Building Scale for the Utility Company's Future

WHITE PAPER

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ENERGY INSIGHTS OPINION

Utilities are entering a new era. Concerns about the aging delivery infrastructure, climate change, and energy security are driving investments in new and cleaner sources of energy — renewables, nuclear, demand response, and energy efficiency. With new investments in the intelligent grid come the promise and the challenge of the availability of massive amounts of data. While there may be help in making the capital investment in physical and information technology infrastructure for intelligent grid and new generation, utilities will still need to make the best economic decisions in choosing technology, keeping in mind initial capital investment, implementation costs, and total cost of ownership.

To be prepared for future demands on the utility industry, utility companies will need to choose hardware and infrastructure applications that are fit to purpose and capable of:

- Processing large volumes of data (terabytes and possibly petabytes)
- Providing high data quality at various levels of precision
- Accommodating multiple types of data (transactional and time series, structured and unstructured) matched with the time period
- Maintaining high availability of data with successful failover without data loss
- Supporting multiple latency requirements (high, low, and medium)

Utilities will be looking to apply analytics to data drawn from multiple sources for long-term, medium-term, quick, and very quick decisions. As always, price, as well as total cost of ownership of maintaining this information technology infrastructure, is a consideration.

IN THIS WHITE PAPER

In this white paper, Energy Insights examines the infrastructure needs of utilities as they move from doing their traditional business to operating in a transformed industry in the new energy economy. The document examines the current challenges that IT faces in supporting the scale and performance required for existing and newer, more dynamic systems. The focus is on where utilities are using Microsoft infrastructure, in combination with industry partners, independent software vendors (ISVs), and systems integrators (SIs), to deliver the applications needed to run, grow, and transform the business.

Two rather different case studies are presented — one focused on the retail side of the utility business and the other on generation. The document concludes with some observations about what is in store for utilities in the future and makes recommendations to utilities on how to approach infrastructure decisions going forward.

SITUATION OVERVIEW

Utilities are entering a new era. Concerns about the aging delivery infrastructure, climate change, and energy security are driving investments in new and cleaner sources of energy — renewables, nuclear, demand response, and energy efficiency. On their own initiative and encouraged by the availability of stimulus funding, utilities are making investments in a new utility infrastructure. Utilities are starting with smart metering deployments and moving on to intelligent grid, embodying new generation and eventually will be exploring new opportunities such as plug-in electric hybrid vehicles (PHEVs). With each of these investments come the promise and the challenge of the availability of massive amounts of data.

The Intelligent Grid Is Becoming a Reality

Utilities are already investing in intelligent grid initiatives. Notable initiatives include Smart Grid City in Boulder (Xcel Energy), the Pecan Street Project in Austin (Austin Energy), Smart Grid (Duke Energy), gridSMART (AEP), and Energy Smart Miami (Florida Power & Light). The list is growing on a daily basis. The most notable, of course, is the 33 million meter initiative of Italian utility ENEL, one of the first movers in the intelligent grid. Then, too, China's grid companies — the State Grid and Southern Power Grid — are devoting time and attention to developing more intelligent grid infrastructure. In North America and Europe, most utilities are starting with installation of smart meters — meters with two-way communications that may also serve as gateways to other appliances in the home. PPL, CenterPoint Energy, and Oncor have been early adopters of smart metering. Other initiatives include smart grid elements such as energy storage and PHEVs.

Energy Insights defines the intelligent grid as an electric transmission and distribution (T&D) network that, through the use of information technology, is smart enough to predict and adjust to network changes. The "smarts" of an intelligent grid come from advanced analytics that help utilities quickly process large amounts of data and make informed decisions. The sensing is done by a host of electronic devices, many of which are IP enabled, including smart revenue meters at the residence or facility, power line sensors, production meters, condition sensors, and other devices.

Intelligent grid information technology infrastructure enables a utility to undertake a number of initiatives, such as:

- **Smart metering:** Automated meter reading, remote connect/disconnect, outage detection, capital investment planning
- **Energy efficiency:** Access for customers to detailed consumption information to provide information to customers to encourage energy conservation
- **Demand response:** Changes in electric usage by end-use customers from their normal consumption patterns in response to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized (Demand response may include direct load control or enabling dynamic pricing options, such as time of use, critical peak pricing, real-time pricing, and peak-time rebate, that allow the utility to vary price according to the cost of electricity.)
- **Integrating renewables:** Integration of renewable resources (solar photovoltaic, wind farms) owned by the utility or distributed and owned by the customer
- **PHEVs:** Smart charging and vehicle-to-grid integration

The focus on intelligent grid investment is accelerating with the availability of economic stimulus funds. Energy Insights estimates that $8.6 billion will be available for intelligent grid initiatives and technology through multiple sources of funding (e.g., American Recovery and Reinvestment Act, energy conservation bonds, and broadband initiatives) with another $3 billion available for technologies that support energy efficiency. Undoubtedly, much more will be invested privately.

The "New Generation" of Generation

The economic recession may have had a dampening effect on growing demands for electricity, but this impact is expected to be temporary. Demand for electricity is continuing to grow in emerging economies such as China and India, with ambitious plans for generation buildout.

With the prospect of climate change and the coming of the "cost of carbon," generators are being impacted. The "new generation" of generation will incorporate more information technology than before:

- **Renewables:** With renewable portfolio standards in the United States, and other renewable initiatives in Europe, wind and solar continue to come on line, despite the temporary setback of reduced availability of capital. These installations require information technology infrastructure. For example, Iberdrola operates a control center for its wind farms that collects operational information — encompassing upward of 300 variables — from each of its monitored installations (roughly 95% of its fleet) and their associated substations via a remote communication channel and facilitates maintenance tasks accordingly. The control center runs diagnostics on all incoming operational information and, upon identification of failures, triggers the appropriate actions for its solution: remote reset or activation of local maintenance teams.

- **Nuclear:** There is a renewed interest in nuclear generation in many regions, with new plant designs that are even more information technology intensive than earlier designs. With expansion of existing nuclear generation comes the increased need for providing workers with access to documentation through electronic means.

- **Coal:** For existing coal generation, there is money available for research and development in carbon sequestration projects; although few projects exist, those that do are in the demonstration stage. Information technology will be required to track and coordinate the transport of carbon to sequestration sites. Likewise, new integrated gasification combined cycle generation, while still in the very early stages, will need new configurations of information technology to run efficiently.

- **Gas:** With the cost of carbon, even owners of gas-fired generation are looking to make their plants more efficient through the use of sophisticated optimization routines that will guide plant operators in tuning the efficiency of the plants to get more production out of the same amount of feedstock to reduce fuel consumption and emissions.

It's Not Just the Technology — It's the Business

Technology for technology's sake is not at the heart of the new energy economy, nor should it be. Intelligent grid and new generation initiatives embody objectives that the utilities have had for many years, with emphasis on the following:

- Increased reliability

- Greater efficiency of operations

- Customer choice and satisfaction
- Sustainability of the environment

Increased Reliability: Quality Power Delivered

Reliability has always been the cornerstone of utility operations. In North America, events such as the blackout of August 2003 and recent hurricanes in the Gulf of Mexico have brought increased public attention to reliability. Customers, shareholders, and regulators measure their utilities by the quantity and duration of power outages.

With the effects of climate change, threats to reliability will only increase. Utilities use a number of applications to increase reliability. Analytic applications, such as outage management, are designed to detect the locus of the outage. When combined with work and asset management applications (WAMs), customer information systems (CIS), and geospatial information systems (GIS), these applications can decrease the duration of an outage, speeding field crews to the locations that need attention.

In addition, there is value to the utility in being able to avoid a preventable outage by identifying potential failure points. This is where investment in intelligent grid can move the utility company to the next level of reliability. Sensors installed throughout the grid, coupled with supervisory control and data acquisition (SCADA) and energy management system (EMS) data served up to information systems, provide the necessary data for predictive analytics that can be used to determine where and under what conditions outages have occurred in the past. This allows utilities to identify and plan for similar situations.

Greater Efficiency of Operations: Doing More with Less

The utility industry continues to face the prospect of a rapidly shrinking qualified workforce to handle operations and maintenance. The recessionary economy has slowed the rate of retirement somewhat, and the utility industry has become more attractive to job seekers, especially those seeking "green" jobs. Even so, the pressure will be on utilities to increase the efficiency of their workforce and to train new workers quickly. Many utilities have been engaged in providing greater mobile capabilities to field workers with mobile devices that can communicate with work and asset management applications, GIS, GPS, and schedule optimization analytics. Some are using mashups with Microsoft's Bing Maps (formerly Virtual Earth), thereby extending access to geospatial data to many more utility staff than with traditional GIS.

Intelligent grid technology will continue the trend toward greater automation. For example, sensing technologies distributed throughout the transmission and distribution grid can help utilities pinpoint the location of trouble, thereby increasing their efficiency. Intelligent grid also promises to reduce maintenance costs through predictive analytics and sensing technology. For example, sensing technology around a recloser allows the system to detect whether there is a true fault in the circuit. If there is, the recloser will not continue to attempt to close the circuit. This reduces wear and tear on expensive equipment.

Another driver of greater efficiency has to do with power itself. The intelligent grid promises reductions in line losses through power factor optimization and system balancing. While much of this is accomplished through control systems, information technology also has a role to play in serving up data for analysis of loss patterns. Power generators are using advanced analytics and data mining such as neural net and linear programming to optimize the operations of generation plants, thereby increasing plant efficiency and reducing the cost of fuel.

Smart metering technology has already demonstrated benefits to utilities. It allows utilities to perform remote connect and disconnect, thereby reducing truck rolls. With smart metering, customer service representatives (CSRs) have access to detailed meter and weather data. Through the use of consumption analytics, in most cases, CSRs are able to address customers' high bill complaints without sending a truck to the site to inspect for meter failure.

Customer Choice and Satisfaction: New Opportunities for Sales

Utilities have always been interested in maintaining high levels of customer service, but at the lowest possible cost of services. Customer relationship management (CRM) and CIS, Web portals, and automated notifications have helped utilities keep a finger on the pulse of their customers. In regions where there is active competition, analytics run on customer and meter data allow a utility to reduce customer churn or help target the marketing of suitable products to customers.

Concern about climate change is leading to a number of actions that will increase the cost of electricity. While coal is plentiful and relatively inexpensive, the cost of carbon will drive up costs for existing coal-fired generation and limit construction of new generation. Cleaner sources of generation are more expensive, and with current restrictions on the availability of capital to build new plants, the cost of power will go up.

As electricity prices increase, customers will be looking for ways to reduce their energy bill. Many states already have indexed pricing, which varies the price of electricity according to the market, and with federal legislation mandating utilities support more dynamic rate structures, customers may opt to reduce or shift their consumption in order to save money. Customer-facing applications delivered through media such as Web portals, phone alerts, or in-home displays will give customers the opportunity to choose the level of comfort they want and when, based on the cost of that comfort at that point in time. Customers may even choose to limit consumption during certain times of tight utility capacity for a lower electric rate. Information technology will allow customers to select what they are willing to pay for comfort and have the systems automate the response of their appliances — smart thermostats, smart refrigerators, pool pumps, etc. — to those preferences.

Sustainability of the Environment

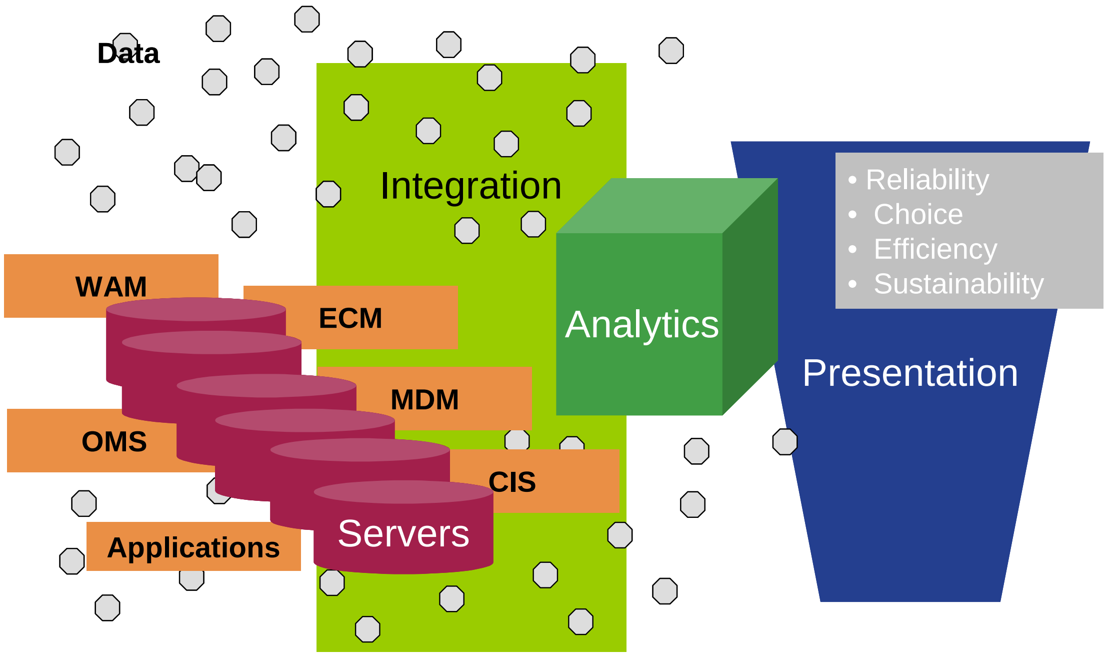
With concern about climate change, utilities must seek new sources of energy. Many states have renewable portfolio standards (RPS), which require a percentage of generation in a utility's portfolio to be generated from wind, solar, or other intermittent sources. Many utilities are choosing on their own to develop renewable generation. One of the promises of the intelligent grid and new generation is to provide the means for balancing the variability of wind and solar. This will take processing of wind and weather data, along with current grid status, to achieve the proper balancing. It may be that utilities will want to call a demand response event to avoid having to go to the spot market for more expensive power when wind or solar is not providing enough capacity. Sophisticated analytics will be needed to make those decisions, most of which may have to be made in less than a second.

Data, Data Everywhere, But Not a Byte to Eat

Utility companies have always had the potential to access large amounts of data. With new sensing devices and meters, there is opportunity to access even more data, more immediately. Having data is one thing, but being able to make sense of that data to make informed decisions is another. Utilities need to have an infrastructure that will support access to many types and sources of data that can be served up for analysis, presentation, and decision making (see Figure 1).

FIGURE 1

Decision Making at Utilities



Source: Energy Insights, 2009

To be prepared for future demands, utility companies will need to choose hardware and infrastructure applications that are fit to purpose and capable of:

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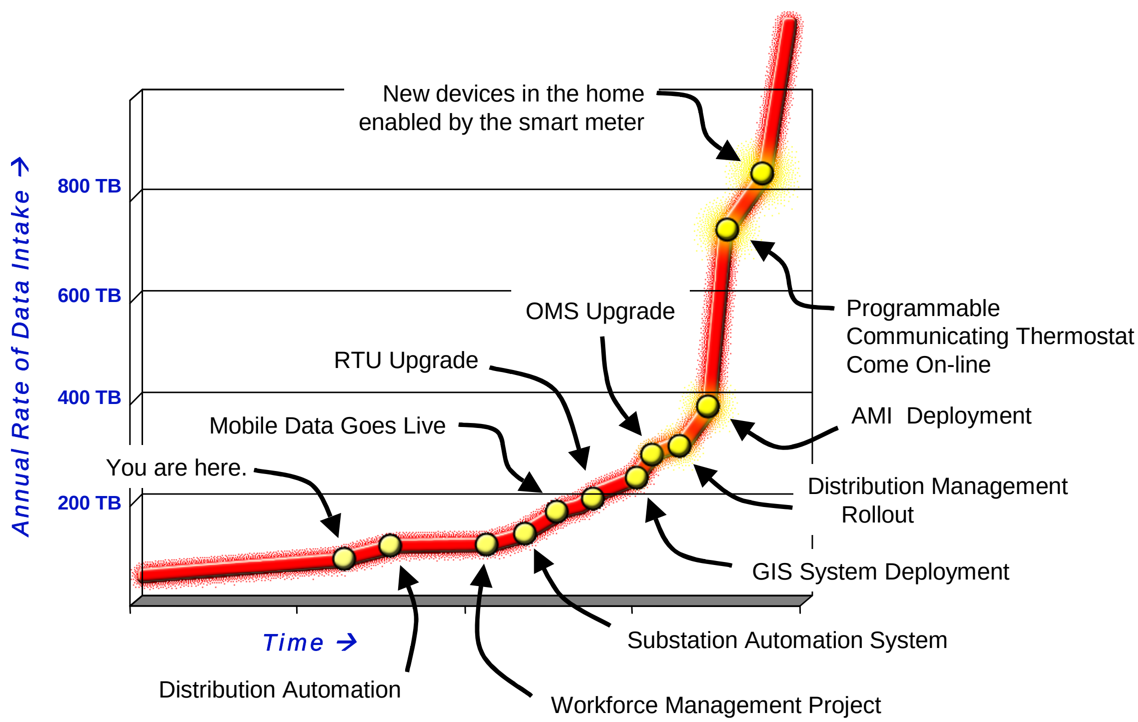
More Data: Volumes Grow Exponentially

The Electric Power Research Institute (EPRI) estimates that the average utility will go from handling less than 200 terabytes of data on a daily basis to handling 800 terabytes of data upon the full implementation of the intelligent grid. In fact, Pacific Gas and Electric Company (PG&E) has estimated that its smart metering project would involve *1 petabyte* of data. This data is meaningful for decision support only if there is a way to query and analyze it. Figure 2 displays a typical ramp-up of intelligent grid and the corresponding data requirements.

FIGURE 2

Exponential Growth of Data



Source: Electric Power Research Institute, 2008

Much of the data that is available for analysis by the utility of the future will be time series data that is sampled according to the purpose for which it is needed. The higher the sampling rate — the shorter the time between reads — the more data will need to be stored, transported, and processed. Table 1 provides a view of current and future sampling rates of typical utility systems.

TABLE 1

Data Handling and Processing

Mission-Critical Systems	Purpose	Current Sampling Rate
Meter data management	Customer care and billing: Provide billing determinants	Monthly
Grid condition data	Identification of potential grid faults	Two seconds or less (SCADA)

Source: Energy Insights, 2009

Even without intelligent grid investments, utilities are collecting large amounts of data. This data is used to support a number of traditional functions — billing customers; performing maintenance; responding to outages; complying with environmental, health, and safety regulations; and procuring equipment and services.

Better Data: Filling in the Gaps

Handling the exponential increase in meter data is a particular challenge for utilities. As described earlier, there is the issue of handling large volumes of data. However, there is also the challenge of processing data to ensure that the data quality is acceptable for further processing, such as billing and load forecasting. As with any time series data delivered via various network media, data-handling issues such as missing values, invalid data, and exceptions require smoothing and exception handling, termed EVEE (error handling, validation, estimating, editing). A meter data management (MDM) application and its supporting hardware must be able to meet performance goals and process data in a reasonable amount of time.

In the summer of 2008, Itron, HP, Microsoft, and Infosys performed a benchmark test of Itron Enterprise Edition (IEE) Meter Data Management V5.3 on Microsoft SQL Server 2005 and Microsoft SQL Server 2008. The benchmark involved validating, automated estimating, and importing up to 4.5 million meters, which sampled every 30 minutes.

The entire population of meter data was tested against validation rules, including historical maximum demand absolute difference, usage high limit, demand high limit, historical total usage absolute difference, historical total usage percent difference, usage tolerance percent different, historical maximum demand percent differences, and demand low limit. In addition, tests were run that varied the missing reads from 0% to 5 %, requiring the system to estimate missing reads.

The results of the benchmark tests demonstrated that IEE MDM on SQL Server 2005 can validate, estimate automatically, and import 4.5 million meters half-hourly, equivalent to 9 million meters hourly, in under two hours. The test demonstrated achievement of a throughput of 35,000 intervals per second and higher, including estimations for 0.5% of the meters.

Matching Data: The Asset Within a Context

Putting together all the data around an asset or a particular event remains a challenge for utilities. Not all data is stored in the same application. In fact, some data does not come from applications at all. To engage in advanced asset management strategies such as condition-based maintenance, an engineer would like to be able to look at integrated views of transactional data from the enterprise asset management (work history, job plans, location, etc.) and time series data from meters and sensors (temperature, vibration, etc.). To perform a root cause analysis of an event, engineers will want to look at historical records and be able to time-match the trends.

Making Use of the Data: Analytics

As utilities gather new information and better leverage existing information for the intelligent grid and new generation, they need some way to analyze all of the information and enable better decisions. For example, utilities may collect interval data from their smart meters, but they may not fully leverage the data for decisions in initiatives such as demand response, time-of-use pricing, and net metering.

At their most basic level, analytics applications are fact-based decision support systems that turn data into information that a company can use to make a decision or take action. According to IDC, analytics applications include:

- Query, reporting, and analysis (QRA) software that uses ad hoc query and multidimensional analysis tools as well as dashboards and production reporting tools (Query and reporting tools are designed specifically to support ad hoc data access and report building by either IT or business users.)

- Advanced analytics software that uses sophisticated technologies to discover relationships in data and make predictions that are hidden, not apparent, or too complex to extract using query, reporting, and multidimensional analysis software (This market can include technical, econometric, and other mathematics-specific software that provides libraries of statistical algorithms and tests for analyzing data.)

A Note About Security

Security of critical infrastructure continues to be a focus for utilities. The North American Electric Reliability Corporation (NERC) is tasked with overseeing Critical Infrastructure Protection (CIP) for utilities. The Energy Policy Act of 2005 called for mandatory compliance with the CIP standards. NERC was granted authority to augment and enforce the standards as well as the ability to penalize electric utilities for noncompliance. Eight new cyber security standards that address asset identification, security management controls, personnel and training, perimeter security, physical security of cyber assets, systems security, incident reporting and response planning, and recovery plans were adopted in 2006. The most recent standards receiving attention are CIP-002 through CIP-009, which "provide a cyber security framework for the identification and protection of Critical Cyber Assets to support reliable operation of the Bulk Electric System" (June 2006).

This makes dynamic management views particularly important. For example, utilities need to be able to track the correct and latest versions of appropriate passes for all the software that makes up the system. Another example is a telemetry transmissions operations data store that may be created to track every action and event that occurs in the operations within a transmission system, equivalent to an operations "system of record."

Microsoft in Utilities

Microsoft is no stranger to utilities. In fact, Energy Insights estimates that globally, Microsoft's 2007 utility revenue (hardware, software, and services) was approximately $1.6 billion, topped only by the utility revenues of HP, IBM, and Dell. Microsoft's success in the market is aided by its strong network of partners that specialize in supporting functions and business processes typically found in the utility industry. Table 2 displays a sampling of the Microsoft partner network by functional area, as well as some of the key utility customers that are taking advantage of what these partnerships have been able to provide.

TABLE 2

Microsoft Installations and Partnerships in Utilities

Solution	Partner
Geospatial information systems (GIS)	ESRI, Autodesk, IDV Solutions
Distribution management systems (DMS)	AREVA
Engineering analysis	Advantica, Cooper Power Systems
Mobile workforce management	Click Software, CGI
Smart metering/AMI	Itron, Landis & Gyr, Aclara, OSIsoft, Yello Strom
Generation automation	Alstom Power, OSIsoft, Wonderware, SmartSignal
Customer care	SAP, EG Utilities, Ferranti, Itineris, NirvanaSoft, Aclara, StreamServe
Environmental health and safety	ESS, IHS, Enviance, VisionMonitor
Work management	SAP, Wonderware, Itineris
ERP	SAP, Ferranti, Axia, CopperLeaf
Enterprise asset management	SAP, Itineris, OSIsoft, SmartSignal, Dassault Systemes, AssetPoint
Rates and tariff management	Flexnova
Regulatory compliance	Flexnova, ClusterSeven, ember, CA MDY
Energy management system (EMS)	AREVA
Network design	Itron
Energy trading and risk management (ETRM)	AREVA, Ventyx, Allegro, SolArc, NirvanaSoft, Covast, Financial Objects
Project intelligence	QuantumPM, Pcubed, Impress, Dassault Systemes, Bentley
Operations performance monitoring	Alstom Power, OSIsoft, Wonderware, Matrikon, Emerson, AspenTech, SmartSignal, Transpara
Enterprise content and document management	McLaren Software, Enterprise Informatics, StreamServe, CA MDY, Bentley
Substation automation	AREVA, Subnet Solutions, DC Systems, GE Fanuc

Source: Microsoft, 2009

In addition, Microsoft has partnerships with professional service firms and SIs with extensive experience in the industry, including firms such as Accenture, AUS, Avanade, BTC, Capgemini, CTS, EMC, Enspiria Solutions, Infosys, KEMA, Logica, Mariner, Microsys, Obvient, SAIC, Sapient, SISCO, SunGard, Tieto, UISOL, UMT Consulting, and Wipro. These SIs and consultants have deployed solutions leveraging a variety of Microsoft software products.

In addition to partnerships, Microsoft technology can be found supporting many business processes in the utility industry. Table 3 provides a list of representative installations.

TABLE 3

SQL Server Projects in Utilities

Sample Business Function	Detail	Business Driver	Utility Customer
Asset management (grid)	Real-time historical data storage to help analysts, dispatchers, and managers gain a better view into the status of 320,000 grid devices; named Pegasus RDS, custom developed in .NET by Nobadeer Software	Need for a more robust system to store and analyze SCADA data, based on expected growth in the volume	Entergy
Asset management (grid)	Relies on supervisory control and data acquisition (SCADA) technology to monitor a wide range of activity, including the precise voltages, currents, and power loads running through its transformers and breakers at any given time; in house–built SCADA system using Visual Studio 2008 and beta version of Silverlight 2	Ease of use — need for a graphical interface and expanded access to SCADA data	ENMAX
Asset management (pipeline)	Monitoring of water distribution and waste water treatment systems (SCADA, pipelines); software named Genesis 32, developed by Iconics	Need for access to information for monitoring assets and design of new pipelines	Loudoun Water
Asset management (pipeline)	Aggregation of SCADA data for analysis and reports, viewable via Web portal; provide information about field conditions to dispatchers; Office Business Application built in-house	Decrease the expense of trips to the field by technicians; expand users' access to data	Vostok GazProm

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SQL Server Projects in Utilities

Sample Business Function	Detail	Business Driver	Utility Customer
Capital planning (distribution assets)	Distribution asset analysis based on meter data to help predict equipment failures and outages; meter data management by Itron	Pilot to determine the value of gathering meter data into a relational database	Exelon
Carbon management	Use of software as a service (SaaS) to manage voluntary and mandatory compliance with emission reduction goals	Complex and changing reporting requirements, changing workforce requiring capture of information from retiring workers and easy access for new workers, need for corporate visibility to progress against goals	American Electric Power
Customer care and billing	In-house development of new customer information system (CIS) called YorBill, built in-house based on .NET	Increase the speed of development to support new rate options	Yorkshire Water
Customer care and billing	Migrate from Linux to Microsoft and standardize billing system on one platform, built in-house	High cost of supporting Linux application, lack of knowledgeable support personnel	ActewAGL
Customer care and billing	Replacement of CIS with SAP-Microsoft solution, built by SAP	Systems to handle future growth and improve customer service (billing, call center, customer consumption)	China Light and Power (CLP)
Energy management	Customers receive split-second data on the amount of power their appliances — refrigerators, washing machines, or stereo systems — consume through their home computer or cell phone; named Yello Sparzähler Online	Providing a means for customers to reduce energy consumption	Yello Strom
Energy trading and risk management	Support integrated wholesale and retail trading divisions with improved business intelligence solutions; named Enterprise Service Business, built in-house and with Casewise and K2.net	Increase speed of development to adapt to the constantly changing market rules and data formats; reduce costs of supporting highly configured trading	British Energy Trading, subsidiary of British Energy

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SQL Server Projects in Utilities

Sample Business Function	Detail	Business Driver	Utility Customer
Energy trading and risk management	Access to multiple sources of data through ETL, data warehouse, and presentation; named Position Report, developed by Avanade	Need for quicker access to information to supporting trading on the MISO market	Ameren
Engineering and design	Replacement of mainframe, consolidation into servers, and installation of document management system; named eB Document Management, built by Enterprise Informatics	Need for access to information for design review, technical documentation to manage equipment	Ameren
Finance	Server consolidation, BI front end to SAP, voice over IP, identity management; named R/3 (SAP)	Need for more up-to-date and efficient information technology to support business functions	Electricidad de Caracas
Generation optimization	Repository for archiving management and process data (SCADA/EMS) from nine power plants to monitor plant availability and forecast demand; ERP and others, SAP and others	Merger and acquisition and to meet new regulations regarding power generation availability	EdiPower
Intelligent grid	New real-time SCADA from AREVA runs on Windows Server 2003	Need to reduce cost of operations of running existing SCADA system and allow for future scale	Scottish Power
Nuclear operations	High-performance computing to support operations of a high-temperature reactor using Microsoft HPC	Need to reduce engineering time and costs	Pebble Bed Modular Reactor, South Africa
Security	Replaced nuclear employee authorization system built in Cobol and running on mainframe with Microsoft Server; named EmPACT, developed in-house with help from Computer Technology Solutions	Long authorization process, need for security post–September 11	Southern Company

Source: Energy Insights, 2009

Challenges and Opportunities

Much has changed since the days when utility industry applications resided mainly on mainframes. The utility support infrastructure is a more heterogeneous environment than in the past, although utility chief information officers are still interested in maintaining enterprisewide standards. Microsoft Office applications have been the standard for the desktop for many years, and utilities are taking up adoption of Microsoft collaboration and presentation tools such as SharePoint.

The utility industry has been slower than other industries in adopting Microsoft server technologies. Various reasons have been given; most have to do with uncertainty about scale and performance for the computation-heavy requirements of the industry. However, Microsoft is showing technology that can support the need among many utilities for heavy-duty processing. For example, using Microsoft's SQL Server Analysis Services, users could create and populate OLAP cubes for synthesizing multiple streams of data and information to develop scenario templates for cap-and-trade activities, such as price forecasting. The collective model created becomes a baseline for performing scenario-based and what-if analyses, taking into account environmental compliance, risk assessment, and business planning together.

The following case studies provide two examples of utilities that have used Microsoft SQL Server 2005 and plan to deploy Microsoft SQL Server 2008 in the near future. Both utilities took scale into consideration and are satisfied with Microsoft's performance.

CASE STUDIES

AGL: Phoenix Rising

AGL Energy Limited (AGL) is Australia's largest integrated renewable energy company with an antecedent history dating back over 170 years. As Australia's largest retailer of gas and electricity, AGL has a customer base of 3.2 million accounts across NSW, Victoria, Queensland, South Australia, and the ACT. Listed on the Australian Securities Exchange, AGL is an S&P/ASX 50 company with a market capitalization of approximately A$6.0 billion.

In July 2006, AGL embarked on an application consolidation initiative — Project Phoenix — that would reduce the total cost of ownership and inefficiency of supporting 11 different customer information systems (CIS) and 100 other applications. The company wanted to take this opportunity not only to reduce costs but also to ensure that all customers are treated in the same way using a single set of processes. According to AGL, "The goal was a system that would enable AGL to house all its customers on a single integrated platform that could scale as new channels emerged and provide consistent information across the various business functions."

The company had grown rapidly through acquisition and had reached a point where it needed the efficiencies of one billing system. The company chose SAP for Utilities for its enterprise resource planning (ERP) and CIS. The decision was made to support the complete SAP installation on Microsoft SQL Server 2005 Enterprise and Windows 2003 Enterprise for 64-bit systems.

At the outset, AGL defined Project Phoenix as a business transformation. The initiative was intended "to deliver operational excellence across the Retail Energy business group." The primary objectives were improved customer service and cost reduction, which were to be achieved through:

- Systems consolidation
- Outsourced application management
- Improved data accuracy and customer insight
- Reduced churn, improved savings, and winning back customers
- Call center automation and increased productivity
- Enhanced "self-serve" and virtualization
- Reduced duplication and greater data accuracy
- Billing productivity and exception reduction
- Transformation of credit management
- More rigorous collections capability

Well-Developed Selection Criteria

AGL has established a set of technology investment principles to guide all of its capital investments. The company seeks to reduce the footprint of technologies and the number of vendor partners.

A project of this size has a range of assessment criteria, and this project began with a decision about the application layer. Once this decision was made, the assessment turned to the infrastructure. The success criteria were:

- Ability to meet performance requirements
- Scalability requirements
- The most commercially attractive price

Price considerations followed only after performance and scalability were tested.

The Challenge: Multiple Big Bangs

At the same time that AGL was implementing a new system, the company was also working toward outsourcing application and infrastructure support. This new dimension added to the complexity of the implementation and handoff. Accenture was responsible for overseeing the implementation and integration of Project Phoenix and also had input into the hardware decisions. Implementation application support was handled by Tata Consultancy Services, and infrastructure support was performed by IBM Global Services.

Current Status

Project Phoenix was completed in two phases and went into full production in November 2008. Approximately 93% of AGL customers are now being served by the system. The total capital expenditure for this project following the final, major retail rollout was A$164.4 million. The project is now in the benefits realization phase, which is characterized by an active plan to ensure capture of the timing and realization of the business benefits.

The Numbers: Benefits Realization

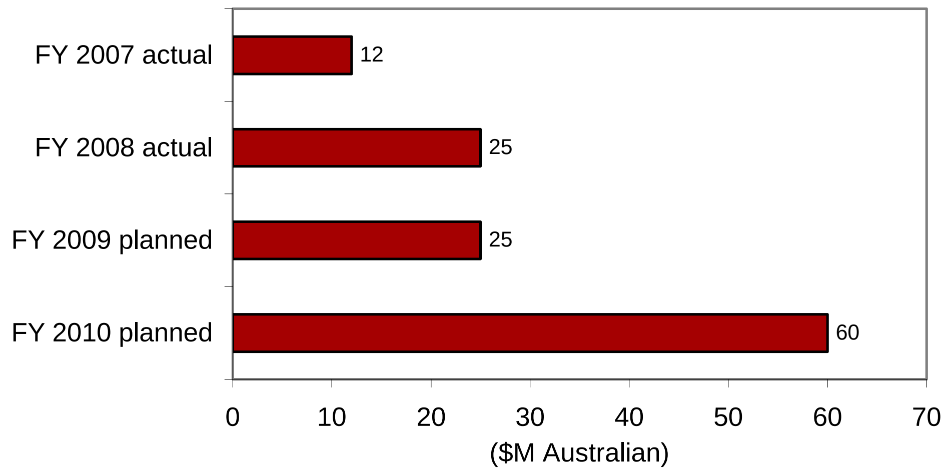
Scale is certainly a measure of success when it comes to large enterprise systems. Scale has its large and small aspects — the ability to support large numbers of transactions with a small number of support staff. The numbers for AGL are as follows:

- 4 terabytes of SAP data on Microsoft SQL Server
- 3.4 million customers on the system
- 1,850 active users
- Daily processing of 60,000 payments and invoicing transactions
- Average SAP transaction time is 400 to 500 milliseconds
- Only three IT staff maintaining the server environment (through IBM Global Services)

The company has also been able to recognize business benefits. Figure 3 shows the actual and projected business benefits of this project. About 5%, or A$7 million, of the total benefits are expected to be in IT support related to systems consolidation.

FIGURE 3

EBIT Benefits Realization for AGL Project Phoenix



Source: Energy Insights, 2009

Plans for the Future

As a next step, AGL will be implementing SAP BW data warehouse. The company is considering implementation of Microsoft SQL Server 2008 to support BW and associated analytics. In addition, the company expects to introduce more self-service capabilities so that customers may access their account information online. This would increase the number of users exponentially.

Australia is quickly moving toward the installation of smart metering for mass market customers. In 2004, the Essential Services Commission of Victoria ordered a mandatory rollout of smart meters to be installed at small businesses and residences by 2013. At this point, AGL's large commercial and industrial customers are on interval metering, but the plan is to extend interval metering to residential customers as regulation dictates. The interval metering of mass market customers (1.3 million) is expected to generate an additional 23 billion meter records based on half-hourly interval polling and requirements. A portion of that data will need to be managed and processed through meter data management (MDM) and CIS applications. Based on AGL's past experience and strategic relationship with Microsoft, first preference will be given to Microsoft SQL Server.

Entergy delivers electricity to 2.7 million utility customers in Arkansas, Louisiana, Mississippi, and Texas. The company owns and operates power plants with approximately 30,000 megawatts of electric generating capacity. It is a Fortune 500 company that reported revenue of more than $13 billion in 2008.

Entergy began pursuing a national nuclear growth strategy in 1998 by acquiring additional nuclear power plants. Entergy is the second-largest nuclear operator in North America and safely operates plants in Arkansas, Louisiana, Massachusetts, Michigan, Mississippi, New York, and Vermont.

Hardware Selection Criteria

Entergy's uptake of Microsoft SQL Server 2005 and 2008 has been happening as decisions are made about replacement or upgrade of applications. Hardware selection criteria are:

- Ability to meet performance requirements
- Application supports the platform
- The most commercially attractive price

The cost consideration depends on the enterprise agreements in place, and the company carefully considers the impact of purchases on any enterprise discounts that it may enjoy.

Migration to SQL Server for Document Management

Like many other owners of nuclear power generation, Entergy is faced with managing the impact of an aging nuclear workforce. According to the U.S. Department of Labor, 30% of the nation's nuclear engineers, 26% of its reactor operators, and 26% of its nuclear technicians are expected to retire by 2012. The challenge for the utility is to capture this experiential knowledge and transfer it to the incoming workforce to be able to access as much knowledge as possible needed to run the plants. Each nuclear facility is unique and has its own rich collection of documentation that needs to be easily accessible to staff.

Information management applications support the transfer of knowledge to the next generation of plant engineers and operators by ensuring that correct and accurate information is readily and easily accessible by plant workers. Since 1995, Entergy had been running eB Nuclear Suite from Enterprise Informatics for Entergy Regulated sites for managing storage/retrieval of plant information and records. In 2006, Entergy made a decision to upgrade to the latest version of eB for Nuclear suite based on new enhancements and an updated architecture as a result of monitoring changing market conditions to identify newly emerging opportunities to further reduce cost and improve service.

Along with the upgrade, Entergy decided to revisit the server platform supporting the application. The previous versions ran on Sun and Oracle servers, but the existing servers had reached the end of their useful life and were in need of replacement. In addition, the application vendors had enabled their applications to run on a wider variety of vendors' servers.

Testing the Options

The major challenge with managing documents and knowledge at a nuclear facility is the sheer volume of records requiring significant storage, indexing, and querying capabilities. For every record, both the data and the metadata must be stored. In addition, nuclear regulations require that all records be stored in two physical locations — one onsite and one offsite.

Applications such as eB are used to manage the metadata that allows data to be queried, drawing each asset within the plant that is relevant to the query. In Entergy's case, eB hosts the regulated data and metadata. The application runs on Microsoft SQL Server 2005, allowing staff to access what they need.

To support its selection of hardware for eB, Entergy decided to fully test the operation of the application on various servers. eB was loaded into the development environment and put through its paces for each of the server options. The company assessed indexing capabilities and the speed of display changes with the movement of data. In the end, the company selected Dell hardware and Microsoft SQL Server database as the preferred platform because this combination passed the evaluation testing and also came in at a much lower cost than another server combination.

Current Status

The eB upgrade was installed at four nuclear sites in the South. eB has been running on the servers for over two years. In supporting many business processes in the operation and maintenance of the fleet, eB identifies, classifies, and manages enterprise information, including documents, records, assets, people, processes, events, and projects based on industry best practices. File types handled by Enterprise Informatics' eB include procedures, engineering standards and specifications, and work orders.

The Numbers: Benefits Realization

All users at Entergy's nuclear sites have access to eB at any point in the day. Each plant has its own SQL Server, which hosts only the metadata. Even so, the numbers are large; quantities per site are approximately:

- 800 to 1,000 users on the system
- 5 to 6 million documents of various types and sizes plus the associated metadata

Other Uses of SQL Server at Entergy

Entergy uses SQL Server to support other applications as well. Although some of the examples are not enterprise systems requiring scale of the document management application, the business does require the infrastructure that supports these applications to be secure and reliable. Some examples are:

- Access authorization for nuclear plants
- Database of qualified suppliers
- Communications for emergency response
- Database with the records of all applications that run in the production environment as required for nuclear facilities
- Processing of training requests
- Real-time data repository for SCADA data

Of note is an application that does require scale. Entergy has deployed Pegasus Real-time Data Store (RDS)™, created by Nobadeer Software, as a data repository for time series historical SCADA data from devices such as remote terminal units (RTUs) on the transmission and distribution grid. The application is deployed using the Microsoft application platform and will soon be deployed on SQL Server 2008. The repository is used to support demand forecasting, operations (rerouting power, for example), and maintenance. Engineers and dispatchers at transmission and distribution control centers are able to query the data without impacting the integrity of the energy management system (EMS). In addition, employees have found that they can export and chart data easily using this repository, which provides a step up in the level of information they are able to access through the control room EMS screen. Table 4 provides details on the scale and response time.

TABLE 4

Historical Data Repository

Objects and Records	Orders of Magnitude
Objects tracked	320,000 SCADA objects
Total SCADA records	2 trillion
Total SCADA database	80 terabytes compressed to 8
Annual SCADA database growth	20 terabytes compressed to 2
Average query response time	2/1o of a second

Source: Microsoft, 2008

FUTURE OUTLOOK

Going forward, Energy Insights expects that utilities that adopt Microsoft Server technology will be able to take advantage of products such as Hyper-V virtualization to reduce the cost of running their servers. EdiPower is an example of one utility that has already taken that approach based on SQL Server 2008. Other new features of the SQL Server 2008 suite may be of particular interest to the utility industry with the digitization of the energy and water delivery grid. Table 5 displays features and potential applicability to the intelligent grid.

TABLE 5

SQL Server 2008 Applicability to Intelligent Grid

Feature	New Capabilities	Examples of Ways Utilities Can Apply
Integration services	Ability to extract, transform, and load data from disparate sources	Integration of time series data from condition monitors with asset management data for condition-based maintenance
Data warehousing	Ability to store hundreds of terabytes of data in a relational database	Perform load analysis and forecasting on more granular customer subsegments
Operation data store	Holistic view of time-sensitive operation data and events	Support for building the intelligent grid including R&D, planning and design, and buildout Support for management of T&D lines, reliability, asset management and maintenance of substation, transformers, and other equipment
Analysis services	OLAP cubes for online analytical processing	Perform a detailed analysis of outage information at the feeder level to determine cause and economic impact
Reporting services	Allows business user to view and generate own reports	Can report on cost of services for customer segments based on utility-defined determinants
Geospatial data type	Spatial support that enables organization to use map-based data	Enhance mobile capabilities and support lower carbon footprint for field service vehicles and greater efficiency for field staff
Backup and compression	Compression ratios of 70%	Handle storage and bandwidth requirements for time series data from meters or sensors
Dynamic management views	Visibility into database to provide server state information	Can be used to monitor critical cyber assets such as servers supporting the energy management system (EMS)
Encryption	Ability to set policies for access privileges and consolidate encryption	Support for enhanced cyber security and role-based access

Source: Energy Insights, 2009

RECOMMENDATIONS

Amid the greater demand of the new energy economy, utilities will need to invest in more advanced technology and deploy systems in new ways. In the rush to meet these new demands, utility companies must not lose sight of the long-term cost of supporting these new deployments. While there may be help in making the capital investment in physical and information technology infrastructure for intelligent grid and new generation, utilities will still need to make the best economic decisions in choosing technology, keeping in mind initial capital investment, implementation costs, and total cost of ownership.

Utilities are looking at innovative ways to deploy the new technologies not only in shorter time periods but also at lower costs. Based on the experiences of AGL, Entergy, and others, Energy Insights offers these recommendations to utility companies seeking to engage with vendors:

- In these days of tight budgets, do not view your technology projects in isolation. The projects that pass muster can show reduced IT costs and business benefits.
- Look to offerings from vendors with experience in handling large quantities of data at other utility companies.
- If you are looking to purchase new servers as part of an application upgrade, look for vendors that will stay with you throughout the project, providing infrastructure "health checks" along the way.
- Manage your risk by partnering with market leaders that have a supplier ecosystem made up of partners with real-world experience in delivering business benefits to utilities.