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2014 Outlook on Power and Utilities
My Take: By John McCue

Leaders across the power and utilities industry have weighed in on the strategic, financial, and regulatory constraints that are challenging the traditional economic models of our industry. These critical issues warrant continued dialogue here and elsewhere. However, it is also worthwhile to step beyond these challenges and highlight some of the technological advancements that can pave the way to future solutions.

Recent Deloitte white papers focus on the dual industry challenges of steeply rising costs and flat or declining demand for electricity, as well as the technological, regulatory, and competitive forces driving the industry into a potentially disruptive period. The reports conclude that innovation and new business models may be required to meet these challenges.

Edison Electric Institute (EEI), which represents U.S. investor-owned electric utilities, addresses the same issues directly and insightfully in its January 2013 report "Disruptive Challenges: Financial Implications and Strategic Responses to a Changing Retail Electric Business." The paper indicates that declining costs for distributed generation and other distributed energy resources could directly threaten the centralized utility model. EEI advises the industry to work on changing the regulatory paradigm and addressing disruptive threats, even if it means transforming established business models.

New technologies will play a key role in 2014 and beyond

As the power and utilities industry heads into this period of transformation, power, gas, and water companies are poised to benefit from a wave of technological advancements that can positively affect results across the value chain. Consider just three categories of technology that will continue to drive the evolution of our industry: 1) advancements in shale oil and gas production, 2) advanced analytics enabled by in-memory database technology, and 3) advanced nano-engineered materials.

Shale production advancements cut costs for power and utility companies

At the first link of the power and utilities value chain, natural gas has clinched its position as a key baseload fuel for electric power companies due to low prices and its lower emissions profile. Moreover, prices are likely to remain relatively low over the next two decades as the shale gas revolution continues to play out. Deloitte MarketPoint's World Gas Model projects an average U.S. Henry Hub spot price of $5.86 per MMBtu over the next 20 years (2014-2034). While this is a 58% increase from the 2013 average spot price of $3.70 per MMBtu at Henry Hub (January to August) reported by the Energy Information Administration, it would still make natural gas one of the least expensive fuels for generators. So how will oil and gas companies maintain the production levels required to keep gas prices low?

Producers are tapping heavily into scientific and technological advancements to boost recovery and improve efficiency in North American shale plays, which are known for low recovery and steeply declining production rates compared with conventional wells.

Advancements such as multi-well pad drilling, multiple fracture stages, and improved well and pipe design have already boosted drilling efficiencies significantly. Producers are using fewer rigs to extract more oil and gas in less time, which keeps costs down. Further advancements promise to keep driving efficiencies in shale production. Consider these examples:

Rock physics – Scientists and engineers are studying how different types of rock fracture to produce hydrocarbons and learning how to optimize drilling in shale formations through more precise well siting.

Improved monitoring/sensing, stimulation, and fracking – Producers are making strides with new seismic software based on radar and sonar techniques to help them "see" how the rock is fracturing digitally and target "sweet spots" in real time. They are stimulating oil and gas flow with new methods such as hydraulic pulsing and reducing water use with water-free fracturing technologies.

Lessons learned – Scientists and engineers believe technology combined with field experience will lead the way to enhanced oil and gas recovery in new shale reservoirs. Producing companies are amassing enormous databases and expect to make significant advances as data is combined and shared.

The effects of these technologies will be magnified as producers use advanced analytics tools to gain insights from the data and continue flattening the cost curve.

In-memory database technology combined with smart data enables advanced analytics

Power and utilities companies are also benefiting from advanced analytics tools – to boost efficiency, save money, ensure reliability, and provide better service to customers. The key is a combination of in-memory database technology, a technology that has been commercialized in other industries in recent years, with the so-called "data tsunami" inundating utilities, primarily from smart meters and other intelligent devices being deployed across power, gas, and water systems.

What's the big deal with in-memory database technology? Before this technology, databases had to continually access disk-based memory to retrieve data. Today, the declining cost of semiconductors has made chip-based memory affordable, enabling storage of large volumes of data in primary memory. This accelerates processing and allows companies to store hundreds of terabytes of data in-memory – more than 10 times what the largest U.S. electric utilities store in data warehouses. Software vendors are continually improving products to help utilities harness the data coming off the grid and analyze it in real time, opening up a range of possibilities that are just now becoming economically viable for the industry. For example:

Predictive asset maintenance – Companies can now communicate in real time with physical assets across the electric grid (or gas or water system), such as substations, reclosers, and meters. They can continually evaluate metrics, such as temperature and vibrations and use them to create predictive models to optimize the system and indicate imminent failure.

Customer service – Advanced analytics provide more information to help utilities restore service during emergencies, such as crew locations, ongoing weather conditions, and downed wires. Companies are prototyping advanced dashboards to help operations teams boost reliability as part of overall system maintenance.

Segmentation and targeting – Utility companies are mining customer data to help segment and target customers for new services and programs like energy efficiency and demand response.

Revenue protection and fraud/theft detection – Utilities are increasingly using analytics to detect fraud and theft from the electric grid, or leaks in the gas and water infrastructure. A $4 million power company project to detect, collect, and analyze tampering could feasibly payback the investment in less than a year.

Advanced nano-engineered materials create efficiencies across the value chain

Imagine materials lighter than a feather, stronger than steel, more conductive than copper, impermeable to standard gases, and as thin as an atom – and you will start to grasp the promise of nanotechnology. Advanced nano-engineered materials are creeping in across the entire energy value chain and will have a multitude of impacts.

Nanotechnology is, simply, the ability to manipulate particles at a molecular level. Special properties of the resulting nanomaterials can create tremendous efficiencies across the energy value chain. Consider these examples:

Oil and gas production – Nanotech particles increase the strength to weight ratio of pipelines, making them more durable, while nanocoatings help equipment resist corrosion. Nanoballs prop shale fractures open to optimize oil and gas flow and reduce water and chemical requirements.

Electricity generation – Using nanocomposites in wind turbine design improves blade performance by maintaining strength and stiffness. Nanolubricants with friction coefficients near zero maximize system efficiency in wind and conventional power generation turbines. Several evolving nanotechnologies reduce the size and enhance the efficiency of solar panels, such as thin film graphene and nanowire coating.

Electricity transmission and distribution – Highly conductive carbon nanotubes can substantially cut energy loss from transmission lines, and researchers believe a breakthrough in mass production of the material is on the horizon. In five to ten years, smaller, faster, and cheaper nanosensors will help utilities detect operations issues in advance by monitoring current and voltage along the grid, detecting the condition of underground cables, and evaluating transformers and other equipment.

Electricity storage – Nanotechnology is contributing to the development of high capacity affordable energy storage, the game-changer expected to help mitigate renewables' intermittency. Nano-infused electrodes increase batteries' storage capacity, and materials like carbon nanotubes will eventually be used to produce ultra or super capacitors that store energy more efficiently.

These technological advancements and others will help support power and utility companies through the coming industry transformation. One important caveat, however, is that as the industry becomes increasingly technology-driven, companies will need to employ greater numbers of "knowledge workers," currently in short supply. Power and utility companies would do well to join others in the business community who are seeking solutions to the dearth of "STEM" students (science, technology, engineering, and math) through education initiatives, partnerships and apprentice programs, immigration policy changes, increased research and development funding, or other efforts. A combination of technological know-how and a pool of job candidates who know how to harness it will serve the power and utilities industry well into the 21st century.