Building the Bridge from Natural Gas to Clean Energy: Challenges and Opportunities

N. Jonathan Peress – EDF 8/5/16 **(Draft)**

Natural gas is widely viewed as a bridge to a low carbon energy future, particularly in the domestic electricity sector. This short paper considers the role of natural gas in the current policy and economic context including natural gas, first as a displacer of coal-fired power plant output, and, then increasingly as a provider of flexible services to balance and facilitate increasing deployment of intermittent and variable renewable energy capacity.[1]

According to a July 2016 analysis by EIA, "the most important [electricity system] trends over the past few years have been large increases in natural gas, solar and wind generating capacities along with a significant decline in coal generating capacity."[2] Due in large part to the cost advantages created largely by the abundant shale gas supply, natural gas-fired power plants are rapidly becoming the dominant source of electric power in the US. In 2016, natural gas is expected to supply 34.3% of electricity generation, and coal is forecast to supply 30.2% of electricity generation.[3] Assuming implementation of the Clean Power Plan, natural gas's market share lead over coal is projected to continue to grow, as is the deployment of renewable energy.[4] EIA's most recent projection would have renewable market share growing from 13% in 2015 to 23% in 2025.[5]

Numerous data points and projections suggest that as renewable penetration increases, output from natural gas-fired power plants, particularly baseload, combined-cycle, plants, will fall.[6] MIT's Future of Natural Gas Study observes that increased renewable deployment will result in market and economic uncertainties as gas-fired baseload power plants experience reduced output and patterns of electricity production are altered. The study predicts market and operational challenges and notes that (as of 2011) "there is no consensus on a suitable regulatory responses which could include enhancements of capacity mechanisms such as those already in place in most U.S. wholesale markets, new categories of remunerated ancillary services or other instruments."[7] These operational and market challenges are now occurring, particularly in regions where distributed and renewable generation is becoming a substantial market participant.

More recently, it is also becoming apparent that commercial incentives for natural gas infrastructure deployment are somewhat misaligned with the ongoing transformation of the electric grid to a more renewable, dynamic and lower carbon grid. Current investment signals are weighted towards building somewhat inflexible pipeline capacity which are being deployed

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[1] See, *The Future of Natural Gas, An Interdisciplinary MIT Study,* June 2011
[2] EIA, *Electricity Monthly Update*, July 2016.
[3] EIA, *Short Term Energy Outlook*, July 12, 2016.
[4] EIA, http://www.eia.gov/todayinenergy/detail.cfm?id=26712
[5] EIA, http://www.eia.gov/todayinenergy/detail.cfm?id=27332
[6] See, e.g., 2016 California Gas Report (filed by California gas companies to the CPUC), August 2016 (California gas demand for electric generation is expected to decline at 1.3 percent per year for the next 20 years due to more efficient power plants, statewide greenhouse gas policies and renewable deployment)
[7] *The Future of Natural Gas, An Interdisciplinary MIT Study* at 94.

with largely static financial and physical designs that will likely be incompatible with GHG reductions beyond the Clean Power Plan and substantial additional renewable deployment. The current natural gas market design is not targeting the right types and amounts of natural gas infrastructure -which will impose unnecessary costs on captive retail ratepayers, strand long-term investment that becomes uneconomic long before its useful life, unnecessarily increased costs for further GHG reductions beyond the Clean Power Plan, and lower cost renewable resource lockout.[8]

The California Duck Curve illustrates some of the operational considerations relevant to natural gas and renewable integration by in particular, highlighting the value of flexible resources in the system.[9] But pipelines are not being built to serve the variable load profiles of electric generation, which increasingly experience rapid swings in output over the course of a day. Pricing and incentivizing investment in flexible services, including those powered by natural gas, is an imperative as more renewables are deployed.

Natural gas pipeline capacity is critical to getting expanding gas supply to markets and end users including electric generators. The current market design rewards pipelines with 12-14 percent annual return on equity for the value of that capacity. Consequently, pipeline operators and developers earn profits based almost entirely on take-or-pay contracts with their customers paying for capacity. One consequence is that pipelines operators are largely indifferent to the extent to which pipelines are used. They make money based on obtaining contracts for and building capacity, which provides a powerful incentive to overbuild - and which appears to be underway in many areas of the country. Overbuilding creates the risk of stranded investment particularly insofar as captive retail ratepayers are obligated for long term contracts, which is typically the case.[10]

Commercial rewards based simply on capacity, rather than deliverability, foster incompatibility between the natural gas and electric sectors because pipelines operators have a diminished financial interest in whether delivery services conform to generator needs such as the flexibility discussed above. In general they do not.[11]

The market refinements we propose are designed to channel investment and innovation towards energy infrastructure, whether natural gas or other alternatives, by providing new commercial opportunities that are better aligned with contemporary energy trends – starting with flexibility -- the new paradigm of the energy system which must be properly valued and compensated.

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[8] A recent study conducted for the Massachusetts Attorney General found that new gas pipeline capacity would be a more expensive solution to address reliability challenges than alternatives and would raise the long term cost of meeting regional GHG reduction policies. See, http://www.mass.gov/ago/doing-business-in-massachusetts/energy-and-utilities/regional-electric-reliability-options-study.html

[9] http://www.caiso.com/Documents/FlexibleResourcesHelpRenewables_FastFacts.pdf

[10] See Peress Testimony before the US Senate Energy and Natural Resources Committee (June 14, 2016) discussing market reviews by FERC staff and industry analysts, as well as utilization analysis by USDOE.

[11] The need for gas pipelines to offer services better geared to generation has been a reoccurring theme of market participants before at FERC. See, e.g., Comments of PJM Interconnection, Docket AD 14-19-000 (October 1, 2014)(stating, "today's natural gas market appears to lack sufficient tools and services to dynamically respond to the reliability needs of gas-fired units servicing electric load.")

They are structured to build from the current market design, improve market efficiency, foster investment and save energy customer money.

In general, the FERC is supportive of efforts to better coordinate the gas and electric industries. Those efforts need to be accelerated and go farther. In its April 16, 2015 Final Order No. 809, *Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities*, the Commission found "that additional intraday nomination opportunities could promote more efficient use of existing pipeline infrastructure and provide additional operational flexibility to all pipeline shippers, including gas-fired generators." It directed the North American Energy Standards Board (NAESB), which is an industry consensus standards-setting body, to explore new options and standards for faster more flexible pipeline scheduling. EDF's proposal for standards in the docket are designed to foster new scheduling services that would align with evolving generator needs now, and provide more variable flows to accommodate rapid and dramatic load swings as the system becomes more renewable and dynamic.[12] [13]

The objective of the proposed standards is to provide new revenue streams for natural gas delivery services based on the system value they provide including for flexibility. Achieving price formation and compensation for that value will foster competition and innovation from market participants (on both the gas and electric sides) that can provide those services. As Skipping Stone and EDF suggested to FERC,

> Gas and electric wholesale markets should be economically and operationally coordinated so that products and services in each market generate effective and actionable price signals in and across these two markets, and so that appropriate, right sized, investments are called forth in a timely manner. Regulations, wherever possible, should be aimed at establishing self-correcting market structures that will further serve to support the generation of appropriate price signals that will incentivize market players to meet established policy goals.

We suggest that because natural gas is a robust resource for providing key system services and attributes for a more renewable and dynamic grid, delineating and pricing those services in the energy markets is critical to calling forth investment through the energy markets. Price signals that arise in and between the natural gas and electric markets will over time call forth the most efficient mix of generation, fuel supply, gas pipeline and electric transmission infrastructure, demand response, renewable energy, energy storage (gas, electric, and other) and distributed energy resources as well as provide accurate price signals for increased energy efficiency deployment.

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[12] EDF, working with Skipping Stone (a gas system/market consultancy), proposed standards for provision of "special efforts scheduling for natural gas pipeline transportation that is: a) scheduled outside of the standard grid-wide nomination cycles, b) permits flow changes outside of standard schedule flow periods; and/or c) involves Shaped Flow Transactions (as defined in the proposed standard)." Note: shaped flows would allow generators to schedule varying flow quantities of gas for delivery the next day that correlate to their anticipated output levels.

[13] A complete and recent report of the ongoing NAESB deliberations is accessible at https://www.naesb.org/pdf4/ferc072916_naesb_order809_status_report.pdf.

With respect to natural gas pipelines specifically, valuing and creating price signals for flexible delivery services can begin the process of evolving away from a market design weighted towards valuing capacity between supply and delivery locations in favor of one that compensates for the value of services and throughput. The day is rapidly approaching when the value of moving gas from place to place will dissipate, as gas supplies are increasingly produced proximate to consumption markets. This will have the effect of devaluing place to place transportation services. Moreover, this change in market dynamics will be largely contemporaneous with ever-increasing demand for tailored load following services, those that put a premium on matching variable deliveries to receipts.

Although the pipelines, as an industry, are content with the current market design, it is a fact that certain pipeline systems are losing revenues from services that are based on the differences between prices of gas between two places, as well as losing demand for throughput as flow patterns change and thus are struggling to earn sufficient revenue. For many incumbent pipeline systems, providing new revenue streams for the value of receipt and delivery services – including variable hourly and sub-hourly transportation services as opposed to depending on fixed rate contracts for capacity (i.e., firm transportation) – will be a tool for continued economic viability.