REGULATORY PATHWAYS FOR MINIMIZING THE CLIMATE IMPACTS OF NATURAL GAS PRODUCTION

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ABSTRACT

The best available science calls for immediate reductions in global methane emissions to avoid the worst effects of climate change. Recent studies indicate that the North American fracking boom is a major cause of atmospheric methane, a potent greenhouse gas which began rising rapidly in the late 2000s. Natural gas has been widely promoted as a "bridge fuel," but it only has climate benefits over coal if fugitive methane emissions throughout the production cycle are minimal. The United States Environmental Protection Agency (EPA) has addressed these emissions through New Source Performance Standards (NSPS) set under the Clean Air Act. However, the existing standards have not reduced methane emissions to the point that natural gas presents any climate benefits, and the Trump Administration has proposed to weaken them further. In the face of uncertainty about the continued use of NSPS to reduce methane and other greenhouse gases, this Article outlines two alternative legal pathways for continuing to regulate and minimize fugitive emissions from the oil and gas sector. The Article advocates first for expanding NSPS regulation beyond new and modified sources to also apply to existing sources. Second, if the current NSPS is successfully rolled back, it advocates alternatively for petitioning the EPA to regulate methane through the National Ambient Air Quality Standards (NAAQS) program.

TABLE OF CONTENTS

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INTRODUCTION

Atmospheric concentrations of methane, a highly potent greenhouse gas, have been rapidly increasing since the late 2000s, alarming scientists and policymakers.[1] Climate experts are working to understand the emissions sources causing these rising methane levels and the associated effects on global climate change.[2] These increases are particularly concerning because the rate of methane emissions prior to 2010 was thought to have flatlined.[3] As a result, many climate policies and models, including the Paris Agreement, assumed methane levels would remain relatively stable.[4]

An emerging body of scientific literature indicates that a large portion of the increasing methane concentrations is attributable to the recent natural gas boom in North America.[5] There is active debate over the exact percentage of global methane levels attributable to natural gas production in comparison to other sources, like melting permafrost, landfills, and cattle.[6] However, fugitive emissions, which escape through leaks in the natural gas production cycle, are one of the largest contributors and the only anthropogenic source easily controlled with existing technolo-

1. *See* Ed Dlugokencky, *Trends in Atmospheric Methane*, NOAA, https://www.esrl.noaa.gov/gmd/ccgg/trends_ch4/ (last visited Oct. 20, 2020).

2. Rebecca Lindsey & Michon Scott, *After 2000-Era Plateau, Global Methane Levels Hitting New Highs*, NOAA (July 11, 2017), https://www.climate.gov/news-features/understanding-climate/after-2000-era-plateau-global-methane-levels-hitting-new-highs.

3. *Id.*

4. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007 - THE PHYSICAL SCIENCE BASIS 129, 142 (Susan Soloman et al. eds., 2007).

5. *E.g.*, Ramón A. Alvarez et al., *Assessment of Methane Emissions from the U.S. Oil and Gas Supply Chain*, 361 SCIENCE 186, 186 (2018); Benjamin Hmiel et al., *Preindustrial $^{14}CH_4$ Indicates Greater Anthropogenic Fossil CH_4 Emissions*, 578 NATURE 409, 409 (2020); Robert W. Howarth, *Methane Emissions and Climatic Warming Risk from Hydraulic Fracturing and Shale Gas Development: Implications for Policy*, 3 ENERGY & EMISSION CONTROL TECH. 45, 45 (2015); Stefan Schwietzke et al., *Upward Revision of Global Fossil Fuel Methane Emissions Based on Isotope Database*, 538 NATURE 88, 88 (2016).

6. *See* Geoff Watts, *The Cows that Could Help Fight Climate Change*, BBC FUTURE (Aug. 6, 2019), https://www.bbc.com/future/article/20190806-how-vaccines-could-fix-our-problem-with-cow-emissions; *Basic Information About Landfill Gas*, EPA, https://www.epa.gov/lmop/basic-information-about-landfill-gas#methane (last visited Oct. 23, 2020).

gies.[7] To reduce global methane emissions, the natural gas production cycle is a logical starting point.

Natural gas is often promoted as a climate-friendly "bridge fuel" that can aid in the transition from conventional fossil fuels to renewable energy sources because of its lower greenhouse gas emissions during combustion.[8] However, fugitive methane leaks throughout the production cycle offset this end-use gain in most instances.[9] For natural gas to be worth pursuing as a fuel source that is more climate-friendly than coal, fugitive methane emissions must stay below 3.2%.[10] This "break-even" point may be achievable, but it will require greater investment in technologies and practices that minimize leaks.[11] And even if natural gas reaches the break-even point, it would only be slightly cleaner than coal, the world's dirtiest fossil fuel.[12] With renewables now at price parity or cheaper than conventional energy sources, reaching the break-even point is critical for those trying to justify continued development of oil and gas reserves.[13]

At the federal level, fugitive methane emissions are regulated through the Clean Air Act's NSPS for the oil and gas sector.[14] Following *Massachusetts v. EPA*,[15] and the subsequent Endangerment Finding,[16] the EPA has authority to directly regulate methane. The Obama Administration pursued this authority as part of its Climate Action Plan, promulgating NSPS OOOOa, also known as the "Methane Rule," which prescribed certain emission-minimizing technologies for the industry.[17]

In September 2019, the Trump Administration published a proposal to weaken and remove portions of these standards and raised questions

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7. *See* sources cited *supra* note 6. Experts are searching for ways to capture and utilize methane emissions from cattle and landfills, but currently no feasible technologies exist for large-scale deployment.

8. *See* Joel Minor, *Completing the Bridge to Nowhere: Prioritizing Oil and Gas Emissions Regulations in Western States*, 34 STAN. ENVTL. L.J. 57, 59–60 (2015).

9. *See infra* Section I.B. A recent study in the Permian Basin found fugitive methane emissions of 3.7%, concluding that oil and gas production in the region was worse for the climate than using coal. Benjamin Storrow, *Is Gas Really Better than Coal for the Climate?*, E&E NEWS (May 4, 2020), https://www.eenews.net/climatewire/stories/1063041299/search?keyword=methane.

10. Robert W. Howarth, *A Bridge to Nowhere: Methane Emissions and the Greenhouse Gas Footprint of Natural Gas*, 2 ENERGY SCI. & ENG'G 47, 56 (2014).

11. *See infra* Section I.B.

12. *See infra* Section I.B.

13. *See* David Ferris, *Energy Transitions: Wind, Solar Cheapest Power for 67% of World – Report*, E&E NEWS (Apr. 28, 2020), https://www.eenews.net/energywire/stories/1062988961/search?keyword=renewables+gas+cheap.

14. *See* 40 C.F.R. § 60.5360a (2020).

15. 549 U.S. 497, 506 (2007).

16. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,516 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch. I).

17. *See* Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources, 81 Fed. Reg. 35,824, 35,825 (June 3, 2016) (to be codified at 40 C.F.R. pt. 60).

about the EPA's authority to regulate methane emissions at all.[18] Given the importance of reducing these emissions, this Article outlines two legal pathways for future regulation of fugitive methane from the oil and gas sector. First, if a new administration takes office in 2021, it advocates reinstating and building upon the Methane Rule's regulation of new and modified sources to also regulate existing sources in the oil and gas sector. Second, if the proposed rollback successfully undermines the Methane Rule and President Trump continues to a second term, it advocates petitioning the EPA to regulate methane through the NAAQS program.[19]

Part I of this Article explains the importance of minimizing methane emissions in the quest to mitigate global climate change and how the recently increasing levels of methane attributable to natural gas development threaten important climate goals. Part II gives a high-level overview of the natural gas production cycle, including levels of fugitive emissions from the various segments and possible control technologies. Part III explains efforts to regulate methane emissions from the oil and gas sector under the Clean Air Act, related litigation, and the recent developments from the Trump Administration. And finally, Part IV outlines the two possible pathways for continued federal regulation of fugitive methane emissions from the oil and gas sector given the current political and legal uncertainties.

I. METHANE AND CLIMATE CHANGE

The most recent and best available science calls for limiting global warming to 1.5°C to avoid the most catastrophic and irreversible effects of climate change.[20] Scientists use a "carbon budget" to measure the total remaining amount of greenhouse gases (GHGs) that can be emitted while still limiting warming to a given temperature threshold.[21] At the end of 2017, the Intergovernmental Panel on Climate Change (IPCC) estimated that for a 66% chance of limiting global warming to 1.5°C, there was around 420 $GtCO_2$[22] remaining in the global carbon budget.[23] The budget is being depleted at a rate of 42 $GtCO_2$ per year and global emissions are increasing by 3% annually.[24] At current rates, the total carbon budget

18. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Review, 84 Fed. Reg. 50,244, 50,252 (proposed Sept. 24, 2019) [hereinafter Methane Rollback Rule] (to be codified at 40 C.F.R. pt. 60).

19. *See* 42 U.S.C. § 7409 (2018).

20. *See* MYLES ALLEN ET AL., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SUMMARY FOR POLICYMAKERS: GLOBAL WARMING OF 1.5°C at 5 (Valérie Masson-Delmotte et al. eds., 2018) [hereinafter SUMMARY FOR POLICYMAKERS].

21. *Id.* at 24.

22. $GtCO_2$ refers to "gigatons of carbon dioxide." MMT refers to "million metric tons."

23. SUMMARY FOR POLICYMAKERS, *supra* note 20, at 12.

24. *Id.* at 12, 16. The COVID-19 pandemic is having profound impacts on global carbon emissions. However, the long-term impacts remain to be seen. *See* Martha Henriques, *Will Covid-19 Have a Lasting Impact on the Environment?*, BBC: FUTURE (Mar. 27, 2020), https://www.bbc.com/future/article/20200326-covid-19-the-impact-of-coronavirus-on-the-

will be depleted in less than ten years, and limiting warming to 1.5°C will become impossible absent the advent of new and extremely costly carbon capture technologies.[25] Current trends, unabated, will lead to warming of 4°C or greater by 2100 and far-reaching, devastating consequences for all populations and ecosystems.[26]

To limit warming to 1.5°C, global methane emissions need to be cut in half by 2030.[27] Methane is the second most emitted greenhouse gas after carbon dioxide, but it is at least twenty-eight times more powerful.[28] Once emitted, methane only exists in the atmosphere for about twelve years, while carbon dioxide and its associated effects last for centuries or longer.[29] Scientists equate the climate effects of a given amount of carbon dioxide versus methane through two metrics: Global Warming Potential (GWP) and Carbon Dioxide Equivalent (CO_2e).[30] Differences in the time variations of climate impacts between the two gases are "critical, and not widely appreciated by the policy community and even some climate scientists . . . . [T]he climate system is far more immediately responsive to changes in methane."[31] "Reducing methane . . . emissions, even if carbon dioxide [emissions are] not controlled, would significantly slow the rate of global warming and postpone reaching the 1.5°C and 2.0°C marks by 15–20 years."[32] Methane has immediate effects on global warming and reductions can bring near-term benefits that would lessen climate disruptions and extreme weather events.[33] Reductions in methane can limit the extent of future warming, temper the current effects, and extend timelines for reducing carbon dioxide emissions.[34]

Minimizing methane emissions is also critically important to avoid triggering "feedbacks" or "tipping points" in the climate system.[35] "Potential additional carbon release from future permafrost thawing and me-

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environment*;* discussion *infra* Part II (addressing the COVID-19 pandemic's impacts on domestic oil and gas production).

25. *See* SUMMARY FOR POLICYMAKERS, *supra* note 20, at 12.

26. James Hansen et al., *Young People's Burden: Requirement of Negative CO_2 Emissions*, 8 EARTH SYS. DYNAMICS 577, 588–89 (2017). Even if warming is limited to 2°C, the IPCC predicts widespread food and water shortages, more frequent droughts, irreversible ice loss in Greenland and the Arctic, and the loss of greater than 99% of coral reefs. SUMMARY FOR POLICYMAKERS, *supra* note 20, at 9–11.

27. SUMMARY FOR POLICYMAKERS, *supra* note 20, at 12.

28. *See Understanding Global Warming Potentials*, EPA, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (last updated Sept. 9, 2020).

29. Howarth, *supra* note 10, at 52.

30. Using a 100-year GWP rating, one ton of methane emissions is equivalent to twenty-one tons of CO_2. On a twenty-year GWP scale, the potency of methane jumps to fifty-six times that of CO_2. *See Global Warming Potentials (IPCC Second Assessment Report)*, UNFCCC, https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials (last visited Oct. 21, 2020).

31. Howarth, *supra* note 10, at 54.

32. *Id.*

33. *See id.*

34. *See* SUMMARY FOR POLICYMAKERS, *supra* note 20, at 12.

35. *See* Hansen et al., *supra* note 26, at 580.

thane release from wetlands would reduce [carbon] budgets by up to 100 $GtCO_2$ over the course of this century and more thereafter."[36] Melting permafrost in the Arctic, which releases methane and carbon dioxide that have been trapped for millennia, is particularly concerning.[37] Once these ancient gases are released they warm the atmosphere, causing additional melting and triggering additional releases.[38] These feedback loops have the potential to instigate climate changes and cycles that would make any anthropogenic emission reductions futile.[39] But the level of warming that triggers feedback loops is not well known, and it is possible that some have already begun.[40]

Methane is emitted from a number of sources, both natural and anthropogenic. It "is released into the atmosphere by natural sources such as wetlands, oceans, sediments, termites, volcanoes, and wildfires, as well as human activities such as oil and natural gas systems, coal mines, landfills, wastewater treatment facilities, and the raising of livestock."[41] In the United States, livestock is the largest source of methane emissions at 175.4 MMT CO_2e annually.[42] Natural gas systems are a close second, emitting 165.6 MMT CO_2e, and landfills follow third, emitting 107.7 MMT CO_2e annually.[43] From 1999 to 2006, global methane emissions flatlined, resulting in far less attention from climate scientists and policymakers.[44] However, beginning in 2007, atmospheric methane levels began steadily rising again.[45]

A. Methane Emissions Caused by Natural Gas Production

Fugitive methane emissions from natural gas systems are the second largest source of energy-sector greenhouse gas emissions in the United States, even before accounting for the end-use combustion emissions.[46] Because natural gas is almost entirely methane, "even small releases . . . to the atmosphere from the development and use of [natural] gas can greatly influence the greenhouse gas footprint"[47] Recent increases in atmospheric methane concentrations have coincided with the North

36. SUMMARY FOR POLICYMAKERS, *supra* note 20, at 12.

37. See ICE ON FIRE (HBO 2019), for a visual depiction of methane releases from permafrost and frozen lakes.

38. Robert McSweeney, *Permafrost and Wetland Emissions Could Cut 1.5C Carbon Budget 'by Five Years'*, CARBONBRIEF (Sept. 7, 2018, 4:59 PM), https://www.carbonbrief.org/permafrost-wetland-emissions-could-cut-1-5c-carbon-budget-five-years.

39. Hansen et al., *supra* note 26, at 582.

40. *See id.*

41. Jonathan Lovvorn, *Climate Change Beyond Environmentalism Part II: Near-Term Climate Mitigation in a Post-Regulatory Era*, 30 GEO. ENVTL. L. REV. 203, 214 (2018).

42. U.S. ENV'T PROT. AGENCY, EPA 430-R-19-001, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS, at ES-15 (2019).

43. *Id. But see infra* Section I.A (discussing how these numbers are likely underestimated).

44. *See* Lindsey & Scott, *supra* note 2.

45. Dlugokencky, *supra* note 1.

46. U.S. ENV'T PROT. AGENCY, *supra* note 42, at ES-18.

47. Howarth, *supra* note 5, at 46.

American "fracking boom" and the "shale revolution," so climate scientists have begun extensively studying the possible link between the two.[48]

The studies typically measure methane emissions from natural gas production using "bottom-up" or "top-down" methods.[49] Bottom-up studies attempt to quantify methane emissions by sampling a number of natural gas production sites, either through inspections or industry reporting, and then multiplying those emissions by the total number of production sites.[50] Top-down studies, to avoid inaccuracies and underreporting, use aerial surveillance methods to observe actual methane emissions in areas with extensive natural gas development.[51] Top-down studies also suffer from some inaccuracies when attempting to scale localized observations regionally or nationally.[52] Nearly all studies agree that the EPA's estimates, which rely on bottom-up methods and industry self-reporting, are too low.[53] This is likely because massive leaks occur irregularly, and abnormal operating conditions are not accounted for in the EPA's methodology.[54]

More recent studies also analyze the isotopic composition of atmospheric methane to link it to various emissions sources.[55] Methane emissions from shale deposits display different isotopic composition than methane from other sources, so scientists can attribute the percentage of global atmospheric methane to this source.[56] These studies have found that global fossil fuel methane emissions are 20–60% higher than current inventories indicate.[57] One study found that "shale gas has contributed 33% of the global increase in all methane emissions in recent years" and "[s]ince virtually all shale-gas development globally through 2015 occurred in North America . . . at least 33% of the increase in methane fluxes came from North America."[58] While the exact amount natural gas development contributes to rising global methane concentrations is ac-

48. *See* sources cited *supra* note 5.
49. See Minor, *supra* note 8, at 84–92, for a comprehensive summary of these early studies.
50. *See id.* at 86.
51. *See id.* at 85.
52. *See* Howarth, *supra* note 10, at 51–52.
53. *See* Alvarez et al., *supra* note 5, at 186; Robert W. Howarth, *Ideas and Perspectives: Is Shale Gas a Major Driver of Recent Increase in Global Atmospheric Methane?*, 16 BIOGEOSCIENCES 3033, 3039 (2019); Howarth, *supra* note 10, at 52; Schwietzke et al., *supra* note 5, at 91.
54. *See* sources cited *supra* note 5. Sometimes these leaks go undetected for substantial periods of time. *See, e.g.*, Mihir Zaveri, *Corroded Well Lining Caused Aliso Canyon Gas Leak That Displaced Thousands, Report Says*, N.Y. TIMES (May 17, 2019), https://www.nytimes.com/2019/05/17/business/porter-ranch-gas-leak.html (describing a single leak in California that "emitted about 100,000 metric tons of methane" over four months).
55. *See* Hmiel et al., *supra* note 5, at 409.
56. *See* Howarth, *supra* note 53, at 3035.
57. Schwietzke et al., *supra* note 5, at 88.
58. Howarth, *supra* note 53, at 3038.

tively debated, there is general consensus among policymakers that these emissions must be drastically reduced to mitigate climate change.[59]

B. Viability of Natural Gas as a Bridge Fuel

Given that fugitive methane emissions from natural gas are extremely high and risk pushing the climate system to irreversible tipping points, it is vitally important to evaluate whether continued use and development of this resource is sensible. Natural gas has long been promoted as a bridge fuel that could aid in the transition from dirtier fossil fuels to renewables.[60] In fact, the Obama Administration considered natural gas and methane capture a central part of its climate strategy:

> Reducing methane emissions is a powerful way to take action on climate change; and putting methane to use can support local economies with a source of clean energy that generates revenue, spurs investment and jobs, improves safety, and leads to cleaner air. When fully implemented, the policies in the methane strategy will improve public health and safety while recovering otherwise wasted energy to power our communities, farms, factories, and power plants.[61]

Capturing methane that would otherwise be released into the atmosphere and combusting it for energy converts the emissions to carbon dioxide and is beneficial from a climate perspective.[62] But as renewable energy sources rapidly reach price parity with fossil fuel energy, further developing natural gas from shale reserves may no longer bridge any gaps.[63] This is especially true if fugitive emissions continue to offset end-use gains, as depicted in Figure 1.

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59. *See* SUMMARY FOR POLICYMAKERS, *supra* note 20, at 18; *see generally* U.S. GLOB. CHANGE RESEARCH PROGRAM, FOURTH NATIONAL CLIMATE ASSESSMENT, VOLUME II: IMPACTS RISKS AND ADAPTATION IN THE UNITED STATES 25–27 (D.R. Reidmiller et al. eds., 2018).

60. Minor, *supra* note 8, at 59.

61. Dan Utech, *A Strategy to Cut Methane Emissions*, THE WHITE HOUSE (Mar. 28, 2014, 11:52 AM), https://obamawhitehouse.archives.gov/blog/2014/03/28/strategy-cut-methane-emissions.

62. *See* K.K. DUVIVIER, ENERGY LAW BASICS 290 (2017).

63. *See* Herman K. Trabish, *End of the 'Gas Rush?' Renewables, Storage Reaching Cost Parity, Report Finds*, UTILITY DIVE (June 11, 2018), https://www.utilitydive.com/news/end-of-the-gas-rush-renewables-storage-reaching-cost-parity-report-fin/524840/.

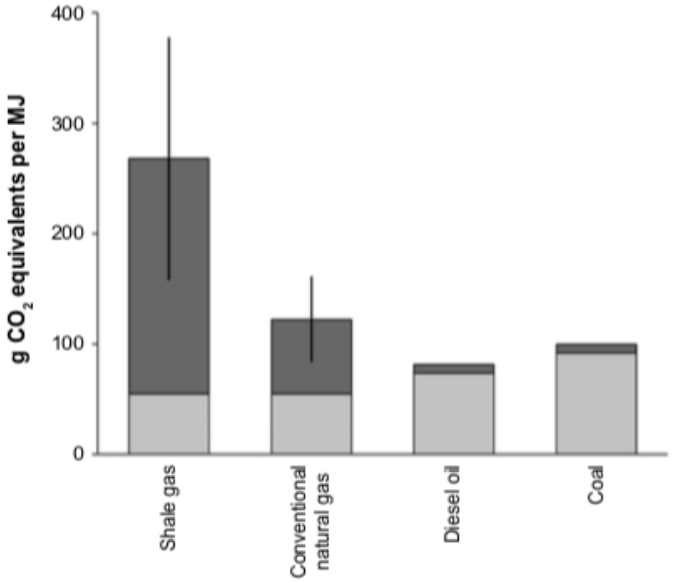

FIGURE 1. *Lifecycle Greenhouse Gas Footprints of Fossil Fuels*[64]

To realize the end-use benefits of natural gas over coal, methane emissions throughout the entire production cycle must be less than 3.2% of the total quantity produced.[65] While some scientists argue this threshold is higher, new studies using the most recent IPCC data have indicated that it may actually be lower, somewhere between 2.4% and 3.2%.[66] This break-even point is "critical to maximizing the climate benefits of natural gas fuel-technology pathways."[67] Nearly all studies have concluded that current fugitive emissions throughout the production cycle are far higher than the break-even point, generally between 4% and 8%.[68] Notably, the studies that focused on unconventional natural gas or shale gas, rather than natural gas generally, found much higher fugitive emissions, between 7.9% and 9%.[69] This is particularly important because most current and projected future natural gas production is from shale reserves.[70]

64. Howarth, *supra* note 5, at 49 fig.2. This Figure represents the greenhouse gas footprints of shale gas, conventional natural gas, oil, and coal expressed as CO_2 equivalents per MJ of heat produced. *Id.* The bottom portion of each column represents direct and indirect emissions of carbon dioxide. *Id.* The top portion of each column represents methane emissions expressed as CO_2 equivalents using a global warming potential of 86. *Id.* Vertical lines for shale gas and conventional natural gas indicate the range of likely methane emissions. *Id.*

65. Ramón A. Alvarez et al., *Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure*, 109 PROC. NAT'L ACAD. SCIENCES 6435, 6437 (2012).

66. Howarth, *supra* note 10, at 56.

67. Alvarez et al., *supra* note 65, at 6438.

68. Howarth, *supra* note 10, at 51 (surveying findings of peer-reviewed studies).

69. *Id.*

70. *Natural Gas Explained: Where Our Natural Gas Comes From*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/natural-gas/where-our-natural-gas-comes-from.php. (last updated Nov. 13, 2019).

Even if fugitive emissions can be reduced to the break-even point, end-use emissions from the combustion of natural gas must also be reduced and eventually ceased to avoid catastrophic climate impacts.[71] All scenarios where global warming is limited to 1.5°C involve reaching net-zero greenhouse gas emissions by 2050.[72] With the total lifecycle emissions of natural gas being higher than coal, it may not be worth investing in the control technologies necessary to reduce fugitive emissions.[73] If the social cost of methane is factored into these investment decisions, it would almost certainly tip the scales toward forgoing further production of natural gas.[74] Additionally, there is extensive literature about the non-climate-related adverse impacts of natural gas development, including "surface and groundwater contamination, degraded air quality, . . . increased frequency of earthquakes, and evidence of harm to the health of humans and domestic animals, including farm livestock."[75] Therefore, reaching the break-even point is critical to justify any continued production and development of natural gas, especially from shale formations.

II. OIL AND NATURAL GAS PRODUCTION CYCLE

Hydraulic fracturing or "fracking" is a process used to extract oil and natural gas from tight shale and other unconventional geologic formations.[76] Prior to the 2000s, it was not economical to develop these reserves, but a combination of new technologies and horizontal drilling strategies led to a massive increase in the amount of recoverable oil and gas.[77] Because of this, the United States has recently become the world's largest producer of oil and gas.[78] Despite massive growth over the past decade, domestic producers have not seen a concurrent rise in profits and

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71. *See generally* SUMMARY FOR POLICYMAKERS, *supra* note 20, *passim*.

72. *See id.* at 12–13.

73. Bobby Magill, *Natural Gas Emissions to Surpass Those of Coal in 2016*, CLIMATE CENTRAL (Aug. 30, 2016), http://www.climatecentral.org/news/natural-gas-emissions-surpass-coal-2016-20650.

74. *See* Niina Heikkinen, *EPA Revises the Social Cost of a Potent Greenhouse Gas*, E&E NEWS (Nov. 20, 2017), https://www.scientificamerican.com/article/epa-revises-the-social-cost-of-a-potent-greenhouse-gas/ (discussing the Trump Administration reducing the social cost of *methane* from $1400 to $55). Even the Obama Administration's $1400 estimate was very low; most economists recommend a price between $2700 to $6000. Howarth, *supra* note 53, at 3033. Typical social cost of *carbon* estimates are around $50. *The True Cost of Carbon Pollution*, ENV'T DEF. FUND, https://www.edf.org/true-cost-carbon-pollution (last visited Oct. 21, 2020).

75. Howarth, *supra* note 5, at 46; *see generally* U.S. ENV'T PROT. AGENCY, EPA 601/R-12/011, STUDY OF THE POTENTIAL IMPACTS OF HYDRAULIC FRACTURING ON DRINKING WATER RESOURCES: PROGRESS REPORT 1, 5, 9, 16–17, 20 (2012); Ruth McDermott-Levy et al., *Fracking, the Environment, and Health*, 113 AM. J. NURSING 45, 46–48 (2013). In certain areas, these problems are exacerbated as fracking operations encroach on residential neighborhoods. *See* Kevin J. Lynch, *Fracking the Public Trust*, 10 SAN DIEGO J. CLIMATE & ENERGY L. 69, 72–73 (2019).

76. *See* DUVIVIER, *supra* note 62, at 276–81.

77. *Id.*

78. Bill Brown & Ari Kahan, *The U.S. Leads Global Petroleum and Natural Gas Production with Record Growth in 2018*, U.S. ENERGY INFO. ADMIN. (Aug. 20, 2019), https://www.eia.gov/todayinenergy/detail.php?id=40973.

many are financially overextended, struggling to compete with offshore producers and the Middle East.[79] With much higher costs than conventional production, the shale sector remains extremely vulnerable to fluctuations in the global market, like the COVID-19 pandemic.[80] Unfortunately, a drop in global prices or a decrease in production does not necessarily lead to lower methane emissions.[81] Venting and flaring during the production cycle may actually increase emissions as producers burn off gas that they cannot sell or store in tanks and pipelines.[82]

The oil and natural gas production cycle encompasses drilling and production, gathering and processing facilities, storage, transmission, and distribution pipelines. For the purpose of considering fugitive emissions and control technologies, the EPA divides the cycle into four segments: (1) production, (2) processing, (3) storage and transmission, and (4) distribution.[83] Production involves extracting "raw natural gas from underground formations" through drilling and fracking.[84] Processing refers to gathering the gas and stripping out impurities, like other hydrocarbons and fluids, to produce pipeline quality gas.[85] The storage and transmission segment consists of "[d]elivery of natural gas from the wellhead and processing plant to city gate stations or industrial end users."[86] Storage typically falls within this segment, though it can occur throughout the production cycle.[87] Last, distribution is the "[d]elivery of natural gas from . . . major pipelines to . . . [residential] end-users[,]" commercial users, and industry or power plants.[88]

Production, where most fugitive emissions occur, begins by locating a shale reserve, typically about a mile or more beneath the earth's surface.[89] The drilling rig uses a bore to drill down through the water table, creating the well, which is then cased with steal and cement.[90] At the "kickoff point," the bore begins moving horizontally for up to two miles,

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79. Jennifer Hiller & Liz Hampton, *U.S. Shale Producers to Tap Brakes in 2020 After Years of Rapid Growth*, REUTERS (Jan. 1, 2020, 11:14 PM), https://www.reuters.com/article/us-usa-shale-outlook/u-s-shale-producers-to-tap-brakes-in-2020-after-years-of-rapid-growth-idUSKBN1Z108U ("The S&P 500 Energy sector only gained 6% for the decade, far less than the 180% return for the broader stock market.").

80. Heather Richards et al., *3 Ways Coronavirus is Upending the Oil Industry*, E&E NEWS: ENERGYWIRE (Mar. 25, 2020), https://www.eenews.net/energywire/2020/03/25/stories/1062693959.

81. Mike Lee, *Methane Emissions May Rise Despite Oil Crash—Report*, E&E NEWS: ENERGYWIRE (Apr. 1, 2020), https://www.eenews.net/energywire/2020/04/01/stories/1062753739.

82. *Id.*

83. *Overview of the Oil and Natural Gas Industry*, EPA, https://www.epa.gov/natural-gas-star-program/overview-oil-and-natural-gas-industry (last updated Aug. 27, 2018).

84. *Id.*

85. *Id.*

86. *Id.*

87. *Id.*

88. *Id.*

89. *Hydraulic Fracturing Process*, SM ENERGY, http://sm-energy.com/about-us/videos/ (last visited Oct. 21, 2020).

90. *Id.*

reaching different deposits.[91] This portion of the well is also cased and cemented.[92] After drilling is finished, the completion stage begins.[93] A valve is installed at the surface and perforating guns are lowered down into the horizontal portion of the well.[94] The gun shoots small explosives out through the casing, creating holes in the shale.[95] The gun is then removed and the fracking process begins by pumping a sand, water, and chemical mixture down the well and into the perforations.[96] The pressure creates fractures through the shale, which the sand props open, allowing the oil and gas to escape.[97] The fracking fluid is then pumped out and the perforating gun inserts a plug to close off that portion of the well.[98] The perforating gun continues in this way, working backward toward the vertical well.[99] Finally, another rig comes in to drill out the plugs, beginning "flowback."[100] During flowback, oil and natural gas escape out of the well and are captured for storage or sale.[101]

Methane emissions occur throughout the natural gas cycle and can be minimized using various equipment upgrades.[102] Emissions "primarily result from normal operations, routine maintenance, fugitive leaks, and system upsets."[103] The EPA estimates that total annual methane emissions from the combined oil and natural gas production cycle are around 175 MMT CO_2e, but as already noted, these estimates are very likely low.[104] Production represents the greatest source of emissions with 47% of the total coming from natural gas and 20% from oil, for a total of 117 MMT CO_2e.[105] The processing segment represents around 7% of the sector's total at 12 MMT CO_2e.[106] Storage and transmission emissions are estimated at 19%, equaling 34 MMT CO_2e.[107] And distribution makes up the final 7% and another 12 MMT CO_2e.[108]

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91. *Id.*
92. *Id.*
93. *Id.*
94. *Id.*
95. *Id.*
96. *Id.*
97. *Id.*
98. *Id.*
99. *Id.*
100. *Id.*
101. *Id.*
102. *Primary Sources of Methane Emissions*, EPA, https://www.epa.gov/natural-gas-star-program/primary-sources-methane-emissions (last updated Aug. 27, 2018); *Recommended Technologies to Reduce Methane Emissions*, EPA, https://www.epa.gov/natural-gas-star-program/recommended-technologies-reduce-methane-emissions (last updated Apr. 23, 2019).
103. *Primary Sources of Methane Emissions*, *supra* note 102.
104. *Estimates of Methane Emissions by Segment in the United States*, EPA, https://www.epa.gov/natural-gas-star-program/estimates-methane-emissions-segment-united-states (last updated Aug. 4, 2020).
105. *Id.*
106. *Id.*
107. *Id.*
108. *Id.*

Numerous control technologies exist for minimizing leaks in the natural gas cycle.[109] The EPA publishes comprehensive data on various equipment, prices, and uses.[110] Wet seals and no-bleed pneumatic controllers are very effective at reducing leaks from pipelines, while minimizing venting and flaring can reduce emissions occurring during production.[111] "Green completion" practices can also lower emissions that occur during flowback after drilling the well.[112] Both the EPA and many states have mandated the use of some of these equipment types and practices.[113] Figure 2 shows the segments of the production cycle and the associated control equipment.

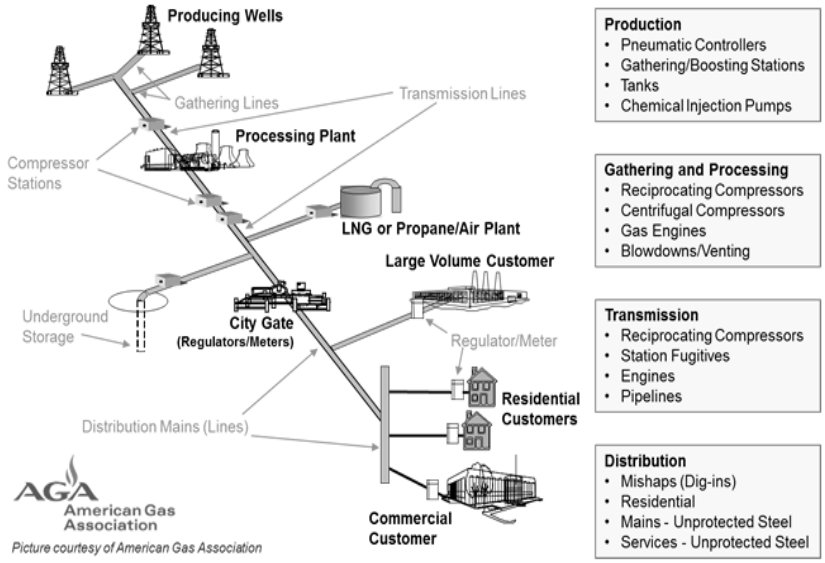

FIGURE 2. *Oil and Natural Gas Production Cycle and Control Equipment*[114]

III. REGULATION OF OIL & GAS SECTOR EMISSIONS

Historically, fugitive emissions from the oil and gas sector were not heavily regulated, but growing concern about climate impacts and the shale boom has brought changes in recent years. Domestically, the Clean

109. *See Recommended Technologies to Reduce Methane Emissions*, *supra* note 102.
110. *See id.*
111. U.S. ENV'T PROT. AGENCY, WET SEAL DEGASSING RECOVERY SYSTEM FOR CENTRIFUGAL COMPRESSORS 1, 4–6 (2014); *see also* U.S. ENV'T PROT. AGENCY, OPTIONS FOR REDUCING METHANE EMISSIONS FROM PNEUMATIC DEVICES IN THE NATURAL GAS INDUSTRY 1–2 (2006).
112. U.S. ENV'T PROT. AGENCY, REDUCED EMISSIONS COMPLETIONS FOR HYDRAULICALLY FRACTURED NATURAL GAS WELLS 1 (2011).
113. *Recommended Technologies to Reduce Methane Emissions*, *supra* note 102.
114. *Overview of the Oil and Natural Gas Industry*, *supra* note 83.

Air Act (CAA) provides the EPA with the authority to regulate oil-and-gas-production-cycle emissions, although the Bureau of Land Management (BLM) possesses some authority to regulate on public lands.[115] States also regulate oil and gas production, and those with delegated Clean Air Act programs often impose additional requirements to aid in complying with State Implementation Plans for criteria pollutants.[116] States can and do play a central role in reducing fugitive methane emissions, but this Article focuses only on EPA regulation, which serves as an essential baseline that states cannot fall below.

A. EPA Regulation of the Oil & Gas Sector

The Clean Air Act requires the EPA to set NSPS for categories of stationary sources that the EPA finds "cause[], or contribute[] significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."[117] Once the EPA has made the "source category" determination, Clean Air Act section 111(b) directs the Agency to promulgate a "standard of performance" that new, modified, and reconstructed sources must meet.[118] Section 111(a)(1) defines a "standard of performance" as one that "reflects the degree of emission limitation achievable through the application of the best system of emission reduction which (taking into account the cost of . . . health and environmental impact and energy requirements) . . . has been adequately demonstrated."[119] Whatever the EPA determines is the "best system of emission reduction" then becomes the baseline standard that the industry must meet.[120]

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115. 42 U.S.C. § 7402 (2018). For a full discussion on BLM's venting and flaring regulation, see Bradley N. Kershaw, *Flames, Fixes, and the Road Forward: The Waste Prevention Rule and BLM Authority to Regulate Natural Gas Flaring and Venting*, 29 COLO. NAT. RES. ENERGY & ENV'T L. REV. 115, 144 (2018) ("BLM's authority to regulate waste stems directly from the Mineral Leasing Act, the Federal Oil and Gas Royalty Management Act, the Federal Land Policy and Management Act of 1976, the Indian Mineral Leasing Act of 1938, and the Indian Mineral Development Act of 1982.").

116. *See, e.g.*, Stephanie Paige Ogburn, *Colorado First State to Limit Methane Pollution from Oil and Gas Wells*, SCI. AM. (Feb. 25, 2014), https://www.scientificamerican.com/article/colorado-first-state-to-limit-methane-pollution-from-oil-and-gas-wells/. The Colorado Department of Public Health and Environment was the first agency in the country to directly regulate methane emissions from the oil and gas sector. *Id.* The EPA modeled its Methane Rule on Colorado's Regulation 7. *See* 5 COLO. CODE REGS. § 1001-9 (2020); *see also* Cathy Proctor, *EPA Follow Colorado Lead in Targeting Methane Leaks from Oil and Gas*, DENV. BUS. J. (May 12, 2016, 1:06 PM), https://www.bizjournals.com/denver/blog/earth_to_power/2016/05/epa-follows-colorado-lead-in-targeting-methane.html. VOCs, emitted alongside methane, are precursors to ground-level ozone. *See* Minor, *supra* note 8, at 63. States with ozone nonattainment areas have additional incentive to regulate methane emissions from oil and gas to comply with the NAAQS. *Id.* at 97. In Colorado, oil and natural gas development in Weld County, sitting atop a large oil and gas formation, is the number-one source of VOC emissions that cause the Denver Metro/North Front Range area's ozone violations. *See* DEP'T OF PUB. HEALTH & ENV'T, COLO. AIR QUALITY CONTROL COMM'N, REPORT TO THE PUBLIC 2017-2018, at 23 (2018).

117. 42 U.S.C. § 7411(b)(1)(A) (2018).

118. *Id.* § 7411(b)(1)(B).

119. *Id.* § 7411(a)(1).

120. *Id.*

The EPA began this process for the oil and gas sector by making a source category determination in 1979.[121] Then, in 1985, the EPA promulgated the first NSPS for the sector that addressed emissions of volatile organic compounds (VOCs), a precursor pollutant to ground-level ozone, which is a primary component of urban smog.[122] This NSPS mandated certain control technologies to reduce emission leaks from processing plants.[123] In 2012, the EPA acted on its duty pursuant to section 111(b)(1)(B) to review and, if appropriate, revise the NSPS.[124] After reviewing the 1985 NSPS, the EPA published a final rule known as NSPS OOOO or "Quad-O."[125] Quad-O updated the sulfur dioxide standards for sweetening units and VOC standards for equipment leaks at natural gas processing plants.[126] It also established VOC standards for several oil and natural gas-related emission sources that were not previously covered, including well completions, centrifugal and reciprocating compressors, pneumatic controllers, and storage vessels.[127] While Quad-O encompassed equipment in the production cycle that was beyond the scope of the prior regulation, the EPA maintained that its original source category determination was broad enough to extend to those segments.[128] The EPA did not directly regulate fugitive methane emissions in 2012, but cited methane reductions as a cobenefit of reducing VOCs because the pollutants are emitted through many of the same processes and leaks.[129]

Quad-O was challenged in the D.C. Circuit, with a number of industry groups also filing petitions for reconsideration with the EPA.[130] Envi-

121. Priority List and Additions to the List of Categories of Stationary Sources, 44 Fed. Reg. 49,222, 49,223–24 (Aug. 21, 1979) (to be codified at 40 C.F.R. pt. 60).

122. *See* Standards of Performance for New Stationary Sources; Equipment Leaks of VOC From Onshore Natural Gas Processing Plants, 50 Fed. Reg. 26,122 (June 24, 1985) (to be codified at 40 C.F.R. pt. 60); *see also Ground-Level Ozone Basics*, EPA, https://www.epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics (last updated Sept. 10, 2020).

123. *See* Standards of Performance for New Stationary Sources; Equipment Leaks of VOC From Onshore Natural Gas Processing Plants, 50 Fed. Reg. 26,122.

124. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. 49,490, 49,492 (Aug. 16, 2012) (to be codified at 40 C.F.R. pts. 60, 63).

125. *Id.*; *see also* Joel Minor & Shannon S. Broome, *New Source Performance Standard OOOOa: Legal and Technical Implementation Issues and Lessons Learned*, *in* AIR QUALITY ISSUES AFFECTING OIL, GAS, AND MINING DEVELOPMENT AND OPERATIONS 4-1, 4-3 (2018).

126. *See* Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. at 49,492; Minor & Broome, *supra* note 125, at 4-4. "A sweetening unit . . . removes sulfur from natural gas." *Summary of Requirements for Processes and Equipment at Natural Gas Processing Plants*, EPA, https://www.epa.gov/sites/production/files/2016-09/documents/20120417summaryprocessing_equipment.pdf (last visited Oct. 23, 2020).

127. Minor & Broome, *supra* note 125, at 4-4.

128. *See id.*

129. Carlos R. Romo & Nicholas Graham, *EPA Regulation of Existing Oil & Gas Sources: Immediate and Long-Term Challenges*, BLOOMBERG L. (Sept. 27, 2015, 10:00 PM), https://www.bloomberglaw.com/document/XAHJF2ES000000?bna_news_filter=environment-and-energy&jcsearch=BNA%25200000016072cfdc0fa5f0f2ff120d0000#jcite.

130. See Minor & Broome, *supra* note 125, at 4-5 to 4-8, for a full summary of the litigation history.

ronmental groups challenged the rule for failure to directly regulate methane and argued that it should encompass more types of control equipment.[131] The EPA granted the petitions for reconsideration, and the litigation was stayed while the parties worked to resolve certain issues.[132]

B. EPA Regulation of Greenhouse Gases

In 2007, the U.S. Supreme Court decided *Massachusetts*, holding that the Clean Air Act permitted the EPA to regulate greenhouse gases.[133] If the EPA found that greenhouse gases were "air pollution which may reasonably be anticipated to endanger public health or welfare[,]" it was legally required to regulate those pollutants.[134] Through rulemaking, the EPA determined that greenhouse gases, including methane, did pose a threat to public health and welfare.[135] Specifically, the EPA found that greenhouse gas pollution would impact public health by increasing the number of hot days and heat waves, increasing ground-level ozone, and impacting frequency and severity of extreme weather events.[136] It also found that greenhouse gases would harm public welfare by shrinking seasonal snowpacks in the West; increasing the number of people at risk of drought exposure; increasing the extent of wildfires and insect outbreaks; and damaging international trade, humanitarian interests, and national security.[137]

The EPA's Endangerment Finding for greenhouse gases opened the door for the Agency to begin addressing climate change through the Clean Air Act.[138] After it became clear that federal climate legislation would not succeed, President Obama began to pursue climate mitigation efforts through the EPA.[139] Perhaps best known was the Administration's efforts to reduce CO_2 emissions from existing coal-fired power plants

131. *Id.* at 4-6 to 4-7.

132. *Id.* at 4-8 to 4-9; Reconsideration of the Oil and Natural Gas Sector: New Source Performance Standards; Final Action, 81 Fed. Reg. 52,778, 52,778 (Aug. 10, 2016) (to be codified at 40 C.F.R. pt. 60).

133. Massachusetts v. EPA, 549 U.S. 497, 506 (2007).

134. 42 U.S.C. § 7521(a)(1) (2018).

135. Endangerment and Cause or Contribute Findings for Greenhouse Gases Under Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,496, 66,516 (Dec. 15, 2009) (to be codified at 40 C.F.R. ch. I) ("The Administrator finds that elevated concentrations of greenhouse gases in the atmosphere may reasonably be anticipated to endanger the public health and to endanger the public welfare of current and future generations. The Administrator is making this finding specifically with regard to . . . methane . . . .").

136. *Overview of EPA Endangerment Finding*, EDF (Aug. 18, 2011), https://www.edf.org/overview-epa-endangerment-finding.

137. *Id.*

138. As further discussed *infra* Section IV.B, the Clean Air Act is not the ideal mechanism for addressing climate change. It was largely designed to regulate localized air pollution that directly impacts public health from exposure or inhalation. Greenhouse gases are spread relatively uniformly throughout the atmosphere and generally do not pose a risk to human health from inhalation.

139. *See* Amber Phillips, *Congress's Long History of Doing Nothing on Climate Change, in 6 Acts*, WASH. POST (Dec. 1, 2015, 9:15 AM), https://www.washingtonpost.com/news/the-fix/wp/2015/12/01/congresss-long-history-of-inaction-on-climate-change-in-6-parts/.

through the Clean Power Plan.[140] The Clean Power Plan capitalized on the EPA's authority under section 111(d) of the Clean Air Act, which allows the Agency to set performance standards for existing sources of air pollutants that are not regulated through the NAAQS.[141] The Clean Power Plan used a "beyond the fence line" approach when setting performance standards, encouraging the use of natural gas and renewables instead of coal.[142] The regulation was immediately challenged and stayed by the Supreme Court until the litigation was resolved.[143] However, the Trump Administration recently promulgated a replacement rule, rendering the litigation moot.[144] The replacement, known as the "ACE Rule," eliminates the beyond the fenceline approach, only requiring consideration of the technologies available for a particular plant.[145] The ACE Rule is currently being challenged by a number of states and environmental groups.[146]

The Obama Administration also pursued efforts to minimize methane emissions, particularly from the oil and natural gas sector.[147] The Administration's methane strategy involved reducing emissions from landfills, coal mines, agriculture, and oil and gas.[148] To reduce oil and gas sector emissions, the strategy set out to (1) work with states; (2) enhance partnerships and stakeholder engagement; (3) minimize venting and flaring on public lands; (4) identify opportunities to reduce emissions from energy infrastructure; (5) support development of new technologies to reduce emissions; (6) prioritize pipeline safety; and (7) build on common sense federal standards.[149] With respect to the final category, the

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140. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,663–64 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

141. *FACT SHEET: Overview of the Clean Power Plan*, EPA, https://19january2017snapshot.epa.gov/cleanpowerplan/fact-sheet-overview-clean-power-plan_.html (last updated June 27, 2016).

142. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. at 64,765 n.497; *see also* Alice Kaswan, *Controlling Power Plants: The Co-Pollutant Implications of EPA's Clean Air Act § 111(d) Options for Greenhouse Gases*, 32 VA. ENV'T L.J. 173, 183–84 (2014).

143. *See* West Virginia v. EPA, 136 S. Ct. 1000 (2016) (mem.).

144. *Affordable Clean Energy Rule*, EPA, https://www.epa.gov/stationary-sources-air-pollution/affordable-clean-energy-rule (last updated July 15, 2020); *see also* Order at 3, West Virginia v. EPA, No. 15-1363 (D.C. Cir. Sept. 17, 2019), ECF No. 1806952.

145. Howard M. Crystal et al., *Returning to Clean Air Act Fundamentals: A Renewed Call to Regulate Greenhouse Gases Under the National Ambient Air Quality Standards (NAAQS) Program*, 31 GEO. ENV'T L. REV. 233, 253 (2019).

146. Am. Lung Assoc. v. EPA, No. 19-1140 (July 8, 2019 D.C. Circuit); New York v. EPA, No. 19-1165 (Aug. 13, 2019 D.C. Circuit); Appalachian Mountain Club v. EPA, No. 19-1166 (Aug. 14, 2019 D.C. Circuit); *see also* Umair Irfan, *Trump's EPA Just Replaced Obama's Signature Climate Policy with a Much Weaker Rule*, VOX (June 19, 2019, 3:51 PM), https://www.vox.com/2019/6/19/18684054/climate-change-clean-power-plan-repeal-affordable-emissions.

147. *See* THE WHITE HOUSE, CLIMATE ACTION PLAN: STRATEGY TO REDUCE METHANE EMISSIONS 2 (2014).

148. *Id.*

149. *Id.* at 7–10.

plan specified that the "EPA will determine what if any regulatory authorities, including setting standards under section 111 of the Clean Air Act or issuing Control Techniques Guidelines under section 182 of the Act, the [A]gency will apply to emissions from these sources."[150]

C. EPA Regulation of Methane Emissions from Oil & Gas

In 2016, the EPA followed through and published a final rule, NSPS OOOOa, also known as the "Methane Rule," setting performance standards for new, modified, and reconstructed sources in the oil and gas sector and specifically targeting methane emissions.[151] The Methane Rule established performance standards for sources of methane and VOC emissions for certain equipment, processes, and operations across the oil and natural gas industry.[152] It built upon existing regulatory requirements from Quad-O but expanded to other types of equipment, specifically addressing the following emission sources:

- Sources that were unregulated under OOOO (hydraulically fractured oil well completions, pneumatic pumps, and fugitive emissions from well sites and compressor stations);

- Sources that were regulated under the OOOO for VOC emissions, but not for GHG emissions (hydraulically fractured gas well completions and equipment leaks at natural gas processing plants); and

- Certain equipment that is used across the source category, for which the OOOO regulates emissions of VOC from only a subset (pneumatic controllers, centrifugal compressors, and reciprocating compressors), with the exception of compressors located at well sites.[153]

The Methane Rule also "requires leak detection and repair (LDAR) surveys for new, modified, or reconstructed well sites and compressor stations."[154] The rule was finalized at the end of the Obama Presidency, at which time the EPA also published Control Technique Guidelines to aid willing industry participants and states in achieving reductions beyond the federal baseline.[155]

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150. *Id.* at 8.

151. *See* Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources, 81 Fed. Reg. 35,824, 35,825 (June 3, 2016) (to be codified at 40 C.F.R. pt. 60).

152. *See id.*

153. Methane Rollback Rule, *supra* note 18, at 50,252 (summarizing the regulatory requirements of OOOOa).

154. Taylor Hoverman, *EPA, Trump, and the Courts: Methane Regulation Under Siege*, AIR QUALITY COMM. NEWSL. (Am. Bar Ass'n Section of Env't, Energy, and Res., Chicago, Ill.), Aug. 2017, at 9.

155. *See generally* U.S. ENV'T PROT. AGENCY, EPA-453/B-16-001, CONTROL TECHNIQUES GUIDELINES FOR THE OIL AND NATURAL GAS INDUSTRY 1-1 to 1-2 (2016).

Shortly after taking office, President Trump issued an executive order titled "Promoting Energy Independence and Economic Growth."[156] It required the EPA to "immediately review existing regulations . . . of domestically produced energy resources and appropriately suspend, revise, or rescind those that unduly burden the development of domestic energy resources beyond the degree necessary to . . . comply with the law."[157] Following this directive, then-EPA Administrator Scott Pruitt attempted to stay the Methane Rule pending reconsideration, but his decision was immediately challenged by environmental groups and reversed by the D.C. Circuit.[158] Section 307 of the Clean Air Act permits the Administrator to issue a stay pending reconsideration only if objections are raised that were "impracticable to raise" during the public comment period or if "grounds for such objection arose" after the public comment period.[159] Because this was not the case, the EPA had unlawfully stayed a final rule.[160]

D. Proposed Rollback of the Methane Rule

After failing to immediately dismantle the Methane Rule, the Trump Administration decided to pursue a more legally sound approach by promulgating a replacement, as it did with the Clean Power Plan.[161] It began by making revisions to the Methane Rule in March 2018 that changed (1) the requirement to conduct repairs for components on a delay of repair during unscheduled or emergency vent blowdowns; and "(2) the monitoring survey requirements for well sites . . . on the Alaska North Slope."[162] The EPA also withdrew its request for information regarding control technologies for existing sources in the oil and gas sector.[163]

On September 24, 2019, the EPA properly published its proposed replacement to the Methane Rule.[164] The replacement includes both a primary proposal and an alternative proposal.[165] The primary proposal would rescind all regulation of methane from every segment in the oil

156. Promoting Energy Independence and Economic Growth, Exec. Order No. 13,783, 82 Fed. Reg. 16,093 (Mar. 28, 2017).

157. *Id.*

158. Clean Air Council v. Pruitt, 862 F.3d 1, 4–5 (D.C. Cir. 2017).

159. 42 U.S.C. § 7607(b)(7)(B) (2018).

160. *Clean Air Council*, 862 F.3d at 10.

161. Crystal et al., *supra* note 145, at 252–53.

162. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources; Amendments, 83 Fed. Reg. 10,628, 10,630 (Mar. 12, 2018) (codified at 40 C.F.R. pt. 60). The Trump Administration is rushing to open up drilling in Arctic National Wildlife Refuge on Alaska's Northern Slope. *See* Anna M. Phillips, *Feds Finalize Plan to Open Alaska's Arctic National Wildlife Refuge to Oil Drilling*, L.A. TIMES (Sept. 12, 2019, 2:39 PM), https://www.latimes.com/environment/story/2019-09-12/interior-finalizes-plan-to-open-alaskas-arctic-national-wildlife-refuge-to-oil-drilling.

163. *See* Notice Regarding Withdrawal of Obligation to Submit Information, 82 Fed. Reg. 12,817 (Mar. 7, 2017).

164. Methane Rollback Rule, *supra* note 18, at 50,244.

165. *Id.* at 50,254.

and gas source category.[166] It would also revise the source category for the oil and gas sector to remove the transmission and storage segments from all regulation under the NSPS program.[167] As justification for this decision, the EPA claims that its NSPS regulations covering those segments in both the 2012 Quad-O and the Methane Rule erroneously extended the source category beyond what the 1979 source category determination was intended to cover.[168] The EPA further claims regulating methane is entirely duplicative with the VOC regulations that already exist and is therefore a needless regulatory burden.[169] The primary proposal essentially repeals all methane regulation and reverts to a narrower version of Quad-O.[170]

The alternative proposal would leave in place the source category determinations used in Quad-O and the Methane Rule, thereby maintaining regulation of the transmission and storage segments.[171] However, it would also rescind all regulation of methane emissions from the oil and gas sector.[172] The alternative proposal similarly cites the existing regulation of VOCs as justification for repealing controls on methane, claiming "the VOC requirements will assure that the methane emissions reductions occur."[173] If the VOC requirements are truly the same as the methane requirements, why not leave methane as a regulated pollutant? Because regulating methane from new sources opens the possibility, and potential requirement, for the EPA to regulate methane from existing sources under section 111(d), as discussed below.

The proposed rollback also gives lengthy treatment to the possibility that the EPA is required to make a pollutant-specific "significant contribution finding" before listing or regulating GHG emissions from a source category.[174] The EPA's longstanding view is that to regulate under section 111(b), it must "(1) . . . find[] that certain air pollution may reasonably be anticipated to endanger public health or welfare, and (2) . . . find[] that the source category's emissions . . . cause or contribute significantly to that air pollution."[175] The EPA now raises the possibility that as a prerequisite to regulating a given pollutant from a source category, it must find that the specific pollutant, in the quantities emitted from that source

166. *Id.*
167. *Id.*
168. *Id.* at 50,255.
169. *Id.* at 50,254.
170. *See id.* at 50,244.
171. *See id.* at 50,254.
172. *Id.*
173. *Id.* at 50,261 n.66.
174. Specifically, in Part VI, the EPA solicits comments on this topic. *Id.* at 50,261–69; *see also* Devin Watkins, *Support Builds for EPA to Reconsider Endangerment Finding*, COMPETITIVE ENTER. INST. (Apr. 12, 2019), https://cei.org/blog/support-builds-epa-reconsider-endangerment-finding.
175. Methane Rollback Rule, *supra* note 18, at 50,261.

category, poses a danger to public health and welfare.[176] This added requirement would weaken the Endangerment Finding and make it more difficult to regulate smaller sources of GHGs. It might require the EPA to consider each of its six listed GHGs separately and determine each pollutant's specific contribution to climate change. The Agency has never taken this view, and the D.C. Circuit has held the EPA needs only a "rational basis" for regulating a source category's emissions of a pollutant already found harmful to human health and the environment.[177]

If the EPA were required to find that each individual pollutant from a source category significantly contributed to air pollution that endangers public health or welfare, it would substantially reduce the EPA's ability to control air pollution.[178] The EPA would have to make an additional endangerment finding each time it sought to regulate another pollutant from a listed source category. In effect, the EPA would only be able to regulate portions of emissions from a given source. But it seems unlikely that the EPA or a court will ultimately adopt this view. And the EPA has not proposed this interpretation, so a finalized rule that adopted it would likely be struck as not being a "logical outgrowth" of the proposed rule.[179] Moreover, *Utility Air Regulatory Group v. EPA*[180] reinforced the EPA's authority to regulate GHGs in situations where the source was already regulated for other pollutants.[181] In that case, the U.S. Supreme Court also affirmed that the Endangerment Finding included GHGs in the general act-wide definition of "air pollutant."[182]

Notably, the proposed rule has faced opposition not just from environmental groups and the general public but also from some industry groups.[183] The opposition stems in part from the extremely minimal cost savings at the sacrifice of public perception about the industry.[184] The

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176. *Id.* at 50,262.

177. Nat'l Lime Ass'n v. EPA, 627 F.2d 416, 432 (D.C. Cir. 1980).

178. The plain text of section 111(b)(1)(A) does not support this limiting interpretation:

> The Administrator shall, within 90 days after December 31, 1970, publish (and from time to time thereafter shall revise) a list of categories of stationary sources. He shall include a category of sources in such list if in his judgment it causes, or contributes significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare.

42 U.S.C. § 7411(b)(1)(A) (2018). The requirement is that the EPA find that the source category significantly contributes to air pollution, not that a specific pollutant emitted by the source category significantly contributes to air pollution. The EPA refers to the latter as a "pollutant-specific significant contribution finding" and argues this may be a prerequisite to setting an NSPS. *See* Methane Rollback Rule, *supra* note 18, at 50,262–69.

179. *See, e.g.*, Portland Cement Ass'n v. EPA, 665 F.3d 177, 189 (D.C. Cir. 2011); Env't Integrity Project v. EPA, 425 F.3d 992, 993, 996–98 (D.C. Cir. 2005).

180. 573 U.S. 302 (2014).

181. *See id.* at 307, 332.

182. *Id.* at 319.

183. Steve Weiler, *EPA Tries to Turn Back Time*, N. AM. OIL & GAS PIPELINES: WASH. WATCH (Oct. 3, 2019), https://napipelines.com/washington-watch-epa-tries-to-turn-back-time/.

184. Dana Nuccitelli, *Key Facts About the New EPA Plan to Reverse the Obama-era Methane Leaks Rule*, DESMOG (Sept. 10, 2019), https://www.desmogblog.com/2019/09/10/key-facts-trump-epa-plan-obama-methane-leaks-rule.

EPA estimates the total cost savings of the proposed regulation are between $97–123 million from 2019 through 2025.[185] Despite claiming that methane and VOC requirements overlap entirely, the EPA acknowledges that the proposal would sacrifice 370,000 tons of methane reductions from the transmission and storage segment.[186] Using the EPA's midrange social cost of methane metric, these emissions impose $444 million of costs on society.[187] Due to the minimal cost savings and the growing threat that the public will view natural gas as a dirty fuel, larger companies like Exxon Mobil have opposed the rollback.[188]

IV. FUTURE EPA REGULATION OF METHANE EMISSIONS FROM OIL & GAS

After *Massachusetts* and the Endangerment Finding, the EPA had the option to regulate greenhouse gases either through the NAAQS or by setting technology-based standards through the NSPS program.[189] The EPA chose the latter,[190] likely because its structure is more palatable for the regulation of GHGs. The two regulatory schemes overlap with conventional pollutants, but as it stands, they are distinct for GHGs and the NAAQS program has not been utilized to date.[191]

Through the NSPS program, the EPA sets performance standards for new and modified sources of air pollution.[192] These standards require sources to achieve emissions levels equivalent to that of the best system of emissions reductions, as determined by the EPA.[193] The EPA took this approach to regulating GHGs from both power plants and the oil and gas sector.[194] The NSPS program is uniquely effective for regulating GHGs because section 111(d) authorizes the EPA to set performance standards for existing sources "for which air quality criteria have not been issued[.]"[195] As it stands, GHGs are not a criteria pollutant regulated through the NAAQS program, so the EPA can mandate performance standards for existing sources in addition to new and modified sources.[196]

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185. *EPA Proposes Policy Amendments to the 2014 and 2016 New Source Performance Standards for the Oil and Natural Gas Industry*, EPA, https://www.epa.gov/sites/production/files/2019-08/documents/fact_sheet._proposed_amendments_to_nsps_for_oil_and_natural_gas_industry.8.28.19.pdf (last visited Oct. 23, 2020).

186. Methane Rollback Rule, *supra* note 18, at 50,278.

187. *See The Social Cost of Carbon*, EPA, https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html (last updated Jan. 9, 2017).

188. Weiler, *supra* note 183.

189. *See* 42 U.S.C. §§ 7408, 7411 (2018).

190. U.S. ENV'T PROT. AGENCY, REGULATING GREENHOUSE GAS EMISSIONS UNDER THE CLEAN AIR ACT 213, 217 (2008).

191. *See generally* JAMES E. MCCARTHY, CONG. RSCH. SERV., CLEAN AIR ISSUES IN THE 114TH CONGRESS *passim* (2016).

192. 42 U.S.C. § 7411.

193. *Id.*

194. *Id.*

195. *Id.* § 7411(d).

196. Craig N. Oren, *Is the Clean Air Act at a Crossroads?*, 40 ENV'T L. 1231, 1255–56 (2010).

To date, the EPA has not exercised its section 111(d) authority to regulate methane from existing sources in the oil and gas sector.[197]

Alternatively, the EPA could include GHGs on its list of criteria pollutants, but this would remove the possibility of regulating existing sources under section 111(d).[198] Once the EPA lists a criteria pollutant, it is required to promulgate NAAQS at a level that reflects an "adequate margin of safety . . . requisite to protect the public health."[199] Based on recommendations from its independent scientific review committee, the EPA selects a pollutant concentration that it deems protective of public health as the maximum allowable concentration, which becomes the NAAQS level.[200] After publishing the final NAAQS for a given pollutant, the EPA works with states to determine areas that are not in compliance.[201] These areas are designated "nonattainment" and states then submit plans for bringing all areas into "attainment" by the deadline.[202] The most obvious issue with using this program to address GHGs is that the ambient atmospheric concentrations of methane and carbon dioxide are relatively uniform across the country and even the world.[203] So, setting a NAAQS based on the atmospheric concentrations used commonly in climate science would put the entire country into nonattainment. This would impose widespread regulatory burdens, even in areas with minimal emissions.

Given the vital importance of minimizing methane emissions from the oil and gas sector and the current regulatory uncertainty, the following sections explore these two possible pathways. The preferred option is expanding NSPS through section 111(d), but if the Methane Rule is successfully repealed, regulation of methane through the NAAQS program is a promising alternative. Because of the interaction between the NSPS and NAAQS schemes, the two are currently mutually exclusive for the purpose of regulating existing sources of GHGs. Additionally, the choice of regulatory pathways depends upon the political climate after the 2020 election as well as the outcome of litigation over the Methane Rollback Rule and, potentially, the ACE Rule.

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197. *See* News Release, U.S. Env't Prot. Agency, EPA Proposes Updates to Air Regulations for Oil and Gas to Remove Redundant Requirements and Reduce Burden (Aug. 29, 2019) (on file with author).

198. 42 U.S.C. § 7408.

199. *Id.* § 7409.

200. *Id.* § 7409(d).

201. *Id.* § 7410.

202. *Id.*

203. *See* Rebecca Lindsey, *Climate Change: Atmospheric Carbon Dioxide*, CLIMATE.GOV (Aug. 14, 2020), https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide.

A. Regulation Through the NSPS Program

Methane emissions from the oil and gas sector are currently regulated only under section 111(b).[204] Section 111(b) only allows the EPA to regulate new, modified, and reconstructed sources, leaving existing sources unregulated and essentially "grandfathered" in.[205] This is extremely problematic from a climate perspective because it leaves emissions from some of the oldest and leakiest sources uncontrolled.[206] Estimates show that nearly 90% of methane emissions from the oil and gas sector come from sources that were operating before 2011.[207] But employing section 111(b) triggers the EPA's section 111(d) authority to set performance standards for existing sources in the same category as long as the regulated pollutant is not subject to regulation under the NAAQS program.[208] Because there are no NAAQS for methane, the EPA could, and should, move to regulate existing sources.[209] The Obama Administration appeared to be pursuing this pathway but ran out of time.[210]

Regulating existing sources depends on the existence of regulations covering new and modified sources of the same pollutant.[211] Therefore, if the proposed rollback is finalized and holds up in the courts, there will be no methane regulation to build upon in a second Trump term.[212] However, even if the EPA is able to promulgate its replacement relatively quickly, the litigation will likely roll over into the next administration, which could choose to settle. Assuming a new administration, advocates should push the EPA to restore the Methane Rule and then expand methane regulation to existing sources in the oil and gas sector. The re-

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204. *See* 42 U.S.C. § 7411(b).

205. *Id.*

206. Myriam Alexander-Kearns, *The EPA's Newest Methane Emissions Rule Is a Crucial Step for Climate Action*, CTR. FOR AM. PROGRESS (Aug. 25, 2015, 9:01 AM), https://www.americanprogress.org/issues/green/news/2015/08/25/119922/the-epas-newest-methane-emissions-rule-is-a-crucial-step-for-climate-action/.

207. *Id.*

208. As was exemplified by the Clean Power Plan. *See* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,663–64 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60).

209. *See* David Woodsmall, *Targeting Fugitive Emissions: Regulating Methane Emissions from the Oil and Natural Gas Industry Under Section 111 of the Clean Air Act*, 28 GEO. ENV'T L. REV. 531, 533 (2016).

210. For *existing* sources of methane in this sector, the Obama Administration issued an Information Collection Request (ICR) under Clean Air Act section 114 to collect data the Agency determined would be necessary to proceed with section 111(d) regulations but took no further action. *See* Information Collection Request Submitted to OMB for Review and Approval; Comment Request; Information Collection Effort for Oil and Gas Facilities, 81 Fed. Reg. 66,962 (Sept. 29, 2016).

211. 42 U.S.C. § 7411(d) (2018) ("[F]or which air quality criteria have not been issued or which is not included on a list published under section 7408(a) of this title . . . .").

212. Section 111(d) authorizes setting "standards of performance for any existing source for any air pollutant (i) [that is not regulated through the NAAQS program] . . . but (ii) to which a standard of performance under this section would apply if such existing source were a new source . . . ." *Id.*

placement rule might also be subject to the Congressional Review Act and could then be reversed relatively quickly.[213]

A new EPA could pursue a similar structure as was followed in the Clean Power Plan by setting the best system of emission reductions and allowing states some flexibility in compliance regimes.[214] Under section 111(d), the "EPA is given broad discretion to choose how it calculates" the best system of emissions reductions, and it could set either "a numerical limit or work practice standards applicable to individual sources."[215] This flexibility would allow the EPA to work with producers in different regions to determine which control technologies would be best suited for various equipment and drilling practices.[216] Another benefit of section 111(d) is that it affords states discretion to set their own standards, tailored to local industry and air pollution needs, as long as they do not fall below the floor set by the EPA.[217] States can draw on the Control Technique Guidelines or existing methane regulations, like that of Colorado, when determining which practices work best for their unique geographic, meteorological, and geologic conditions.[218] This would allow for maximum flexibility and lower compliance costs, while still achieving the needed emissions reductions.

B. Regulation Through the NAAQS Program

If NSPS regulation of methane from existing sources in the oil and gas sector is not possible, states and environmental groups should consider petitioning the EPA to list methane as a criteria pollutant.[219] While many question the viability of this approach, the EPA would at least have to take a definitive stance on its authority to pursue NAAQS regulation.[220] And the plain text of the Clean Air Act seems supportive of listing methane as a criteria pollutant.[221] The arguments against listing GHGs as a criteria pollutant include how the "standard would be structured given that [GHG] emissions are not localized like other criteria air pollutants[;]" legal risks that implementation would pose to the EPA's authority to regulate GHGs at all; and the lengthy timelines typically involved in NAAQS attainment.[222]

Some authors have recently revived the call for the EPA to list GHGs as a criteria pollutant, forwarding a number of convincing argu-

213. *See* 5 U.S.C. § 801 (2018).
214. *See* Kaswan, *supra* note 142, at 180–85.
215. Woodsmall, *supra* note 209, at 552.
216. *Id.*
217. *Id.* at 553.
218. *See id.* at 555.
219. Crystal et al., *supra* note 145, at 256.
220. *See* Oren, *supra* note 196, at 1231 (arguing the CAA is not suited to address GHG reductions). If the EPA finds that a pollutant meets the criteria of § 108, it must set air quality standards. *See* Nat. Res. Def. Council, Inc. v. Train, 545 F.2d 320, 322 (2d Cir. 1976).
221. *See* 42 U.S.C. § 7408(a)(1)(A)-(B) (2018).
222. Crystal et al., *supra* note 145, at 236.

ments.[223] They first cite the strength of the NAAQS program and its amazing successes to date.[224] Indeed, "only the NAAQS program forces the EPA to achieve the critical goal of protecting human health and welfare, as distinguished from focusing solely on improving technologies within each separate sector."[225] Additionally, *Whitman v. American Trucking*[226] held that the EPA is not authorized to consider costs when choosing a NAAQS level that is "requisite to protect the public health."[227] Thus, the extremely far-reaching economic consequences of NAAQS regulation are specifically contemplated by the Clean Air Act and have already been interpreted as such by the Supreme Court.[228] However, there are weaknesses to this approach, including the difficulty of setting an attainment deadline because carbon dioxide will persist in the atmosphere for centuries.[229] Notably, this concern is absent with methane because it dissipates over a decade or so.[230] Setting separate methane NAAQS could be an effective first step, even if carbon dioxide regulation is ultimately unsuccessful. Petitioning for methane to be listed as a criteria pollutant may make sense given the urgency of climate change, the need to immediately reduce methane emissions, and the fact that half measures will not bring about the necessary reductions. Even if the petition resulted in a bad legal outcome, it might also inspire desperately needed legislative action.

The threat of a possible NAAQS listing and the extreme breadth of regulation it would entail could push Congress to act on climate change. A negative reaction from Congress might result in express EPA authority to regulate GHGs through a separate or new program within the Clean Air Act. It could also result in a federal statute specifically aimed at climate change, like a carbon tax or cap-and-trade law.[231] The EPA's current failure to pursue this route is "a double blow, hindering both the full use of the Clean Air Act to address the climate crisis and separate efforts to address that crisis with other regulatory tools, both within and beyond the Act."[232] Either outcome of a NAAQS petition would likely result in greater action on climate than the status quo.[233] This is a risk worth tak-

223. *Id.*
224. *Id.* at 237–38.
225. *Id.*
226. Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 469 (2001).
227. 42 U.S.C. § 7409(b)(1) (2018).
228. Crystal et al., *supra* note 145, at 260.
229. *Id.* at 262.
230. *See* UNFCCC, *supra* note 30.
231. *See generally* William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 REV. ENV'T ECON. & POL'Y 26, 27, 40 (2007).
232. Crystal et al., *supra* note 145, at 240.
233. By pursuing stringent regulation of VOCs or other pollutants, states could still continue to reduce methane as a cobenefit. Colorado is an excellent example of how reducing methane from the oil and gas sector can be done in an effort to comply with the ozone NAAQS. *See, e.g.*, 5 COLO. CODE REGS. § 1001-9 (2020). Many states are already taking action on this front. *See* Mike Lee & Carlos Anchondo, *EPA May Roll Back Methane Rules. Will States Fill the Gap?*, E&E NEWS (Aug. 15, 2019), https://www.eenews.net/stories/1060954759.

ing because the ongoing half measures under the Clean Air Act will not achieve the reductions necessary to avoid climate catastrophe.

CONCLUSION

Given the extreme urgency of climate change and the importance of reducing atmospheric methane to avoid future crisis, controlling and stopping fugitive emissions from the oil and gas sector must be pursued by any means possible. With estimates attributing as much as 33% of global atmospheric methane to the North American fracking boom, emissions from this sector are a critical front in the battle against climate change.[234] The Clean Air Act provides available tools to reduce these emissions domestically, so continuing to push the EPA for stronger regulation is necessary. Depending on the outcome of the attempt to roll back the Methane Rule, expanding NSPS regulation to existing sources is a favorable option. Petitioning the EPA to regulate methane and other GHGs through the NAAQS program may also be a promising way to force federal action on climate change. Strategic pursuit of these possibilities by states and environmental advocates is critical in combatting global climate change and protecting the most vulnerable people and ecosystems around the world.

234. Howarth, *supra* note 53, at 3038.