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THE ROLE OF NATURAL GAS IN THE CLEAN POWER PLAN

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I. INTRODUCTION

Two of the biggest environmental—and energy—stories of this decade are the resurgence of natural gas due to the shale gas boom and the Obama administration's decision to regulate greenhouse gas emissions from power plants under the Clean Power Plan. Each of these stories, on its own, is worth significant attention. Even more important, they are connected.

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Since at least the 1960s, it has been clear that energy and environmental issues are deeply intertwined.[1] Today, climate change makes that even more plain, and the question of how the nation produces electricity is the pinnacle of that problem. Electricity generation is the leading source of greenhouse gas emissions in the United States. Thus, if the nation is serious about a global solution for climate change, reducing emissions from the electricity sector is non-negotiable.

Both natural gas and the Clean Power Plan offer possible solutions to reducing greenhouse gas emissions from electricity. Natural gas is a cleaner burning fuel than coal, the leading energy source for electricity generation today, and it also produces significantly lower CO_2 emissions than coal. The Clean Power Plan compels states to reduce CO_2 emissions from their electricity generation fleets, and it affords them flexibility to determine how to do so.

Thus, not only are the stories of natural gas and the Clean Power Plan connected, it is quite possible that natural gas and the Plan may work together to help the United States lower its greenhouse gas emissions profile.[2] In fact, use of natural gas for electricity production was already on the rise, in large part because its price has declined as greater supplies have been made available.

Now, the Clean Power Plan has put an even brighter spotlight on natural gas. Indeed, for years, observers have argued that natural gas could act as a "bridge" fuel to a clean energy economy, simultaneously fostering energy independence and facilitating a transition to greater reliance on renewables and other low carbon energy sources. It is hardly surprising, then, that many assume the Clean Power Plan seeks to do just that—utilize natural gas as a bridge to a lower carbon economy. Whether the Clean Power Plan will reshape the nation's electricity sector depends, of course, on whether it can survive legal challenge in the courts, a fact underscored by the Supreme Court's recent issuance of a stay of

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1. Despite this, energy law and environmental law have remained largely separate fields, and a key challenge to solving climate change and other problems that arise at the connection of energy use and environmental degradation depends on better coordinating these fields. *See generally, e.g.*, Lincoln L. Davies, *Alternative Energy and the Energy-Environment Disconnect*, 46 IDAHO L. REV. 473 (2010); Alexandra B. Klass, *Climate Change and the Convergence of Environmental and Energy Law*, 24 FORDHAM ENVTL. L. REV. 180 (2013); Amy J. Wildermuth, *Is Environmental Law a Barrier to Emerging Alternative Energy Sources?* 46 IDAHO L. REV. 509 (2010); Amy J. Wildermuth, *The Next Step: The Integration of Energy Law and Environmental Law*, 31 UTAH ENVTL. L. REV. 369 (2011).

2. The counterpoint, of course, is that natural gas, particularly through leaks, can exacerbate climate change by releasing methane, a far more potent greenhouse gas than CO_2, into the atmosphere. *See infra* Part IV.B.

the rule.[3] Nonetheless, the Clean Power Plan is momentous enough that the inquiry carries merit even as the Plan's legal basis remains under attack.

This article explores the role of natural gas in the Clean Power Plan. It asks whether and how natural gas will be used under the Plan. In doing so, the article highlights that the relationship between natural gas and the Plan is almost certain to be more complex than it would at first seem. Whether gas will serve as a bridge to a clean energy future is a complicated enough question, and prognosticating how states may use gas to satisfy the Plan's mandate is an even more intricate and multifaceted endeavor. Many factors are likely to impact gas's role under the Clean Power Plan, including its price, the price of competing fuels, geography, and states' adoption of (or failure to adopt) energy efficiency measures. Energy system models give some insight into these issues, and they suggest that natural gas's role in U.S. electricity production will increase initially under the Plan but either level off or decline as the rule's 2030 compliance date approaches. Gas, then, may serve as a bridge to some degree under the Clean Power Plan, but big questions about that bridge's length, width, and shape remain.

This article proceeds in five parts. Part II provides a broader context for understanding natural gas's role in society today by tracing its role through history. Part III surveys various models that have estimated what impact the Clean Power Plan may have on the gas industry, and how gas may be used to help states achieve compliance with the Plan. Part IV explores two competing metaphors that have been offered to describe the role of gas in the future—a "bridge" and a "dead end"—and then uses those analogies as lenses to explore how the role of natural gas under the Clean Power Plan might be assessed. Part V concludes that even if the Clean Power Plan survives judicial scrutiny, it will not be the only influence shaping the role of natural gas in the future.

II. A BRIEF HISTORY: THE ROLE OF NATURAL GAS IN THE UNITED STATES

Natural gas is one of the most important energy resources in the world today. Internationally, it both divides and binds nations together, as made clear, respectively, by many European countries' tenuous relationship with Russia as a gas supplier,[4] as well as by the extensive movement of gas among nations across borders,

3. Chamber of Commerce v. EPA, 136 S. Ct. 999 (2016).

4. Justin Clune, *The Natural Gas Trade Between the Russian Federation and the European Union: Power Dynamics, Legal Challenges, and a Country Caught in the Middle*, 35 NW. J. INT'L L. & BUS. 199, 202–03 (2014).

oceans, and continents.[5] In the United States, natural gas has long dominated the residential and commercial heating sectors, has become one of the most crucial fuels for electricity generation, and remains a central industrial input.[6]

In this way, natural gas is both remarkable and unique. It is more nimble and, because of that, arguably more influential than any other single energy resource. Unlike many primary energy resources, it is not tied to a single industry, such as coal is for electricity production or oil is for transportation.[7] And unlike other resources, like nuclear, which has provided roughly a fifth of U.S. electricity production for almost two straight decades but appears poised to lose that position if more investment in the technology is not made,[8] natural gas's importance seems only to be growing. Indeed, natural gas plays a critical role in all three of the United States' secondary energy systems: electricity, heating, and transport. Other energy sources cannot make that claim.

Natural gas also occupies a commanding role in the modern energy-environment discourse. From a climate perspective, policymakers and others point to natural gas as a potential "bridge" fuel from the world's current fossil fuel system to a possible clean energy economy of the future.[9] At the same time, many environmentalists and others push against natural gas use—in large part because of perceived and real water quality, wildlife, and local land use risks from the insurgent practice of horizontal drilling and hydraulic fracturing,[10] but also because of

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5. Major international natural gas movement occurs predominantly between Europe, Asia, and Africa. *See* BP, BP STATISTICAL REVIEW OF WORLD ENERGY 29 (2015). Liquefied natural gas movement occurs between South America and Europe, while major natural gas movement in North America occurs via pipelines. *Id*.

6. Electricity generation comprises the largest share of natural gas use in the United States, constituting 30 percent of total consumption. U.S. ENERGY INFO. ADMIN., *Natural Gas Consumption by End Use*, www.eia.gov/dnav/ng/ng_cons_sum_dcu_nus_a.htm (last updated Feb. 29, 2016). Industrial use constitutes the second-highest use at 28 percent, followed by residential use at 19 percent. *Id*.

7. Electricity production accounts for 93 percent of coal consumption in the United States. U.S. ENERGY INFO. ADMIN., QUARTERLY COAL REPORT, APRIL–JUNE 2014 (2014), www.eia.gov/coal/production/quarterly/pdf/t32p01p1.pdf. Transportation accounts for 71 percent of oil consumption in the United States. Ethan Fawley, *Energy 101: Oil*, FRESH ENERGY (NOV. 21, 2011), http://fresh-energy.org/2011/11/energy-101-oil/.

8. *See* U.S. ENERGY INFO. ADMIN., January 2016 Monthly Energy Review, 110 tbl. 7.2b (Jan. 27, 2016), www.eia.gov/totalenergy/data/monthly/archive/00351601.pdf. In 1988, nuclear accounted for 19.5 percent of U.S. electricity generation; in 2014, that figure was 20.2 percent.

9. *See infra* Part IV.A.

10. Craig Segall, SIERRA CLUB, *Look Before the LNG Leap: Why Policymakers and the Public Need Fair Disclosure Before Exports of Fracked Gas Start* 1 (2012); Sharron Kelly, *Environment: The Trouble with Fracking*, NATIONAL WILDLIFE FEDERATION (Sept. 15, 2011), www.nwf.org/News-and-

near- and long-term climate risks from relying on the fuel.[11] In both cases, natural gas holds great sway in both the public consciousness and the imaginations of those who think deeply about energy policy, transformation, and governance.

Natural gas did not always hold such prominence. Indeed, its centrality in the United States' modern energy system bears little relationship to its former history. Natural gas's early role in modernity was as little more than an afterthought—a curious happenstance used occasionally by farmers or sometimes in cities for lighting but hardly the raging force it is today, both central and dominant at once. It took many years, decades really, for natural gas to catch on, and when it did, it was largely for industrial processes and domestic and commercial heating use.[12] The fuel's centrality to the energy economy is truly a modern phenomenon, a trend beginning in earnest in the lead up to and after World War II and reaching full force only as the century turned.

The history of natural gas is an amalgam of fascinating vignettes, technological change, competition, and legal-political intrigue. It is a rich history, and one that is often told from the vantage of how law and regulation hindered, and then severely disrupted, markets for this valuable resource.[13] That perspective is undeniably important, and a critical part of the story, but it is also useful to pull the lens farther back to see the role of natural gas in a broader context.

From a historical perspective, natural gas's role in society can be categorized into five key periods: (1) its nascent, minor, and opportunistic use for lighting, a period in which it largely lost out to town gas and kerosene, and then electricity, as a source of illumination; (2) its role as a nuisance byproduct of oil and coal extraction that was largely burned off as waste; (3) its growing use for home and commercial heating and appliance use, as well as an industrial feedstock, leading up to World War II, made possible in large part by key developments in steel, welding, and pipeline technology; (4) its tumultuous years as an unreliable and unpredictable resource that caused and was part of economic disruptions, particularly in the 1970s and 1980s; and (5) its expanding role as a fuel for electricity production, driven in no small part by the rise of hydraulic fracturing and horizontal drilling technology that have unlocked shale gas resources.

Magazines/National-Wildlife/Animals/Archives/2011/Trouble-with-Fracking.aspx; Hannah Wiseman, *Regulatory Adaptation in Fractured Appalachia*, 21 VILL. ENVTL. L.J. 229, 242–48 (2010).

11. *See infra* Part IV.B.

12. *See infra* Part II.B.

13. *See generally, e.g.*, PAUL W. MACAVOY, THE NATURAL GAS MARKET: SIXTY YEARS OF REGULATION AND DEREGULATION (2000).

The remainder of this Part briefly surveys the history of natural gas in the United States by examining each of these roles played by natural gas in society over time.

A. Early Light: Natural Gas in the Shadows

The early history of natural gas in the United States is humble indeed. There are, of course, ancient stories of natural gas use, from Ming Dynasty texts describing gas's extraction from the earth using long bamboo tubes and storage in pig bladders to provide light,[14] to the construction of an ancient Greek temple on Mount Parnassus "over an ignited natural gas leak" found by a sheepherder around 1000 B.C. to house the Oracle of Delphi and that priestess's eternal flame.[15] Still, reliance on natural gas in the United States—the "birthplace of the natural gas industry"—came much later.[16]

French explorers observed Native Americans igniting gas seepages near Lake Erie as early as 1626,[17] but it was not until 1821 that natural gas was put to practical use. In that year, in Fredonia, New York, young boys accidentally ignited a seepage of natural gas while throwing flaming sticks across the Canadaway Creek.[18] Following this discovery, townspeople drilled a 27-foot-deep well and piped the gas using small hollowed-out logs to several nearby homes, which burned the gas to provide light.[19] Subsequently, William Hart, a local gunsmith, replaced the logs with a quarter-inch lead pipe he had made to transport the gas to Abel House, a local inn that also used the gas for illumination.[20] Another key contribution of Hart's was the "gasometer," an

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14. LINCOLN L. DAVIES ET AL., ENERGY LAW AND POLICY 100 (2014); BARBARA FREESE, COAL: A HUMAN HISTORY (2003).

15. DAVIES ET AL., *supra* note 14, at 101; *see also* MALCOLM W. H. PEEBLES, EVOLUTION OF THE GAS INDUSTRY 5 (1980) (describing other ancient natural gas use); LOUIS STOTZ & ALEXANDER JAMISON, HISTORY OF THE GAS INDUSTRY 68 (1938) ("Natural gas was known in Biblical days, and in the region of the Caspian sea eternal fires of natural gas were worshipped long before the Christian era. In Japan, gas wells were known as early [as] 615 A.D . . .").

16. PEEBLES, *supra* note 15, at 51; *cf*. STOTZ & JAMISON, *supra* note 15, at 68 ("At an early date, the City of Genoa, Italy, was lighted by gas brought from the nearby wells of Anniamo, in Parma. This was probably the first commercial use of natural gas in the Western World.").

17. American Public Gas Association, *A Brief History of Natural Gas*, www.apga.org/apgamainsite/aboutus/facts/history-of-natural-gas (last visited Feb. 3, 2016); *see also* STOTZ & JAMISON, *supra* note 15, at 69 (noting that natural gas was also detected in springs in West Virginia in 1775, again in a salt well in 1815, and on the south bank of the Ohio River in Pittsburgh in 1820).

18. PEEBLES, *supra* note 15, at 51. *But* cf. STOTZ & JAMISON, *supra* note 15, at 69 (stating that this discovery was in 1824).

19. PEEBLES, *supra* note 15, at 51.

20. *Id*. at 51–52.

"inverted water-filled vat" that could hold the gas for distribution.[21] By 1825, using the gasometer, Fredonia had added 66 gas lights, while Fredonia's newspaper bragged that the town had enough gas for over 300 more lights—a gas supply "'unparalleled on the face of the globe."[22]

Despite its pioneering efforts, Fredonia's application of natural gas for lighting proved less than a harbinger. Other cities did not adopt natural gas an energy resource. Still, Fredonia's decision to use natural gas for lighting was emblematic of the larger economic environment into which the fuel was introduced. While today natural gas is an extraordinarily flexible fuel used in many sectors of the economy, its chief purpose in the nineteenth century was for lighting,[23] driven in part by the introduction of various burners to improve illumination efficiency.[24] Available, then, primarily as an alternative to other options for illumination, natural gas languished in the shadows in these early years, beaten out by more competitive fuels.[25]

A fierce battle raged in the nineteenth century to satisfy a burgeoning demand for lighting. That demand was growing in part because of declining whale populations. "For those who had money, oil from the sperm whale had for hundreds of years set the standard for high-quality illumination; but even as demand was growing, the whale schools of the Atlantic had been decimated . . . ."[26] Thus, as whale oil prices soared and demand for lighting grew, energy entrepreneurs sought different ways to make light. An early option was camphene, "a derivative of turpentine, which produced a good light but had the unfortunate drawback of being highly flammable, compounded by an even more unattractive tendency to explode in people's houses."[27] So, eventually, industry turned to other options.

It would not be until 1879 that Thomas Edison developed a reliable incandescent lightbulb,[28] and in the meantime—and for

21. *Id.* at 52.

22. *Id.* (citation omitted).

23. *See* Connie C. Barlow, *Coal Gasification in the 19th Century and the Origins of the Gas-Distribution Business*, *in* ARLON R. TUSSING & BOB TIPPEE, THE NATURAL GAS INDUSTRY: EVOLUTION, STRUCTURE, AND ECONOMICS 59, 59–61 (2d ed. 1995).

24. WILLIAM T. BRANNT, PETROLEUM: ITS HISTORY, ORIGIN, OCCURRENCE, PRODUCTION, PHYSICAL AND CHEMICAL CONSTITUTION, TECHNOLOGY, EXAMINATION AND USES; TOGETHER WITH THE OCCURRENCE AND USES OF NATURAL GAS 659–60 (Hans Hoefer and Alexander Veith, eds., 1895). Some gas burners were also used for cooking.

25. While gas was used at this time primarily for lighting, at least one company employed it for industrial purposes, namely, to evaporate brine in salt manufacturing. STOTZ & JAMISON, *supra* note 15, at 70.

26. DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY, AND POWER 6 (2008).

27. *Id.* at 6–7.

28. *E.g.*, RICHARD MUNSON, FROM EDISON TO ENRON: THE BUSINESS OF

some time thereafter—three other energy sources dominated the illumination market: candles, kerosene, and gas.[29] All shared major drawbacks. "[T]hey produced soot, dirt, and heat; they consumed oxygen; and there was always the danger of fire."[30] It was in part this last risk that ultimately gave electric lights such a key advantage, but the fugacious and volatile nature of gas posed another problem. Because natural gas was hard to capture and harder still to transport, its use for lighting was largely limited to localized properties where it was easily moved and readily available.[31] Thus, where it was used, natural gas was primarily a source for light.

The irony, however, was that natural gas played a rather minor role in gas's share of the lighting market. Rather, it was a close cousin of natural gas—so-called "town gas," which was manufactured from coal (and other sources, such as pine tar) and had a lower illumination value than natural gas—that became a widespread source for light in U.S. cities. In fact, Baltimore, the first city to use synthetic town gas, began doing so in 1816, five years before natural gas was discovered in Fredonia.[32] By the end of the nineteenth century, town gas had a wide grasp on the U.S. illumination market, from New York, Boston, and Philadelphia on the East Coast to San Francisco, Seattle, and Los Angeles on the West Coast, from Detroit, St. Paul, and Chicago in the Midwest to Atlanta, Norfolk, and New Orleans in the South.[33] Indeed, although it is seldom discussed today, town gas maintained an important position in the U.S. economy for decades after the century ended, while natural gas struggled to find its niche. As Louis Stotz and Alexander Jamison observed as late as 1938,

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POWER AND WHAT IT MEANS FOR THE FUTURE OF ELECTRICITY 14–18 (2005); *see also The Quintessential Innovator*, TIME, Oct. 22, 1979, http://content.time.com/time/subscriber/article/0,33009,947523-1,00.html. For more on Edison, *see generally*, *e.g.*, PAUL ISRAEL, EDISON: A LIFE OF INVENTION (2000); JILL JONNES, EMPIRES OF LIGHT (2003); MATTHEW JOSEPHSON, EDISON: A BIOGRAPHY (1959); BLAINE MCCORMICK, AT WORK WITH THOMAS EDISON (2001).

29. Paul Rutter & James Keirstead, *A Brief History and the Possible Future of Urban Energy Systems*, 50 ENERGY POL'Y 72, 77 (2012).

30. YERGIN, *supra* note 26, at 62. Pressed by competition from gas and electricity, kerosene effectively fell out of use for lighting by 1895. STOTZ & JAMISON, *supra* note 15, at 8.

31. PEEBLES, *supra* note 15, at 54.

32. BARLOW, *supra* note 23, at 63. More sporadic uses of coal gasification occurred in England in the seventeenth and eighteenth centuries. *See id.* at 62.

33. *Id.* at 63. Baltimore began using town gas in 1816, and New York followed seven years later. Other early adopters of gas for lighting included Boston (1828), Louisville and New Orleans (1832), Philadelphia and Pittsburgh (1836), Cincinnati (1840), St. Louis (1846), Newark (1847), Providence and Washington, D.C. (1848), and Cleveland, Detroit, Norfolk, and Syracuse (1849). By 1887, at least fifty U.S. cities were using gas lighting. STOTZ & JAMISON, *supra* note 15, at 9–10.

natural gas's value "was always recognized, but there was either too much or too little of it at a time; the pressure was variable, there was no way to store it, and with coal and oil so cheap, the economic incentive to overcome the difficulties in handling it was lacking."[34]

B. Byproduct: Nuisance and Flaring

At the same time some in the United States had begun using natural gas opportunistically for lighting, the oil industry was taking off. Edwin Drake's discovery of Pennsylvania oil in 1859 prompted a rush to harvest crude wherever it could be found, setting the stage for the all-too-common boom-and-bust cycle of resource extraction that would play out again and again in U.S. history, including for oil itself.[35]

The clamor for oil was at first mostly about light—"new light," or the processing of crude into kerosene for illumination purposes. While oil later became critical as a transport fuel, its use for kerosene as a lighting source dominated its early years, driven in part by international demand for this U.S. export.[36] Thus, from the beginning, oil and natural gas were connected in at least two ways: first, as alternates to each other for illumination, with oil handily winning that match; and second, physically, because oil and natural gas are often present together under the ground.

Throughout the nineteenth century and reaching well into the twentieth, this latter connection proved most critical for natural gas's role in society. That it was often found alongside oil, but was difficult to manipulate and control, relegated natural gas to status largely as an unwanted byproduct: a nuisance.[37] Men on the prowl for oil feared natural gas, because it was dangerous, flammable, and explosive.[38] It was also hard to contain. Unlike oil, which could be stored in anything that would hold it, including what Drake first used—whiskey barrels[39]—natural gas escapes

34. STOTZ & JAMISON, *supra* note 15, at 71.

35. YERGIN, *supra* note 26, at 10–18.

36. *Id.* at 40–41.

37. Natural gas can be categorized in two key ways. First, natural gas can be categorized according to its extraction method. Natural gas extraction occurs either "conventionally" or "unconventionally," or sometimes as coalbed methane (CBM). Conventional natural gas refers to gas stored in permeable reservoir rock formations. By contrast, unconventional natural gas—or "shale gas"—is found in tight sand and shale formations. Coalbed methane, as its name implies, is present in seams of coal reserves. Second, natural gas can be categorized according to its relationship to oil. "Associated" natural gas refers to gas that is found in the same reservoir as oil. "Non-associated" natural gas refers to gas that is present in its own geologic formations, absent oil. DAVIES ET AL., *supra* note 14, at 123, 629.

38. Barlow, *supra* note 23, at 59.

39. YERGIN, *supra* note 26, at 10–18.

immediately upon release into the atmosphere because it is exactly that, a gas.[40] Thus, even when those seeking oil wanted to take the gas too, that was difficult to capture. Often, moreover, they had no such desire. While, in many reservoirs, associated natural gas provides the pressure that aids extraction of the crude, this was not well known in the early years of oil development, so gas was habitually treated as a barrier to acquiring the oil.[41]

For all these reasons, common practice throughout the nineteenth century was simply to vent or flare—that is, burn off—natural gas when it was discovered. In fact, although much less common now than then, the practice continues today,[42] made perhaps most infamous by satellite images of the Bakken shale region of North Dakota, which at night can appear as wide and bright as any large metropolitan area of the United States.[43] For the hydrocarbon pioneers of the nineteenth century, flaring was an efficient and economical way to reduce the risk of oil extraction.

Despite this prevailing treatment of natural gas, the irony that a very valuable resource was literally going up in flames while companies in cities were manufacturing an inferior replacement fuel at a much higher cost was not lost on everyone. Some oil producers, looking to at least minimize the waste, sold natural gas to nearby "carbon-black plants for mere pennies per thousand cubic feet, while urban dwellers typically bought manufactured gas at prices of a dollar or more."[44] Lawmakers also stepped into the gap. In regions where natural gas availability and use were growing, such as Indiana and Texas, state legislatures banned or limited the practice of flaring in an effort to reduce waste.[45] At the same time, basic oil and gas law principles, such as

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40. DAVIES ET AL., *supra* note 14, at 123.

41. *Cf.* Connie C. Barlow et al., *From Manufactured to Natural Gas and Emergence of the Gas-Transmission Industry*, *in* TUSSING & TIPPEE, *supra* note 23, at 79, 79–81; DENNIS OTIOTIO, GAS FLARING REGULATION IN THE OIL AND GAS INDUSTRY: A COMPARATIVE ANALYSIS OF NIGERIA AND TEXAS REGULATIONS, at 10–11 (2013), www.academia.edu/3615407/GAS_FLARING_REGULATION_IN_THE_OIL_AND_GAS_INDUSTRY_A_Comparative_Analysis_of_Nigeria_and_Texas_Regulations.

42. *See, e.g.*, *Natural Gas Flaring, Processing, and Transportation*, UCSUSA.ORG, www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/natural-gas-flaring-processing-transportation.html#.VqxPDY-cGM8 (last visited Feb. 3, 2016); Bjorn Hamso, *Time to End Routine Gas Flaring*, WORLDBANK.ORG (July 7, 2014), www.worldbank.org/en/news/feature/2014/07/15/gas-flaring-reduction-takes-center-stage-at-global-event.

43. Bobby Magill, *North Dakota Gas Flaring Doubles, Pumping CO_2 Into Air*, CLIMATE CENTRAL (Mar. 21, 2014), www.climatecentral.org/news/north-dakota-gas-flaring-doubles-pumping-co2-into-air-17212; *see also* U.S. ENERGY INFO. ADMIN., *North Dakota Aims to Reduce Natural Gas Flaring*, (Oct. 20, 2014), www.eia.gov/todayinenergy/detail.cfm?id=18451 (noting that roughly one-third of natural gas recovered in North Dakota in recent years has been flared rather than delivered to market).

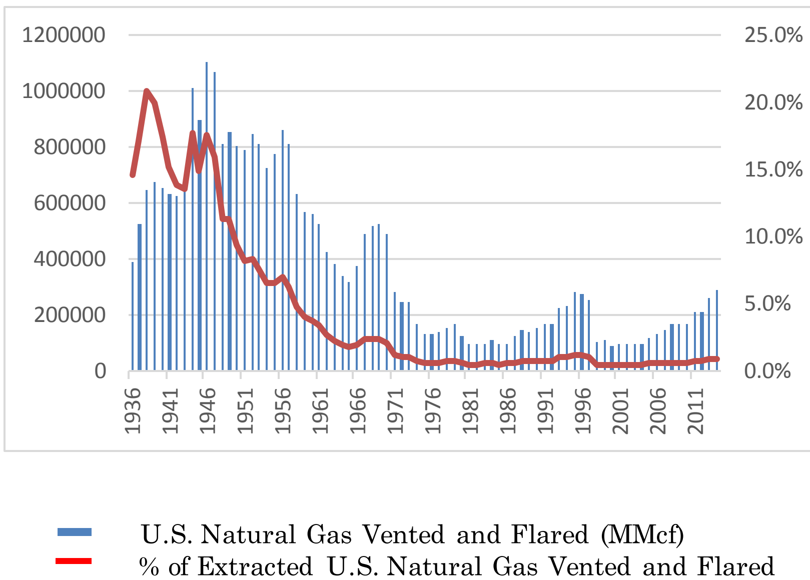
44. Barlow et al., *supra* note 41, at 79 (emphasis omitted).

45. *See* State v. Ohio Oil Co., 49 N.E. 809 (Ind. 1898); Tex. Acts 26th Leg.

the rule of capture, incentivized flaring and other forms of gas wastage because they promoted as rapid extraction of oil as possible.[46]

Thus, even as natural gas gained prominence as an energy resource in the first and second quarters of the twentieth century, it also maintained its role as a nuisance byproduct. In fact, as late as 1949, more than ten percent of natural gas extracted in the United States was vented or flared.[47] And, while that percentage has declined precipitously since then, the gross amount of natural gas vented and flared in the United States is higher today than it has been since 1970, as shown in Figure 1 below.

Figure 1: Venting and Flaring of U.S. Natural Gas[48]



Reg. Session, 1899, Ch. 49, p.8. For more on the early development of state oil and gas conservation regulation, *see generally, e.g.*, A.B.A., SECTION OF MINERAL AND NATURAL RESOURCES LAW, CONSERVATION OF OIL & GAS: A LEGAL HISTORY (Robert E. Sullivan, ed. (1958); A.B.A., SECTION OF MINERAL LAW, LEGAL HISTORY OF CONSERVATION OF OIL AND GAS (1938).

46. David E. Pierce, *Minimizing the Environmental Impact of Oil and Gas Development by Maximizing Production Conservation*, 85 N.D. L. REV. 759, 762–63 (2009).

47. This is according to data from the U.S. Energy Information Administration. *See* U.S. Energy Info. Admin., *U.S. Natural Gas Gross Withdrawals and Production* (2016), www.eia.gov/dnav/ng/ng_prod_sum_dc_nus_mmcf_a.htm.

48. *See id*.

C. Emergence and Prominence: Appliances, Heating, and the Rise of Pipelines

As the century turned, the natural gas industry faced both obstacles and opportunities. The key obstacle was certainly significant but also surmountable. Moving natural gas was difficult, so pipeline technology needed to be improved for the industry to mature.[49] The opportunities were equally plain. Natural gas had many advantages over manufactured gas, including that it did not risk asphyxiation because it lacked "poisonous carbon monoxide," "did not blight the atmosphere with the soot and sulfur compounds that spewed out of [synthetic] gas works," and packed twice the energy punch per cubic foot as manufactured gas.[50] Moreover, because use of manufactured town gas had become quite prevalent, the groundwork was laid for natural gas to make a move: In many cities, much of the distribution infrastructure was already in place.[51]

The largest hurdle really was the lack of sufficient pipeline technology. How much gas a pipeline can move depends on pressure, which in turn is a function of the pipe's tensile strength, its diameter, and the compression of the gas it is moving. Early compressor technology was available by 1880, but improvements in piping technology lagged behind.[52] The first serious natural gas pipelines were made from cast iron, but even as steel began to replace iron as a primary material in the 1890s, pipelines were limited. This was in part because steel manufacturing had not advanced sufficiently, but even more so because the steel had to be welded or riveted, so pipes were only as good as their weaker seams.[53]

As a result, early gas markets were extremely localized.[54] The first gas transport system that used metal, a five-and-a-half-mile-long wrought iron pipeline that moved gas from the same Titusville field where Colonel Drake had discovered oil, was built in 1872 and was only two inches in diameter.[55] For almost two

49. Barlow, *supra* note 23, at 59 (noting S.R. Dresser's invention of a leak-proof coupling in 1890).

50. Barlow et al., *supra* note 41, at 82.

51. *Id.* at 82–83.

52. *Id.* at 83.

53. *Id.* at 84; JAMES G. SPEIGHT, NATURAL GAS: A BASIC HANDBOOK 127 (2007).

54. PEEBLES, *supra* note 15, at 54.

55. Barlow, *supra* note 23, at 59. Remarkably, this system was preceded by a 25-mile-long wooden pipeline built in 1870 from West Bloomfield, New York, to Rochester. The "pipe" for this line consisted of "Canadian white pine logs, two to eight feet long, turned down to a diameter of 12½ inches and bored to 8 inches." STOTZ & JAMISON, *supra* note 15, at 78. Lack of demand for the gas, coupled with difficulties running a wooden pipeline, forced the company to later collapse, with a resulting loss of $1.5 million. *Id.*

decades after that, no natural gas pipeline exceeded 100 miles, and even when some lines grew longer, markets stayed local or regional. The first line of significant length, for instance, a 120-mile pipeline that served Chicago, brought fuel from the gas fields of Indiana.[56] Likewise, the first company to supply a large city with natural gas, run by J.N. Pew, brought gas from western Pennsylvania to Pittsburgh.[57]

Another problem for the early natural gas industry was that developers often found the resource in shallow fields that were easily depleted. This made the industry a risky business not just physically but also financially, with many gas companies going out of business after "a short and hectic" life.[58] "Indeed, such disappointments were common in the Gas Belt of central Indiana, where shallow reservoirs were tapped and effectively drained within two decades (1886–1907)."[59]

What propelled gas forward, then, were two separate but equally important developments. First, improvements in pipeline manufacturing allowed the industry to expand its reach. Increased demand for natural gas as an industrial feedstock and fuel promoted the growth of new natural gas transportation systems.[60] The introduction of oxyacetylene welding in 1911 and electric welding in 1922 meant that pipelines could extend their reach, particularly when combined with new steel manufacturing and procurement methods developed during World War II.[61] Thus, by 1924, there were only seven long-distance natural gas pipelines: the Titusville and Chicago lines already mentioned, plus a 92-mile line from Ohio to Detroit, a 183-mile line from West Virginia to Cleveland, a 199-mile line in Texas, a 16-mile line from Louisiana to Little Rock, and a 120-mile California line from Buena Vista to Los Angeles.[62] In the last half of the 1920s, however, a boom of pipeline construction broke out, with over 7,000 new miles of pipe being laid for nineteen different long-distance lines—two of which approached 1,000 miles and one of which exceeded that length—to a variety of cities, including Houston, Wichita, Denver, Salt Lake, St. Louis, Atlanta, and Washington, D.C.[63]

For obvious reasons, the Great Depression slowed construction of gas pipelines. In the ensuing years, however, the nation added thousands of miles of natural gas pipelines, including converting two lines, Big Inch and Little Big Inch, from

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56. Barlow, *supra* note 23, at 83; SPEIGHT, *supra* note 53, at 127.
57. YERGIN, *supra* note 26, at 76. Gas transport lines also were generally small in diameter, with few exceeding 8 inches. STOTZ & JAMISON, *supra* note 15, at 80.
58. PEEBLES, *supra* note 15, at 54.
59. BARLOW, *supra* note 23, at 60.
60. SPEIGHT, *supra* note 53, at 126.
61. BARLOW ET AL., *supra* note 41, at 84.
62. *Id.* at 86–87.
63. *Id.* at 88–91.

oil to gas. The government had built those lines during the war to circumvent the Germans' sinking of oil tankers off the East Coast, but now they were free for gas use.[64] The effect was significant. From 1932 to 1944, the nation added nearly 2,000 miles of line; from 1945 to 1956, over 16,000 miles; and 1957 to 1967, more than 9,000 miles.[65] These pipelines also were different in kind from their early predecessors, commonly using diameters between 24 and 30 inches.[66] Even more important, they transformed the gas market. In the 1910s, there were three distinct natural gas markets—a northern market, a midcontinent market, and a south-central market.[67] The construction of all these pipelines obliterated this regional balkanization. Even if the market was not yet quite fully national, it was clearly moving in that direction, and it had become heavily interstate in nature.[68]

The second development that changed the natural gas industry was a series of shifts in how the fuel was used. As electric lighting took hold of the illumination market, the gas industry (both manufactured and natural) turned its focus to other applications. Natural gas had been used in Pittsburgh as early as 1883 for industrial purposes,[69] but given the increasing competition from electricity, the gas industry quickly developed a wide array of domestic and other thermal applications—including cooking ranges, air conditioners, refrigerators, hot plates, toasters, irons, hair curlers, and, most importantly, space and water heating.[70] Industrial applications also increased, with carbon black manufacturers, for instance, moving their facilities from one natural gas field to another to make that product, which long had been used in ink, dyes, and paint but was also becoming a critical input for rubber and tires.[71]

While undeniably transformative, the natural gas industry's evolution did not take place over night. "The output of natural gas" in the United States rose from "a value of $215,000 in 1882 . . . to $13 million in 1896," but it did not exceed $50 million until 1908.[72] By that year, there were over 21,000 producing wells in the United

64. *Id*. at 92–95.

65. *Id*. at 93–107.

66. *See id*.

67. JOHN H. HERBERT, CLEAN CHEAP HEAT: THE DEVELOPMENT OF THE RESIDENTIAL MARKETS FOR NATURAL GAS IN THE UNITED STATES 11–13 (1992).

68. *See id*. at 100-03.

69. Peebles, *supra* note 15, at 54. By 1883, natural gas had become a prominent fuel source for glass making in Pittsburgh, in part because of its relative inexpensiveness. Brannt, *supra* note 24, at 661.

70. Herbert, *supra* note 67, at 21; Barlow, *supra* note 23, at 66; JOHN G. CLARK, ENERGY AND THE FEDERAL GOVERNMENT: FOSSIL FUEL POLICIES, 1900–1946 21 (1987).

71. PEEBLES, *supra* note 15, at 57–59.

72. STOTZ & JAMISON, *supra* note 15, at 88.

States.[73] Still, as late as 1934, over half the gas in the Texas Panhandle was still being flared.[74] Even by 1953, "bright spears of light" dotted the night sky "along the endless highways of Texas," because natural gas remained "the orphan of the oil industry," a "useless, inconvenient by-product of oil production."[75]

Cities were also slow to transition fully to natural gas, with many mixing natural gas and manufactured gas for years. Detroit, for instance, which had started using natural gas in 1848, took 90 years before it transitioned fully away from town gas.[76] Nonetheless, the transition proceeded, even if unevenly. Beginning in the mid-1920s and extending into the 1930s, scores of gas companies transitioned from manufactured gas to straight gas, including in Atlanta, Birmingham, Buffalo, Denver, Des Moines, Pittsburgh, Phoenix, and over 90 other cities.[77] As a result, by 1930, "natural gas accounted for about four-fifths of all distributor sales in the United States."[78] Many cities, in fact, particularly in the Southwest, had never used manufactured gas, although coal-rich Appalachia hung on to this product the longest, with town gas comprising 40 percent of Pennsylvania's gas supply as late as 1930.[79] To that end, 1935 marked a turning point. It was in that year that natural gas overtook manufactured gas as a fuel source in the United States.[80] And by the 1940s and 1950s, town gas was finally phased out.[81]

It was in the first half of the twentieth century, then, that natural gas shifted from an emerging industry to a prominent one. This was especially true on the residential front. "The volume of sales in this market grew fifty-fold between 1906 and 1970 and eight-fold during the great growth period between 1945 and 1970."[82] By way of example, there were just over 5 million residential gas customers in 1930, but there were just under 9.2 million only ten years later.[83] After the war, even more people started using gas, with the nation adding 291,000 new residential customers in 1945; 512,000 in 1946; 732,000 in 1947; 1.3 million in 1948; 1.2 million in 1949; and 2.2 million in 1950.

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73. *See id*.

74. PEEBLES, *supra* note 15, at 55; *see also* Herbert, *supra* note 67, at 64.

75. YERGIN, *supra* note 26, at 411.

76. Barlow et al., *supra* note 41, at 83.

77. *See* STOTZ & JAMISON, *supra* note 15, at 298–302. As natural gas replaced manufactured gas, prices also dropped. For instance, manufactured gas in New York City in the late 1820s might run north of $12/Mcf, but by the 1910s, a similar amount of natural gas might sell for less than a dollar. *Id*. at 9.

78. BARLOW ET AL., *supra* note 41, at 83.

79. *Id*.

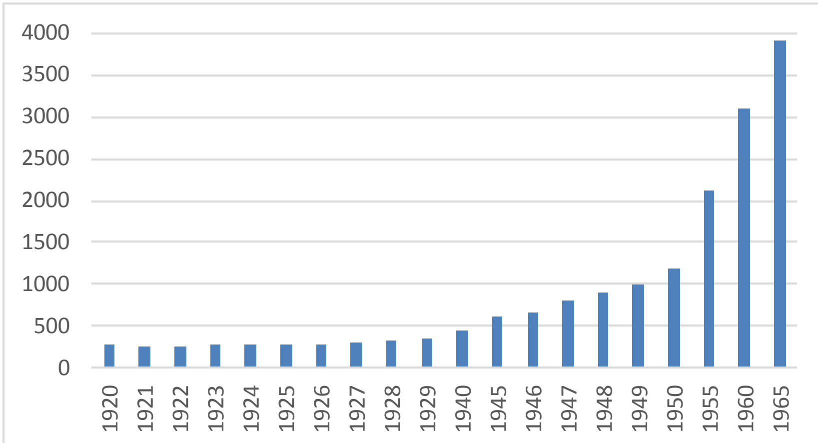
80. PEEBLES, *supra* note 15, at 55.

81. *Id*.

82. HERBERT, *supra* note 67, at 1.

83. *Id*. at 57, 87.

Figure 2: U.S. Residential Natural Gas Use (billions of cubic feet)[84]



At the same time, the way the nation used natural gas was changing. At the beginning of the twentieth century, industry consumed 75 percent of total metered natural gas.[85] By 1948, however, residential natural gas consumption "exceeded for the first time the amount of [gas] that was vented or flared and wasted . . . ."[86] In fact, as illustrated by Figure 2 above, residential natural gas consumption increased almost fourteen-fold from 1920 to 1965, from 286 billion cubic feet to 3,903 billion cubic feet.[87] This was remarkable enough, but it was even more notable given that lighting in U.S. homes had shifted from 88 percent kerosene in 1900, to 85 percent gas in 1910, to 79 percent electricity in 1940, as illustrated in Figure 3. Utility use of natural gas was also growing, increasing from 22 billion cubic feet in 1920 (2.7 percent of total natural gas use) to 120 billion cubic feet (6 percent of total natural gas use).[88]

Thus, as the century unfolded, the natural gas industry's transition was complete. By the mid-1900s, the fuel had lost the battle for the illumination market, but it also had become not just an increasingly significant energy source but a truly important one for the nation as well.

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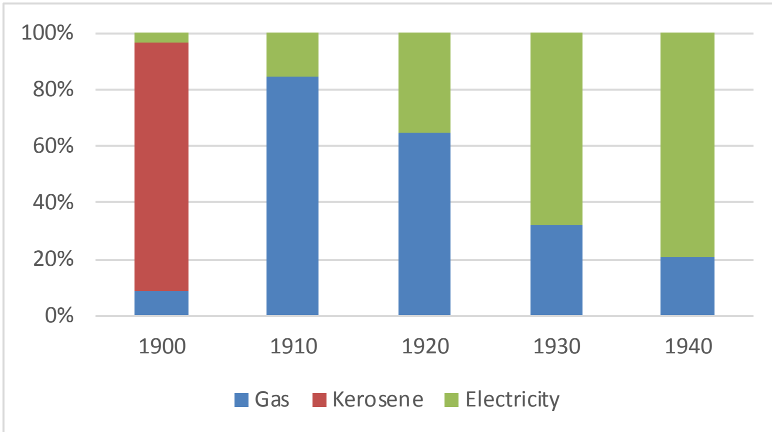
84. *Id*. at 98.
85. CLARK, *supra* note 70, at 145.
86. *Id*. at 103.
87. HERBERT, *supra* note 67, at 49, 104.
88. CLARK, *supra* note 70, at 145.

Figure 3: Energy Sources for Illumination in U.S. Homes[89]



D. Turbulence: Energy Crisis, Legal Malfunction, and the Opening of Markets

Just as gas began to settle into its growing role in the economy, new and powerful external forces pushed it to change again. One key driver was law. Public utilities became early distributors of natural gas and were first subject to regulation by municipal authorities, then by state agencies, and finally by the federal government for some activities as well.[90] Adoption of the Natural Gas Act (NGA) in 1938 gave the Federal Power Commission (FPC) and then its successor agency, the Federal Energy Regulatory Commission (FERC), authority to regulate transportation prices for gas in pipelines, as well as prices and terms for wholesale sales of gas.[91] For years, the FPC exercised this authority using cost-of-service ratemaking, that is, determining prices based on the actual cost of delivering the service plus a reasonable rate of return. The FPC applied this mechanism to interstate gas pipelines but not to independent producers. "Thus, the FPC did not regulate producer prices, and pipelines simply passed through producer prices to their end customers."[92]

In 1954, all that changed. In *Phillips Petroleum Co. v. Wisconsin*,[93] the Supreme Court overturned the FPC's determination that independent gas producers—that is, producers who did not own pipelines—were not natural gas companies

89. *Id.* at 60.
90. CLARK, *supra* note 70, at 21.
91. 15 U.S.C. § 717; *see also* CLARK, *supra* note 70, at 21.
92. DAVIES ET AL., *supra* note 14, at 634.
93. 347 U.S. 672 (1954).

subject to NGA jurisdiction. "Regulation of the sales in interstate commerce for resale made by a so-called independent natural-gas producer," the Court wrote, "is not essentially different from regulation of such sales when made by an affiliate of an interstate pipeline company. In both cases, the rates charged may have a direct and substantial effect on the price paid by the ultimate consumers [, whose protection is] the primary aim of the Natural Gas Act."[94] As a result, following *Phillips*, the FPC was required to apply rate regulation to thousands of independent gas producers.

The impact of *Phillips* was immense, although it took some time to become visible in the public sphere. The FPC responded to *Phillips* by attempting to follow its edict, instituting individual rate cases for each of the now-jurisdictional gas producers. This was a futile endeavor. "By 1960, [the FPC] had completed ten rate cases and had developed a backlog of 2,900 pending cases."[95] Chastised by the Court for its slow progress,[96] the Commission then tried another tack. It began setting "area rates" for multiple gas producers based on geography and historical costs.[97] And with that move, the public actually began to feel *Phillips*'s impact.

In 1969, a year after the Supreme Court approved the FPC's "area rate" practice,[98] pipelines started reducing their deliveries to local gas utilities. The FPC's imposition of price controls had disincentivized new exploration of gas, so a supply shortage was developing—and it was quickly getting worse.[99] "By the unusually cold winter of 1976–1977," the shortage was so bad that "gas service was no longer available to most prospective new customers; thousands of manufacturing plants and schools were closed by service curtailments; and, over 1 million workers were laid off because of their employers' inability to obtain gas."[100]

At the same time, how the nation used natural gas had again begun to evolve. In 1950, roughly 59 percent of gas was used by industry, 27.5 percent went to residential and commercial purposes, and only 11 percent was used to produce electricity, as seen in Figure 4.[101] By 1975, those shares had changed

94. *Id*. at 685.

95. Richard J. Pierce, Jr., *The Evolution of Natural Gas Regulatory Policy*, 10 NAT. RESOURCES & ENV'T 53 (Summer 1995).

96. *See* Atlantic Refining Co. v. Public Serv. Comm'n of New York, 360 U.S. 378 (1959).

97. *See, e.g.*, Area Rate Proceeding (Hugoton-Anadarko Area), 30 F.P.C. 1354 (1963); Area Rate Proceeding (South Louisiana Area), 25 F.P.C. 942 (1961); *see also* Comment, *Regulating Independent Gas Producers: The First Area Attempt*, 115 U. PA. L. REV. 84 (1966).

98. *See* Permian Basin Area Rate Cases, 390 U.S. 747, 769–70 (1968); *see also* Mobil Oil Corp. v. FPC, 417 U.S. 283 (1974).

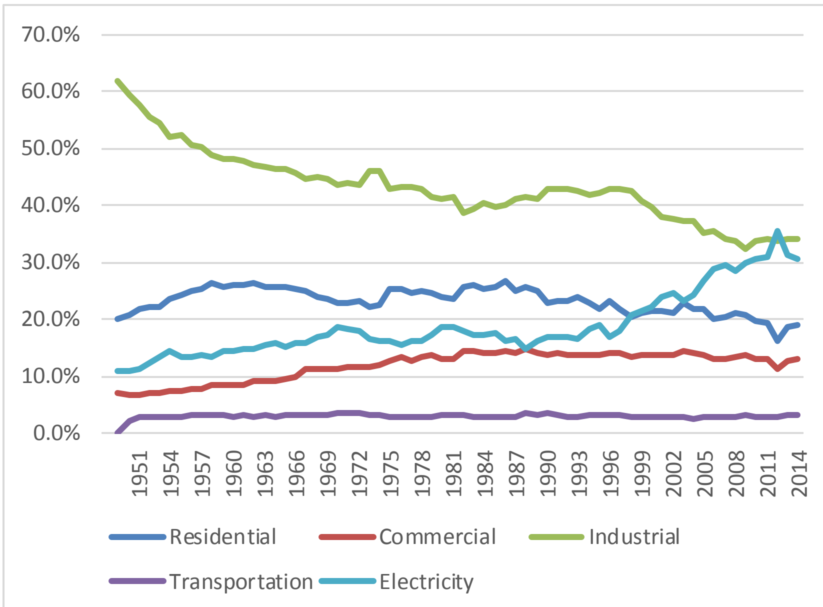
99. Pierce, *supra* note 95, at 53.

100. *Id*.

101. U.S. Energy Info. Admin., *December 2015 Monthly Energy Review*, 85 tbl. 4.3 Natural Gas Consumption by Sector (Release Date: December 23, 2015), www.eia.gov/totalenergy/data/monthly/archive/00351512.pdf.

significantly. A full 38 percent of gas was consumed for residential and commercial uses, industrial use had shrunk to 43 percent, and the electricity sector's share had grown to 16 percent.[102] The fact that consumers were increasingly reliant on gas as an energy source only made the national shortage that much more acute.

Figure 4: U.S. Natural Gas Consumption by Sector[103]



Congress responded to the gas shortage with two key pieces of legislation included in President Carter's National Energy Act.[104] First, the Natural Gas Policy Act of 1978 (NGPA) created a complicated regime of twenty-three different classifications of gas, creating statutory price ceilings that sought to protect consumers but also to encourage natural gas exploration.[105] The NGPA also gave FERC authority over both interstate and intrastate gas production and markets. This unification of the gas market was important, because part of the problem during the gas shortage was that producers wanted to put gas into the intrastate market,

102. *Id*.
103. *Id*.
104. Pub. L. No. 95-91 (1977); *see also* Julia Richardson & Robert Nordhaus, *The National Energy Act of 1978*, 10 NAT. RESOURCES & ENV'T 62 (Summer 1995).
105. 15 U.S.C. §§ 3301 *et seq.*; *see also* Richard J. Pierce, Jr., *The Past, Present, and Future of Energy Regulation*, 31 UTAH ENVTL. L. REV. 291, 292 (2011) [hereinafter *The Past, Present, and Future of Energy Regulation*].

which was tied to the higher world price of gas. However, gas could not be taken out of the price-controlled interstate market without Commission approval.[106] Second, the National Energy Act included the Powerplant and Industrial Fuel Use Act of 1978 (Fuel Use Act),[107] which prohibited new (and existing, as designated by DOE) powerplants and major industrial facilities from using natural gas or petroleum as their primary fuel unless they had received an exemption from the Department of Energy.[108] The idea of the Fuel Use Act was to shift oil and gas away from industry and to conserve it for consumers, in light of both the gas shortage and the Arab oil embargo and the ensuing energy crisis of 1973.[109]

The NGPA, while a step toward a more functional market, did not solve all the nation's gas problems. During the shortage, pipelines had entered into take-or-pay contracts with producers, attempting to ensure that they would have adequate gas to deliver to consumers.[110] When gas prices were high because of the shortage, this was not problematic. But as supplies increased and prices fell following the NGPA's adoption, these take-or-pay contracts became troublesome.[111] Pipelines did not want to pay higher contract rates when cheaper gas was available. Producers wanted to reap the benefits of the bargains they had negotiated. And consumers, of course, wanted the lowest-cost gas available.[112] Despite Congress' efforts in the NGPA, then, the gas market still needed restructuring.[113]

FERC began its restructuring effort in earnest in 1985, when it adopted Order No. 436.[114] That rule encouraged pipelines to

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106. DAVIES ET AL., *supra* note 14, at 638–40.

107. Pub. L. No. 95-620, 92 Stat. 3289 (1978) (codified in scattered sections of 42 U.S.C.)

108. 15 U.S.C. §§ 3301 *et seq.*; *see also* Edward Lublin, *The Future of the Department of Energy's Coal Conversion Program*, 2 ENERGY L.J. 355 (1981).

109. *The Past, Present, and Future of Energy Regulation*, *supra* note 105, at 291–95.

110. DAVIES ET AL., *supra* note 14, at 639.

111. *Id.* at 639–40.

112. *Id.* at 640.

113. For more on this topic, see Richard J. Pierce, Jr., *Natural Gas Regulation, Deregulation, and Contracts*, 68 VA. L. REV. 63 (1982); Richard J. Pierce, *Reconsidering the Roles of Regulation and Competition in the Natural Gas Industry*, 97 HARV. L. REV. 345 (1983).

114. Order No. 436, Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol, [Regulations Preambles 1982–1985] F.E.R.C. Stats. & Regs. ¶ 30,665 (1985), *modified*, Order No. 436-A [Regulations Preambles 1982–1985] F.E.R.C. Stats. & Regs. ¶ 30,675 (1985), *modified further*, Order No. 436-B, III F.E.R.C. Stats. & Regs. ¶ 30,688, *reh'g denied*, Order No. 436-C, 34 F.E.R.C. ¶ 61,404, *reh'g denied*, Order No. 436-D, 34 F.E.R.C. ¶ 61,405, *reconsideration denied*, Order No. 436-E, 34 F.E.R.C. ¶ 61,403 (1986), *vacated and remanded sub nom.*, Associated Gas Distrib. v. F.E.R.C., 824 F.2d 981 (D.C. Cir. 1987), *cert. denied sub nom.*, 485 U.S. 1006 (1988); *see also* John Wyeth Griggs, *Restructuring the Natural Gas Industry: Order No. 436 and Other Regulatory Initiatives*, 7 ENERGY L.J. 71 (1986); Philip M. Marston,

become something akin to common carriers. In exchange for "blanket" authorization to enter into transportation agreements with gas producers, participating pipelines had to agree to provide "open access" service to all producers on a first-come, first-serve basis; "unbundle" their transportation services and gas sales; not discriminate in their provision of transport service; and disaggregate their merchant and transport functions.[115] "Although voluntary, all of the major pipelines eventually took part in the Order No. 436 scheme. This allowed their customers to save money, by accessing the cheaper gas in the spot markets."[116]

Four years later, in 1989, Congress took the opening of U.S. gas markets to the next level. In the Natural Gas Wellhead Decontrol Act (NGWDA),[117] Congress effectively reversed the *Phillips* decision and the band-aid solution the NGPA had put on it. This law dictated that, with the exception of gas sales by pipelines and local distribution utilities, all gas wellhead price regulations would be lifted as of January 1, 1993. Then, just as the NGWDA was about to take effect, FERC completed the job. In its Order No. 636, adopted in 1992, FERC made mandatory the various pipeline practices it had only encouraged in Order No. 436.[118]

As a result, competition became king in the gas industry. While regulation still remained, including by FERC for transport rates and by state public service commissions for retail prices, producers now enjoyed the clearest path to market for their gas they had ever had.

Pipeline Restructuring: The Future of Open-Access Transportation, 12 ENERGY L.J. 53 (1991); Stephen F. Williams, *The Proposed Sea-Change in Natural Gas Regulation*, 6 ENERGY L.J. 233 (1985).

115. DAVIES ET AL., *supra* note 14, at 640.

116. *Id*.

117. Pub. L. No. 101-60, 103 Stat. 157 (codified at 15 U.S.C. §§ 3311–3432); *see also* Steven M. Spaeth, *Our Experience Under the Natural Gas Policy Act of 1978, and Its Relevance to the Natural Gas Wellhead Decontrol Act of 1989*, 12 U. ARK. LITTLE ROCK L.J. 265 (1989/1990).

118. Order No. 636, Pipeline Service Obligations and Revisions to Regulations Governing Self-Implementing Transportation under Part 282 of the Commission's Regulations and Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol, 59 F.E.R.C. Stats. & Regs. ¶ 61,030, *order on reh'g*, Order No. 636-A, 60 F.E.R.C. Stats. & Regs. ¶ 61,102, *order on reh'g*, Order No. 636-B, 61 F.E.R.C. ¶ 61,272 (1992), *order on reh'g*, 62 F.E.R.C. ¶ 61,007 (1993), *aff'd in part and remanded in part sub nom.*, United Distribution Cos. v. F.E.R.C., 88 F.3d 1105 (D.C. Cir. 1996), *order on remand*, Order No. 636-C, 78 F.E.R.C. ¶ 61,186 (1997). For more on the impact of Orders No. 436 and 636, see, for instance, Anne V. Roland, *Status Report on the US Natural Gas Industry*, 16 ENERGY POL'Y 226 (1988); Arthur De Vany & W. David Walls, *Natural Gas Industry Transformation, Competitive Institutions and the Role of Regulation: Lessons from Open Access in US Natural Gas Markets*, 22 ENERGY POL'Y 755 (1994).

E. Modern Light: The Increasing Connection Between Gas and Electricity

Far and away, as we near the end of this decade, the biggest headline for natural gas is the rise of hydraulic fracturing. Indeed, it should be the headline. The combination of horizontal drilling and hydraulic fracturing—often referred to as "fracking" or "fracing"—has utterly transformed gas production in the United States. In 2007, gas from shale resources accounted for only 8 percent of total U.S. gas withdrawals.[119] As of 2013, however, shale gas tallied almost 40 percent of U.S. production.[120] Shale gas also clearly has affected gas prices in the United States, driving them down by increasing supplies. Thus, natural gas spot prices at Henry Hub were $7.11 per million BTU in December 2007, but they were down to $1.93 per million BTU in December 2015.[121] Likewise, NYMEX futures prices for Contract 1 natural gas were $7.114 per million BTU in 2007 but only $2.627 per million BTU in 2015.[122]

While the shale gas revolution has received more than its fair share of media and scholarly attention, less commonly highlighted is its connection to the use of gas in electricity production.[123] That connection is both immediate and deep. It is immediate in the sense that more abundant, less expensive gas has made the production of electricity using gas more attractive to the industry. It is deep in the sense that the use of gas to generate electricity has only grown over time, and already was on a strong uptick heading into the 2000s. Facilitating this, just as had been the case for natural gas restructuring, was a series of important legislative and regulatory changes that sought to promote competition in the electricity generation industry.

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119. U.S. Energy Info. Admin., *U.S. Natural Gas Gross Withdrawals and Production* (Aug. 31, 2015), www.eia.gov/dnav/ng/ng_prod_sum_dcu_nus_a.htm.

120. *Id*. Several major "shale plays" exist across the United States, the largest of which are: the Bakken Shale in eastern North Dakota and Western Montana, the Marcellus Shale in the Appalachian Basin, the Barnett Shale in Texas, the Fayetteville Shale in Arkansas, and the Haynesville Shale in Louisiana and eastern Texas. William J. Brady & James P. Crannell, *Hydraulic Fracturing Regulation in the United States: The Laissez-Faire Approach of the Federal Government and Varying State Regulations* 14 VT. J. ENVTL. L. 39, 40–42 (2012). Other significant shale plays exist in Arizona, Colorado, Kentucky, Michigan, Utah, and Wyoming. *Id.*

121. U.S. Energy Info. Admin., *Henry Hub Natural Gas Spot Price,* (last updated Apr. 13, 2016), www.eia.gov/dnav/ng/hist/rngwhhdm.htm.

122. U.S. Energy Info. Admin., *Natural Gas Futures Contract 1* (last updated Apr. 13, 2016), www.eia.gov/dnav/ng/hist/rngc1a.htm.

123. Debate surrounding hydraulic fracturing focuses on fracturing fluid and wastewater and methane emissions resulting from the fracturing process. Elizabeth Burleson, *Climate Change and Natural Gas Dynamic Governance*, 63 CASE W. L. REV. 1217, 1224 (2013).

The changes began in 1978. Another key statute adopted as part of the National Energy Act was the Public Utility Regulatory Policies Act of 1978 (PURPA).[124] Among other things, PURPA required incumbent electric utilities to purchase power from small renewable and cogeneration facilities, collectively referred to as "qualifying facilities," or QFs, under the statute.[125] The utilities, moreover, had to pay incentive rates for this power—the so-called "avoided cost" of the electricity that the utility would have had to pay to otherwise acquire power.[126] Thus, while this law did not formally encourage electricity production from natural gas, it did set the stage. It did so by opening the market, which previously had been dominated by vertically integrated incumbent utilities, to other types of generators.

Of course, the Powerplant and Industrial Fuel Use Act, also adopted as part of the National Energy Act, generally foreclosed use of natural gas in new electricity generation facilities.[127] However, as natural gas supplies increased in the 1980s, Congress saw fit to repeal the portions of that law pertaining to prohibitions on the use of natural gas; it did so in 1987, only nine years after the Fuel Use Act had been adopted.[128] With this, the door was cracked open for greater natural gas use in electricity production.

Five years later, Congress swung the door the rest of the way. In the Energy Policy Act of 1992 (EPAct 1992),[129] Congress created a new kind of electric entity—the "exempt wholesale generator," or "EWG."[130] The idea was simple: encourage more competition for electricity production. The creation of EWG status did this by breaking down the legal and financial barriers to participation in the wholesale electricity market. Prior to EPAct 1992, there were only three basic ways a non-utility could sell wholesale generation.[131] It could build or acquire a QF under PURPA. It could create a "PUHCA pretzel," a generator in which no utility held more than a 10 percent ownership share. Or it could become a holding company under the Public Utility Holding Company Act of

124. Pub. L. No. 95-617, § 2, 92 Stat. 3117, 3119 (codified at 7 U.S.C. § 918c, 42 U.S.C. § 6808, scattered sections of 15 U.S.C., 16. U.S.C., and 43 U.S.C. (2013)).

125. Pub. L. No. 95-617, § 210, 92 Stat. 3117, 3119 (codified at 16 U.S.C. § 824a-3 (2014)).

126. Pub. L. No. 95-617, § 210(b)–(d), 92 Stat. 3117, 3119 (codified at 16 U.S.C. § 824a-3(b)–(d)).

127. Pub. L. No. 95-620, § 102, 92 Stat. 3289 (codified at 42 U.S.C. §§ 8301–8484 (1978)).

128. Pub. L. No. 100-42, § 1, 101 Stat. 310 (1987).

129. Pub. L. No. 102-486, 106 Stat. 2776 (1992) (codified at 12 U.S.C. § 1701z-16, 25 U.S.C. §§ 3501–3506, scattered sections of 16 U.S.C., 26 U.S.C., 30 U.S.C., 42 U.S.C. (2013)).

130. Pub. L. No. 102-486, §§ 711–715, 106 Stat. 2776 (1992).

131. Jeffrey D. Watkiss & Douglas W. Smith, *The Energy Policy Act of 1992—A Watershed for Competition in the Wholesale Power Market*, 10 YALE J. ON REG. 447, 464–65 (1993).

1935 (PUHCA).[132] None of these options was palatable. The scope of facilities that could be QFs was narrow. Lenders were not fond of the PUHCA pretzel model. And becoming a PUHCA holding company posed significant regulatory hurdles that most developers were not willing to bear.[133] The ability for non-utility generators to become EWGs, however, created a path around these obstacles, because it razed the PUHCA barrier.

Thus, EPAct 1992 meant that non-renewable and non-cogeneration facilities, including gas-fired generators, could start competing in the market. The law was unquestionably successful in this endeavor. In fact, "the first application for EWG status was filed with FERC within two days of [EPAct 1992's enactment, and] a total of three applications were filed within the first month."[134] As one commentator observed only three years after the law's passage, "EWGs are multiplying and are looking for markets to serve."[135]

In the early 1990s, FERC was also busy doing its own work to foment a competitive wholesale generation market. It began by granting authority for utilities and other entities to sell electricity at "market-based" rates, or prices they negotiated with each other,[136] rather than seeking cost-of-service approval under the "just and reasonable" standard of Federal Power Act Section 205.[137] FERC also adopted perhaps its most significant rule ever on the electricity side of its jurisdiction, Order No. 888, which imposed on transmission owners the same requirements that Order No. 636 did on gas pipelines.[138] Thus, beginning in 1996, transmission owners were required to sell excess transmission capacity on a first-come, first-serve basis. As a result, just as had been the case for gas, competitors in the electricity industry now could move their product freely within the market, without worrying that their competitive threats to incumbent utility

132. 15 U.S.C. §§ 79 to 79z-6.

133. Watkiss & Smith, *supra* note 131, at 464–65.

134. *Id.* at 465.

135. Arturo Gándara, *United States-Mexico Electricity Transfers: Of Alien Electrons and the Migration of Undocumented Environmental Burdens*, 16 ENERGY L.J. 1, 23 (1995).

136. DAVIES ET AL., *supra* note 14, at 399–409.

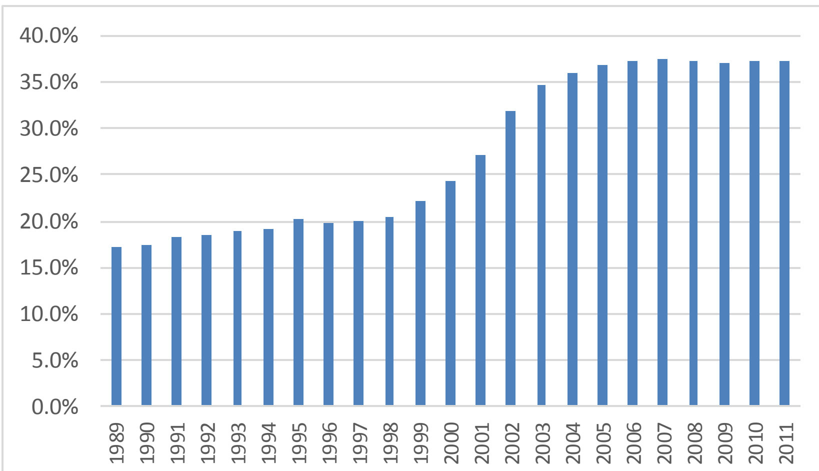
137. 16 U.S.C. § 824d.

138. Order No. 888, Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, [Regs. Preambles 1991–1996] F.E.R.C. Stats. & Regs. ¶ 31,036 (1996), 61 Fed. Reg. 21,540 (1996) (to be codified at 18 C.F.R. §§ 35, 385) [hereinafter Order No. 888], *order on reh'g*, Order No. 888-A, F.E.R.C. Stats. & Regs. ¶ 31,048 (1997), *order on reh'g*, Order No. 888-B, 81 F.E.R.C. ¶ 61,248, 62 Fed. Reg. 64,688 (1997), *order on reh'g*, Order No. 888-C, 82 F.E.R.C. ¶ 61,046 (1998), *aff'd in relevant part sub nom.*, Transmission Access Policy Study Grp. v. FERC, 225 F.3d 667 (D.C. Cir. 2000), *aff'd sub nom.*, New York v. F.E.R.C., 535 U.S. 1 (2002).

transmission owners' longstanding business would result in discrimination.

At the same time that Congress and FERC were pushing hard to open the generation market to more competition, technological developments helped ensure that natural gas would gain an increasingly important role in the market. Rather than using old-style boilers to burn gas and create electricity, companies had started using small, modular units employing jet engine technology to produce power.[139] Not only were these units more efficient, they also could be quickly deployed and targeted to specific areas in need of power. Indeed, when EPAct 1992 was adopted, the expectation was that many EWGs would be gas-fired generators.[140] That, in fact, turned out to be the case.[141]

Figure 5: Share of Natural Gas in the U.S. Electricity Fleet[142]



139. *See, e.g.*, RICHARD F. HIRSH, TECHNOLOGY AND TRANSFORMATION IN THE AMERICAN ELECTRIC UTILITY INDUSTRY 164 (1989).

140. Richard D. Cudahy, *PURPA: The Intersection of Competition and Regulatory Policy*, 16 ENERGY L.J. 419, 424 (1995); Richard D. Cudahy & William D. Henderson, *From Insull to Enron: Corporate (Re)Regulation After the Rise and Fall of Two Energy Icons*, 26 ENERGY L.J. 35, 82 (2005); *see also* Alan Miller & Adam Serchuk, *The Promise and Peril in a Restructured Electric System*, 12 NAT. RESOURCES & ENV'T 118 (Fall 1997) (noting the expectation in 1995 that gas generation would increase from 15 to 31 percent of the market share).

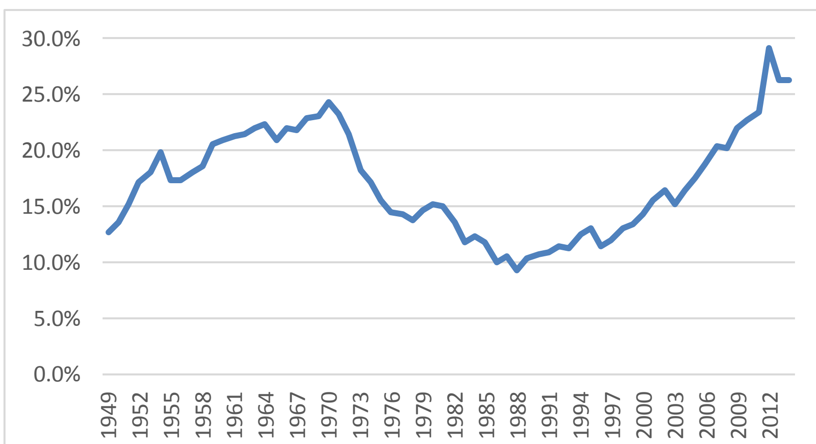
141. *See, e.g.*, Jess Totten, *Development of Competition in Electricity in Texas*, 1 ENVT'L & ENERGY L. & POL'Y J. 67, 69 (2005) (noting that in Texas "roughly 28,000 MW of new generation capacity was built" between 1995 and 2005—and most of it was "efficient combined-cycle capacity fueled by natural gas").

142. *See* U.S. ENERGY INFO. ADMIN., *Annual Energy Review 2011*, 260 tbl. 8.11c (2011), www.eia.gov/totalenergy/data/annual/pdf/aer.pdf.

From the late 1980s through the restructuring of the 1990s to now, natural gas has only become a more and more dominant force in the production of electricity in this country. In fact, natural gas accounted for the largest growth in electricity generation over the last seventeen years.[143] Thus, from 1989 to 1995 to 2011, natural gas generation capacity installed in the United States grew from 119,304 MW to 145,282 MW to 368,260 MW—a more than threefold increase in just over two decades.[144] Likewise, as illustrated in Figure 5, natural gas's share of installed generation facilities more than doubled in this timeframe—from 17.3 percent in 1989, to 20.2 percent in 1995, to 37.3 percent in 2011.[145]

Even more critical, the addition of all this natural gas capacity significantly changed how the nation produces power, aided, no doubt, by declining gas prices from the shale gas revolution. Consequently, in 1989, only 10.4 percent of the nation's electricity came from natural gas.[146] In 1995, that figure was up only slightly, to 13.1 percent.[147] But by 2011, it had reached nearly a quarter of total electricity production, at 23.5 percent—and by 2014, it had surpassed that threshold, soaring to 26.2 percent, as shown in Figure 6.

Figure 6: Share of Natural Gas in U.S. Electricity Generation (kWh)[148]



143. Jeff Hopkins, Center for Climate and Energy Solutions, *Modeling EPA's Clean Power Plan: Insights for Cost-effective Implementation* 6–7 (2015).

144. *See* U.S. Energy Info. Admin., *Annual Energy Review 2011*, 260 tbl. 8.11c (2011), www.eia.gov/totalenergy/data/annual/pdf/aer.pdf.

145. *Id*.

146. *See* U.S. Energy Info. Admin., *January 2016 Monthly Energy Review*, 110 tbl. 7.2b (Jan. 27, 2016) www.eia.gov/totalenergy/data/monthly/archive/00351601.pdf.

147. *Id*.

148. *Id*.

Thus, as the Obama administration prepared to issue its proposed Clean Power Plan rule in 2014, natural gas occupied a unique place in the U.S. energy landscape. In one sense, its position was new. With technological change and the opening of markets, natural gas had become quite dominant. It was critical in the economy, increasingly used for electricity production, and looked to as a fuel for the future. Still, in another sense, natural gas's perch was old—and possibly shaky. It was only two-and-a-half decades earlier that gas was "reserved by regulatory fiat for its highest use—home heating[—and] was emphatically not to be used for electric generation, for heating swimming pools, or for burning in gas logs."[149] That this fuel had come so far in so short a time revealed much about its evolution, and the rapidity with which energy outlooks can change. But, the fact that energy landscapes can shift so quickly also begged the question whether natural gas can maintain its position—and if it can, what role in society it will play next.

The Clean Power Plan, as it turns out, may have much to say about that.

III. FORECASTS AND PROJECTIONS: THE ROLE OF NATURAL GAS IN THE CLEAN POWER PLAN

The Clean Power Plan cannot be understood outside the context of natural gas's growing prominence in U.S. electricity production generally, including the role that hydraulic fracturing has played in building gas's newfound position. While natural gas's role in the nation's energy economy has evolved over time, today the fuel is in perhaps its starkest transition yet. In recent years, as noted, both natural gas production and its use by the electricity sector have grown rapidly, driven heavily by the combination of horizontal drilling and hydraulic fracturing. Together, those technologies have rapidly expanded the availability—and lowered the cost—of gas resources.[150] Thus, a fuel that once was seen as a nuisance byproduct of oil, and only in recent decades became stable enough to garner a strong position in the electricity sector, now is a dominant force in the United States' energy system.

Shifts in natural gas production alone demonstrate the immensity—and extensiveness—of this change. Over the last ten years, domestic natural gas production grew by 40 percent: from approximately 50 Bcfd in 2005 to 70 Bcfd in 2014.[151] U.S. natural

149. Richard D. Cudahy, *The Folklore of Deregulation (with Apologies to Thurman Arnold)*, 15 YALE J. ON REG. 427, 435 (1998).

150. *See* Advanced Energy Economic Institute, Impacts of the Clean Power Plan on U.S. Natural Gas Markets and Pipeline Infrastructure 4 (2015) [hereinafter Impacts of the Clean Power Plan].

151. *Id.*

gas consumption also rose roughly 20 percent in that same period, from approximately 22 million cubic feet in 2005 to 26.6 million cubic feet in 2014.[152] Again, shale gas was a primary catalyst for this transition, accounting for approximately 50 percent of U.S. production in 2014.[153] Indeed, today, shale gas production exceeds that from conventional natural gas resources.[154]

While undeniably important, the rise of hydraulic fracturing is not the sole cause of natural gas's rise in the electricity sector. Other factors, including the opening of competition in the generation sector of the electricity industry,[155] as well as other new regulatory regimes, have also encouraged electricity producers to switch out coal for other fuels, including natural gas.

EPA's Mercury Air Toxics Standards (MATS), for instance, adopted in 2012, effectively encourage electric utilities to reduce their coal generation.[156] These standards place limits on coal- and oil-fired electric generating units (EGUs) to reduce mercury air pollution from units with a capacity of 25 MW or more.[157] Natural gas is a competitive fuel source for electricity under the MATS because burning natural gas results in negligible mercury emissions compared to coal.[158]

Likewise, since the mid-1990s, over two-thirds of states have adopted renewable portfolio standards (RPSs) and other laws encouraging use of renewable resources for electricity production.[159] As electricity generation from renewables has

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152. U.S. Energy Info. Admin., *U.S. Natural Gas Total Consumption*, www.eia.gov/dnav/ng/hist/n9140us2a.htm (last visited Dec. 31, 2015).

153. Impacts of the Clean Power Plan, *supra* note 150, at 5.

154. *Id.* Increased production from shale resources has offset production declines from conventional resources. Production from conventional resources declined substantially over the past decade—from roughly 45 Bcfd in 2005 to approximately 35 Bcfd in 2014. Reliance on shale resources also has shifted the locus of natural gas production, creating new supply centers and changing regional markets. Prior to the shale gas revolution, prices were usually lower in the Gulf Coast, where there are many conventional resources, and higher in the Northeast, where winter demand is heavy. However, growth of Marcellus shale production in the Northeast significantly lowered spot market prices in that area. *Id.* at 4–5.

155. *See supra* Part II.E.

156. Impacts of the Clean Power Plan, *supra* note 150, at 6; *see also* 40 C.F.R. pts. 60, 63.

157. U.S. Envtl. Protection Agency, *Mercury and Air Toxics Standards: Basic Information*, www3.epa.gov/mats/basic.html (last visited Dec. 31, 2015).

158. *See* Union of Concerned Scientists, *Environmental Impacts of Natural Gas*, www.ucsusa.org/clean_energy/our-energy-choices/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas.html#.VogntjbT7q8 (last visited Dec. 31, 2015).

159. Lincoln L. Davies, *State Renewable Portfolio Standards: Is There a "Race" and Is It "To the Top"?*, 3 SAN DIEGO J. CLIMATE & ENERGY L. 3, 5 (2012); *See also* Lincoln L. Davies, *Evaluating RPS Policy Design: Metrics, Gaps, Best Practices, and Paths to Innovation*, 4 KLRI JOURNAL OF LAW & LEGISLATION 3 (2014); Uma Outka, *Intrastate Preemption in the Shifting Energy Sector*, 86 U. COLO. L. REV. 927, 935 (2015).

increased, more nimble generation resources like natural gas have gained importance, because they are needed to ramp up and down quickly to maintain system stability when intermittent renewables like wind and solar fall off in production.

The future of natural gas often is placed in this context. Many observers suggest that natural gas will play an even greater role in electricity production going forward because of the shale boom, and that gas must play that role if the United States is to move to a clean energy economy.[160] This, certainly, is how many have portrayed the Clean Power Plan—as a rule that does not just seek to limit electricity production from coal-fired plants but also as one that will use natural gas facilities to get there.

It should come as little surprise, then, that many suggest that natural gas's role in electricity production, and society, will only increase under the Clean Power Plan. As it turns out, however, what effect the Plan may have on natural gas use may be more complicated than would first appear.

The remainder of this Part first summarizes the EPA's recently promulgated Clean Power Plan rule. It then surveys various forecasts and projections of that Plan's likely impact on natural gas.

A. The EPA's Clean Power Plan

On August 3, 2015, the EPA issued its new rule limiting greenhouse gas emissions from electricity facilities—*Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units (EGUs)*—more commonly known as the Clean Power Plan (CPP).[161] The Clean Power Plan seeks to reduce CO_2 emissions from the electricity sector by roughly 32 percent of 2005 levels by 2030.[162] In this way, and in combination with other measures,[163] the EPA seeks to reduce domestic greenhouse gas emissions from the electricity sector, which leads

160. *See infra* Part IV.A; *see also, e.g.*, JOSEPH P. TOMAIN, ENDING DIRTY ENERGY POLICY: PRELUDE TO CLIMATE CHANGE 112 (2011).

161. Carbon Pollution Emissions Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,661 (Oct. 23, 2015) (to be codified at 40 C.F.R. § 60) [hereinafter Clean Power Plan].

162. *Id.*

163. Use of energy in the United States can be divided roughly into two halves—electricity and transport. The CPP is the EPA's primary effort to reduce GHG emissions in the electricity sector. For transport, the EPA and the National Highway Traffic Safety Administration established limits on GHG emissions in 2012 via mobile source pollutant limits and Corporate Average Fuel Economy (CAFE) standards. *See* 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 40 C.F.R. §§ 85, 86, 600 (2012). The agencies promulgated the standards following the Supreme Court's ruling in *Massachusetts v. EPA*, 549 U.S. 497, 534 (2007), which clarified that GHG emissions are a pollutant under the Clean Air Act.

the nation in such emissions.[164] The EPA estimates that the Clean Power Plan will result in $26 to 45 billion in net overall benefits, which includes $14 to 34 billion in health benefits for the public, and $20 billion in climate benefits such as changes in net agricultural productivity and energy system costs.[165] Nonetheless, if it is upheld in court,[166] the Plan will also significantly impact the electricity sector. In fact, the EPA estimates that power sector compliance with the Plan will cost roughly $7.4 billion per year between 2020 and 2030.[167]

EPA issued the CPP rule under Section 111(d) of the Clean Air Act (CAA), which gives the agency authority to promulgate regulations requiring states to "establish[] standards of performance for any existing" stationary source of air pollutants regulated under the CAA, including rules "for the implementation and enforcement of such standards of performance."[168] Relying on that power, the CPP established two targets that each state must meet to reduce their CO_2 emissions.[169] First, the Plan set interim compliance targets for states between 2022 and 2029. Second, the Plan announced a final target that states must meet by 2030.[170] These interim and final emission reduction targets were based on EPA's determination of the "best system of emissions reduction" (BSER) for CO_2 emissions from fossil-fuel-fired electric steam generating units and stationary combustion turbines.[171]

Under the Clean Air Act's cooperative federalist regime, each state has flexibility in deciding how to meet the CPP's emissions limits.[172] The EPA determined BSER using three "building blocks" that states might leverage to reach their targets: (1) "reducing the carbon intensity of electricity generation by improving the heat rate of existing coal-fired power plants";[173] (2) "substituting

164. In 2013, emissions from the electricity sector totaled 31 percent, outweighing emissions from transportation, which accounted for 27 percent of U.S. emissions. U.S. Envtl. Protection Agency, *Sources of Greenhouse Gas Emissions*, www3.epa.gov/climatechange/ghgemissions/sources.html (last visited Jan. 6, 2016).

165. *See* Clean Power Plan, *supra* note 161; *see also* U.S. Envtl. Protection Agency, *The Social Cost of Carbon*, www3.epa.gov/climatechange/EPA activities/economics/scc.html (last visited Jan 14, 2016).

166. Thomas Overton, *Political Opposition to Clean Power Plan Looms Large, Experts Say*, POWER MAGAZINE (Dec. 9, 2015), www.powermag.com /political-opposition-to-clean-power-plan-loom-large-experts-say/.

167. Hopkins, *supra* note 143, at 5.

168. 42 U.S.C. § 7411(d)(1) (2013).

169. U.S. Envtl. Protection Agency, Overview of the Clean Power Plan: Cutting Carbon Pollution From Power Plants 5 (2015), www.epa.gov/clean powerplan/fact-sheet-overview-clean-power-plan#print [hereinafter Overview of the Clean Power Plan].

170. *Id.*

171. Clean Power Plan, *supra* note 161.

172. Overview of the Clean Power Plan, *supra* note 169, at 3.

173. *Id.* at 4.

increased electricity generation from lower-emitting natural gas plants," also known as coal-to-gas switching;[174] and (3) "substituting increased electricity generation from new zero-emitting renewable energy sources."[175] Thus, although each state will choose different measures to reach their respective CPP mandate,[176] the final rule anticipated that increasing the role of natural gas in the electricity sector will be one key way that jurisdictions reach compliance.

The interim and final emission reduction goals established by the CPP give states two different options for achieving compliance: (1) a rate-based goal measured in pounds of CO_2 per megawatt hour and (2) a mass-based goal measured in total short tons of CO_2 reduced. The EPA established these separate targets to "maximize the range of choices available to states in implementing the standards and to utilities in meeting them."[177] The mass-based goals and rate-based goals have similar reduction targets, but the mass-based target seeks to facilitate allowance trading programs. The EPA also developed an alternative mass-based goal that includes a new source complement for states that may want to include both existing and new sources in their plans and to account for emissions growth.[178]

Because the CPP does not mandate how states must meet their targets, the rule's likely effects remain uncertain. Not until states submit their compliance plans for EPA approval will it become clear exactly how the CPP may impact composition of the nation's generation fleet.[179] States have the flexibility to develop plans relying on any combination of the three building blocks, as well as other CO_2 emissions-reducing strategies—including increased use of nuclear power or implementation of energy efficiency and conservation initiatives.[180] Indeed, EPA specifically contemplated that the Plan will reduce electricity demand through end-use energy efficiency.[181]

The ultimate impact of the CPP is not just unclear because it will take time for states to decide how to comply. Legal wrangling around the rule also has created significant uncertainty.[182]

174. *Id.*

175. *Id.*

176. Overview of the Clean Power Plan, *supra* note 169, at 5.

177. *Id.* at 3.

178. Kevin Poloncarz & Ben Carrier, EPA Finalizes Ambitious Clean Power Plan, Paul Hastings Insights (Aug. 7, 2015), www.paulhastings.com/publications-items/details/?id=b759e669-2334-6428-811c-ff00004cbded.

179. Hopkins, *supra* note 143, at 2.

180. *Id.*

181. *Id.* at 1.

182. E&E Publishing, LLC, *The Fate of the Obama Administration's Signature Climate Change Rule is in the Hands of the Courts*, www.eenews.net/interactive/clean_power_plan/fact_sheets/legal (last visited Apr. 28, 2016).

Currently, twenty-seven states have challenged the rule in federal court,[183] and on February 9, 2016, the Supreme Court stayed the rule, halting implementation pending review by the D.C. Circuit.[184] Partially in response to the Court's stay, nineteen states suspended their efforts to develop compliance mechanisms with the Plan.[185]

If the CPP rule is upheld in court, models project that energy efficiency measures will provide the least-cost option for compliance, so many states may be likely to rely heavily on efficiency measures first before making other changes to their electricity systems. Once energy efficiency is maximized, however, most models show a likely increased reliance on natural gas, though the precise contours of how that shift may develop are more complex.[186]

B. Forecasting Natural Gas's Role Under the Clean Power Plan

It is clear that the Clean Power Plan, if upheld, will have an immediate effect on both the natural gas market and the use of natural gas for electricity generation. Numerous groups have run models to forecast how the Clean Power Plan may impact the nation's energy systems. Here, we summarize the results of seven of these models. Three of the models—the EPA's, Energy Ventures Analysis's (EVA), and the Natural Resources Defense Council's (NRDC)—considered only the CPP's impact on the power sector.[187] The other four—the Advanced Energy Economic Institute's (AEE), the U.S. Energy Information Administration's (EIA), National Economic Research Associates' (NERA), and the Rhodium Group and Center for Strategic and International Studies' (Rhodium-CSIS)—assessed the Plan's likely impact on both the electricity sector and the broader natural gas sector.[188]

Each model took a slightly different approach. The EPA model is unique because it created forecasts using both the rule's

183. Overton, *supra* note 166.

184. Chamber of Commerce v. EPA, 136 S. Ct. 999 (2016).

185. E&E Publishing, LLC, *E&E's Power Plan Hub: Legal Challenges*, www.eenews.net/interactive/clean_power_plan#legal_challenge_status_chart (last visited Jan. 6, 2016) (noting that Alabama, Arizona, Arkansas, Colorado, Florida, Georgia, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Missouri, Montana, Nebraska, Nevada, New Jersey, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Texas, Utah, West Virginia, Wisconsin, and Wyoming suspended planning).

186. HOPKINS, *supra* note 143, at 2.

187. *See id*. at 3.

188. *See id., see also* Impacts of the Clean Power Plan, *supra* note 150, at 3, U.S. Energy Info. Admin., Analysis of the Impacts of the Clean Power Plan 5 (2015) [hereinafter Analysis of the Clean Power Plan].

rate-based emission goals and its mass-based emission goals.[189] The other models relied on rate-based targets. AEE, EIA, EVA, NERA, NRDC, and Rhodium-CSIS ran their models based on the proposed rule. EPA ran its model in 2015 based on the final rule.[190]

The models also differed in their construction, and which sensitivities they measured. EVA's model included a single scenario with projections to 2020.[191] The NRDC ran a series of scenarios with different generation portfolios, reflecting varying levels of conversion from high-CO_2-emitting resources to lower-emitting sources.[192] NRDC also performed a sensitivity analysis that assumed states and utilities would implement only half of available energy efficiency measures.[193] NERA ran two scenarios: an "unconstrained" scenario where states were assumed to utilize all compliance mechanisms, and a "constrained" scenario where states would reach compliance without using renewables or energy efficiency.[194] The AEE model includes two scenarios: a "mixed-source" compliance scenario where states use a mix of compliance mechanisms, and a "stress-test" scenario where Henry Hub gas prices fall by 20 percent.[195] Similarly, the EIA model includes, among others, a scenario with higher natural gas supply and low natural gas prices.[196] Rhodium-CSIS modeled a regional emissions rate and conducted national and regional scenarios with and

189. Envtl. Protection Agency, Regulatory Impacts Analysis for the Clean Power Plan Final Rule 3-7 (2015) [hereinafter Regulatory Impacts Analysis].

190. Although the AEE, EIA EVA, NERA, NRDC, and Rhodium-CSIS models based their projections on the rate-based emission goals in the EPA's proposed Clean Power Plan, the final rate-based emission goals do not substantially differ from the proposed goals. A majority of the state goals remained roughly the same, increasing or decreasing by less than 300 lbs CO_2/MWh. The EPA altered the goal of fifteen states, however, by more than 300 lbs CO_2/MWh. In the final rule, the EPA increase the rate-based emission goal of Arizona, Idaho, Maine, Minnesota, New Hampshire, New York, Oregon, South Carolina, South Dakota, and Washington by 300 lbs CO_2/MWh or more. Kentucky, Montana, North Dakota, West Virginia, and Wyoming saw their emissions goal decrease by 300 lbs CO_2/MWh or more. *See* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 79 Fed. Reg. 34830 (proposed June 18, 2014) (to be codified at 40 C.F.R. § 60); Clean Power Plan, *supra* note 161.

191. Energy Ventures Analysis, Energy Market Impacts of Recent Federal Regulations on the Electric Power Sector 10 (2014) [hereinafter Energy Market Impacts].

192. Natural Resources Defense Council, Comment on EPA's Proposed Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 8-2 (Dec. 1, 2014), www.regulations.gov/#!documentDetail;D=EPA-HQ-OAR-2013-0602-2332 [hereinafter NRDC Comment].

193. *Id.*

194. David Harrison et al., NERA Economic Consulting, Potential Energy Impacts of the EPA Proposed Clean Power Plan S-2 (2014) [hereinafter Potential Energy Impacts].

195. Impacts of the Clean Power Plan, *supra* note 150, at 2.

196. Analysis of the Clean Power Plan, *supra* note 188, at 12.

without energy efficiency as a CPP compliance mechanism.[197] Rhodium-CSIS also conducted two stress-test scenarios with high and low gas prices. The AEE, EVA, and NERA scenarios allowed interstate emissions trading. The AEE, EVA, EPA, NERA, and NRDC models include projections to 2030. The EIA model includes projections to 2040. Table A summarizes the major points of each CPP model.

Table A: Summary of CPP Models

Model	Model End Year	Scenarios Modeled	Sensitivity Analyses	Version of Rule Modeled
Advanced Energy Economic Institute	2030	States utilize mix of compliance mechanisms	Henry Hub prices decrease by 20%	Proposed
Energy Information Administration	2040	Various	High natural gas supply combined with low gas prices	Proposed
Environmental Protection Agency	2030	Rate-based and mass-based emissions goal projections	None	Final
Energy Ventures Analysis	2030	Rate-based emissions goal projections	None	Proposed
National Economic Research Associates	2030	States implement all compliance mechanisms	States reach compliance without using renewable resources or energy efficiency	Proposed
Natural Resources Defense Council	2030	Various	States utilize half of available energy efficiency measures	Proposed
Rhodium Group and Center for Strategic and International Studies	2030	National and regional emissions rate scenarios with and without energy efficiency	A high gas price scenario and a low gas price scenario	Proposed

197. JOHN LARSEN ET AL., RHODIUM GROUP & CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES, REMAKING AMERICAN POWER: POTENTIAL ENERGY MARKET IMPACTS OF EPA'S PROPOSED GHG EMISSION PERFORMANCE STANDARDS FOR EXISTING ELECTRIC POWER PLANTS 12 (2014) [hereinafter, Remaking American Power].

Predicting energy futures is an infamously perilous task.[198] Nonetheless, these models' forecasts of how the Clean Power Plan may play out are illuminating, particularly because they align in a number of key ways. First, the models suggest that electricity generation and consumption should decrease under the CPP, likely driven by the rule's encouragement of demand reduction through energy efficiency measures.[199] Second, the models show declining coal generation, which makes sense given that this is a key objective of the CPP. Finally, and importantly, a majority of the models anticipate an increase in natural gas generation in the near-term but declining natural gas demand and production by 2030.[200] Accordingly, the models do not project large increases in natural gas infrastructure.

The models' projections fall into three key areas relevant to the role of natural gas under the Clean Power Plan: (1) electricity generation and consumption; (2) natural gas demand and price; and (3) natural gas infrastructure.

1. Electricity Generation and Consumption

The models uniformly predict that the Clean Power Plan will result in less coal generation and, concomitantly, more natural gas generation as power producers switch from coal to gas.[201] Under these forecasts, the Clean Power Plan should cause three distinct shifts in the electricity sector. First, the models suggest that the Plan will cause an overall reduction in energy consumption, and thus, also generation.[202] Second, because the Plan aims to reduce CO_2 emissions, coal's generation share will decrease. Third, to replace lost generation from coal, most models project that the share of natural gas generation will increase and either exceed coal or match it. Specifically, the EIA, EPA, EVA, NERA, and Rhodium-CSIS models all project natural gas overcoming coal generation, while NRDC's model sees natural gas and coal generation roughly equaling out over time.[203]

The EPA's model provides a good example of how these trends may play out. In 2014, coal accounted for 39 percent of electricity generation in the United States, while natural gas accounted for 27 percent.[204] Under the business-as-usual projection in EPA's

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198. *E.g.*, VACLAV SMIL, ENERGY AT THE CROSSROADS: GLOBAL PERSPECTIVES AND UNCERTAINTIES 121 (2003) ("[M]ore than 100 years of long-term forecasts of energy affairs . . . have, save for a few proverbial exceptions confirming the rule, a manifest record of failure.").

199. *Id.* at 3–25; *see also* Hopkins*, supra* note 143, at 1.

200. Hopkins, *supra* note 143, at 1.

201. *Id.* at 8.

202. *Id.*

203. *Id.*, Analysis of the Clean Power Plan, *supra* note 188, at 87–91. AEE did not address generation mix in their model.

204. U.S. Energy Information Administration, *What is U.S. Electricity*

model, natural gas generation will increase to 31 percent of total generation by 2030, or 1,400 TWh, while coal generation would decline to almost the same share as natural gas, at 32 percent, or roughly 1,450 TWh.[205] Under the Clean Power Plan, however, the EPA model predicts that natural gas generation will increase to 33 percent, or roughly 1,300 TWh, by 2030 under a rate-based emissions goal.[206] Under a mass-based emissions goal, the EPA predicts natural gas to increase its generation share to 32 percent, or roughly 1,300 TWh.[207] Coal's generation share would decline to 27 percent under both scenarios, or approximately 1,100 TWh.[208]

The other models project similar overall trends, with natural gas uniformly predicted to make greater inroads into coal's overall generation share under the CPP, as detailed in Figure 7.[209] NRDC, for instance, projects that coal and natural gas generation will be roughly equal in proportion by 2030 across all the model's scenarios, at roughly 23 percent each, or 1,100 TWh.[210] Rhodium-CSIS's model reaches comparable results.[211] NERA, on the other hand, sees a less robust role for natural gas, with the resource increasing to 29 percent of electricity generation, or roughly 1,300 TWh, in their unconstrained scenario, up slightly from 28 percent in their model's business-as-usual scenario.[212]

Generation by Energy Source, www.eia.gov/tools/faqs/faq.cfm?id=427&t=3 (last visited Jan. 2, 2016).

205. Regulatory Impacts Analysis, *supra* note 189, at 3-28.

206. *Id.*

207. *Id.*

208. *Id.*

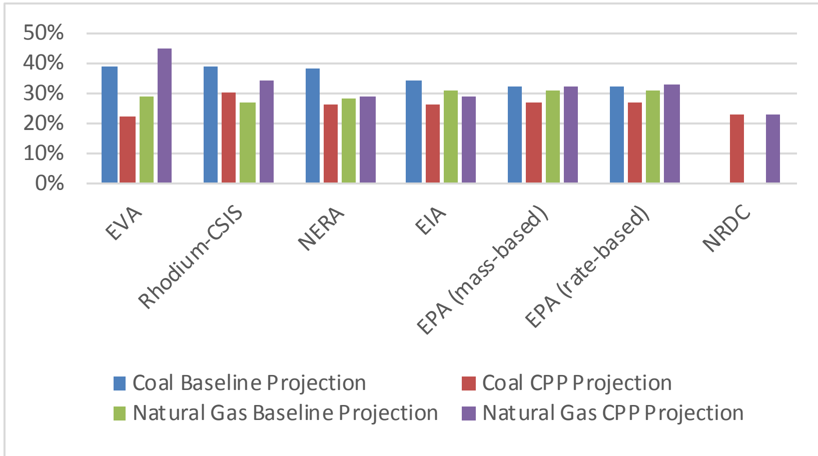
209. Hopkins, *supra* note 143, at 8.

210. NRDC Comment, *supra* note 192, at 8-24.

211. Rhodium-CSIS produced models with and without energy efficiency as a compliance mechanism. In this model, natural gas generation rises to roughly 1,300 TWh, or 34 percent of generation, when states utilize energy efficiency, compared to nearly 1,200 TWh, or 27 percent, under the business-as-usual forecast. John Larsen et al., *Remaking American Power National Data Table*, http://csis.org/files/publication/141118_National_Results_0.pdf (last visited Jan. 10, 2016). Coal generation decreases to roughly 1,200 TWh, or 30 percent of generation, consistent with projections suggesting that natural gas generation overcomes a substantial amount of coal's generation share, compared to roughly 1,700 TWh or 39 percent under the business-as-usual forecast. *Id.*

212. POTENTIAL ENERGY IMPACTS, *supra* note 194, at S-6. Under this scenario, coal generation would decrease to 25 percent of generation, or roughly 1,200 TWh.

Figure 7: CPP Model Generation Share Projections[213]



EIA's model predicts an initial spike in natural gas generation, with an increase to 32 percent of electricity generation, or roughly 1,400 TWh, by 2020—a large jump from their business-as-usual projection of 26 percent, or 1,100 TWh.[214]

By 2040, however, EIA's model projects natural gas generation to decline to 29 percent, or roughly 1,450 TWh, down 2 percent from their business-as-usual projection of 31 percent, or 1,550 TWh.[215] EIA projects a steady decline in coal generation throughout the compliance period.[216]

Of course, the degree to which the use of natural gas for electricity production will grow under the Clean Power Plan depends on which strategies states use to reduce CO_2 emissions. In this regard, each of the models assumes that states will rely on energy efficiency to some degree. The EPA assumed that all states will achieve a level of energy efficiency performance achieved by leading states,[217] and the other models followed EPA's lead or assumed a similar level of energy efficiency.[218]

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213. CPP projection shares noted herein refer to the end of each model's projection period. NRDC did not provide baseline shares for comparison, and EVA did not provide generation shares in terms of TWh, so the table only includes percentages.

214. ANALYSIS OF THE CLEAN POWER PLAN, *supra* note 188, at 87.

215. *Id.* at 91.

216. *Id.*

217. Regulatory Impacts Analysis, *supra* note 189, at 3-12.

218. *See* Envtl. Protection Agency, Regulatory Impacts for the Proposed Carbon Pollution Guidelines for Existing Power Plants and Emission Standards for Modified and Reconstructed Power Plants 3-14 (2014) (EPA assumed a 1.5 percent incremental demand reduction rate); ENERGY MARKET IMPACTS, *supra* note 191, at 13 (EVA did not provide a reduction rate, but instead assumed 179 TWh in annual energy efficiency savings, compared to

Because states might not necessarily adopt energy efficiency strategies, however, the Rhodium-CSIS, NRDC, and NERA, models included sensitivity scenarios where efficiency measures were either unavailable or extremely limited.[219] Under these scenarios, coal-to-gas switching is expected to become the predominant CPP compliance mechanism.[220] Thus, these scenarios highlight the large role that natural gas is likely to play if states do not employ—or do not receive credit for—energy efficiency measures under the Clean Power Plan.

NRDC performed a sensitivity analysis in which states and utilities take advantage of only half of available energy efficiency gains.[221] Under this scenario, coal's generation share would fall to 24 percent, or roughly 1,000 TWh, while natural gas generation would account for 29 percent of total electricity generation, or approximately 1,300 TWh—a 7 percent gain for gas over NRDC's scenario where states utilize energy efficiency.[222] This effect is accentuated even more under NERA's sensitivity analysis constraining use of renewables and eliminating energy efficiency measures.[223] In that scenario, coal's generation share would decline to roughly 4 percent of total generation, or 200 TWh, by 2030, while natural gas would increase its share to 57 percent, or approximately 2,500 TWh.[224]

EPA's assumption of 119 TWh); Potential Energy Impacts, *supra* note 194, at 12 (NERA assumed the quantities of energy efficiency that the EPA assumed in its model of the proposed rule); NRDC Comment, *supra* note 192, at 8-2 (NRDC assumed energy efficiency levels on the basis of the performance of leading state programs); REMAKING AMERICAN POWER, *supra* note 197, at 18 (Rhodium-CSIS relied on EPA's energy efficiency assumptions); *see generally* ANALYSIS OF THE CLEAN POWER PLAN, *supra* note 188 (EIA contracted to obtain information about current energy efficiency programs to develop their assumptions). Although the models relied on the EPA's energy efficiency levels contained in their model of the proposed rule, the EPA decreased the energy efficiency levels used in its model of the final rule by 0.5 percent points, to 1 percent. *See* Regulatory Impacts Analysis, *supra* note 189, at 3-13.

219. *See* REMAKING AMERICAN POWER, *supra* note 197, at 18; NRDC Comment, *supra* note 192, at Appendix 8A-1; Potential Energy Impacts, *supra* note 194, at S-6.

220. *See* REMAKING AMERICAN POwer, *supra* note 197, at 18; NRDC Comment, *supra* note 192, at Appendix 8A-1; Potential Energy Impacts, *supra* note 194, at S-6.

221. NRDC Comment, *supra* note 192, at 8-2.

222. *See id.* at 8-24; Appendix 8A-5.

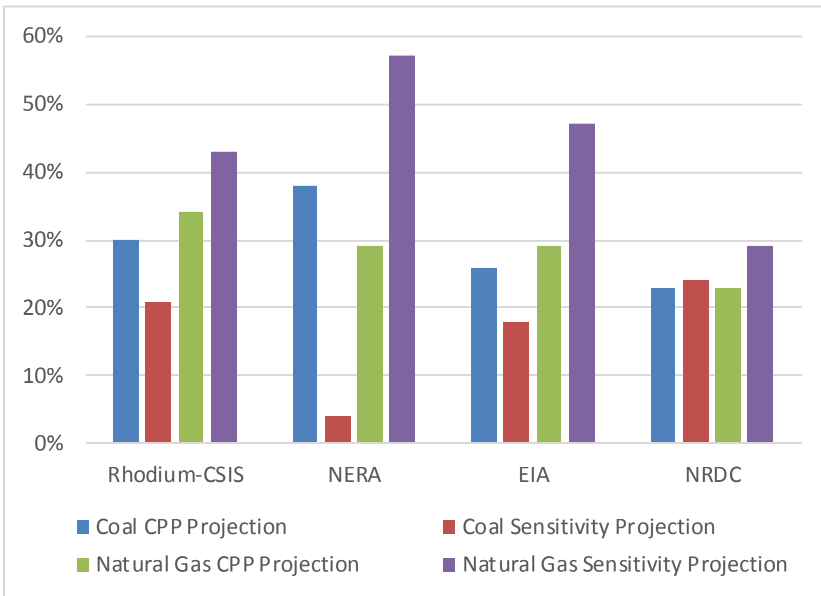
223. Potential Energy Impacts, *supra* note 194, at S-6.

224. *See id.* at 19. Rhodium-CSIS projects similar changes in generation shares under a scenario with no energy efficiency. Natural gas generation rises to roughly 1,800 TWh, or 43 percent of total generation, while coal's generation share declines to roughly 900 TWh, or 21 percent of total generation. These shifts compare to 27 percent for gas and 39 percent for coal under the business-as-usual forecast, respectively. REMAKING AMERICAN POWER, *supra* note 197.

EVA's model only includes projections to 2020, but EVA also predicts that natural gas will overcome a substantial amount of coal's generation share.

EIA's sensitivity analysis assumed an increased availability of natural gas and low Henry Hub prices.[225] EIA projects an increase in natural gas's generation share when Henry Hub prices fall. Contrary to the normal policy scenario, EIA does not project a tapering-off effect over the course of the compliance period.[226] Under its sensitivity analysis, natural gas's generation share steadily rises from 37 percent in 2020, or roughly 1,300 TWh, to 47 percent in 2040, roughly 2,400 TWh.[227] These CPP model sensitivity projections are summarized in Figure 8.

Figure 8: Generation Share Sensitivity Projections



Importantly, the models also acknowledge that the CPP's impact on the electricity sector will not be nationally uniform.[228]

EVA projects natural gas to increase its generation share by 16 percent, from 29 percent under the business-as-usual case to 45 percent under the CPP. Coal decreases its generation share by 17 percent, from 39 percent under the business-as-usual case to 22 percent under the CPP. ENERGY MARKET IMPACTS, *supra* note 191, at 23.

225. Analysis of the Clean Power Plan, *supra* note 188, at 12.

226. *Id.* at 93.

227. *Id.*

228. NRDC and the EPA did not conduct regional model breakdowns. Rhodium-CSIS modeled national cooperation and regional fragmentation but did not include projections for specific regions. *See* Remaking American Power, *supra* note 197, at 15. EVA conducted a generation breakdown mix for each state rather than focusing on regions. *See* Energy Market Impacts, *supra* note

This has important implications for the role of natural gas under the CPP, as the models show varying levels of increased natural gas use for electricity production depending on the region. For example, AEE projects natural gas consumption will increase predominantly in the South and Midwest through 2020,[229] chiefly because these are the regions where they expect the majority of coal-retirements to occur.[230] However, AEE's model suggests that lower overall electricity consumption in the Mid-Atlantic, Northeast, and the West will offset the increases in the South and Midwest by 2030.[231] NERA projects natural gas consumption will increase the Southeast, North Central, and South Central regions from 2017 to 2031, comporting with their projections of greater coal retirement in those regions.[232] NERA also projects decreased natural gas consumption in the Northeast, East Central, and West.[233] Consequently, by 2030, reduced electricity consumption in these geographic regions would result in a net decrease in natural gas consumption by the power sector as a whole.[234]

2. *Natural Gas Demand and Price Trends*

The Clean Power Plan will not just affect how natural gas is used for electricity generation. It will also influence the natural gas market itself, including demand, production, and price. Three of the models make numerical demand projections, and all but one include Henry Hub gas price projections.[235]

Consistent with the models' prediction that electricity production from natural gas will initially increase through 2025 but then decrease through 2030,[236] they suggest that natural gas demand and production will follow a similar trend. AEE, for instance, predicts that natural gas demand will initially grow as a result of expected coal-to-gas switching, but then decline over time as renewables and demand-side resources flourish.[237] Specifically, AEE's model, which assumes a mix of resources used to achieve

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191, at 24–25.

229. Impacts of the Clean Power Plan, *supra* note 150, at 10.

230. *Id.*

231. *Id.*

232. Potential Energy Impacts, *supra* note 194, at B-7.

233. *Id.*

234. *Id.* EIA's model attributes natural gas trends to the degree of renewable penetration in various regions. Analysis of the Clean Power Plan, *supra* note 188, at 54. In Florida, the Great Lakes, and the Virginia-Carolina regions, EIA expects renewables to make greater inroads, and consequently projects slow or declining growth in natural gas generation. *Id.* On par with AEE's and NERA's projections, EIA expects greater natural gas generation in the South, specifically Texas and the Mississippi, due to lagging renewable development in this region. *Id.*

235. AEE did not include natural gas price projections in their model.

236. *See* Hopkins, *supra* note 143, at 8.

237. *See* Impacts of the Clean Power Plan, *supra* note 150, at ii.

CPP compliance, sees natural demand growing to 3.9 Bcfd above the business-as-usual case through 2020, but decreasing to 0.7 Bcfd lower than the business-as-usual scenario by 2030.[238] EVA's model only forecasts through 2020, but likewise predicts demand growth for natural gas in that period,[239] specifically, an increase of 6.4 Bcfd from 2012 levels by 2020.[240] Finally, Rhodium-CSIS's model averages growth rather than creating individual time-span breakdowns,[241] but it also predicts an increase in natural gas demand from 2020 to 2030, in a range from 3.1 to 10.9 Bcfd across four scenarios.[242]

The models also predict that the initial increase in natural gas generation and demand will cause natural gas prices to rise. The EPA, EVA, NERA, NRDC, and Rhodium-CSIS rate-based models all project an increase in natural gas prices ranging from $5.36 to $6.62 per MMBtu by 2030,[243] compared to business-as-usual prices ranging from $4.60 to $6.01 per MMBtu.[244] However, EPA projects natural gas prices to fall below their business-as-usual level of $6.01 per MMBtu to $5.92 per MMBtu under their mass-based goal scenario.[245] EIA's projections to 2040 suggest that prices could rise to $8.15 per MMBtu, compared to their business-as-usual forecast of $7.85 MMBtu.[246] The models that conducted sensitivity analyses with limited or no energy efficiency measures projected even greater increases in natural gas prices, ranging

238. *Id.* at 7-9.

239. Energy Market Impacts*, supra* note 191, at 33.

240. *Id.* at 34. EVA did not provide a business-as-usual model for natural gas demand, but instead compared their projections to 2012 levels. *Id.*

241. REMAKING AMERICAN POWER, *supra* note 197, at 34.

242. *Id.* at 32. Rhodium-CSIS's inclusion of their sensitivity scenarios contributes in part to their large range of demand increase. *See id.* Rhodium-CSIS explains that demand is approximately three times higher without energy efficiency. *See id.*

243. *See* Regulatory Impacts Analysis*, supra* note 189, at 3-35 (EPA predicts gas prices to rise to $6.21 per MMBtu, a 3.3 percent increase above their business-as-usual price of $6.01 MMBtu); ENERGY MARKET IMPACTS, *supra* note 191, at 34 (EVA predicts an increase to $6.62 MMBtu. EVA does not use a business-as-usual model for comparison, but instead compares gas prices to the 2012 amount of $2.82 per MMBtu); POTENTIAL ENERGY IMPACTS*, supra* note 194, at S-6 (under NERA's unconstrained scenario, gas prices rise to $5.36, a 2 percent increase from their business-as-usual forecast); NRDC Comment, *supra* note 192, at 8-19 (across their scenarios, NRDC predicts prices to rise to an average of $5.90 per MMBtu, compared to their business-as-usual forecast of $5.6 MMBtu); REMAKING AMERICAN POWER, *supra* note 197 (under their unconstrained scenario, Rhodium-CSIS predicts prices to rise to $5.33 per MMBtu, a 1 percent increase above their business-as-usual forecast of $5.27 per MMBtu).

244. *Id.* EVA did not provide a business-as-usual model for natural gas prices, but instead compared their projections to the 2012 prices of $2.82 per MMBtu. *See* ENERGY MARKET IMPACTS, *supra* note 191, at 34.

245. Regulatory Impacts Analysis, *supra* note 189, at 3-35.

246. Analysis of the Clean Power Plan, *supra* note 188, at 92.

from $5.73 to $6.78 per MMBtu, compared to business-as-usual prices ranging from $4.60 to $6.01 per MMBtu.[247]

Thus, the models suggest that the extent to which states rely on energy efficiency for CPP compliance will be critical. That choice will impact not just the mix of generation resources used to reduce greenhouse gas emissions but also national gas prices and demand.

Table B: Henry Hub Price Projections (per MMBtu)

Model	Business-as-Usual	Clean Power Plan Projection	Percent Change	Sensitivity Analysis	Percent Change
EPA Rate-Based	$6.01	$6.21	+3.3%	-	-
EPA Mass-Based	$6.01	$5.92	-1.5%	-	-
EIA	$7.85	$8.15	+3.8%	-	-
EVA	$2.82 (2012 Henry Hub)	$6.62	-	-	-
NERA	$5.25	$5.36	+2.0%	$6.78	+29.0%
NRDC	$5.60	$5.90	+5.3%	$6.10	+9.0%
Rhodium-CSIS	$5.27	$5.33	+1.0%	$5.73	+9.0%

3. *Natural Gas Infrastructure*

Although the models suggest that the role of natural gas will grow over the next decade, they do not predict that the Clean Power Plan will require large increases in natural gas infrastructure. In recent years, the natural gas industry has rapidly added incremental infrastructure to accommodate growing production volumes.[248] The models generally show that the current trajectory of natural gas infrastructure growth should be adequate to compensate for additional fuel demand under the CPP.[249]

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247. *See* Potential Energy Impacts, *supra* note 194, at S-6 (under NERA's constrained scenario with no energy efficiency available, prices rise to $6.78 per MMBtu, 29 percent above their business-as-usual forecast); NRDC Comment, *supra* note 192, at 8B-6 (NRDC's constrained scenario projects with only half of energy efficiency measures available projects gas prices to rise to $6.10 per MMBtu, 9 percent above their business-as-usual forecast); REMAKING AMERICAN POWER, *supra* note 197 (under Rhodium-CSIS's constrained scenario with no energy efficiency available, prices rise to $5.73 per MMBtu, 9 percent above their business as usual forecast). Note that no figure is shown in the Percent Change column of Table B for the EVA model because that model reported 2012 Henry Hub prices rather than a business-as-usual projection.

248. Impacts of the Clean Power Plan, *supra* note 150, at 4.

249. *Id.* at 5. Only the EPA and AEE models contain projections concerning natural gas infrastructure. Rhodium-CSIS addresses

Because the models project an overall decline in generation and consumption, they do not foresee large infrastructure increases as necessary.[250] For instance, under AEE's business-as-usual scenario, investments of approximately $47 billion in infrastructure would be necessary to support the continued growth of natural gas supply and demand by 2030.[251] By contrast, AEE projects only an additional 4 percent in expenditures for pipeline expansion beyond business-as-usual expenditures between 2016 and 2020, and no incremental requirement beyond the business-as-usual forecast after 2020.[252] In a scenario with unusually low gas prices, which would likely drive increased gas use, the AEE model predicts a 6 percent increase in infrastructure expenditures by 2020 and another 8 percent increase by 2030.[253] The EPA forecasts an even lower need for infrastructure increases—less than two percent by 2020.[254]

Overall, then, the models do not project that the Clean Power Plan will transform the natural gas market. Because the EPA included coal-to-gas switching as a compliance mechanism within the Plan, natural gas is expected to make inroads into coal's overall generation share. Critically, however, whether and how states choose to adopt energy efficiency strategies to meet the CPP's mandate will heavily influence the degree to which the Plan drives further gas use. If efficiency is utilized, the models suggest that natural gas use will grow initially but level off or decline by 2030. But if states do not rely on efficiency, natural gas's role may be more prominent.

IV. COMPETING VISIONS: THE ROLE OF NATURAL GAS IN ELECTRICITY'S FUTURE

As the spotlight has shone brighter and brighter on natural gas in recent years, competing visions of the fuel have emerged. Just as natural gas was once seen as a nuisance byproduct that was more problematic that beneficial, only to quickly become not merely a

infrastructure impacts in their model, but does not provide detailed numerical forecasts. Specifically, this model provides data on current infrastructure needs under a business-as-usual forecast, and observes that the "CPP will require a greater need for many types of infrastructure, not just natural gas infrastructure." REMAKING AMERICAN POWER, *supra* note 197, at 44.

250. Impacts of the Clean Power Plan, *supra* note 150, at 9; *see also* Regulatory Impacts Analysis, *supra* note 189, at 3-35.

251. Impacts of the Clean Power Plan, *supra* note 150, at 8.

252. *Id.* at 10. AEE points out that these projected increases fall within the range of historical expansion of natural gas infrastructure, and the required additions under the Clean Power Plan are less than additions that occurred in the past ten years. *Id.* at 12.

253. *Id.* at 10–11.

254. Regulatory Impacts Analysis, *supra* note 189, at 3-35.

relevant energy source but a key one, a war of public opinion is waging today over how to see natural gas anew.

The visions are diametrically opposed. On one hand, many observers suggest that natural gas may be a "bridge" to a clean energy future—that is, a stopgap measure that would immediately reduce greenhouse gas emissions and help ease the nation into greater reliance on near- or effectively zero-carbon resources such as renewables and nuclear.[255] On the other hand, some urge that natural gas is hardly a bridge, but rather, a "gangplank" or a "dead end"—that is, a short-sighted empty promise that will not solve our climate change woes but only further entrench the nation in a destructive, fossil fuel-dependent path.[256]

Not only are these visions in tension, they are both primarily about electricity. The very premise of a natural gas bridge hinges on the notion that gas will replace coal in the generation fleet,[257] although gas of course could be used to displace oil in the vehicle fleet as well.[258] The likely impact of the Clean Power Plan is thus potentially relevant to whether gas will be a bridge or a dead end. That rule, as detailed above, may heavily influence how much and in what ways the nation uses gas. And, those choices may well drive whether greater reliance on gas for electricity production offers a transition to a new and different energy future, or whether it locks us into one already quite familiar.

To begin untangling these thorny questions, this Part first describes each of the competing visions of natural gas's future. It then briefly explores possibilities of how the Clean Power Plan may push in either direction.

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255. *See, e.g.*, John Podesta & Timothy E. Wirth, *Natural Gas: A Bridge Fuel for the 21st Century*, Center for American Progress (Aug. 10, 2009), www.americanprogress.org/issues/green/report/2009/08/10/6513/natural-gas-a-bridge-fuel-for-the-21st-century/.

256. Yuill Herbert, *Natural Gas: A Bridge or a Gangplank*, *A Submission to the Independent Hydraulic Fracturing Review on the Issue of Climate Change* (Apr. 27, 2014), www.ssg.coop/wp-content/uploads/2015/03/140207_-Hydraulic-Fracking-submission-Final.pdf; *see also* Brad Plumer, *Obama Says Fracking Can Be a 'Bridge' to a Clean-Energy Future. It's Not That Simple*, WASH. POST (Jan. 29, 2014), www.washingtonpost.com/news/wonk/wp/2014/01/29/obama-says-fracking-offers-a-bridge-to-a-clean-energy-future-its-not-that-simple/; Anthony R. Ingraffea, *Gangplank to a Warm Future*, N.Y. TIMES (July 28, 2013), www.nytimes.com/2013/07/29/opinion/gangplank-to-a-warm-future.html?_r=0.

257. Richard J. Pierce, Jr., *Natural Gas: A Long Bridge to a Promising Destination*, 32 UTAH ENVTL. L. REV. 245, 245 (2012) [hereinafter *Natural Gas: A Long Bridge to a Promising Destination*].

258. *See, e.g.*, M. Rood Werpy et al., Natural Gas Vehicles: Status, Barriers, and Opportunities 1–2 (2010) (assessing the viability of natural gas vehicles); *see also* Michiel Nijboer, The Contribution of Natural Gas Vehicles to Sustainable Transport 11 (2010).

A. A Bridge?

On its surface, the metaphor that natural gas can serve as a "bridge" is straightforward. The suggestion is that by switching from coal, which is CO_2 intensive, to gas, which is both cleaner burning and less CO_2-intensive, producing more electricity from gas is a first step toward reducing climate emissions. As one set of observers has summarized, because natural gas's CO_2 emissions are "about 45 percent lower per Btu than coal and 30 percent lower than oil, its apparent abundance raises the possibility that [it] could serve as a bridge fuel . . . . Such a transition would seem particularly attractive in the electric power sector if natural gas were to displace coal."[259]

Yet looking beneath the surface reveals a more complex path for gas than the simple suggestion that it can be a "bridge." One question is how long the bridge will be. If it is short, the natural gas bridge could in fact facilitate a shift to the clean energy economy for which many commentators clamor.[260] Many observers, however, have opined that the bridge will not be short at all. As Professor Pierce has suggested, "[T]he natural gas bridge to carbon-free fuels is likely to be extremely long, at least decades and probably a century."[261]

There are good reasons for such prognostications. Gas appears quite abundant, particularly in light of the shale boom.[262] It has become increasingly inexpensive, driven by greater supplies.[263] It is extraordinarily nimble as a fuel, as its own history makes clear. And in the electricity sector, it remains less expensive—and arguably more valuable in terms of its quick dispatchability and load-following abilities—than many renewables and other alternatives, such as nuclear power.[264]

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259. Stephen P.A. Brown, *Natural Gas: A Bridge to a Low-Carbon Future?*, RFF Issue Brief 09-11, 1 (Dec. 2009).

260. *See Natural Gas: A Long Bridge to a Promising Destination*, *supra* note 257, at 245. *See generally, e.g.*, JOSEPH P. TOMAIN, ENDING DIRTY ENERGY POLICY (2011).

261. *Natural Gas: A Long Bridge to a Promising Destination*, *supra* note 257, at 245.

262. *See* U.S. Energy Info. Admin., Short-Term Energy Outlook 1 (2016) (stating that proved natural gas reserves are at a "record" high); Zhongmin Wang & Alan Krupnick, US Shale Gas Development: What Led to the Boom? 1 (2013) (noting that shale gas has grown approximately 23 percent from 2000–2010); U.S. Energy Info. Admin., U.S. Crude Oil and Natural Gas Proved Reserves (2015).

263. *See supra* Part II.E; *see also, e.g.*, Impacts of the Clean Power Plan, *supra* note 150, at 6.

264. *See* Lincoln L. Davies, *Power Forward: The Argument for a National RPS*, 42 CONN. L. REV. 1339, 1373–74 (2010); U.S. Energy Info. Admin., Levelized Cost and Levelized Avoided Cost of New Generation Resources in the Annual Energy Outlook 2015 7 (2015).

In that light, another question is, "Where does the natural gas bridge lead?"[265] Conventionally, the assumption is that the bridge will take society to a low- or zero-carbon destination. Of course, that is not necessarily the case, and the degree to which gas will help reduce greenhouse gas emissions depends on what other resources are used along with it—or are used to replace it. If, for instance, the natural gas bridge is a road to simply more gas, that destination may promise a better energy future than business as usual, but it is also unlikely to offer a kind of clean energy panacea.[266]

Thus, one analyst has assessed different bridge scenarios for natural gas.[267] In one version, a truly short bridge, natural gas use would peak between 2020 and 2030. If this were the case, CO_2 concentrations could also peak at 450 parts per million, perhaps allowing the world to keep global temperature growth below 2 degrees Celsius.[268] If the bridge lasted longer—if, for example, natural gas use peaked between 2020 and 2060—CO_2 concentrations might top out at 550 parts per million, and the chance would be significant that the 2 degree Celsius threshold would be breached.[269] Importantly, however, either bridge scenario would offer a substantial improvement on a situation where gas simply replaced coal and failed to incent a broader energy transition. In that case, the International Energy Agency has estimated that CO_2 concentrations would rise to 650 parts per million and global temperatures would increase by more than 3.5 degrees Celsius.[270]

Still, utilizing natural gas as a bridge may offer benefits of its own. Even if it cannot be used to encourage greater reliance on renewables and other effectively zero-carbon resources, a gas bridge may help the world transition away from coal. As Michael Levi has observed, "it may be useful to think of a natural gas bridge as a potential hedging tool against the possibility that it will be more difficult to move away from coal than policymakers desire or can achieve, rather than merely (or primarily) as a way to achieve particular desired temperature outcomes."[271]

265. *Natural Gas: A Long Bridge to a Promising Destination*, *supra* note 257, at 248.

266. *See id*. at 248–50.

267. Michael Levi, *Climate Consequences of Natural Gas as a Bridge Fuel,* 118 CLIMATIC CHANGE 609 (2013).

268. *Id*. at 616-18.

269. *Id*.

270. International Energy Agency, Golden Rules for a Golden Age of Gas 91 (2012), www.worldenergyoutlook.org/media/weowebsite/2012/goldenrules/WEO2012_GoldenRulesReport.pdf.

271. Levi, *supra* note 267, at 622.

B. A Dead End?

The contrary version of natural gas's future is much drearier than the bridge view. In this metaphor, if increasing the nation's (or the world's) reliance on natural gas fails to adequately reduce CO_2 emissions, the natural gas bridge might become "a bridge to nowhere."[272] Or, in starker terms: A natural gas bridge that fails to deliver society to a clean energy economy is simply a "dead end."[273]

Suggestions that expanding natural gas use might not solve climate change are not based in fantasy. Some research has suggested that prior estimates of leaks in the natural gas system—both from wellhead to burner tip and in the initial extraction and closing phases of gas mining—drastically undervalue how much methane is being released into the atmosphere from gas use.[274]

Once that point is established, the argument against natural gas as a bridge fuel is an easy syllogism. Methane—the primary component of natural gas—is a far more powerful greenhouse gas than carbon dioxide.[275] Too much methane in the atmosphere thus can heat the planet far more quickly than can CO_2. And, while methane also dissipates much more quickly than CO_2 (on the order of decades rather than centuries),[276] the planet is in imminent enough danger that any delay in reducing climate change emissions cannot be tolerated.[277] As Richard Howarth contends, "At best, using natural gas rather than coal to generate electricity might result in a very modest reduction in total greenhouse gas emissions, if those emissions can be kept below a range of 2.4–

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272. Robert W. Howarth, *A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas*, 2(2) ENERGY SCI. & ENGINEERING 47 (2014).

273. *White House Stands by FERC Pick; Senate Aide Says Others Weighed*, REUTERS, Sept. 26, 2013, www.reuters.com/article/us-usa-ferc-binz-idUSBRE98P10I20130926.

274. *See* Howarth, *supra* note 272; *see also, e.g.*, A.J. Burnham et al., *Life-cycle Greenhouse Gas Emissions of Shale gas, Natural Gas, Coal, and Petroleum*, 46 ENVTL. SCI. & TECH. 619 (2012); Robert W. Howarth et al., *Methane and the Greenhouse Gas Footprint of Natural Gas from Shale Formations*, 106 Climatic Change 679 (2011); N. Hultman et al., *The Greenhouse Impact of Unconventional Gas for Electricity Generation*, 6 ENVTL. RES. LETTERS (2011); U.S. Envtl. Protection Agency, *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2014*, at 3-63 to -67, 3-73 to -81 (April 2016), http://epa.gov/climatechange/emissions/usinventoryreport.html; A. Venkatesh et al., *Uncertainty in Life Cycle Greenhouse Gas Emissions from United States Natural Gas End-uses and Its Effect on Policy*, 45 ENVTL. SCI. & TECH. 8182 (2011).

275. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS 714 (2013).

276. Howarth, *supra* note 272, at 52.

277. *See generally id*.

3.2% . . . . That is a big 'if,' and one that will require unprecedented investment in natural gas infrastructure and regulatory oversight."[278]

Another reason to think that natural gas might be a dead end rather than a bridge is path-dependence. Energy infrastructure is expensive, and notoriously difficult to plan, site, and construct.[279] Thus, if expanding gas use also requires significantly building out the fuel's infrastructure, it could be difficult for society to move away from continued use of those facilities in the future. After all, a core premise of U.S. energy law and policy is keeping prices as low as possible,[280] and energy history is littered with lengthy and costly battles over "stranded costs" as energy systems move from one regulatory regime to another.[281] It is not unreasonable to worry that past may again be prologue.

For these reasons, some observers have suggested that if the nation seeks to use natural gas as a bridge fuel, perhaps the bridge needs "guardrails."[282] Such guardrails might include limiting electricity demand growth; managing and reducing methane leakage; using the gas bridge primarily to eliminate coal use in the electricity sector rather than replacing other fuels with gas; and ensuring that greater gas use does not lock out effectively zero-carbon energy sources such as renewables.[283]

The possible need for guardrails on the bridge, moreover, underscores a broader point. The "bridge" and "dead end" metaphors are catchy and easy to grasp, which may help explain why they have received so much play. Yet truth rarely lies at polar opposites; rather, it is often found somewhere in between. That may be the case for natural gas as well, as the ultimate effect of switching heavily to it to reduce climate emissions may be more complex than either vision of gas's future lets on. As Chris Busch

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278. *Id*. at 57. *But see* L.M. Cathles, *Assessing the Greenhouse Impact of Natural Gas*, 13 GEOCHEMISTRY, GEOPHYSICS, GEOSYSTEMS (2012) (suggesting that, while not as effective as switching to renewables, increased gas use should reduce CO_2 emissions by 40 percent of what otherwise could be achieved).

279. *See* Alexandra B. Klass & Danielle Meinhardt, *Transporting Oil and Gas: U.S. Infrastructure Challenges*, 100 IOWA L. REV. 947, 1004 (2015).

280. Joseph P. Tomain, *The Dominant Model of United States Energy Policy*, 61 U. COLO. L. REV. 355, 375 (1990).

281. Steven Ferrey, *Exit Strategy: State Legal Discretion to Environmentally Sculpt the Deregulating Electric Environment*, 26 HARV. ENVTL. L. REV. 109, 143–44 (2002); Paul A. Kemnizter, *The Anti-Competitive Effects of Stranded Costs on the Creation of Municipal Electric Companies*, 45 N.Y.L. SCH. L. REV. 701, 703–09 (2002); *see also* Suedeen G. Kelly, *The New Electric Powerhouses: Will They Transform Your Life?*, 29 ENVTL. L. 285, 296–98 (1999) (discussing the difficulties stranded costs pose when restructuring the electric industry).

282. Michael Lazarus et al., *Natural Gas: Guardrails for a Potential Climate Bridge*, New Climate Economy Contributing Paper (May 2015).

283. *Id*. at 12.

and Eric Gimon have noted, "[W]hen there are opportunities to substitute for coal power on the margin, looking at GHG emissions alone, it likely makes sense under a wide range of circumstances . . . . Significant leakage in the methane system may not completely eliminate the GHG benefit of new gas over coal, but it will erode the relative climate benefit of natural gas as a GHG mitigation option."[284]

Such measured statements carry less panache than analogies to bridges, gangplanks, and dead ends. Ultimately, however, they may be more reflective of likely reality than any scenario suggesting a certain outcome one way or the other.

C. The Path of the Clean Power Plan

In the context of the bridge/dead-end dichotomy, the position of the Clean Power Plan is perhaps less clear than one might initially assume. The Plan expressly includes coal-to-gas switching as a mitigation technique, which might suggest that the EPA sees the Plan as a way to facilitate using natural gas as a bridge fuel. At the same time, the Plan also specifically contemplates other compliance mechanisms, including more efficient use of coal-fired powerplants and displacement of CO_2-emitting facilities with low- and effectively zero-carbon renewables.[285] And, EPA has made it clear that states are not bound to only these options but can also use other alternatives to reduce CO_2 emissions, including efficiency measures and greater reliance on nuclear energy.[286] Thus, it is not obvious that the Plan views gas as a bridge fuel per se.

What is obvious is that the Plan leaves much up to the states to determine how they will meet its emissions reduction targets. The extensive modeling of the Plan's possible impacts makes this abundantly clear. In scenarios where energy efficiency plays a key role in compliance, the importance of natural gas is significantly reduced under the Plan.[287] And, of course, the Plan's impacts may differ regionally, with areas that today rely on coal perhaps also being most inclined to switch most heavily to gas.[288] Thus, it is possible that gas may be treated as a bridge in some states but not others.

If gas is a bridge under the Clean Power Plan, it appears designed to be a short one. In general, the models agree that while natural gas use should increase under the Plan, that trend will either level off or dissipate by 2030. For example, AEE projects an initial growth in demand above the business-as-usual case through

284. Chris Busch & Eric Gimon, *Natural Gas Versus Coal: Is Natural Gas Better for the Climate?*, 27 ELECTRICITY J. 97, 110 (2014).

285. *See supra* Part III.A.

286. *See id.*

287. *See supra* Part III.B.

288. *See id.*

2020, but an eventual decrease below business-as-usual forecasts by 2030.[289] In fact, one of the models suggests that natural gas will not play a heavy role in Plan compliance at all, with natural gas's generation share growing just one percent above business-as-usual projections by 2030.[290] In any case, no matter which of these scenarios might play out, the models agree that any gas bridge will be a relatively short one—certainly much shorter than the decades- or century-long bridge some observers have suggested could be the case.[291]

Further underscoring the idea that a gas bridge under the Clean Power Plan will be short are the models' predictions that substantial gas infrastructure investment will not be necessary to accommodate the Plan. While the models do suggest that the Plan will incent some additional infrastructure investment—on the order of 2 to 8 percent more than business-as-usual[292]—this is hardly the kind of additional investment that will lock the nation into significantly expanded gas use over the next hundred years. In fact, what the models suggest is that other factors are already driving up gas infrastructure investment, namely, the shale gas revolution—a revolution that was already taking place notwithstanding the Clean Power Plan's adoption, and that will almost certainly continue irrespective of whether the Plan is upheld in court. If one thing is true in energy history, it is that price reigns. Thus, the availability (or unavailability) of cheap gas ultimately may have more sway over whether there is a gas bridge (or how long it is) than will the Plan itself.[293]

To at least some degree, the various models of the Clean Power Plan should thus allay concerns that the Plan will create a gas bridge to nowhere, or lead to a dead end. The models do not suggest that the Plan will necessarily build a bridge, that the bridge will exist throughout the United States, or that it will be long. Gas may well play an important role in achieving Plan compliance, but its role may be short-lived, and will certainly be impacted by other factors, including energy efficiency and gas prices, as well.

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289. *See* Impacts of the Clean Power Plan, *supra* note 150, at ii.

290. Potential Energy Impacts, *supra* note 194, at S-6.

291. *See, e.g.*, *Natural Gas: A Long Bridge to a Promising Destination*, *supra* note 257, at 245.

292. *See supra* Part III.B.3.

293. AEE conducted a stress-test scenario with Henry Hub prices at 20 percent lower than their normal compliance scenario. IMPACTS OF THE CLEAN POWER PLAN, *supra* note 150, at 3. Demand rose 6.2 Bcfd higher than the business-as-usual case by 2020, compared to the 3.9 Bcfd rise that occurred their normal compliance scenario. *Id.* at 9. Similarly, EIA's sensitivity analysis assuming low Henry Hub prices projected continued growth in natural gas generation through 2040 to levels of about 47 percent, roughly 16 percent higher than their business-as-usual forecast. ANALYSIS OF THE CLEAN POWER PLAN, *supra* note 188, at 93.

Admittedly, energy modeling is notoriously unreliable, so these forecasts of the Plan's likely impacts must be taken with some caution. Nonetheless, the core point they highlight has strong basis in both logic and history. The role of natural gas in the Clean Power Plan, just as has been true for the role of gas in society historically, is difficult to predict—and almost certainly will be less simple than complex going forward.

V. CONCLUSION

Over time, natural gas has played many roles in society. Sometimes, these roles have conflicted—such as in the 1800s when gas was both an emerging competitor in the illumination business but was also widely treated as a nuisance byproduct. Often, these roles have evolved, many times quite quickly—such as in the early 1900s when gas switched from a lighting source to a home heating fuel, or in the 1970s when Congress declared it off-limits for new electricity generation facilities, only to reverse that decision a decade later.

Today, natural gas is in another period of change. The shale gas revolution has made gas more ubiquitous and more relevant than ever, and in turn gas has cemented an even stronger position as an electricity generation fuel than at any other time in its history. The need to combat climate change makes gas's prospects as a generation fuel brighter still, at least in the short term when gas could serve as a bridge fuel to a clean energy future. While the bridge analogy is attractive, it also raises many questions, and has caused significant consternation for some who believe that relying more on natural gas will further entrench the nation in an unsustainable fossil fuel economy.

A common view is that, under the Clean Power Plan rule, assuming the rule survives legal challenge, gas will take on an even greater role in electricity production, thus realizing its "bridge" potential. What the models show, however, is that gas's role in the Clean Power Plan is likely to be more nuanced. That role will depend heavily on what other approaches states decide to adopt, with energy efficiency measures at the top of that list. Its role also will be impacted by regionalism and gas prices, both of which relate to the Clean Power Plan but are not necessarily dictated by it. There is thus good reason to expect that under the Clean Power Plan, the role of natural gas may grow, although the models show that growth may be rather short-lived, leveling off or receding near 2030.

Perhaps, then, the only thing that is certain for the future of natural gas under the Clean Power Plan is the same thing that has been true throughout the fuel's history. Its role, over time, will continue to shift, change, and evolve.