Utility Dive

On Earth Day, natural gas is the power sector's biggest environmental problem

Gas has played a big part in stabilizing US emissions, but its days as a 'bridge fuel' are numbered

By Gavin Bade | April 22, 2016

Natural gas is the new king of the U.S. power sector. After outpacing coal in the generation mix in the latter half of 2015, gas is projected by the EIA to produce about a third of the electricity consumed in the U.S. this year, more than any other resource.

In the short term, that seems like good news for the environment. After the economic recession cut into U.S. carbon emissions at the end of the last decade, replacing coal generation with gas has been instrumental — along with enhanced energy efficiency — in stabilizing U.S. emissions at lower levels and reducing the economy's carbon intensity.

Central to that trend has been the relative carbon efficiency of gas generation. Combined cycle gas plants emit about 60% of the carbon of a modern coal generator for every MWh produced. Even as gas stole coal's crown in 2015, the EIA estimates (http://www.eia.gov/tools/faqs/faq.cfm?id=77&t=11) it contributed only 28% of total power sector carbon dioxide emissions throughout the year, while coal accounted for 71%.

Historically low natural gas prices, enabled by the rise of hydraulic fracturing, have combined with environmental regulations to push utilities from coal to gas. U.S. utilities retired 18 GW of coal generation last year, according to SNL, spurred both by gas prices and the EPA's Mercury and Air Toxics Standards, which set limits on mercury and other harmful emissions from coal plants.

The Clean Power Plan also played a role. Though recent forecasts have posited that wind and solar will make up most of the new capacity additions (http://rhg.com/notes/renewable-tax-extenders-the-bridge-to-the-clean-power-plan) to meet the plan after key tax credit extensions were passed last year, many states and utilities can meet their emissions targets primarily through gas.

Indeed, many utilities have already begun to move in that direction (http://www.utilitydive.com/news/naruc-2015-how-the-clean-power-plan-is-transforming-baseload-generation/409014/) , retiring coal and replacing it with gas to meet the MATS requirements, close in on CPP compliance, and take advantage of low gas prices. About 8 GW of U.S. natural gas capacity was added in 2015, and cumulative additions between 2013 and 2017 are expected to exceed 26 GW.

The shift away from a coal-fired power sector has produced some exciting environmental outcomes. Earlier in April, a new World Resources Institute report (http://www.wri.org/blog/2016/04/roads-decoupling-21-countries-are-reducing-carbon-emissions-while-growing-gdp) highlighted that a number of developed economies, including the U.S., have began to decouple economic growth from greenhouse gas emissions. While the U.S. economy has expanded 28% since 2000, the report found, GHG pollution has grown only 6%.

"In the United States," Coral Davenport noted (http://www.nytimes.com/2016/04/06/upshot/promising-signs-that-economies-can-rise-as-carbon-emissions-decline.html) at the New York Times, "the decoupling of emissions and economic growth was driven chiefly by the boom in natural gas … The glut of cheap natural gas drove electric utilities away from coal, while still lighting and powering ever more homes and factories."

But if the benefits of increased natural gas usage in the power sector have been widely publicized, its potential environmental and financial downsides for utilities have been less so. Beyond significant issues stemming from gas extraction and methane leakage, experts say the rush to gas could inhibit utilities' abilities to meet greenhouse gas goals under the Paris Climate Accord and future environmental regulations related to it. If utilities do not plan well today, they could end with a whole new set of stranded assets — gas facilities.

The glory days of gas are numbered

On Earth Day today, more than 150 nations are expected to symbolically sign on to the Paris Climate Accord, which aims to keep cumulative global warming below 2 degrees Centigrade.

Central to the agreement is a goal among the nations to move toward zero net GHG emissions (http://www.vox.com/2015/12/21/10629172/climate-change-target-zero) by the end of the century, with wealthy countries attaining the goal before developing ones.

In the run-up to the Paris climate talks, President Obama committed (http://www.carbonbrief.org/g7-leaders-target-zero-carbon-economy) the U.S., along with six other major economies, to zero out net emissions by 2100. By midcentury, the G7 countries promised, they would cut carbon on the "upper end" of a 40%-70% range from 2010 levels, something called for (http://www.climatecentral.org/news/major-greenhouse-gas-reductions-needed-to-curtail-climate-change-ipcc-17300) by the most recent report from the UN Intergovernmental Panel on Climate Change. In the shorter term, President Obama committed the U.S. to a 26%-28% emissions cut by 2025 in a bilateral agreement with China last year, roughly in line with the interim goals under the Paris agreement.

While a future president could end U.S. involvement in all these international climate policies, the global trajectory for carbon reduction appears clear — cut GHGs by half or more by midcentury with the goal of zero net emissions by 2100. Even China (http://www.theguardian.com/environment/2016/apr/01/us-and-china-to-sign-paris-climate-deal-in-april) and India (http://www.climatechangenews.com/2016/04/04/india-affirms-commitment-to-sign-paris-climate-accord/) , long holdouts in international climate negotiations, have announced they will adopt this paradigm by

signing on to the Paris deal, and recent numbers from the Chinese government suggest its emissions may have peaked already (http://www.nytimes.com/2016/04/04/world/asia/china-climate-change-peak-carbon-emissions.html?_r=0) , years ahead of schedule.

The boom in natural gas presents a number of issues in the effort to meet this international consensus.

First, the increase in natural gas use has also led to a spike in leakage of methane — the main compound present in natural gas and a greenhouse gas over 80 times more potent than carbon dioxide in the short term.

Scientists largely agree (http://thinkprogress.org/climate/2014/10/22/3582904/methane-leaks-climate-benefit-fracking/) that when natural gas leakages begin to exceed 4% of produced gas, the climatic benefits of a gas generator over a coal one begin to be cancelled out. While the exact rate depends on a number of factors, a 2012 article (http://science.sciencemag.org/content/343/6172/733.summary) in the journal ***Science*** provided a good rule-of-thumb chart:

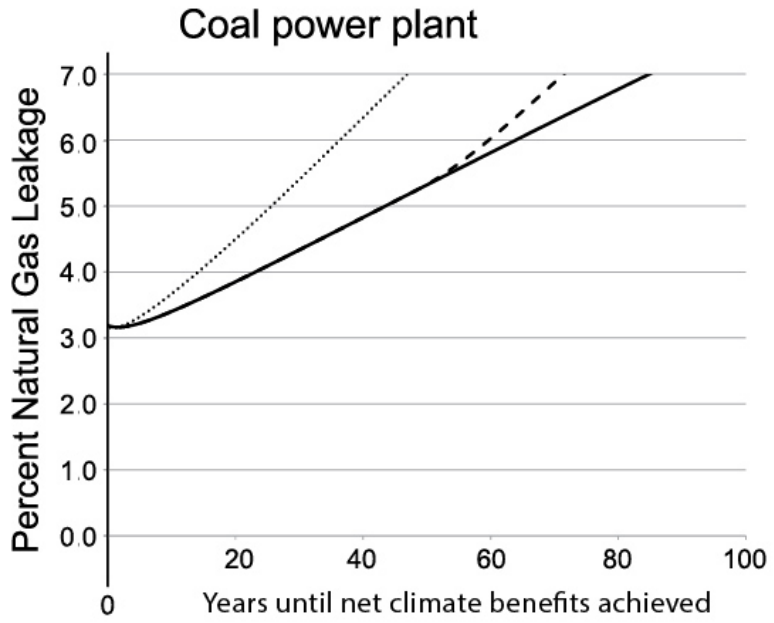


Figure: Maximum life-cycle natural gas leak rate as a function of the number of years needed to achieve net climate benefits after switching from coal power to natural gas. The three curves represent: single emissions pulses (dotted lines); the service life of a power plant, 50 years (dashed lines); and a permanent fleet conversion (solid lines).

Credit: Alvarez et al via ThinkProgress (http://thinkprogress.org/climate/2014/10/22/3582904/methane-leaks-climate-benefit-fracking/)

The EPA previously estimated that 1.8% of methane produced in the U.S. escapes into the atmosphere, but recent studies have shown methane leakage in some systems to be nearly four times that amount (http://www.pbs.org/wgbh/nova/next/earth/methane-regulations/) . Last week, the EPA released (https://www.washingtonpost.com/news/energy-environment/wp/2016/04/15/epa-issues-large-upward-revision-to-u-s-methane-emissions/) an updated report saying the U.S. emitted significantly more methane than previously thought last year, due in large part to increases from the oil and gas sector. Stricter methane regulations are forthcoming (http://www.energylegalblog.com/blog/2016/03/11/methane-regulations-existing-oil-gas-sources-are-coming) from the Obama administration.

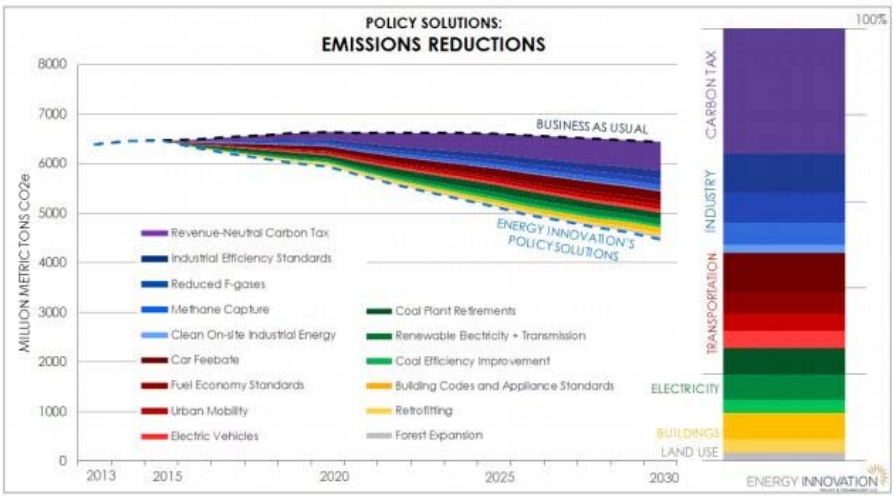
Beyond methane, the upshot for American utilities is that while they can meet their current regulatory goals by building out natural gas generation, they will soon have to start using less of it. While more efficient than coal, natural gas still emits 60% of the greenhouse gases that coal does, meaning any economy that decreases emissions by half by midcentury will need to burn a lot less of both resources.

This presents a conundrum for both policymakers and utilities. Even if the Clean Power Plan was not mired in a legal battle that could see it delayed by two years, its 32% targeted reduction in greenhouse gases by 2030 is not ambitious enough to meet the bilateral agreement with China. Something more, whether it be regulations or clean energy incentives, will be needed to draw down emissions further if the U.S. is to meet the Paris goals.

Some charts from Energy Innovation's Energy Policy Simulator help illustrate the dilemma. The Simulator was developed by the think tank as an emissions and policy modeling tool for the Chinese government, but it is now free and open to the public.

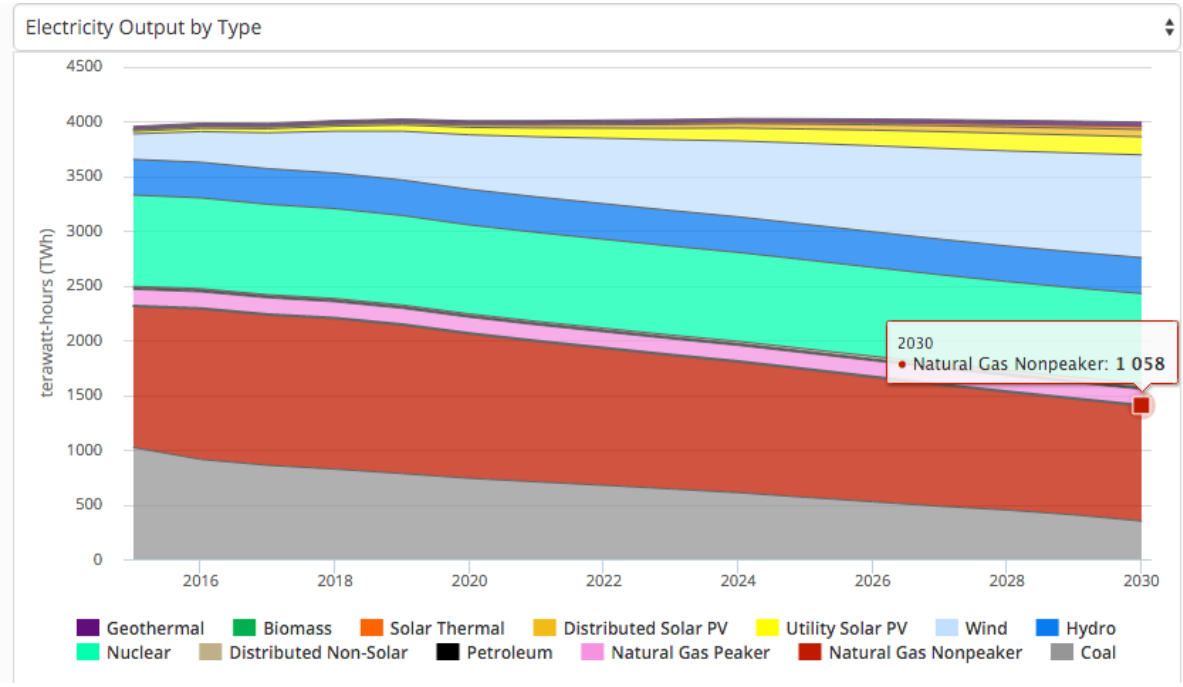
Last year, I went 14 charts deep (http://www.utilitydive.com/news/how-to-decarbonize-the-us-energy-system-in-14-charts/408669/) in a post showing the Simulator's options for decarbonization policy, but it can also help in addressing the outlook for gas. In the program, think tank analysts compiled what they say is the cheapest combination of policies to meet the targets of the bilateral agreement with China, putting the U.S. on

a path to meet the Paris accord:



Credit: Energy Innovation (https://www.energypolicy.solutions/)

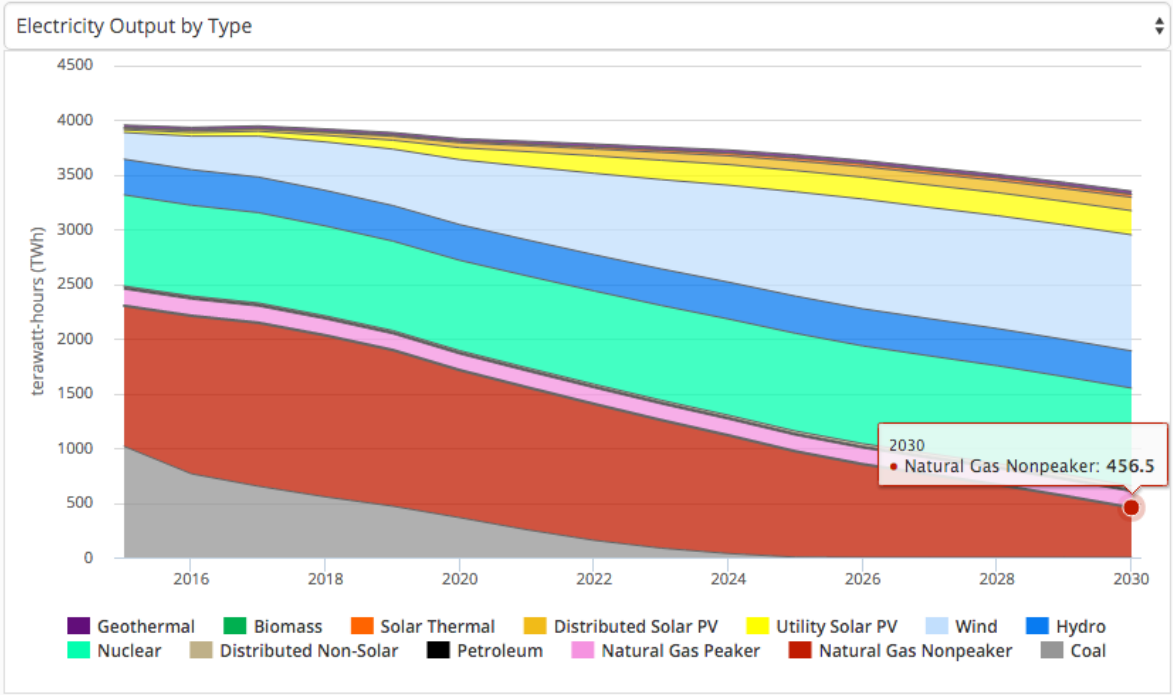
The policies any U.S. government would likely enact are probably different than the ones envisioned by the Energy Innovation analysts, but the overall trend of addressing natural gas burn is notable. The Simulator allows the user to manage more than 50 different energy policy options, and in every option that achieves the carbon reductions of the bilateral agreement, natural gas generation begins to fall. Under EI's set of preferred policy options, annual production from non-peaking natural gas plants would fall from nearly 1,300 TWh a year to just over 1,000 TWh.



Credit: Energy Innovation (http://www.energypolicy.solutions/)

Given the immense scale of natural gas generation in the U.S. today, the decline may not seem particularly significant. But that policy set only gets the U.S. about halfway to the goal of halving GHGs by midcentury. In the years after 2030, not modeled by the Simulator, deeper greenhouse gas cuts would need to be made. With a large amount of existing coal generation already retired by that time, natural gas plants would become the main resource to cut.

While the Simulator can't yet show us what its policies would look like going out to 2050, it can illustrate the impact of deeper carbon cuts on natural gas generation. In addition to their preferred policy set, the researchers also compiled what they called a "CO2 Minimizing" policy set, which cranks the 50 policy levers to the max and aims to zero out emissions by 2050. It's not an accurate forecast of what would happen if that goal were extended to 2100, but it does show the overarching trajectory that natural gas is on as we move toward a zero emissions economy:



Credit: Energy Innovation (http://www.energypolicy.solutions/)

Keep in mind that the graph only shows policy effects to 2030. The CO2 Minimizing set would zero out emissions in the 20 years after that, effectively eliminating fossil fuels from the grid. While the Paris Accord puts the zero emissions goal on a longer timeframe—much too long, according to some scientists (https://www.washingtonpost.com/news/energy-environment/wp/2016/03/22/we-had-all-better-hope-these-scientists-are-wrong-about-the-planets-future/) —the trajectory for natural gas is undoubtedly one that leads to the end of its use for electricity generation, at least under current policies and goals.

The charts put into stark contrast what Rachel Cleetus, lead economist at the Union of Concerned Scientists, told (http://www.utilitydive.com/news/what-utilities-should-watch-at-the-paris-climate-talks/409958/) Utility Dive ahead of the Paris talks.

“If we are going to meet the deep emission reductions we need by midcentury and beyond, [gas] just can’t be an overly large part of the pie in our electric mix,” she said, “and I think that’s where the utility sector needs to think about stranded assets, consumer risk from an overreliance on natural gas, and climate risk.”

Utility investment decisions

At first blush, the transition away from natural gas doesn’t seem to present unique challenges to utilities. They are, after all, currently managing a resource transition away from coal and the most ambitious emission targets, at least in the U.S. economy, still appear to be decades in the future.

The trouble for power companies is that the investment decisions they make today will affect their ability to meet those targets decades in the future.

“Utilities build 30-year assets,” Peter Kind, a utility consultant and author of the well-known EEI “Disruptive Challenges” report, told Utility Dive. “What happens if the world changes during that 30-year time frame in terms of the recovery of those 30-year assets?”

The worry is that utilities will build out natural gas plants and transportation infrastructure now, only to see it rendered uncompetitive or inoperable due to future greenhouse gas regulations or market conditions, something that occurred to many coal plants with the introduction of the MATS rule.

“We need to start thinking about that,” Kind said, “not only because of the embedded investment, but every day that we make another investment that may no longer have a usefulness out 30 years from now, we need to think about the fact that we may be building stranded assets.”

Kind’s comments were echoed by Peter Fox-Penner, an academic advisor to The Brattle Group and the author of ***Smart Power.***

“The proposition that some natural gas plants and pipelines will not live out 50- or 60-year lives if they are recent or about to be built is a very plausible proposition,” he said, “[but] not one that I think is severely damaging for the overall economics of the sector.”

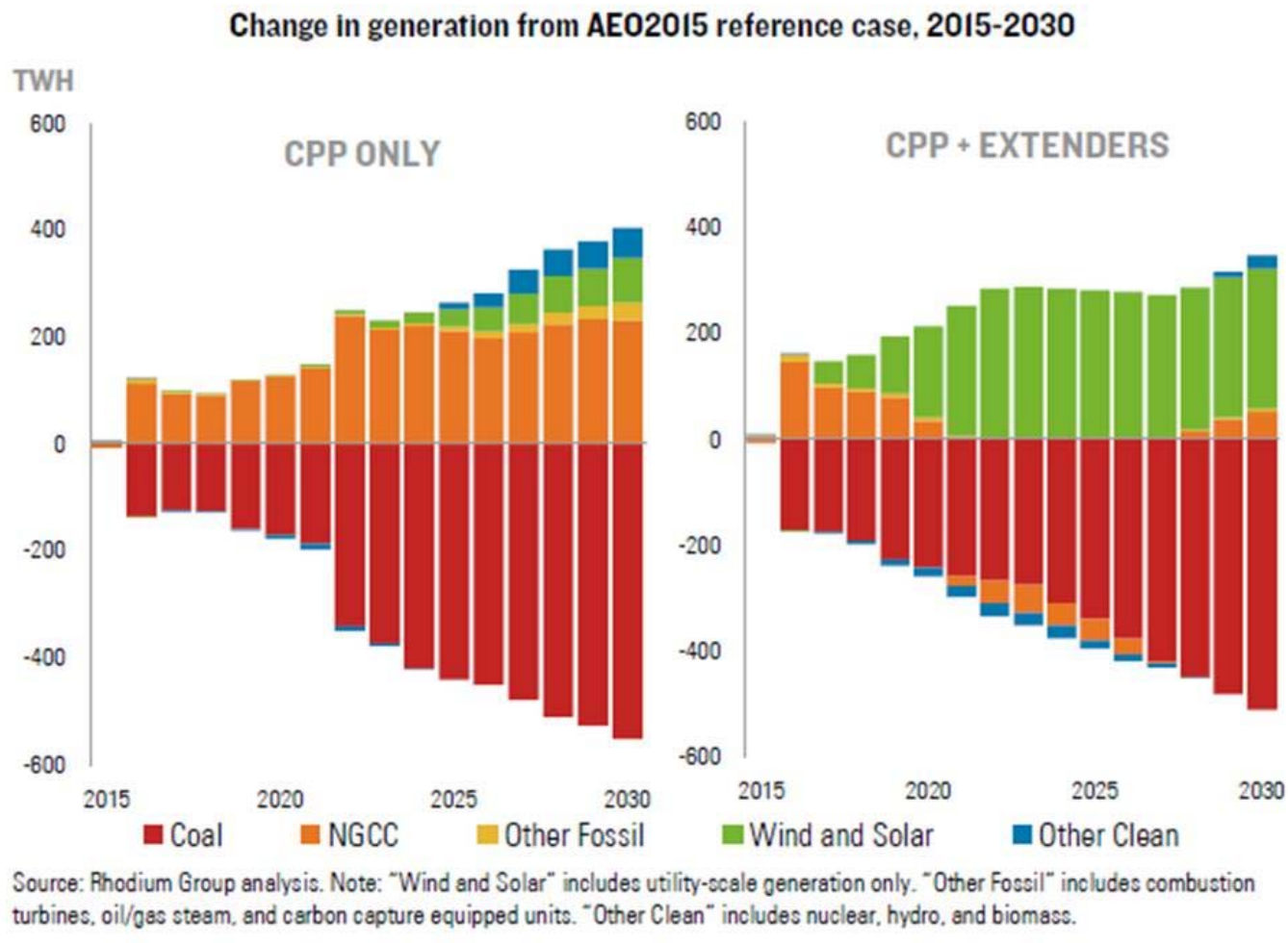
Industry officials say they see the writing on the wall and are considering the environmental constraints of tomorrow in their investment decisions today.

“I’ve told people, 'Don’t look at 2030. Start looking at where you're going to be in 2050 and beyond,'” Brian Wolff, vice president for policy and

external affairs at the Edison Electric Institute, the investor-owned utility trade group, told (http://www.utilitydive.com/news/after-paris-utilities-look-to-deeper-decarbonization/411023/) Utility Dive late last year.

"That's exactly what they're trying to plan for now — when the Clean Power Plan comes into compliance period, what's the evolution of moving toward 2050 and beyond?" he said.

Recent changes in federal renewables policy have made it easier for utilities to consider that lower-carbon future. At the end of last year, Congress approved five-year extensions of vital tax credits for wind and solar energy. As a result, the Rhodium group estimates that the vast majority of capacity additions in coming years will be renewables, with a bit of gas mixed in.



Credit: Rhodium Group (http://rhg.com/notes/renewable-tax-extenders-the-bridge-to-the-clean-power-plan)

Toward a post-gas era

Tax credits have made renewable energy, especially wind, competitive with natural gas generation in more and more regions of the country. But unless renewables are paired with energy storage, they are still intermittent resources, requiring fossil fuels to provide backup power for when the wind doesn't blow and the sun doesn't shine.

Finding a way to solve the intermittency issue will be key for both utilities and grid operators as they work together to integrate higher levels of renewable resources, reduce fossil fuel burn, and preserve reliability.

Fox-Penner said he sees the decarbonization of the power sector in two phases, with the first — now through 2030 — "governed largely by the Clean Power Plan and the set of technologies that are not only cost effective but deployable at scale over that time period."

After incremental progress in both distributed and grid-scale storage over the next few years, Fox-Penner expects it to start displacing natural gas as a tool for integrating renewable resources.

"Natural gas is the substitute for storage in that it's the balancing fuel of last resort," he said. "So when you look at the second wave of decarbonization from 2030 to 2060, I would say, you have cheaper renewables, you have much more storage, you need to electrify transportation ... and in that period you will start to face constraints on natural gas, which means retiring some natural gas generating units and retiring some natural

gas pipelines."

The transition from a power grid based on fossil fuels to one that relies predominantly on renewables and storage won't just happen automatically, Kind said. Policymakers will need to consider how to change utility business models (http://www.utilitydive.com/news/rev-in-2016-the-year-that-could-transform-utility-business-models-in-new-y/412410/) so they are incentivized not just to invest in centralized plants and infrastructure, but also distributed resources like solar and storage.

"The other issue we have is, how do utilities make money? They make money by putting money in the ground — investing in resources," he said. "Unless we tell them there's a new game in town, they have a fiduciary responsibility to their investors to play the old game."

That responsibility to their investors has made some utilities apprehensive of swift changes to environmental policy meant to cut greenhouse gas emissions. But Kind says that will change as utilities divest from their dirtiest assets and put more money into the clean energy economy.

"I think they see it coming and quite frankly they're going to be agnostic," he said. "The only reason why they've been slow to respond is because they do have a lot of investment in old fashioned brown fuels and the generation facilities behind them ... So it takes a while to change, but we need the policymakers to help them think through change, and I suspect if we get the game rules right, they'll find a way to be a leader."

Editor's Note: This post has been updated to reflect more accurate figures for the level of gas leakage necessary to cancel out climactic benefits of gas plants over coal generators.

Top Image Credit: Depositphotos (http://depositphotos.com)

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