EPRI | ELECTRIC POWER RESEARCH INSTITUTE

THE INTEGRATED ENERGY NETWORK

EXECUTIVE SUMMARY

Over the past few years, EPRI has examined the forces changing the world's energy systems. We have gained insights through discussions with our advisors and leaders from energy organizations, regulatory commissions, academic institutions, environmental organizations, finance and government. These conversations, along with EPRI's science-based insights, are reflected in our report: *The Integrated Energy Network: Connecting Customers with Reliable, Affordable and Cleaner Energy*[i].

The **Integrated Energy Network** envisions a future in which customers have flexibility to use, produce, and manage energy as they choose, while improving access to reliable, safe, affordable, and cleaner energy. The report outlines three important areas of focus: Using Cleaner Energy Through Efficiency and Electrification, Producing Cleaner Energy, and Integrating Energy Resources.

Eight key insights from this work highlight implications for research and infrastructure investment:

1. Electric, gas, transport, and water systems are increasingly interdependent, but their planning and operations are largely separate. EPRI believes we should seek to integrate them more closely to improve reliability, gain efficiency, and increase value to customers. We emphasize that infrastructure investment will be more effective if broad energy and natural resource implications are considered, rather than focusing narrowly on the effects in a single energy sector.
2. Advances in wireless connected technologies including information, communications, sensors, data analysis, and modeling will be instrumental in integrating energy systems. Investment in these "connected" technologies can drive the rapid advances essential for the efficient operations of energy systems' plants, wires, pipelines, for enhanced customer engagement. The Integrated Energy Network expands customer choice and control, while maintaining a focus on critical issues such as affordability, reliability, security, and data privacy.
3. An essential step is the full implementation of what EPRI calls the Integrated Grid—an electric system that effectively integrates central and distributed energy resources and enables customers to use, produce, and store electricity as they desire.[ii] The Integrated Grid is the backbone of the Integrated Energy Network. Although progress has been made, EPRI sees the need to re-double efforts to create technical and communication standards, to deploy advanced electric grid technologies, and to provide infrastructure for emerging technologies such as electric vehicles.

[i] To learn more about EPRI's Integrated Energy Network, see *The Integrated Energy Network: Connecting Customers to Reliable, Safe, Affordable, and Cleaner Energy*. EPRI. 3002009917. February 2017 or visit the website http://ien.epri.com.

[ii] To learn more about the Integrated Grid visit the website at http://integratedgrid.com/.

4. Investment in the electric grid is essential. The emergence of low-cost shale gas and rapid deployment of large-scale solar and wind energy have fundamentally changed the electric generating fleet, and are imposing new demands and stresses on the grid infrastructure. Investments in the grid, both at the transmission and distribution level, are crucial to maintain reliability, increase security and ensure resiliency. Moreover, changing electric generation portfolios necessitate expanding regional and long-distance transmission infrastructure to enable more effective utilization of these resources.

5. Technology advances are essential to controlling costs and to creating new possibilities. In addition to advanced technologies for delivering energy, there are promising new technologies for generating electricity including next generation nuclear plants; advanced thermal fossil plants with carbon capture, utilization, and storage (CCUS); and next-generation renewable technologies. The central generation fleet will need to operate more flexibly to support a power system that is much more dynamic and efficient, and which can in turn support the broader energy network.

6. Efficient electrification emerges as a cornerstone for environmental improvement in addition to its potential to lower customer's costs, increase productivity, improve product quality, and provide a cleaner, safer work environment. Cleaner energy is an essential pillar of the Integrated Energy Network. Growing populations, growing economies, and urbanization present local environmental challenges, and create increasing attention to global environmental issues. From a societal perspective, increased adoption of efficient electrification technologies can accelerate the pathway to a cleaner economy fueled by cleaner electricity while simultaneously improving efficient use of energy and natural resources. Natural gas, hydrogen and other cleaner energy sources are also important for continuing to reduce emissions.

7. Re-evaluating energy and environmental policies and regulations to understand how sector-focused policies create disincentives or can work to reinforce desired outcomes will be important for efficient, effective compliance throughout the energy sector. New market designs that drive business model options will increasingly come from sources outside the traditional energy industry.

8. Global collaboration in science and technology innovation, demonstrations and thought leadership are key to successfully navigating a rapidly changing,increasingly complex, multi-dimensional global energy sector where opportunities for progress abound.

The Integrated Energy Network pathway outlines EPRI's view of first steps to an efficient, reliable, affordable and cleaner energy future. Such a future is plausible but not assured. The pathway requires advances in science, technology, markets, policy, regulation, business models, and customer awareness.

EPRI offers this document to spark new thinking and discussion about how integration can affect the production and use of energy. Additional information may be found at the website http://ien.epri.com.

ABOUT EPRI

EPRI is in its 45th year as an independent, non-profit company whose mission is to advance safe, reliable, affordable and clean electricity for society through global collaboration, thought leadership, and science and technology innovation. Our annual research funding is over $400 million, principally from electric utility companies in more than 30 countries. Our research focuses on the generation of electricity; the delivery of electricity; and the use of electricity, including energy efficiency.

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