clients to monitor and reduce their energy costs as soon as the AMI network can support them.

## 6.6 Recommendations

From the available documents, we believe that Hydro Quebec has made reasonable decisions concerning the choice of a 5 year project deployment timeline and the technology selected. However, from our understanding of the status of the pilot programs to date, the timing for requesting authorization to move forward with Phase 1 deployment at this time is not appropriate. It is not clear that sufficient numbers of smart meters have been deployed to verify that network performance will be achieved at a 99.4% level for a large population of meters, and thereby demonstrate that the mesh network can reliably read all meters at this level of performance.

Many of the meters installed in the pilot areas, such as the 2,600 meters used for the Heure Juste project, are older technology that will be replaced with new generation meters. It appears that 17,500 meters in the 1st pilot area are being read using older MV-90 technology, and the 19,000 new meters

[43] Hydro Quebec authorization request HQD-1, doc 1, dated June 30, 2011, pages 39 and 40.

planned for Villeray in the 3rd pilot area require installation by the outside installation contractor. From the information provided to date, it appears that only 800 new meters in the 1st pilot area will be used to verify proposed network performance for the entire province.

Hydro Quebec has stated that only 8,738 new meters out of 27,176 had been installed by September 19, 2011[44]. It is not known how many of these meters are being read over the network at the required level of performance. Based on our understanding of the progress made to date, SAP integration will not be completed before November 2011, and the current extent of the SAP integration with L&G and EnergyICT is not known. We don't know, for example, if the remote disconnect/reconnect function will be fully operational in time for Phase 1 and can be activated through SAP.

It is also not clear how HQ intends to deploy the smaller quantity of Elster meters that is being purchased, or if extensive testing is planned to determine if they can operate in the same mesh configuration as the L&G meters and provide full functional capability. No strategy has been identified for deploying and testing the Elster meters separately or in a configuration with the L&G meters.

Valutech is not convinced that a sufficient number of new meters and network collectors and routers has been installed to date to adequately verify network performance. The Landis+Gyr mesh network technology requires a sufficient number of collectors, routers and meters be installed to reduce the number of hops and provide an adequate level of bandwidth and transmission speed. A larger population of meters should be installed to confirm network performance, since an 800 meter deployment with a small number of collectors and routers may not be sufficient to confirm consistent network performance across the entire province.

1. The Energy Board should extend the pilot period by a sufficient amount of time, perhaps 6 months to a year beyond the proposed June 2012 completion date, for Hydro Quebec to deploy and test a more extensive pilot network, using both L&G and Elster meters and Rogers Communications, to clearly demonstrate adequate network read performance and refine new business processes. Satellite as well as cellular communications should be tested to satisfy the WAN data backhaul requirements.

2. Hydro Quebec should submit a detailed report to the Energy Board describing the extent of the end-to-end AMI system testing that has been conducted during the pilot period, the interfaces and features that were tested, and the results achieved, before approval is granted to proceed with Phase 1. This testing should verify reliable communications using the cellular and satellite WAN backhaul services provided by Rogers Communications.[45]

3. Hydro Quebec should confirm its initial assumptions concerning the ratio of meters, collectors and routers that will be required to achieve a 99.4% read rate across the entire province, and

[44] Hydro Quebec response to commitment no. 14, HQD-3, doc 2, dated September 21, 2011, page 29. See also the table provided in response to Question 8.1 of HQD-2, doc 1, page 25.

[45] Reference: HQD-4.1, doc 5, dated October 13, 2011, Table R-68, page 8, shows that no communications link has yet been established that uses satellite technology. No daily readings are taking place using satellite communications.

should certify to the Energy Board that the cost of the project includes a sufficient quantity of network devices so that cost overruns will not occur and be passed on to clients in later phases.

4. Hydro Quebec should submit a Client Services report to the Energy Board describing its plans to implement a full portfolio of client benefits including demand response, home energy management, client access to usage data, electric vehicle metering and time based pricing. The Energy Board should approve this implementation plan during Phase 1 before approval is granted to proceed with Phase 2.

5. As a condition for moving forward with Phase 1, the Energy Board should require Hydro Quebec to expand its Heure Juste tariff project and offer it to all residential clients with smart meters as soon as the Landis+Gyr network is sufficiently deployed in each phase to support it. HQ should revise the pricing tiers to make it more attractive, which would increase the incentive for clients to shift energy usage to off peak periods.

# 7.0 Economic Analysis

Valutech Solutions was also asked to review Hydro Quebec's Phase 1 authorization request for the LAD project to determine if the selection of the Landis+Gyr AMI system was the optimal choice and is in the best interest of its clients. Among the areas cited for discussion were the acquisition and integration of the AMI and meter data management systems and review of the requests for proposals for these systems, including the telecommunications services and Metering Operations Center (MOC). Analysis of the cost of future new features could be discussed generally, but should not be specifically included in the current project analysis.

Hydro Quebec has submitted a request to the Energy Board to proceed with Phase 1 of the $997 million LAD project, which would include the cost for installation of 1.7 million meters plus $82 million in AMI IT costs and recovery of preparatory costs in the amount of $42 million, for a Phase 1 total of $440 million. This amount would be expended over a period from June 2012 through December 2013, with the project balance expended in two subsequent phases through 2017. Preparatory costs have been expended since June 2010 on MDMS and 3 pilot projects designed to get ready for the Phase 1 deployment to begin in 2012.

**Availability of Material**

In order to comply with our mandate, Valutech requested but was not provided copies of all business case materials, financial models and pricing proposals needed to evaluate Hydro Quebec's assumptions and validate the project cost. We also requested copies of the other vendor proposals, the approved vendor contract documents and the detailed written description of work to be performed, in order to evaluate the results in accordance with our mandate. Valutech was not given access to these documents.

We believe that the contract documents and description of work would have provided some necessary insight into the many project cost assumptions that were made, such as use of an estimated meter installation cost and the projected cost of telecommunications service, so that the reasonableness of the overall project estimate could be assessed.

In the absence of these documents, Valutech has examined the authorization request and other available documents, including responses to the Energy Board's questions, and has attempted to provide its best assessment of overall project cost.

## 7.1 General Comparison of Costs

Hydro Quebec has publicly announced that the LAD project will cost an estimated $997 million, including $42 million in preparatory costs, expended during the period from 2010-2017. Authorization is currently being requested for recovery of preparatory costs and to proceed with the meter installations planned for Phase 1. A 24 month pilot period has been underway since 2010, during which time HQ has been evaluating 3 separate pilots, testing equipment and interfaces and modifying its internal processes.

Since none of the supporting material for Hydro Quebec's business case and cash flow analysis, including vendor pricing, has been provided, Valutech has proceeded with a general assumption that figures provided in the authorization request are correct. However, given HQ's statements that only the elimination of manual meter reading and remote disconnect functions are included among benefits, Valutech believes that other utility benefits may have been significantly understated (See Section 3.6 above for a listing of benefits that were not included) in the figure for total project cost. The addition of the Accenture material provided in the authorization request suggests that many of the benefits may have been quantified and included in HQ's internal return on investment calculations, but were not used to offset other project costs for tariff recovery purposes.[46] Based on Valutech's experience, we will make some observations, and provide some recommendations concerning the potential project cost.

**Capital Cost Per Meter**

Based on a projected capital cost of $997 million, and a meter population in of 3.8 million meters, the projected average cost per meter for the Hydro Quebec AMI system is calculated to be $262.37. This figure compares reasonably with other AMI project estimates in North America, but is on the high end of the pricing spectrum[47].

Figure 10 below provides a graphical representation of the relative cost per meter compared to 8 other publicly announced large utility projects, where economies of scale would presume to bring the average cost per meter down. We find that due to the wide range of utility sizes and quantities of meters, average cost per meter represents the best overall method for comparing project costs.

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[46] Reference: B-0006, HQD-1, Document 1, Pages 13 and 18, Source: Accenture 2009

[47] Figures for North American projects with publicly available data were used. Data is for the estimated cost of AMI projects, as most of these projects are not yet completed. EPCOR's 2009 study projected a capital cost of $77 million for 330,000 meters, or approximately $233.00 per meter. Data provided from publicly available sources, and presented at Ohio PUC Smart Metering Workshop.

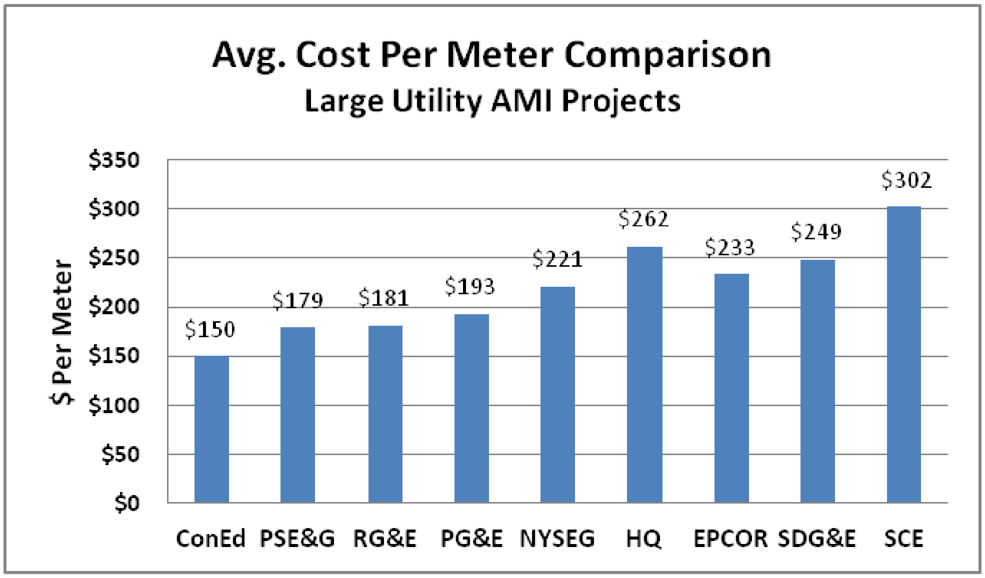


Figure 10 – Average Cost Per Meter

The significant variation in AMI system cost for these projects can partly be attributed to the particular features that were offered and the size of the service area. Consolidated Edison, for example, covers a service area of approximately 2,200 sq. miles, while the Southern California Edison service area exceeds 51,000 square miles, which is over 23 times greater and involves a much larger communications network. SDG&E and SCE also included remote disconnect devices in their estimates, which at the time were still a quite expensive alternative.

Other factors such as the addition of meter data management, ZigBee and the AMI technology selected will also contribute to variations in the total project cost. Hydro Quebec has incurred preparatory costs, including the cost of MDM software and interfaces, which are added into the project cost as well as an estimated $82 million for AMI IT costs. In its responses to the Energy Board's questions, Hydro Quebec indicated that the average cost of placing a meter in service (meter cost plus installation) will be $165.18 during the course of the project[48]. This means that $97.19 of the $262.37 total average meter cost, or 36% of the project cost, will be spent on network, software and project management functions.

The proposed $636.4 million for meter and installation costs will represent 64% of the total project expenditure, and therefore a slight increase in the unit cost of installation could produce a noticeable increase in total project cost. Hydro Quebec has based its total installation cost figure on installation benchmarking estimates that could soon prove to be inaccurate. Once the outside installation contractor's contract is signed, HQ should revise the project cost and inform the Energy Board of the resulting increase or decrease.

[48] Response to Questions HQD-2, doc 1 dated September 9, 2011, Table R-8.1, page 25.

A second area of potential cost risk is the large number of meters that are located inside buildings. Hydro Quebec states that 35% of all meters are located inside, including 69% within Montreal[49]. Since Montreal falls into the Phase1 deployment area, a small deviation from the installation contractor's access assumptions (higher than expected number of appointments, for example) could produce a significant increase in the Phase 1 installation cost. Valutech recommends that the Energy Board review performance in this area during completion of pilot programs, particularly in Montreal, to determine if difficulties gaining access have produced a higher number of return visits and will increase the overall project cost.

As mentioned above, non-meter related costs represent 36% of the project cost. Some observed reasons for the high cost in the non-meter categories are the level of IT expenditures, $120 million for collectors and routers, consultant costs and $157 million of capitalized operating costs. These areas should be further scrutinized as follows:

**IT Expenditures.** Hydro Quebec is budgeting $72 million for IT infrastructure and $63 million for IT operations over the life of the project. These amounts represent 37% of the non-meter cost, and suggest that a migration to a service oriented architecture or similar transition may be taking place. HQ has also suggested that some $30 million in It related expenditures may be spent on SAP integration.[50] The Energy Board should request an audit of these expenditures to ensure that they aren't improperly subsidizing other project budgets such as the SAP implementation budget. While improvements in IT network platforms, software and governance are generally required to support these types of projects, utility wide upgrades that also support other enterprise systems should not be disproportionately allocated to the AMI project.

**Network Equipment Charges.** In its authorization request, HQ stated that $120 million is being allocated to pay for collectors and routers. The exact quantities of these devices have not been provided, but this area represents a significant risk factor for increased total project cost. Hydro Quebec appears to be basing its contracted quantities, and therefore the projected network cost, on the results of two pilots in which a relatively small number of smart meters have been installed. Additional unbudgeted quantities of network devices that must be added to meet read performance requirements would cause an increase in network costs and associated Rogers Communications expenses.

Other installed pilot meters read by MV-90 and installed for the Heure Juste tariff project, for example, will be replaced and are most likely not capable of being read over the new network. As we have previously mentioned, Valutech is not convinced that the number of new smart meters installed within reach of the test network is sufficient to validate network read performance system wide. If contract provisions providing network cost caps were not included, the cost exposure to add additional collectors and routers later could be significant.

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[49] Hydro Quebec Authorization Request, HQD-1, doc 1 dated June 30, 2011, page 16.

[50] See HQD-4, doc 13 dated November 23, 2011, page 21. This document states that a portion of the $30 million will be spent on data warehouse acquisition, integration with legacy systems and SAP. It is not clear if these expenditures are related to this LAD project or general IT system upgrades. Energy Board should ensure that these costs are not being misapplied to the LAD project.

**Consultant Costs.** Without knowing the specific scope of services provided by the HQ consultants, it is not possible to provide a definitive opinion concerning the amount or rationale for these costs. However, at 11% of the total non-meter related expenditures, they do represent a significant portion of project cost. Typically, a significant level of implementation services effort is required during the beginning stages of the project to design, build and test system interfaces, set up, configure and test the project software, support requirements workshops and training, and perform certain project management functions. Much of this effort may have been included in the Preparatory Work category. However, Hydro Quebec states that only a "partial integration" of the AMI and meter data management systems with SAP will have been completed by the end of November 2011[51].

It is not known whether advanced, near real time AMI functions, such as remote disconnect, outage detection and on request reads will be working at the time of Energy Board authorization for Phase 1. Since EnergyICT is not yet certified on SAP's Enhancement Pack 5 and its MDUS interface protocol at this time, some clarification is needed to determine the extent of progress made so far by the system integrator Ericsson. These expenses are included in the $42 million of preparatory work identified on Table 4 of the authorization request, and this work should be certified as complete prior to the start of Phase 1. If not fully implemented, these functions cannot be properly tested over the network during end-to-end testing initiated from SAP, which could limit HQ's ability to identify design and latency issues within the network.

Approximately $30 million out of the $40 million consultant cost is expected to be spent in years 2012-2017 after the project has moved into Phase 1. A Project Management Office (PMO) is most likely being established to perform project management functions and manage change control for the entire project. However, a much lower level of effort is typically required in the later years of the project, and we believe the associated costs for these services should be reduced during the final years.

**Operating Costs.** Hydro Quebec expects to capitalize a significant amount of operating expenses that will be incurred to support project implementation from the preparatory work stage through project completion. The $157.4 million identified in Table 4 that will be spent represents 44% of the total non-meter cost, and includes $63 million of the IT cost. Over $11 million will be expended annually in years 2015-2017 mostly for licenses, maintenance and operation expenses. No detailed breakdown of these costs has been provided to determine if software maintenance costs are above average, or if IT costs for operation of other enterprise systems may have been included.

HQ has included $31 million in this category for relocation of displaced employees. If HQ's estimate that 300 employees will fall into this category is accurate, this represents an average of over $100,000 per employee. Displaced employee costs are included in the project cost each year, yet no offsetting credit to the project cost is provided in subsequent years for the resulting elimination of their salaries and expenses. Valutech recommends that the individual operating departments should budget for these costs and offset them with corresponding reduced operating department labour and expenses during the period that the positions are vacated.

[51] See response to Question 4 of Request for Information No 1 dated September 28, 2011.

Telecommunications costs totaling over $19 million are included, and are apparently the costs for cellular and satellite connections to backhaul data from the collectors to the operations center. Since the quantity of collectors is not known, and the Rogers contract was not provided, it is not possible to evaluate the reasonableness of these costs. However, it should be noted that if increases in the number of collectors are required to achieve the contracted 99.4% read rate system wide, then a greater number of cellular and satellite connections will be needed, which will increase the long term network operating costs.

At its peak deployment year in 2015, HQ projects that nearly $37 million in annual operating costs will be incurred to support AMI system operation and rollout. In our view, this amount appears to be higher than anticipated, and includes approximately $10.4 million in misc. charges that should be further scrutinized to determine if some departmental operating expenses, such as training and transportation, are being inappropriately allocated to the project cost.

## 7.2 Phase 1 Cost Considerations

Hydro Quebec is currently requesting authority to proceed with only Phase 1 of the LAD Project at this point. However, the Energy Board should consider the implications of completing, or not completing the entire project before making a final decision on Phase 1. If, for example, subsequent phases are not completed, the situation could exist where different levels of service are being provided to different areas of Quebec Province.

A key driver of the project justification has been that clients will be able to receive monthly bills and required access to buildings will be eliminated. These benefits may not be implemented under a partial deployment scenario, and therefore some benefits promised at the time of Phase 1 authorization may not be realized even for the Phase 1 clients if the rest of the project doesn’t go forward.

Budgets for some items will be nearly 100% expended during Phase 1, and therefore the purchased assets could be significantly underutilized if the entire project were not completed. For example, IT infrastructure costs, listed as $72.1 million in the Phase 1 budget, would be completely spent, and approximately $10.1 million in consulting fees would also be fully utilized. And Hydro Quebec would still expect to obtain recovery for the entire $42 million in preparatory work whether or not the entire project moves forward.

Since the pressure to continue with Phases 2 & 3 would be so great, the Energy Board should establish certain fixed project performance metrics before approving Phase 1 that would determine whether or not Hydro Quebec could move forward with subsequent phases.

### 7.2.1 Phase 1 Average Meter Cost

Hydro Quebec’s current authorization request is for Phase 1 costs totaling $440 million, which will involve installation of approximately 1.7 million meters, including pilot areas, during the period from

June 2012 to December 2013[52]. This would produce an average cost per meter of $258.82, which is actually slightly below the average meter cost figure for the entire project. One apparent reason for this counterintuitive result is that some identified Phase 1 cost categories appear to be disproportionately low.

Phase 1 operating costs, listed at $44.2 million, are only 28% of the total project operating costs, even though 45% of the meters would be installed. There may be some justification for this since some operating cost categories would continue to grow as additional meters were installed. However, in order to calculate a true comparison of the Phase 1 commitment vs. total project cost, the project timelines should be similar to reflect the ongoing need to operate the system even if the project ended with Phase 1.

Normalizing the cost would require presenting recurring Phase 1 operating costs, capitalized borrowing costs and some IT costs through 2017. The current scenario where Phase 1 runs through December 2013, and yet no associated operating costs are included for these installations during the years 2014-2017 is not a complete picture of the commitment being made.

Employee displacement costs appear to assume that retirements and turnover will occur early in the process to handle displaced employees, and therefore only $7 million out of a $31 million displacement budget, or 23%, will be required in Phase 1. If these and similar costs as mentioned above are simply prorated over time or by the percentage of meters installed, the Phase 1 costs would be significantly higher.

### 7.2.2 Phase 1 Performance

In its Phase 1 authorization request, Hydro Quebec proposes to include project tracking along with its annual report filed with the Energy Board. Given the size of the project, this appears to be an inadequate level of reporting to provide sufficient information for the Energy Board to properly evaluate Hydro Quebec's project performance prior to making a decision on Phase 2. Valutech believes Hydro Quebec should provide a quarterly report to the Energy Board with detailed project tracking, cost and schedule analysis, including progress against certain pre-determined project milestones. Phase 1 performance metrics should be established and agreed on before authorization is given to proceed.

Hydro Quebec currently proposes to track performance in the following 4 areas:

A. **Meters installed relative to the plan.** Simply tracking the meter installations is not sufficient. If network or meter installations fall behind schedule, due to building access problems for example, HQ should provide a recovery plan for on time completion that is monitored in the quarterly report.

B. **High level project cost tracking.** A detailed work breakdown structure and cost tracking methodology should be implemented so that corrective action plans can be instituted when cost

[52] Cost data for Phase 1 is taken from the Hydro Quebec Authorization Request, HQD-1, doc 1 dated June 30, 2011, page 46.

overruns begin to occur. This approach should ensure that cost containment does not occur at the expense of reduced system performance (lower read performance, for example).

C. **Tracking of quantified savings.** Historically, this category is most difficult to monitor. Utility operating budgets, for example may benefit from savings which occur through AMI implementation without allocating these savings to offset the project cost (meter reading labour and transportation, IT hardware replacement budgets, etc. are examples). HQ should provide quarterly updates with detailed descriptions of all capital and operating cost savings (positions and vehicles eliminated, etc.), across the utility.

D. **Project implementation due dates.** Certain due dates should become hard milestones that progress is measured against. These milestones should include performance as well as cost and schedule milestones, such as achieving certain read rates, beginning monthly billing, implementing the remote disconnect function, etc.

The transition to Phase 2 should be conditioned on meeting specific project performance metrics as discussed above so that the results will be clear and the Energy Board will not be pressured into approving further expansion of a system that is exceeding the approved cost or not capable of delivering the promised functionality.

## 7.3 Benefits Contributions

In its authorization request, Hydro Quebec explains that for simplicity purposes, it has included only a basic portfolio of client and utility operating benefits that will be provided before project completion in 2017.

The benefits potentially offered during the 5 year deployment period are limited to automated meter reading with the resulting elimination of building access, eliminating estimated bills, remote disconnect functions for collections shut offs, and possibly a transition to monthly meter reading. However, it should be noted that Hydro Quebec has indicated in its response to questions that they will only transition to monthly billing if the entire project (all 3 phases) is authorized[53]. So the benefits portfolio HQ is committed to implementing appears to be rather limited.

Following is a generally accepted listing of direct and indirect operating benefits that are typically included in AMI system business cases. These benefits will often accrue to the various operating departments that perform the work on a routine basis. However, savings occurring during the years of project implementation should be credited against the $157.4 million in operating costs HQ is allocating to the project cost while project deployment is taking place.

[53] Hydro Quebec's response to Question 13.1 of the First Response to Questions, HQD-2, doc 1, dated September 9, 2011, pages 34-35.

It does not appear that the LAD Project budget is being credited for any of the reductions in the meter reading work force; yet the project is being charged for the expenditures associated with transitioning the meter readers to other jobs or exiting the company. For many AMI projects, meter reader labour reductions are the single greatest utility related benefit.

| Typical Operating Benefits Included in Utility Business Cases | |
|---|---|
| • Older billing system operation & maintenance | • Engineering- transformer sizing/planning |
| • Manual bill processing for estimates | • Cash flow improvements |
| • Billing adjustments and rebills | • Meter reading labor savings |
| • Call center- billing inquiries | • Meter reading field re-reads |
| • Call center- call in readings | • Meter inspection costs |
| • Call center- reread meter requests | • Energy diversion losses |
| • Call center- outage calls/restoration call backs | • Collections shut offs and restorations |
| • Call center- reduced collections calls | • Fewer truck rolls- fuel and maint. savings |
| • Reductions in bad debt expenses | • Preparing consolidated bills |
| • Replacement of hand held meter reading equip. | • Reduced outage management efforts |
| • Reduction in high bill write offs | • Reduction in scheduled meter replacements |
| • Fewer field visits for no light calls | • Employee benefits savings |
| • Reduced personnel and vehicle accidents | • Fewer lost time accidents |

Table 3 – Typical AMI System Operating Benefits

As the above operating benefits are realized, departments will normally be expected to reduce their associated operating costs by a corresponding amount. Hydro Quebec's authorization request reflects what are characterized as additional project related operating costs, but does not appear show any of these resulting credits for the operating benefits, including reductions in manual meter reading costs.

Typically, utilities implementing AMI will experience the most sizable operating savings in the meter reading area through a steady, down trending reduction in the number of meter readers and field shutoff personnel required, along with a corresponding reduction in transportation, uniforms, equipment and other related expenses. Capital budgets for future automobile and small truck purchases for these functions should also be reduced. The HQ project budget should reflect these reductions both during the 5 year deployment period and in the subsequent operating periods after project completion.

Section 5.4 of this report discusses a range of client benefits that should be implemented as soon as practicable during Phase 1 implementation. Many of these benefits will contribute to improved project acceptance and increase client satisfaction. Outage detection, on request reads and adjustable bill due dates, for example, are some good examples of AMI system benefits that can shorten outage times, provide better client service and make timely energy usage information available to resolve client billing inquiries.

The following figure provides a composite look at the major system benefit categories and shows a relative weighting of these areas against one another. Clearly, regular meter reading is only a portion of the utility benefits that can be achieved, and Hydro Quebec should quantify and include additional utility benefits in its cash flow analysis before any future request for a tariff revision is considered.

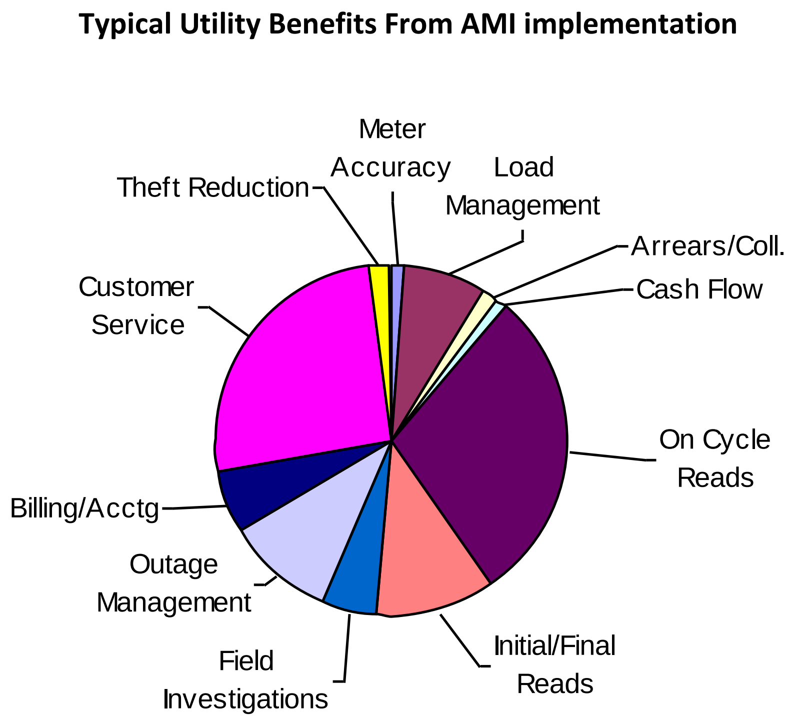


Figure 11 – Composite View of AMI System Benefits

**CATVAR Project**

Although the CATVAR automation project generally falls outside of the parameters of this present case, Hydro Quebec has provided some information relayed to the CATVAR project that does have some relevance to the current proceedings, and Valutech's mandate does include the review of CATVAR if it affects AMI implementation. As described by HQ, the CATVAR system monitors some 2000 lines including 1,000 voltage transformers and 800 capacitors for voltage control purposes,[54] with telephone lines used for real time operation of these line devices. If the AMI communications network can be used for CATVAR, a more efficient combined communications network could result, which could save HQ some operating costs associated with payment for CATVAR telephone lines.

[54] See response to GRAME's Request For Information Number 1, HQD-4.1, doc 5 dated October 13, 2011, pages 3-5.

HQ has been exploring the potential for use of the AMI network, including possibly WiMAX, as possible alternatives to the costly use of telephone lines for CATVAR data backhaul.[55] If either of these alternatives can be used, HQ could adjust the AMI business case and apply a credit to AMI for some portion of the telephone line based CATVAR operating costs that are being offset by shared use of the AMI communications network.

Hydro Quebec indicates that the Boucherville zone has been selected for pilot testing of CATVAR communications over the AMI network. In addition to the potential savings in communications and deployment costs, the CATVAR system could benefit from AMI generated low voltage information coming from the smart meters, to provide HQ with a detailed picture of voltage conditions during both on and off peak periods. This voltage mapping potential should be more fully explored by HQ for use in positioning capacitors and other network devices, and in evaluating circuit loading to minimize outages and improve distribution network reliability.

Valutech recommends that Hydro Quebec perform a rigorous testing of the AMI system's backhaul and voltage monitoring capabilities and its ability to support CATVAR. HQ should provide the Energy Board with a report of its findings in the Boucherville pilot area prior to the start of Phase 1 AMI deployment.

With regard to all potential AMI supported utility/client benefits, Hydro Quebec, should not wait for project completion, and should develop a specific implementation plan to capture operational and client benefits as soon as possible in Phase 1.[56]

## 7.4 Observations

It is apparent from general industry cost comparisons that the Hydro Quebec AMI project cost is within the general range of other projects, but is on the high end of the pricing spectrum. In addition to the cost drivers already mentioned, the decision to install the system over a 7 year period (including pilots) is also a modest driver of total project cost.

**Project Length**

Generally, projects of this size are completed in a 3-5 year time period (with some notable exceptions) which helps to reduce the amount of fixed and operating costs coming from project management and other sources. In addition, certain benefits can be captured more quickly, and the dollar value of those benefits can be more rapidly realized and credited against project cost.

In cases where projects are planned that involve longer deployment periods, cost containment often occurs by retaining more project installation functions in house through use of internal utility staff.

[55] See Hydro Quebec's WiMAX RFP, Section F Specifications. Sub-section F.3.1 MAIN APPLICATIONS lists the LAD AMI system as a potential user of the system. Also, Sub-section F.4.10.1 discusses availability of design tools that should be capable of determining if there is sufficient bandwidth for the LAD Collectors.

[56] This data is a composite of several different project business cases, and was prepared courtesy of the Structure Group.

Meter and network hardware installations, for example, can be performed by utility personnel rather than outsourcing, using an extended installation timetable. As another example, there would be additional time for a utility's IT department to perform many of the set up, integration and testing functions that would otherwise be contracted out to an outside system integration firm.

From the information provided, it appears that Hydro Quebec is planning a longer installation period while still outsourcing many significant project functions. HQ is also proposing to implement only a very limited number of operational and client benefits over the 5 year deployment period, which will limit the amount of savings that can be credited to project cost during the implementation period.

**Operating Benefits**

In Section 3.6, we outlined a number of operating benefits that are derived from AMI implementation, including call center savings, fewer truck rolls for turn ons and turn offs, reduced billing inquiries, shortened power outages, cash flow benefits, etc., which are typically included in AMI business cases but are apparently not being specifically reflected in Hydro Quebec's project savings areas. These operating benefits should be quantified (staff reductions in the call center, for example) and credited against operating charges and future operating and maintenance costs. Progress in achieving these benefits should be reported on in the HQ quarterly reports to the Energy Board discussed in other areas of this report.

### *A. In Valutech's opinion, overall project cost is in the higher range of industry experience, but could be considered reasonable if certain cost adjustments and utility benefits are included.*

1. Hydro Quebec should re-examine the approach taken to capitalizing employee displacement costs, and should reassign them back to the affected operating departments to be offset through credits against reduced department salaries and other expenses that are realized.

2. The project IT budget should be re-examined to ensure that new equipment and software upgrades, operating platforms, database licenses, and other IT improvements that are being shared by other enterprise systems are not being inappropriately charged to the AMI project.

3. The amount of consultant costs appears to be higher than expected. HQ should consider taking back some functions such as meter installation project management and change control if these areas are currently assigned to consultants, and should reevaluate the amount of effort that is being contracted out to consultants to support system set up, testing and end of project wrap up. Internal HQ staff should be able to perform many of these functions.

4. Hydro Quebec should review the 2009 Accenture study on typical project benefits[57] as well as the benefits listed herein, and should quantify these benefits if they were not already included in its business case. HQ should credit the associated savings from the additional benefits to the project cost and subsequent post project operating cash flow.

[57] Figure 4- Main Functionalities Used Beyond Remote Meter Reading, Hydro Quebec Authorization Request, HQD-1, doc 1 dated June 30, 2011, page 18.

5. Hydro Quebec should implement appropriate measures to ensure that additional meter and network installation and equipment costs, and associated telecommunications costs, are capped and that the suppliers of these services share an appropriate amount of the risk for any project cost overruns.

6. Hydro Quebec should reevaluate its approach to depreciation of retired equipment that is taken out of service with remaining net book value. Since many of the meters removed from service will retain some operating life, and could potentially be reused elsewhere in areas not yet converted, HQ should consider carrying the newer replaced meters in inventory at their current book value until end of project adjustments, if any, are made.

7. Although a 15 year life is often used for new smart meters for depreciation purposes, some projects have extended the depreciable life to 20 years given the absence of actual long term industry failure data. The currently published Landis+Gyr specification life for their FOCUS E350 AX-SD smart meter is 20 years. Valutech therefore recommends that HQ use a 20 year life as the depreciation standard for the project smart meters.

***B. In our opinion, the project controls anticipated for Phase 1 implementation are not adequate and would not provide sufficient information to the Energy Board to monitor progress and approve subsequent project phases.***

1. The Energy Board should require Hydro Quebec to submit quarterly progress reports showing progress against specific project milestones, and should pre-condition approval to proceed with Phase 2 on completion of these milestones. Cost, schedule and system performance categories should all be included in the performance milestones.

2. The Phase 1 project budget should be revised to reflect the above discussed cost adjustments and to assume the continuation of project operating costs through a similar (2010-2017) deployment timeline to better compare the true costs through 2017 if only Phase 1 is approved.

3. The Energy Board should place project cost overruns at risk for recovery purposes and should obtain Hydro Quebec's concurrence in the expected disposition of any cost overruns as a condition for authorizing HQ to proceed with Phase 1.

***C. In Valutech's opinion, Hydro Quebec is not attempting to capture sufficient utility and client benefits during the deployment period to minimize project cost and fully utilize the capabilities of the AMI system.***

1. Hydro Quebec should reassess and reconsider the timing of its plans for implementing utility and client benefits, and should implement additional utility benefits during Phase 1 to partially offset other project operating costs. Implementing the use of daily reads for move in/move out transactions in Phase 1, for example, would contribute significantly to reductions in field labour and transportation costs.

2. A greater emphasis should be placed on the implementation of client benefits that can improve client services and generate increased client satisfaction. Consolidated billing, adjusted bill due dates, web access to daily usage information and outage detection and notification are all examples of client benefits that could be provided during Phase 1 to engender a positive attitude among clients and create good will.

3. Monthly billing should be implemented as soon as possible for clients with smart meters once they are being read by the AMI network. The Energy Board should approve any required adjustments to the current tariff to permit monthly billing for smart meter clients to proceed no later than the completion of Phase1.

4. Hydro Quebec should commit to developing a demand response plan for Energy Board approval within one year of authorization to proceed with Phase 1. This plan should include the widespread offering of time-of-use rates learning from the experience of the Heure Juste tariff project, and should include a specific rate for electric vehicle charging. HQ should commit to offering time based rates on a voluntary basis to all smart meter residential clients in Phase 1 before authorization is provided for Phase 2 deployment.

5. Hydro Quebec should begin developing a voluntary Home Area Network/Load Control program that provides load control devices, programmable thermostats and in-home energy displays to smart meter clients, and explores the potential for use of the AMI system for other smart appliances. While other third party supporting software may be required in addition to the AMI system to monitor devices and send pricing signals, the Landis+Gyr Gridstream AMI system and ZigBee enabled meters are already designed to pass signals over the two way communications network.

## 7.5 Recommendations

Valutech believes that Hydro Quebec has submitted a project cost for the AMI project that is somewhat above the cost per meter of other similar projects, but that could be considered reasonable if some adjustments were made in certain cost categories as discussed above. General comparisons are always difficult due to the large number of variables involved, but the current strategy being followed that limits the introduction of new benefits to only automated meter reading, remote disconnect for collections purposes and some other minor benefits appears to be overly conservative, underutilizes the Landis+Gyr system and produces a potentially higher project cost with a quite modest level of benefits.

Again, we have not been given access to HQ’s project business case study to determine if many of the benefits identified by Accenture[58] and included in this study were previously quantified and used to calculate the project internal rate of return. However, inclusion of more utility benefits to offset the $157.4 million HQ has included for Operating Costs would bring down the total project cost and reduce the potential impact of the project on future client rates.

[58] Reference: B-0006, HQD-1, Document 1, Pages 13 and 18, Source: Accenture 2009

Hydro Quebec is requesting authorization to proceed with Phase 1 at a projected cost of $440 million. We believe that this cost somewhat understates the true cost that will be incurred since the Operating Charges do not reflect Phase 1 operating expenses through 2017. Previously, we suggested that employee displacement costs be removed from the project budget and transferred to the operating departments to be offset by eliminated salaries. If these costs are permitted to remain in the project cost, however, the Phase 1 cost of $7 million out of the $31 million total displacement seems disproportionately small.

Since eliminating manual meter reading and implementing remote disconnect for collections, and a potential for monthly billing, appear to be the only stated benefits drivers for the AMI project, it is questionable how this project can be justified if only Phase 1 is completed. As previously observed, HQ has stated that they may not actually implement monthly meter reading unless the entire project is completed. If the total project does not go forward, maintaining a manual meter reading operation for approximately 55% of the client base and an automated system for the other 45% would subject HQ to the higher ongoing operating costs of operating two (manual and automated) billing processes for the indefinite future. And offering AMI system enabled client benefits for some but not all of HQ's client base could prove to be problematic.

In our view, the higher operating costs and potential reduction in utility and client benefits increase the likelihood that Hydro Quebec would request a client tariff increase if the Energy Board does not approve the continuation of the project to Phases 2 & 3. Therefore, given the pressure that could be placed on the Energy Board to approve a full system deployment, some specific pre-conditions should be imposed that HQ must achieve during Phase 1, including the appropriate resolution of any cost overruns, before authorizing Phase 1 deployment to proceed.

1. Hydro Quebec should reevaluate the total project cost and make the adjustments discussed in this report before receiving authorization to proceed with Phase 1.

2. Phase 1 project costs should also be recalculated to reflect the adjustments discussed herein before the Energy Board authorizes Hydro Quebec to proceed.

3. Hydro Quebec should agree to a significantly increased reporting regime that provides quarterly progress reports to the Energy Board and includes progress against agreed on cost, schedule and performance related metrics, analysis of problem areas and status of corrective action plans.

4. Hydro Quebec should reexamine its business case benefits categories and include the utility and client benefits identified by Accenture[59] and included in this report as offsets to project cost. These benefits should be substantially initiated with reported progress made during Phase 1.

5. A demand response plan should be developed during Phase 1 that requires Energy Board approval before moving to Phase 2. This plan should include voluntary offering of time based rates that builds on the lessons learned from the Heure Juste tariff program.

[59] Reference: B-0006, HQD-1, Document 1, Pages 13 and 18, Source: Accenture 2009

6. A voluntary Home Area Network/Load Control program should be developed during Phase 1 that would provide increased client usage information, home energy management devices and other load control options, and would more fully utilize the AMI network and ZigBee technology assets that are already included in the project cost.

# 8.0 Overall Conclusions

Valutech Solutions has been engaged by the Groupe de recherche appliquèe en macroècologie (GRAME) to provide an independent report in connection with Hydro Quebec's Project Authorization Request for Remote Meter Reading Project (LAD) – Phase 1, File No. R-3770-2011 dated June 30, 2011. This engagement, which was approved by the Quebec Energy Board, provided a mandate for Valutech to examine three (3) specific areas:

1) *Analysis of the Pilot Project Results*

2) *Analysis of the Technology Choices*

3) *Economic and Financial Analysis of LAD*

To that end, Valutech requested a number of documents, reports and exhibits issued or prepared by Hydro Quebec to demonstrate the financial viability of the project and to review the vendor solicitation process. Unfortunately, as has been previously discussed, only a limited number of the requested documents were provided. It is therefore not possible to provide definitive judgments concerning the appropriateness of many decisions and costs, or to assess whether in all cases Hydro Quebec has made decisions in the most cost effective manner. For example, it is not possible to compare the Landis+Gyr cost proposal with other vendor proposals since these proposals were not provided.

Given our knowledge and experience in this area, however, Valutech has attempted to provide a reasonable analysis of the costs and technology options considered by Hydro Quebec as it completes its various pilot programs and requests authorization to proceed with Phase 1 deployment. In some cases, industry data is available to provide a general benchmark of performance on a cost per meter basis. But the nature of AMI technology projects is such that no two projects are exactly alike.

Some AMI systems are capable of supporting advanced functions without the use of meter data management software, although the more recent trend is to implement MDMS as a form of application software to perform validating, editing and estimating (VEE) functions for advanced time of use and critical peak pricing rates[60]. The MDMS can also play a central role in brokering events and alarms coming from the AMI system to various other enterprise systems such as outage management. Many

[60] A recent Pike Research press release (October 31, 2011) states that 98% of the smart meters in North America will be supported with a meter data management system by 2018.

of the top AMI market performers have acquired their own MDMS software and can offer a full deployment solution in this regard, which reduces project risk. Landis+Gyr has developed a relationship with Ecologic Analytics, another MDMS provider, and the two companies have been collaborating on development of the next generation of MDUS protocol for use with SAP[61].

It is not clear from our perspective how much, if any, prior experience Landis+Gyr, EnergyICT and SAP have accumulated in working with one another on one fully integrated AMI project. Since EnergyICT is not an SAP certified Lighthouse Council member, it is not certain that SAP and EnergyICT have fully integrated their business processes on any other project at this point. As previously mentioned, Hydro Quebec has stated that only a partial integration with the EnergyICT MDMS and SAP will be completed as of November 2011, which exposes a potential risk factor for implementation of advanced AMI functions, such as an SAP initiated remote disconnect and reconnect feature, that can be demonstrated as working before Phase 1 authorization is received.

## Recommendations and Conclusions

In this report, Valutech Solutions has made a total of 38 observations and 16 recommendations related to its three specific mandate areas. Based on these observations and recommendations, Valutech has reached the following conclusions:

1. Hydro Quebec's pilot program does not appear to have sufficiently demonstrated that the Landis+Gyr network as planned will provide the necessary level of functionality or network read performance for all 3 phases at the budgeted cost.
    - Proof of concept only; read performance not validated
    - Total project cost not validated
    - WAN backhaul bandwidth not substantiated
    - Installation contractor performance on inside meters

   ➢ **Conclusion: Extend Pilot Period by 6-12 Months beyond June 2012 to validate network performance**

2. The AMI system total project cost appears to be on the high end of the cost spectrum, and includes some identified categories that should receive additional scrutiny.
    - Update cost based on extended pilot results
    - Revise operating charges; credit additional utility benefits
    - Re-examine consultant and employee disposition costs & allocation
    - Review IT costs; properly allocate shared IT costs to other enterprise systems

   ➢ **Conclusion: Revised Project Cost Estimate should be developed & provided to the Energy Board**

[61] See Landis+Gyr Press Release "Gridstream MDS 2.0: Landis+Gyr and Ecologic Analytics Develop Next Generation Smart Metering Management Solution" dated September 29, 2011.

3. Several areas in the project estimate, including network equipment, meter installation costs and Rogers Communications, are particularly susceptible to cost overruns.
   - Expanded pilot network read performance should determine proper quantity of network devices, which may cause the number of collectors and routers to increase at higher cost
   - High percentage of inside meters may necessitate re-evaluation of installation costs
   - Higher numbers of collectors, and increased bandwidth requirements may increase Rogers Communications cost

➢ **Conclusion: Additional attention should be placed on high risk cost areas during pricing review**

4. In this Filing, Hydro Quebec has not discussed any future plans to add distribution automation, substation automation, Volt/VAR controls or other smart grid functions that could require additional network bandwidth at additional cost.
   - Impact of other applicable Filings in these areas should be examined for effect on AMI system costs during the pilot period
   - Results of WiMAX tender and CATVAR pilot study should be examined for impact on AMI system deployment and potential for reduced Rogers Communications costs
   - Landis+Gyr's capabilities in these areas should be studied as the first option to leverage installed AMI system assets

➢ **Conclusion: An advanced smart grid plan with associated AMI impact should be filed with the Energy Board for consideration by the end of the extended pilot deployment period**

5. Authorization to proceed with Phase 1 commits HQ and its clients to a substantial amount of the total project cost while providing only limited benefits, which could lead to pressure on the Energy Board to authorize subsequent phases to obtain planned and future benefits.
   - Identified Phase 1 pricing adjustments should be considered
   - Suitable increased cost risk sharing mechanism should be developed to hold HQ accountable for any cost overruns
   - Pre-established set of performance metrics needed to proceed to Phase 2

➢ **Conclusion: Project pricing adjustments and pre-determined performance metrics are needed before authorizing Phase 1**

6. Plans to implement only minimum utility and client benefits during the full 5 year implementation period appear to be insufficiently responsive to client needs and will delay adding value while underutilizing the AMI network assets.
   - An in-depth utility/client Benefits Plan should be submitted that provides for accelerated benefits
   - A 5 year delay in providing additional benefits will place Quebec residents at a disadvantage over residents in other provinces

- **Conclusion: Delays in implementing many utility and client benefits until the end of Phase 3 deployment are unwarranted and will underutilize paid for assets**

7. Hydro Quebec has no immediate plans to introduce demand response or home energy management programs even though they could benefit clients and are capable of being supported by the Landis+Gyr network.
   - A utility demand response program should be developed during Phase 1 deployment
   - Home energy management features such as programmable thermostats and in-home energy displays should be introduced for voluntary use by the end of Phase 1 deployment

- **Conclusion: Hydro Quebec is not being sufficiently aggressive in providing demand response solutions and should fully utilize the available Landis+Gyr network and ZigBee capability to support these programs**

8. Hydro Quebec's proposed results tracking regime is not adequate to provide the Energy Board with sufficient visibility and control concerning project cost, schedule and system performance
   - Quarterly reporting on project performance should be required
   - Pre-established cost, schedule and system performance milestones should be agreed on
   - Specific project milestones should dictate progress to the next phase

- **Conclusion: Project reporting should be significantly strengthened over what Hydro Quebec has proposed in its authorization request for Phase 1**

**Statement of Condition**

This report has been prepared by Valutech Solutions Inc. in connection with the aforementioned Filing R-3770-2011 on June 30, 2011 by Hydro Quebec with the Quebec Energy Board and shall not be used for any other purpose. The expert opinions and recommendations contained herein reflect our professional views based on the available documentation in this case, and are subject to clarification or revision if additional material related to this proceeding becomes available.

Submitted By:

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December 7, 2011