Insights from Natural Gas Fuel Price Scenarios

A scenario-based analysis of the US electric sector through 2050

- **Natural gas-fired, wind, and solar are expected to be the predomoninant sources of new power generation capacity,** with the future mix depending on natural gas prices.
- **Natural gas consumption is expected to increase by 2050** under all scenarios modeled, except the one assuming "high" future natural gas prices that approach $8/MMBtu starting in 2020.
- **At higher natural gas prices, nuclear power generation becomes economic** in some regions, and wind and solar resources are expected to displace much of the existing natural gas-fired generation capacity.
- **2050 results appear robust to final natural gas fuel prices,** but **not the specific price paths.** Natural gas Price trajectories with similar 2050 "end" prices, but different trajectories, yield similar capacity mixes in 2050.

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This Back Pocket Insight (BPI) summarizes key insights from one component of EPRI's *2019 REGEN Scenarios Analysis Project*[1] that focused on exploring how the power generation fleet in the United States may evolve under different future natural gas (NG) price paths.

The *2019 REGEN Scenarios Analysis Project* used EPRI's Unites States Regional Economy, Greenhouse Gas, and Energy (US-REGEN) model to examine the potential evolution of the U.S. power sector under 14 different scenarios[2] that explored varying future NG prices, different policies to achieve near-zero or zero CO_2 emissions in the electric sector by mid-century, and different costs to deploy battery energy storage technologies. This overall analysis compares generation fleet evolution, electrification of various end-use technologies, regional electricity trade, policy compliance choices, technology costs, the potential role for energy storage, and other electric system impacts across the range of scenarios explored between 2020 and 2050.

US-REGEN Model[3]

EPRI's US-REGEN model is an integrated "energy-economy" model that combines a detailed dispatch and capacity expansion model of the U.S. electric sector with a technologically detailed consumer choice model of end-use service and energy demand. The two models are solved iteratively to convergence, allowing analysis of policy impacts on the electric sector taking into account electricity demand responses, and conversely allowing analysis of how end-use energy policies and technological improvements impact electric demand and load shapes. US-REGEN is capable of modeling a wide range of environmental and energy policies in both the electric and non-electric sectors.

Figure 1 compares the NG fuel price paths assumed in the five specific scenarios explored in this BPI. The Reference path reflects the Annual Energy Outlook[4] (AEO) 2019 High Oil and Gas Recovery Path (HOGR), while the High NG trajectory reflects the AEO 2019 Reference case.

Among the three "static" or "flat" natural gas price paths shown, we assume the NG prices move to the given price in 2020, and remains at the same price (in real terms) through 2050. These price points were chosen based on preliminary anaylsis which identified these price points as likely to correspond to significant changes in modeled electric generation capacity.

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[1] See *2019 REGEN Scenarios Analysis: Understanding Key Factors That May Impact the Evolution of Electricity Generation in the United States 2015-2050*, EPRI 2019. Palo Alto, CA. 3002016570.

[2] The "Integrated End-Use" version of the US REGEN Model was used to iteratively determine electricity demand based on electrification in end-use sectors. Technology costs are based on the *Program on Technology Innovation: Integrated Generation Technology Options 2017*. EPRI, Palo Alto, CA 2018. 3002011806, with renewable costs updated in Q3 2019.

[3] Model documentation online at https://eea.epri.com/models.html .

[4] The Annual Energy Outlook (AEO) is published by the United Staets Energy Information Administration.

For example, at "low" NG prices, 80% of generation could be natural gas-fired by 2030, with the existing nuclear fleet effectively retiring by then. By comparison, at "high" NG prices, only 20% of generation might be natural gas-fired, and 40 GW of new nuclear generation could be economic to deploy.

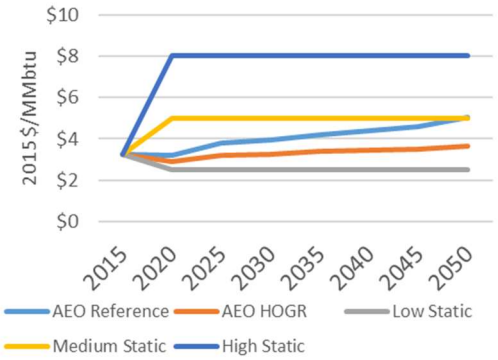

Figure 1: Natural Gas Price Path Comparison

Figure 2 shows the changes in expected future electric generation capacity in 2050 compared to the Reference case for each of the natural gas price scenarios. Because Figure 2 only shows *changes* from Reference case, and not absolute *level*s, the amounts shown do not reflect *total* generation capacity. For example, in the High NG scenario, no new nuclear capacity is expected to be built, but less nuclear is retired for economic reasons than in the Reference scenario. (New nuclear capacity is only deployed in the High Static scenario.) Not surprisingly, deployment of natural gas capacity is inversely related to natural gas prices. High NG prices result in lower NG capacity, and greater deployment of other technologies, primarily wind and solar, and some nuclear generation.

Interestingly, the NG-fired capacity in the High NG and the Medium Static NG scenarios are very similar, despite the two price *trajectories* being very different (although the prices converge in 2050). This is a result of several factors. First, US-REGEN addresses "end-of-horizon" by considering costs across the lifetime of generation units *beyond* 2050, assuming conditions remain constant. Second, new renewable resource investment decisions are decided by conditions in *that* year. Given similar input prices, similar amounts of renewables will be built, which require similar amounts of capacity to provide energy for load given the same load and resource availability patterns, as well as cover the reserve margin constraint.

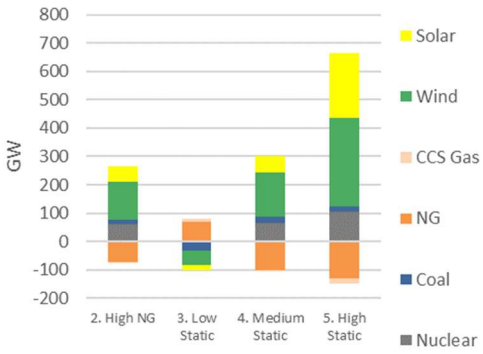

Figure 2: Capacity Changes from Reference Scenario 2050

Figure 3 shows total projected annual NG use for each scenario. These various natural gas price trajectories lead to a wide range of expected NG consumption by 2050, ranging from roughly half to double the NG burn in 2015. Even in scenarios where total NG consumption eventually increases beyond 2015 levels, NG consumption may still decline in the medium term before rebounding, as in the High NG and Medium NG scenarios.

The price of natural gas remains a key uncertainty for future generation capacity investment. However, this analysis indicates natural gas-fired capacity may remain a significant part of the capacity mix in the future, even at "high" prices, as gas-fired capacity can provide both energy and dispatchable capacity as needed.

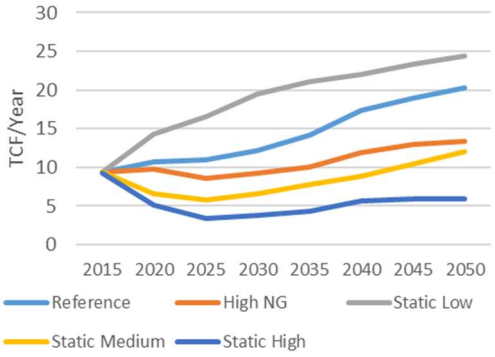

Figure 3: Annual Total Natural Gas Consumption 2015-2050

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