IEEJ Energy Journal Special Issue December 2018

Challenges for Nuclear Power in Deregulated Markets

Peter B. Lyons*

As Japan moves toward liberalized or deregulated (or sometimes labelled as “competitive”) markets, it may be informative to consider comparable U.S. experience. Many U.S. industries deregulated in the 1970s, such as the telephone and airline industries. These actions generally enabled a wider set of consumer options through competition, innovation and efficiencies with reduced consumer costs. Similar expectations encouraged many states to deregulate their electricity markets.

Before deregulation, electricity markets were a regulated monopoly. State utility commissions set rates that assured adequate compensation for utilities, analyzed future electricity needs, and approved new construction with cost recovery. Deregulated utilities, in contrast, generally focus only on short term profits. It is very hard to argue that electricity deregulation has reduced consumer costs since some deregulated states have the highest rates in the contiguous 48 states with Connecticut - 17.2, Massachusetts 16.5, Rhode Island - 16.3, New York - 14.5, and California - 15.2 cents/kwh, as compared to a national average of 10.3 for 2016.[1]

With the advent of fracking for natural gas, U.S. gas prices plummeted in the last decade, falling by a factor of four. In addition, mandates to utilize renewables distorted markets when coupled with federal and (some) state production tax credits, sometimes driving electricity prices below zero. (Renewables are still profitable when production tax credits offset any negative price.) In a recent study, “In New England, … over 70% of revenues for … wind and solar units in 2015-16 were federal/state programs… investment/production tax credits, … renewable energy credits.”[2]

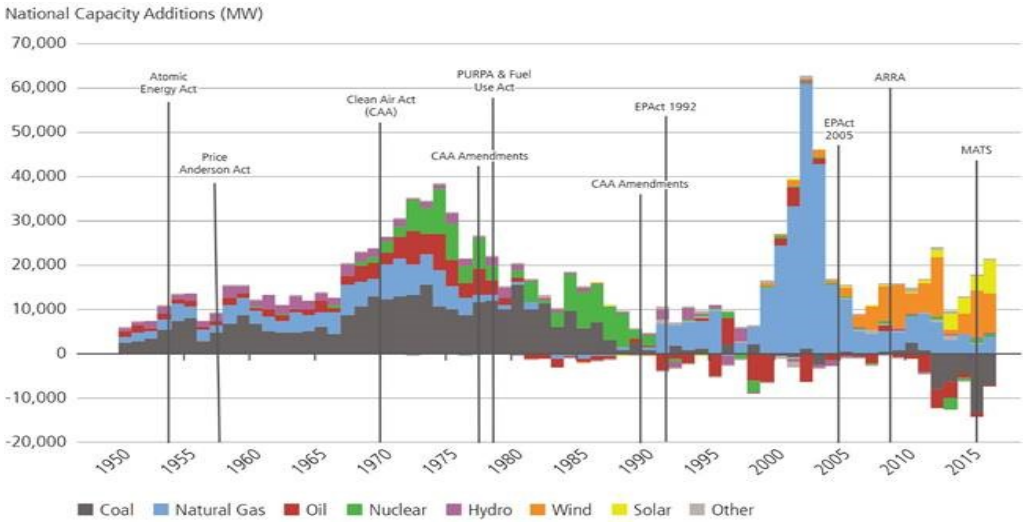
Moving to renewables and low-cost natural gas in deregulated states benefits consumers in the short term but, barring other mandates or incentives, they may forego: construction for future energy needs, carbon reduction, clean air, supply diversity, or planning for weather contingencies. These lower costs have forced many baseload generation resources (coal and nuclear) into retirement. Fig. 1 shows the changes in U.S. electricity generation capacity over many decades. (Note that generation capacity and actual generation are related by the capacity factor, which varies widely among nuclear 92%, wind 37%, solar photoelectric 27% in the U.S. in 2017[3]).

To evaluate impacts of these changes in generation capacity, especially the retirement of baseload facilities, the U.S. Energy Secretary requested a report on electricity markets and reliability. That report[4] noted that “severe weather events have demonstrated the need to improve

* Former Assistant Secretary for Nuclear Energy, Department of Energy, US

system resilience." and "work is needed to understand what can be done to maintain resilience in a variety of conditions." The Secretary then proposed that the U.S. Federal Energy Regulatory Commission (FERC) take swift action to address threats to U.S. electric grid resilience.[5] The Secretary noted that: "A … resilient … grid is critical not only to our national and economic security, but also the everyday lives of American families. A diverse mix of power generation resources, including those with on-site resources, is essential to the reliable delivery of electricity…". The "on-site resources" mentioned here encompass both coal and nuclear energy, and inclusion of carbon-emitting coal precluded any support from environmentalists. A coalition of clean (wind) and fossil (petroleum and natural gas) groups opposed the Secretary's request.[6]

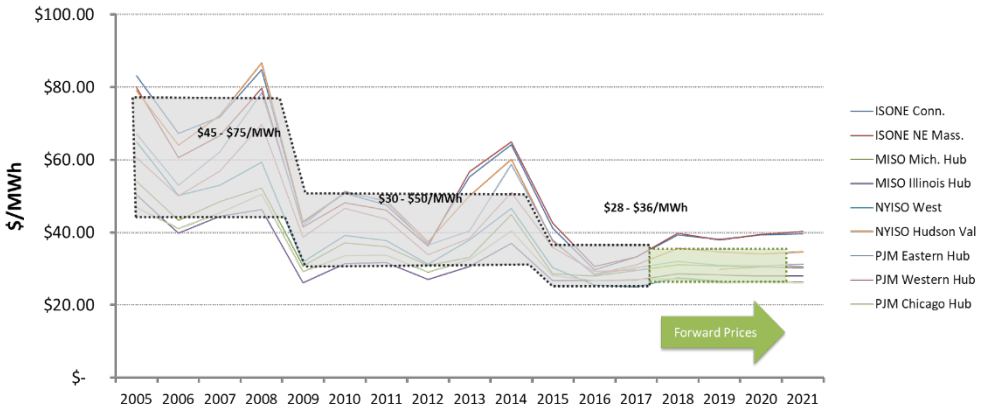
Fig. 1　U.S. Electricity Capacity Changes - Additions and Retirements[4]



FERC responded in January 2018 and noted that, while they shared the goal of strengthening resilience of the grid, they did not support assistance for nuclear and coal plants in competitive electricity markets. FERC directed regional transmission operators (Independent System Operators or ISOs) to further examine this matter. ISO-New England reported[7]: "The increasing shift away from generators with on-site fuel to natural gas-fired generators relying on "just-in-time" fuel delivery infrastructure (or to generators using inherently variable fuel...) has further exposed the limits of New England's existing fuel delivery system and heightened the region's fuel-security risk, particularly during the winter." Some press reports since these events note the Secretary's continued interest in support to coal and nuclear plants for resiliency, but other reports claim that this suggestion has been deferred.[8]

Low-cost natural gas and renewable mandates and incentives, coupled with flat U.S. electricity demand, have led to reduced wholesale electricity generation prices. Fig. 2 shows curves for different electricity distribution organizations in the northeast U.S. Fig. 2 also shows approximate envelopes that encompass most of these wholesale electricity generation prices at different times.

Fig. 2　The Impact on U.S. Wholesale Electricity Generation Prices from Low Cost Natural Gas, Flat Demand, and Renewable Subsidies and Incentives[9]



This downward trend in generation price complicates economics for U.S. nuclear generators despite their improved operations. Average nuclear generating costs[9] have decreased from a peak average of $40.25/MWh in 2012 to $33.93/MWh in 2016. Furthermore, there is a significant disparity between single unit and multi-unit sites ($41.39 vs $31.63/MWh in 2016). While the average nuclear generators are producing electricity consistent with Fig. 2, although towards the upper end of the current range, some higher cost plants are not economical and are at risk of closure.

Over the past five years, 18 nuclear reactors at 14 sites across the U.S. have either closed or their premature closings have been announced.[10] These closures result in loss of a major source of clean energy but, in deregulated markets, that factor is not considered by the markets unless other credits are available. Furthermore, these closures have typically been accomplished with an increase in use of natural gas, leading to the observation that “Closing nuclear … means erasing almost all the … gains in addressing climate change … It’s happened in … every state that has prematurely closed nuclear in the last few years.”[11]

Some states have recognized the clean energy attributes of nuclear power and protected their plants from closure. New York and Illinois now provide credit for the zero-carbon emission of nuclear plants. Dennis Kucinich (Ohio Congressman, 1997-2013) noted “Ohio’s economy cannot absorb the shock of taking existing nuclear utilities off-line in a deregulated market. Deregulation has been a failure in Ohio. It has not in any way, shape or form resulted in benefits for either Ohio utility ratepayers or Ohio businesses.”[11]

The previous Administration of President Obama was strongly supportive of efforts to limit carbon emissions. The science that drove his concerns has not changed. The recent scientific Report[12] from the current Trump Administration concluded that “it is extremely likely that human activities, especially emissions of greenhouse gases, are the dominant cause of the observed warming since the mid-20th century.” Nevertheless, the position of the Trump Administration has generally been to discount human influences on climate change and to cease implementation of the

Paris Accord.[13]

Despite diverging views between science and Administration policy, U.S. industries are generally working to reduce their carbon footprints. For example, Duke Energy recently outlined their intent to reduce their carbon footprint[14] while noting: “We do not believe 100 percent renewables can reliably deliver the power required by a modern economy.” In this statement, Duke Energy does not accept the premise advanced by some groups that a 100 renewable future is feasible[15], a view that has been strongly rebutted by other writers.[16.]

The primary lesson with respect to nuclear power for Japan from U.S. experience with deregulation is that great care should be used in transition to a liberalized market to avoid jeopardizing utilization of clean and reliable nuclear power. While nuclear power has not been popular in Japan after the Fukushima accident, it is essential to meet the electricity needs of Japan’s modern industrial society while minimizing carbon emissions. Intermittent renewables are not able to provide the reliable power-on-demand that a modern society requires. And while storage systems can help renewables, available battery systems are not suitable for a grid-level mission.

In closing, the author provides two suggestions for consideration by the Japanese government and the Japanese people to address these challenges:

If the focus of the Government of Japan and the electric utilities is only on restart of the existing nuclear plants under the very stringent current safety standards, it seems difficult to regain public trust. Changing public opinion depends on changing traditional approaches! If these entities embraced some of the new, far safer, modern plant designs, like some of the small modular reactors, then the Japanese public could realize that there will be a strong emphasis on evolution toward significantly safer nuclear systems.

And if the Japanese government intends to fulfill its climate change goals, carbon reductions are required for all sectors, including electricity production, industry and transportation. Extensive international research, with strong participation from Japan,[17] is in progress to study systems that couple the best features of nuclear and renewable energy sources, so that the two sources work together to extend clean energy to multiple sectors. The IAEA is now sponsoring international meetings on this topic[18] and Japan was a founding member (with Canada and the U.S.) at the May 2018 Clean Energy Ministerial of the “Nuclear Innovation: Clean Energy Future (NICE Future) [which] will address … power system integration through … nuclear-renewable systems”[19] But, to date, none of these integrated systems are actually operating in either Japan or the U.S.

Ideally, Japan will regain its past leadership in reduction of greenhouse gas emissions. Effective integration of nuclear and renewable energy will be a key contributor to that success.

[1] U.S. Energy Information Administration State Electricity Profiles for 2016-Average Retail Price; January 25, 2018.

[2] Richard Myers*; America's Hidden Energy Crisis-If Competitive Electricity is Such a Good Business, Why are Companies Closing Power Plants, Taking Write-downs, Seeking Bankruptcy Protection, and Scrambling for the Exits?*, Copyright 2017 by Richard J. Myers.

[3] U.S. Energy Information Administration; *Electric Power Monthly - Capacity Factors for Utility Scale Generators Not Primarily Using Fossil Fuels*, January 2013-July 2018; September 25, 2018.

[4] U.S. Department. of Energy; *Staff Report to the Secretary on Electricity Markets and Reliability*; August 2017.

[5] U.S. Department of Energy Press Release; *Secretary Perry Urges FERC to Take Swift Action to Address Threats to Grid Resiliency*; September 29, 2017.

[6] Timothy Gardner; *Gas, Renewable Groups Oppose U.S. DOE's call to Support Nuclear, Coal*; Reuters, October 2, 2017.

[7] ISO New England, Inc.; *Grid Resilience in Regional Transmission Organizations and Independent System Operators*; FERC Docket No. AD18-7-000; March 9, 2018.

[8] Eric Wolff and Darius Dixon; *Rick Perry's Coal Rescue Runs Aground at White House*; Politico; October 15, 2018.

[9] Matthew Crozat; *Nuclear Market Update;* Energy Information Administration Nuclear Workshop; Washington, DC; March 6, 2017.

[10] Nuclear Energy Overview, Nuclear Energy Institute, March 29, 2018.

[11] James Conca; *Dennis Kucinich Wants to Bring Regulation Back to Ohio's Electricity Market*; Forbes, April 6, 2018.

[12] U.S. Global Change Research Program*; Climate Science Special Report: Fourth National Climate Assessment*; U.S. Dept. of Commerce/National Oceanic and Atmospheric Administration*;* June 2017.

[13] The White House; *Statement by President Trump on the Paris Climate Accord*; June 1, 2017.

[14] Duke Energy; *2017 Climate Report to Shareholders*; March 2018.

[15] Mark Z. Jacobson et al; *Low-Cost Solution to the Grid Reliability Problem with 100% Penetration of Intermittent Wind, Water, and Solar for All Purposes*; Proceedings of the National Academy of Sciences, Vol. 112, No. 49, pages 15060-15065; December 8, 2015.

[16] Christopher T.M. Clack and 21 co-authors, *Evaluation of a Proposal for Reliable Low-Cost Grid Power with 100% Wind, Water, and Sola*r, Proceedings of the National Academy of Sciences, Vol. 114, No. 26, pages 6722-6727; June 27, 2017.

[17] C. Forsberg, R. Lester, N. Sepulveda, G. Haratyk, A. Omoto and T. Taniguchi, R. Komiyama, Y. Fujii, K. Matsui, X. Yan, T. Shibata and T. Murakami; *The MIT-Japan Study: Future of Nuclear Power in a Low-Carbon World: The Need for Dispatchable Energy*; The Center for Advanced Nuclear Energy Systems, Massachusetts Institute of Technology, MIT-ANP-TR-171; September 2017.

[18] IAEA Technical Meeting, *Nuclear-Renewable Hybrid Energy Systems for Decarbonized Energy Production and Cogeneration*, October 22-25, 2018, Vienna, Austria.

[19] Clean Energy Ministerial Press Release*; Countries Launch a Nuclear Innovation initiative under the Clean Energy Ministerial*; May 24, 2018.

Writer's Profile

Peter B. Lyons

He led the Office of Nuclear Energy in the U.S. Department of Energy while serving as the primary policy advisor to the Secretary of Energy on issues involving U.S. and international civilian nuclear energy research, development and demonstration activities. He was a Commissioner of the Nuclear Regulatory Commission and served as Science Advisor on the staff of U.S. Senator Pete Domenici and the Senate Committee on Energy and Natural Resources, where he focused on military and civilian uses of nuclear technology. He now acts as a consultant to several corporate and laboratory boards, as well as assisting several international groups.