Transition to the New Energy Economy: The Role of Business and Technology Frameworks

WHITE PAPER

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EXECUTIVE SUMMARY

The energy industry is embarking on a journey that will fundamentally transform the roles of energy companies, energy consumers, and all other industry stakeholders. This journey will take us from the current or "old" energy economy with which we are all familiar to a new energy economy that is characterized by an increased use of renewable energy resources such as wind, solar, and biofuels (and an assumed decrease in the use of fossil fuels); an increase in the number of plug-in electric or hybrid electric vehicles; and active consumers whose energy is delivered through intelligent or "smart" networks and who use it more efficiently. This transformation will require the industry to balance supply and demand in real time and, as such, will impact the entire energy value chain.

To successfully navigate the transition, energy and utility companies and other market participants must understand and address a number of critical business and technology issues. To adequately address these issues, companies must take a holistic or enterprise approach that aligns the business with its technology investments while allowing flexibility for each company to implement new business processes and systems according to its own priorities. Business and technology frameworks offer a solution to these requirements. A framework can take business processes or patterns defined in an enterprise architecture and provide capabilities, using technology components, that can deliver business solutions to the enterprise. Additionally, frameworks incorporate industry standards to enable interoperability among technology components and can be used to incorporate best practices from similar organizations in the industry.

A number of energy and utility companies in North America, Asia, and Europe have successfully used IBM's Solution Architecture For Energy and Utilities Framework to deploy "intelligent utility" business solutions. In the case of EnergyAustralia, the solution involves approximately 15,000 new distribution sensors, a data communications network, interfaces to existing grid management applications, and

development of new data historian and data visualization capabilities. For one U.S. utility, the solution includes the deployment of over 2 million smart meters over a five-year period, a communications network, and back-office enterprise software systems.

MARKET OVERVIEW

The energy industry is embarking on a journey that will fundamentally transform the roles of energy companies, energy consumers, and all other industry stakeholders. This journey will take us from the current or "old" energy economy with which we are all familiar to a new energy economy that is already being promoted by scientists, policy makers, investors, and consumer advocacy groups. The transition between the old energy economy and the new energy economy will not occur overnight — indeed, it likely will take decades — and it will almost certainly involve surges of innovation and change as well as detours and setbacks. Although energy and utility companies are already making significant investments in new information, communications, and energy technologies and will continue to do so during the next few years, the full economic, business, and cultural transformation will take longer to play out. All participants in the energy industry must understand the basics of this transition and the issues it raises.

The old energy economy has a number of familiar characteristics. It relies heavily on fossil fuels such as coal, oil, and natural gas. As an example, according to the U.S. Energy Information Administration (EIA), 70% of the net power generation in the United States relies on fossil fuels. Similar situations exist in many other countries. Government policies have traditionally protected the status quo in the energy industry through tax codes, subsidies, and, some might argue, even foreign policies that support the current market structure and the companies that operate within it. Increasingly, the old energy economy is being criticized for its lack of energy security, primarily because of reliance on foreign oil for transportation fuels, and for the environmental damage caused by burning fossil fuels. This last point has galvanized the industry around the issues of climate change and sustainability. Finally, the old energy economy can be characterized by passive consumers who treat energy as a commodity that is delivered to them by unintelligent infrastructure and which they use inefficiently. However, this energy has been relatively cheap, safe, and reliable.

The new energy economy is being driven by a shift in government policies, as evidenced by the recent U.S. American Recovery and Reinvestment Act, which contains over $40 billion of funding for renewable energy, energy efficiency, and the smart grid. Other U.S. federal government policies such as a mandatory carbon cap-and-trade program and a national combined renewable and energy efficiency standard are expected to follow. These policies will help push the industry toward an increased use of renewable energy resources such as wind, solar, and biofuels (and an assumed decrease in the use of fossil fuels), enabling more energy security and a lower impact on the environment. An increase in the number of plug-in electric or hybrid electric vehicles goes hand in hand with these changes. The new energy economy can also be characterized by active consumers whose energy is delivered through intelligent or "smart" networks and who use it more efficiently. In fact, energy efficiency could have the biggest short-term impact on the transition. A recent Electric Power Research Institute (EPRI) study showed that energy efficiency has the potential to reduce growth in electricity consumption by 22% through 2030. A separate study conducted by IBM — *Lighting the Way: Understanding the Smart Energy Consumer* — showed that almost 70% of the 5,000 respondents were willing to experiment with how they interact with their energy providers. However, despite these encouraging indicators, energy produced, delivered, and consumed in this new economic model must still be reliable and safe, and although it probably is not as cheap as in the past, consumers must be able to control its cost.

During the transition from old to new, the costs associated with the old energy economy (or of being an old energy company) will increase due to rising fossil fuel prices, government policies that are less favorable to the old economic model, and the cost of maintaining aging infrastructure. At the same time, the costs associated with the new energy economy (or of being a new energy company) will decrease due to economies of scale for new technologies and more favorable government policies. This changing cost structure will attract capital to the new energy economy, thus funding the transition.

This transformation will require the industry to balance supply and demand in real time and, as such, will impact the entire energy value chain.

The generation business domain will need to:

- Optimize the performance of existing plants
- Manage the carbon footprint of plants and participate in carbon trading markets
- Retire older fossil-fired plants and build new renewable, nuclear, or "clean coal" plants

The transmission and distribution business domain will need to:

- Add intelligent devices, communications capabilities, and advanced analytics to the grid
- Integrate distributed energy resources, including plug-in electric/hybrid electric vehicles and enable customer demand response and energy efficiency programs
- Ensure the security and reliability of the grid

The customer operations business domain will need to:

- Provide customers with detailed real-time information on energy usage and costs
- Offer customers a range of energy efficiency, demand response, and renewable/distributed energy programs
- Respond to the preferences and behavior of "millennials"

The corporate support services business domain will need to:

- Deal with aging workforce issues through education, training, and collaboration (see the Workforce Issues section)

To successfully navigate the transition, energy and utility companies and other market participants must understand and address a number of critical business and technology issues. Some of these issues are discussed in the following sections.

Business/Regulatory Issues

- New business models
- New pricing structures
- Information security and privacy
- Sustainability
- Partner/vendor management

Technology Issues

- IT evolution (e.g., cloud computing, Web 2.0, service-oriented architecture [SOA], IP-based networks)
- Proliferation of smart devices
- Communications choices (e.g., private versus public, wireless versus powerline)
- Emerging energy technologies (e.g., renewables, energy storage, electric vehicles)
- Smart grid interoperability standards

Workforce Issues

- Aging workforce
- Education/training
- Collaboration

Consumer Issues

- Consumer preferences
- Behavioral change
- Technology adoption

To adequately address these issues, energy and utility companies must take a holistic or enterprise approach that aligns the business with its technology investments while allowing flexibility for each company to implement new business processes and systems according to its own priorities. Business and technology frameworks offer a solution to these requirements. For example, IBM's approach to addressing these critical industry issues has been to develop a business and technology framework called the Solution Architecture For Energy and Utilities Framework, use the framework to help energy and utility companies identify specific pain points or business patterns in need of improvement, and then develop projects that can be combined to deliver specific business solutions.

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THE IMPORTANCE OF FRAMEWORKS

Business and technology frameworks borrow from and, in many instances, are extensions of enterprise architecture methods and practices. These frameworks enable organizations to "see" the entire business or enterprise across the value chain in terms of business processes and business rules, information needs and flows, user requirements, and technology components and solutions. As such, they are valuable tools that companies can use to align business and technology strategies and investments by fostering collaboration between IT organizations and lines of business.

Enterprise architecture is a key enabler of business and technology transformation. It provides organizations with opportunities to harvest the benefits of interoperability by improving business processes, enabling new business models, and increasing organizational agility. At its core, an enterprise architecture is a blueprint that describes the current and desired states of an organization in both business and technical terms, as well as a plan for transitioning between the two states. A successful enterprise architecture captures the mission or business of an organization in models, diagrams, and narratives for the enterprise it defines. It clearly articulates the principles for governance, the reference models required to drive the process, and the guidelines required to deploy new technology capabilities that ensure repeatability, reduce complexity, and increase flexibility.

The implementation of enterprise architecture has been and continues to be a challenge. In the past, many enterprise architecture initiatives have stalled after the definition phase and have languished as exercises on paper only. This is where frameworks come in. A framework can take business processes or patterns defined in the enterprise architecture and provide capabilities, using technology components, that can deliver business solutions to the enterprise. A good framework also uses appropriate industry standards to enable interoperability among hardware and software components. Additionally, frameworks can be used to incorporate best practices from similar organizations in the industry.

A framework can take business processes or patterns defined in the enterprise architecture and provide capabilities, using technology components, that can deliver business solutions to the enterprise.

As shown in Figure 1, IBM's Solution Architecture For Energy and Utilities Framework, which uses an SOA, currently provides the following capabilities using technology components from IBM and its business partners:

- Asset, device, and service monitoring — visualizes infrastructure availability and performance through device, event, and usage data, providing real-time control and analysis

- Asset lifecycle management — tracks, documents, and supports decisions about the procurement, deployment, operation, maintenance, and disposal of generation, transmission, and distribution assets

- Business process automation — models, manages, and optimizes business processes

- Improved customer experience — delivers a convenient, personalized customer experience by enabling interactive communication and giving customers more control of their energy usage

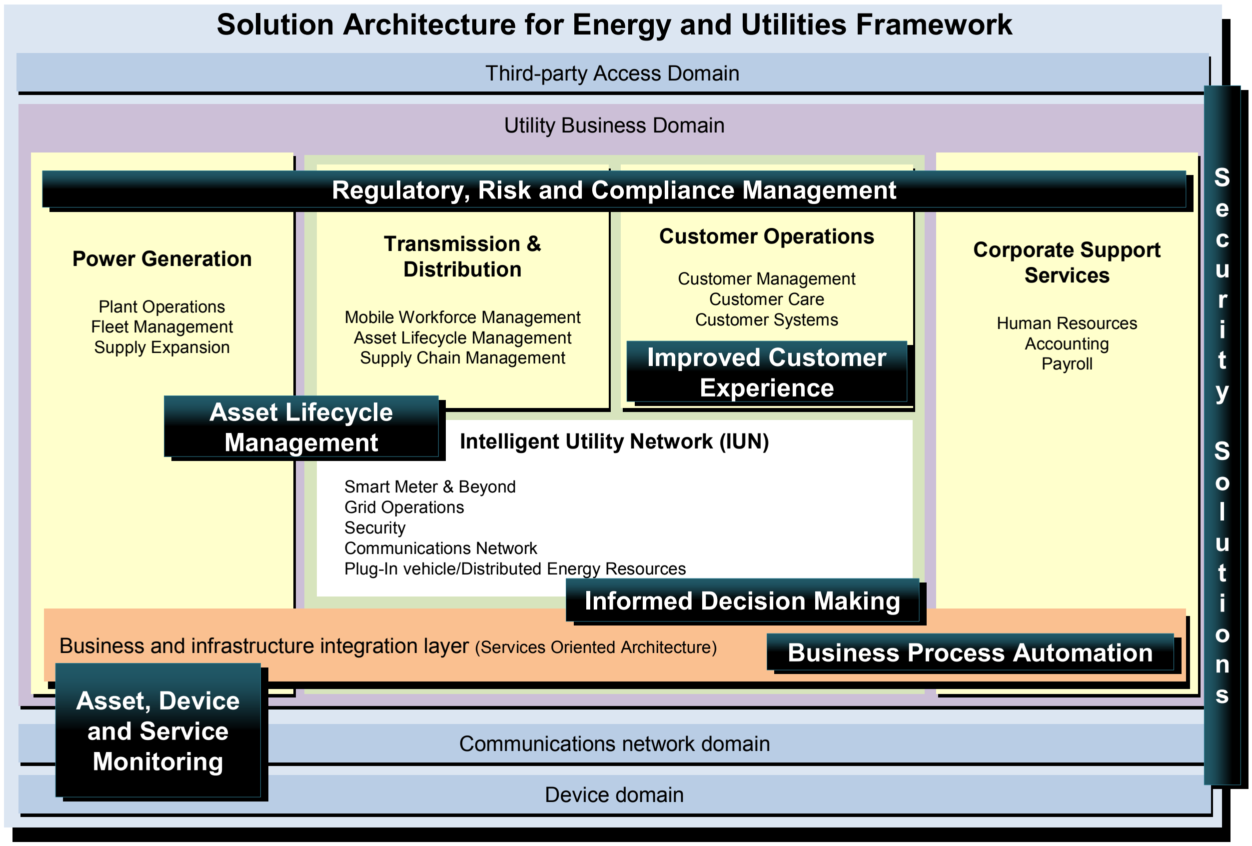
- Informed decision making — uses data and information aggregated from business and operations systems to analyze events, develop insights, and correlate reactions to change

- Regulatory, risk, and compliance management — manages large quantities of utility documents and workflows to comply with government-mandated regulations

- Security solutions — comprehensively manages and prevents security risk across all business domains

FIGURE 1

IBM's Solution Architecture for Energy and Utilities Framework



Source: IBM, 2009

The following case studies show how the capabilities provided by IBM's Solution Architecture for Energy and Utilities Framework have been used to support specific transformation projects at utility companies.

CASE STUDIES

EnergyAustralia

EnergyAustralia owns and operates the largest electricity distribution network in Australia. The corporation is owned by the government of New South Wales. Its electricity distribution network covers the Sydney, Central Coast, and Hunter regions — a service territory of over 22,000 square kilometers — and serves 1.5 million customers. Additionally, EnergyAustralia is a retail electricity provider in New South Wales, Victoria, Queensland, and the Australian Capital Territory (ACT).

EnergyAustralia has approval from the Australia Energy Regulator to invest close to $8 billion during the 2009–2014 time period to serve growing demand, replace aging assets, and comply with the regulatory requirements for system reliability. Part of this investment will be used for an intelligent network project that will deploy approximately 15,000 new distribution sensors, a data communications network, interfaces to existing grid management applications, and development of new data historian and data visualization capabilities. Prior to this initiative, EnergyAustralia had limited visibility into the operating conditions of its distribution network. Existing substation instrumentation only recorded maximum demand information — it did not capture any time series data. It also did not communicate data in real time, requiring time-consuming and costly manual data collection.

The project was formally kicked off in September 2008, and phase I, which includes the first group of sensors, the communications network, and the first software applications, is scheduled to go live in November 2009. All of the sensors will be deployed over the next three years.

The project utilizes the asset, device, and service monitoring capability of IBM's Solution Architecture For Energy and Utilities Framework. Key technology components of the project include:

- DISCOS sensors from IBM business partner PowerSense (originally developed by DONG Energy of Denmark)
- PI data historian from IBM business partner OSIsoft
- Tibco enterprise service bus (ESB)
- IBM WebSphere DataPower appliance and WebSphere Application Server
- IBM consulting and system integration services

Importantly, EnergyAustralia has taken a framework-based approach that uses an SOA and a common information model standard (IEC CIM), which will enable the company to more easily maintain the current environment and expand into other areas. For example, the ESB is being used to integrate the data from the sensors with the data historian, outage management and distribution management systems, and Web 2.0 visualization applications.

The main benefits from the project are expected to include improvements in system reliability, reduced operations costs associated with manual data collection, and improved asset management.

During the course of the project, EnergyAustralia encountered and overcame a number of challenges. One challenge was to manage risk when the mix of project partners included at least one small technology vendor with relatively new products, given the complexities of integration among multiple components. Another significant challenge involved the magnitude of business transformation required. Because the project cut across multiple business groups and required changes in the way long-term employees approached the job and performed day-to-day tasks, the company invested extra time and resources in working closely with field staff early in the project design phase.

Adrian Clark, Manager of Intelligent Networks for EnergyAustralia, stated that the company has learned a number of valuable lessons from the project. First, get the data communications strategy and solution in place — this is the enabler for successful implementation of the other technology components. Choose a systems integration partner that has the right resources available at the right time — always look to create the "A team," remembering that it is important to develop the internal team's capabilities because the team must be responsible for leading strategy and architecture and retaining project knowledge once the systems integrator completes the engagement. Regarding project organization, the team must be multidisciplined across power engineering, telecommunications, and contemporary IT with the business support and capabilities to work across organizational boundaries.

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Future directions for the project are expected to include an expansion from the distribution network to tackle the complexities of the transmission network. The next steps for the distribution network are part of EnergyAustralia's road map to a "self-healing" grid that will look to introduce remote control in conjunction with physical network augmentation to further improve fault restoration times and make the grid more resilient.

U.S. Electric and Gas Utility

This United States–based combined electric and gas utility distributes energy to over 2 million electric and 3 million natural gas customers. Following the 2003 Northeast blackout, the company and its regulators recognized that the blackout was not an isolated event. The notion of upgrading transmission and distribution systems to meet the reliability objectives the regulators strived for became evident. The company embarked on a long-term vision of better balancing supply and demand. To improve overall reliability, the utility took a two-pronged approach. One tenet it held committed to reducing consumption to help offset the restrictions that new generation plant approvals faced in the regulatory process. The utility also focused on creating more points of automation in its asset portfolio. An added benefit, which helped rationalize the investment further, provided operations and maintenance cost savings.

In 2008, the regulator asked the company to draw up full plans to implement advanced metering infrastructure (AMI) to achieve a systemwide upgrade to the electric distribution network. The company, which had already been in a pilot project for the past year, moved quickly and won approval later that year with a plan to deploy over 2 million smart meters over a five-year period. The budget would fund the rollout of meters, a communications network, and the back-office enterprise software systems, which began in early 2009.

Unlike the deployment of new meters and communications networks, the deployment of the software environment presented a different challenge for the utility. Focused on maintaining the dozens of multivendor application installations, the company needed to integrate the new infrastructure with the existing systems and applications. Maintaining operational stability and leveraging previous investments where possible were key design goals.

The utility fully understood that the implementation of AMI provided the opportunity to change its business processes to complement the new technology capabilities. The existing business processes not only relied on multiple technologies but also spanned business units and functional areas. For example, the meter-to-cash business process relies on numerous integrated software applications that span field operations, IT, customer service, and business analysts. In addition, maintaining those systems was paramount to successfully navigate the process changes the AMI project would catalyze.

Fully leveraging the company's AMI implementation, the software integration strategy hinged on building a flexible, modular architecture that would enable the utility to change business processes without technology restrictions. To maintain previous investments in meter to cash; future-proof the architecture with a flexible design; manage the proliferation of assets such as smart meters, communication network components, and future consumer-facing devices; and navigate the changing business processes to the new energy economy paradigm, the company leveraged multiple capabilities from IBM's Solution Architecture For Energy and Utilities Framework, including:

- Asset, device, and service monitoring
- Asset lifecycle management
- Business process automation
- Informed decision making

The utility has been an IBM customer for many years, and it relies on IBM's products alongside those of the dozens of other vendors that make up its IT architecture. For this project, however, the company originally engaged with IBM as an integration partner, not as a software vendor. It was vitally important for the company to maintain its installed software base, and the company needed a way to achieve that goal. As the company's chief technologist explained:

> "We adhere to an established set of [architecture] principles and industry standards. Our requirement for building any architecture is to not violate any of the existing software. We adhere to IEEE application development and open standards of Web service protocols — e.g., SOAP, for instance. When we look at software, whether IBM or not, it needs to use standard interaction and interface capabilities. So over time we can change them [applications], without problems. We are driven by a standards model, and that's how we assess [products]. That's very different than commoditized software, since we look at software that provides the agility."

He further explained how the IBM framework allowed the utility to establish new capabilities while integrating and maintaining the existing functionality of its current IT investments. For example, the utility enabled business process automation using Web services built on the WebSphere ESB.

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The SOA built on the ESB permitted the utility to separate the rigid integration found in the hard coding of legacy applications to its business processes. This approach allows the company to quickly and easily reconfigure applications when a business process change is required but impacts multiple software components. Additionally, the ESB is essential in managing the Web service links between the utility and its external business partners.

The immediate benefits of the standards-based SOA design allowed rapid integration of disparate vendor applications without the needless risk for future costs related to business process change. Longer-term benefits will allow business process change unencumbered through a modular framework. Having the ability to remotely manage the meters has allowed the company to reduce customer meter turn on/off from a 24-hour cycle to less than 2 hours. The utility has improved customer service for new accounts and reconnects and also realized cost reduction and cash flow improvement for overdue accounts and disconnects. Additionally, The company has eliminated onsite meter diagnostics as well as the lag time to knowing that power is out at the meter, which used to depend on a phone call but now is monitored and reported automatically.

The road has not been trouble free for the utility. With any new technology implementation, lessons are constantly being learned. The company also says that utilities need to appreciate that this journey to the new energy economy is uncharted territory for everyone, so companies shouldn't be afraid of making errors and trying different approaches. The pilots have helped with that process and have limited mistakes to a select few instead of the masses. The company has changed business processes, which quickly affected the organization. It believes the impact of these changes needs to be thought through in advance where possible. It helps to have a vendor partner that understands the utility's needs and can help manage the expectations of business process change that impacts customers and suppliers as well as the utility's business unit staff.

CONCLUSION

As the energy industry embarks on the transition to the new energy economy, energy and utility companies must take a holistic or enterprise approach that aligns the business with its technology investments while allowing flexibility for each company to implement new business processes and systems according to its own priorities. Business and technology frameworks offer a solution to these requirements.

Multiple energy and utility companies, including one in Australia and one in the United States, have successfully used IBM's Solution Architecture For Energy and Utilities Framework to deploy "intelligent utility" business solutions. These utilities have shown that a framework can successfully take business processes or patterns defined in an enterprise architecture and provide capabilities, using technology components, that deliver business solutions to the enterprise. Additionally, frameworks that incorporate industry standards can enable interoperability among technology components and can be used to incorporate best practices from similar organizations in the industry.