



News & Highlights

The Next Energy Battle: Cheap Natural Gas versus Renewables

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Since 2011, a total of 121 power plants in the United States have stopped burning coal and switched to burning natural gas [1], which produces about 50% less carbon dioxide (CO₂) per megawatt-hour of electricity generated than does burning coal [2,3]. If current plans come to fruition, more than 170 new gas-fired generating plants could join them by the mid-2030s [4]. These actions may reduce greenhouse gas emissions, but they were triggered less by concerns for the climate and more by the availability of cheap natural gas.

Unleashed by hydraulic fracturing and other drilling technologies, plentiful gas supplies have transformed US power production, with the cost of gas-generated electricity falling by more than 40% between 2010 and 2019 [5]. Partly as a result, the percentage of US electricity obtained from coal-fired plants has declined over the last 20 years from 52% to 23%, whereas the share from gas has vaulted from 16% to 38% [6,7]. The US Energy Information Agency now projects that gas will furnish about the same percentage of the energy mix—a little under 40%—through 2050 [8].

Natural gas provides a cleaner profile than coal, but the climate effects of the surge in natural gas use remain unclear. A 2020 study estimated that new gas-fired power plants in the United States resulted in a 24% drop in CO₂ emissions from electricity generation between 2000 and 2018 [9]. Yet the reduction over the next several decades will only be half as much, the researchers projected, because utilities often replaced old coal-fired plants that were close to retirement with gas-fired plants that will continue to release CO₂—albeit at lower levels—for an average of 50 years [3,9]. Given the rapid decline in costs for renewable energy generation [10,11], and especially if these declines continue, some experts argue that adding gas-fired power plants will burden consumers with higher prices for those 50 years while still harming the environment [12].

The falling costs for renewables are setting up another energy battle. Natural gas won the battle against coal, but the next struggle will pit cheap natural gas against sources such as solar and wind. Natural gas advocates often tout it as a bridge between fossil fuels and new renewable technologies. But others worry that the fuel's affordability could impede a transition to cleaner energy sources and slow US progress toward climate goals [13–15]. For example, even if no new gas-fired power plants were to come online, existing facilities would have to slash their capacity by two-thirds by 2050 to meet targets the United States assented to

under the 2016 Paris Agreement [9]. Although the Trump administration pulled out of the accord, US president-elect Joseph Biden has pledged to rejoin it. If the current energy mix remains about the same, with gas continuing to play a major role in electricity generation, a 2020 report concludes that US CO₂ emissions would decline less than 10% over the next 15 years, much below the 50% decrease by 2030 called for by the United Nations Intergovernmental Panel on Climate Change [16]. To meet the goal of converting US electrical power generation to 90% renewable sources by 2035, which would cut CO₂ emissions by 88%, “The role of natural gas has to be significantly reduced,” said Amol Phadke, a staff scientist at the Lawrence Berkeley National Laboratory in Berkeley, CA, USA and a co-author on the report. “Gas can play a limited role in terms of providing backup when renewables are not available,” he said, supplying about 10% of electric power until it is phased out after 2035.

The economic arguments for sticking with gas for electricity generation typically cite cost and intermittency, or the ability to deliver power no matter the time of day or weather [14]. Natural gas has set a low price bar that renewable sources will have to slip under, and “nobody expects cheap gas to go away anytime soon,” said Sheila Olmstead, an economist and professor of public policy at the University of Texas at Austin. But over the last decade, “The cost of renewable electricity decreased much faster than anyone anticipated,” said Tom Konrad, a Stone Ridge, New York-based investment analyst who tracks clean energy stocks.

The latest figures suggest that renewables are beating gas on price (Fig. 1). A respected annual analysis sponsored by Lazard, a financial advisory company based in Bermuda, estimates the levelized cost—the amount power companies need to charge to recoup construction and lifetime operating costs—of different energy sources [17]. The 2020 figures calculate a levelized cost per megawatt-hour for utility-scale crystalline silicon solar panels, the most common photovoltaic technology, of between 31 and 42 USD, with thin-film solar panels, a newer and more efficient alternative, coming in at 29–38 USD [18]. Meanwhile, costs for so-called peaker gas-fired plants, which switch on only when the grid is short of energy, range from 151 to 198 USD. Estimates for gas combined cycle plants, which operate steadily, run from 44 to 73 USD.

Renewables are also making some headway on intermittency, Konrad said. Lithium-ion battery storage that can compensate for dips in power production over several hours has become much



Fig. 1. The cost of generating electricity with renewable sources, such as the solar energy captured by the immense Topaz Solar Farm in San Luis Obispo County, CA, USA, has fallen below the cost of using natural gas. The facility covers 25.6 km² and generates 550 MW of energy with nine million thin-film cadmium telluride panels. Credit: Sarah Swenty/USFWS (CC BY 2.0).

cheaper in recent years, he said. For short term storage, “Gas peaker plants are starting to be less cost-effective than large batteries,” but for middle-term storage of days, weeks, and months, however, gas still has the advantage.

In addition, the largest component of natural gas, methane, is some 80 times more potent as a greenhouse gas than CO₂ over a 20-year time period. Thus, the impact of switching to natural gas depends on how much methane is intentionally vented or escapes during its production, transportation, and use [19], a number that has proven difficult to pin down [20]. Recent estimates suggest that leaks and venting could reduce or even eliminate the potential climate change benefits of the switch from coal to gas [9,21].

The prices for natural gas would be higher if they reflected the environmental impact of its associated greenhouse emissions, Phadke and Olmstead noted. “Because gas does not pay for its climate costs, which are significant, it is not a fair competition,” said Phadke. However, there are significant negative environmental impacts associated with solar panel production and disposal that are not factored into the cost of solar power as well [22].

How or if to price carbon to account for environmental damage remains a matter of debate in the United States [23]. In one approach that would end up making fossil fuels more expensive, several states, cities, and counties have filed lawsuits that would require major oil companies to pay for the costs of climate change [24]. Another option, said Olmstead, could be requiring power plants to employ carbon-capture technology, which some facilities are now testing, and which would also increase the cost of electricity generated with gas [25]. However, all carbon pricing strategies have an uncertain future.

Some analysts, pointing to cancellations of high-profile projects and record increases in renewable generation, claim that gas has already fallen out of favor with investors and decision-makers, dubbing it “the new coal” for wealthier countries [26]. The economic calculations about which energy source to use are complex, however. Olmstead cautioned that the biggest obstacles to increased use of renewable energy may be factors other than fuel cost. Decisions about what type of plant to build include factors such as capital costs and the expense of adding transmission lines to distribute the generated power [27]. Regulatory decisions also play a role, and currently tend to favor construction of gas plants in the United States, Konrad said. The bottom line is that whether building a new gas plant makes sense “depends on what it is replacing,” said Olmstead. “Do we want to use it instead of coal?

Yes.” But if the choice is between a gas-fueled plant and a renewable facility, “it depends on what you are doing about emissions.”

References

- [1] Today in energy [Internet]. Washington, DC: US Energy Information Administration; 2020 Aug 5 [cited 2020 Nov 16]. Available from: <https://www.eia.gov/todayinenergy/detail.php?id=44636>.
- [2] Biello D. Fact or fiction? Natural gas will reduce global warming pollution [Internet]. New York: Scientific American; 2015 Aug 3 [cited 2020 Nov 16]. Available from: <https://www.scientificamerican.com/article/fact-or-fiction-natural-gas-will-reduce-global-warming-pollution/>.
- [3] Kaufman AC. New study casts doubt on climate benefits of natural gas plants [Internet]. New York: Huffington Post; 2020 Oct 9 [cited 2020 Nov 16]. Available from: https://www.huffpost.com/entry/gas-bridge-fuel_n_5f7f74f0c5b664e5babb0ea8.
- [4] Weise E. As Earth faces climate catastrophe, US set to open nearly 200 power plants [Internet]. McLean: USA Today; 2019 Sep 9 [cited 2020 Nov 16]. Available from: <https://www.usatoday.com/story/news/2019/09/09/climate-change-threatens-earth-us-open-nearly-200-power-plants/2155631001/>.
- [5] US natural gas electric power price [Internet]. Washington, DC: US Energy Information Administration; 2020 Sep [cited 2020 Nov 16]. Available from: <https://www.eia.gov/dnav/ng/hist/n3045us3m.htm>.
- [6] Total energy [Internet]. Washington, DC: US Energy Information Administration; 2012 Sep 27 [cited 2020 Nov 16]. Available from: <https://www.eia.gov/totalenergy/data/annual/showtext.php?t=ptb0802a>.
- [7] Electricity explained [Internet]. Washington, DC: US Energy Information Administration; 2020 Mar 20 [cited 2020 Nov 16]. Available from: <https://www.eia.gov/energyexplained/electricity/electricity-in-the-us.php>.
- [8] Annual energy outlook 2020 [Internet]. Washington, DC: US Energy Information Administration; 2020 Jan 29 [cited 2020 Nov 16]. Available from: <https://www.eia.gov/outlooks/aeo/>.
- [9] Shearer C, Tong D, Fofrich R, Davis SJ. Committed emissions of the US power sector, 2000–2018. *AGU Adv* 2020;1(3):e2020AV000162.
- [10] Eckhouse B. Solar and wind cheapest sources of power in most of the world [Internet]. New York: Bloomberg Green; 2020 Apr 28 [cited 2020 Nov 16]. Available from: <https://www.bloomberg.com/news/articles/2020-04-28/solar-and-wind-cheapest-sources-of-power-in-most-of-the-world>.
- [11] Palmer J. Solar reaches for grid parity. *Engineering* 2020;6(2):105–6.
- [12] Kohler J. Is natural gas a bridge fuel too far with the rise in renewables? It depends on who you ask [Internet]. Denver: Denver Post; 2020 Jan 31 [cited 2020 Nov 16]. Available from: <https://www.denverpost.com/2020/01/31/colorado-natural-gas-bridge-fuel-wind-solar-xcel-tri-state/>.
- [13] Malik NS, Eckhouse B. Cheap gas imperils climate fight by undercutting wind and solar [Internet]. New York: Bloomberg Green; 2020 Feb 14 [cited 2020 Nov 16]. Available from: <https://www.bloomberg.com/news/articles/2020-02-14/solar-and-wind-power-can-t-compete-with-gas-that-s-this-cheap>.
- [14] Penn I. The next energy battle: renewables vs. natural gas [Internet]. New York: New York Times; 2020 Jul 6 [cited 2020 Nov 16]. Available from: <https://www.nytimes.com/2020/07/06/business/energy-environment/renewable-energy-natural-gas.html>.
- [15] Worland J. US emissions fell last year but progress on climate action is bleak [Internet]. New York: Time; 2020 Jan 7 [cited 2020 Nov 16]. Available from: <https://time.com/5760098/us-emissions-2019/>.
- [16] 2035 report: plummeting solar, wind, and battery costs can accelerate our clean energy future. Report. Berkeley: University of California; 2020 Jun.
- [17] Levelized cost and levelized avoided cost of new generation resources in the annual energy outlook 2020. Report. Washington, DC: US Energy Information Administration; 2020 Feb.
- [18] Levelized cost of energy and levelized cost of storage–2020 [Internet]. Hamilton: Lazard; 2020 Oct 19 [cited 2020 Nov 16]. Available from: <https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2020/>.
- [19] Borunda A. Natural gas is a much ‘dirtier’ energy source than we thought [Internet]. Washington, DC: National Geographic; 2020 Feb 19 [cited 2020 Nov 16]. Available from: <https://www.nationalgeographic.com/science/2020/02/super-potent-methane-in-atmosphere-oil-gas-drilling-ice-cores/#>.
- [20] Nasralla S. Satellites reveal major new gas industry methane leaks [Internet]. London: Reuters; 2020 Jun 25 [cited 2020 Nov 16]. Available from: <https://www.reuters.com/article/us-climatechange-methane-satellites-insi/satellites-reveal-major-new-gas-industry-methane-leaks-idUSKBN23W3K4>.
- [21] Storrow B. Is gas really better than coal for the climate? [Internet]. Washington, DC: E&E News; 2020 May 4 [cited 2020 Nov 16]. Available from: <https://www.eenews.net/climatewire/stories/1063041299>.
- [22] Mulvaney D. Solar energy isn’t always as green as you think [Internet]. New York: IEEE Spectrum; 2014 Nov 13 [cited 2020 Nov 27]. Available from: <https://spectrum.ieee.org/green-tech/solar/solar-energy-isnt-always-as-green-as-you-think>.
- [23] McDonnell T. How one obscure federal agency is clearing the path for a US carbon price [Internet]. New York: Quartz; 2020 Oct 21 [cited 2020 Nov 16]. Available from: <https://qz.com/1920177/new-ferc-policy-is-clearing-the-path-for-a-us-carbon-price/>.
- [24] Grandoni D. States and cities scramble to sue oil companies over climate change [Internet]. Washington, DC: Washington Post; 2020 Sep 15 [cited 2020 Nov 16]. Available from: <https://www.washingtonpost.com/climate/>

- [environment/2020/09/14/states-cities-scramble-sue-oil-companies-over-climate-change/](#).
- [25] Temple J. A game-changing carbon-capture power plant just passed its first big test [Internet]. Cambridge: MIT Technology Review; 2018 May 30 [cited 2020 Nov 16]. Available from: <https://www.technologyreview.com/2018/05/30/142651/a-carbon-capture-game-changer-power-plant-just-passed-its-first-big-test/>.
- [26] Dezem V, Stapczynski S, Malik NS. Natural gas is the rich world's new coal [Internet]. New York: Bloomberg; 2020 Sep 8 [cited 2020 Nov 16]. Available from: <https://www.bloomberg.com/news/features/2020-09-09/climate-natural-gas-is-the-rich-world-s-new-coal>.
- [27] Leslie M. Transmission infrastructure challenges use of renewable energy. *Engineering* 2020;6(6):587–9.