Targeting Fugitive Emissions: Regulating Methane Emissions from the Oil and Natural Gas Industry under Section 111 of the Clean Air Act

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Abstract

Natural gas is currently undergoing a renaissance in the United States. Due to its abundant domestic supply, cheap price relative to other fossil fuels used to generate energy, and potential environmental advantages over coal as an energy source, natural gas is playing an increasingly large role on the United States energy landscape. All signs point toward this trend continuing for the foreseeable future.

The exponential growth in domestic natural gas production and consumption, and the development of hydraulic fracturing that has facilitated this surge, raise concerns about the negative environmental effects of natural gas production. The potential for hydraulic fracturing fluids and natural gas to contaminate drinking water has garnered the most concern and spurred a backlash against hydraulic fracturing and the expansion of domestic natural gas production generally. There is also a growing focus on the climate impact of methane emissions from natural gas production.

This note argues that the Environmental Protection Agency ("EPA") should impose stringent regulations covering new and existing sources of fugitive methane emissions from the natural gas industry. Part I provides a brief introduction, and Part II outlines the rise of natural gas production and consumption in the United States and the factors that have contributed to that rise. Part III provides an overview of the effect that elevated levels of atmospheric methane have on the global climate. Part IV discusses the sources and magnitude of fugitive methane emissions from the natural gas industry, and argues that these fugitive methane emissions must be controlled. Part V outlines and critiques EPA's regulatory actions aimed at reducing methane emissions from new oil and natural gas facilities. Part VI argues that EPA must take further action under section 111(d) of the Clean Air Act ("CAA") to require that the oil and gas industry reduce methane emissions from existing sources.

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INTRODUCTION

The United States energy landscape is currently undergoing a paradigm shift. Hydraulic fracturing and horizontal drilling have unleashed previously unrecoverable reserves of domestic oil and natural gas, causing a surge in domestic production and consumption. This abundant domestic supply, coupled with increased use of natural gas as a power source, has made the United States the world's largest petroleum and natural gas producer, significantly eclipsing Russia

and Saudi Arabia.[1] This is largely due to domestic natural gas production, which surpasses that of all other countries in the world with the exception of Russia, which comes in a close second.[2]

The increased production and combustion of natural gas as an energy source is a double-edged sword for the environment. The large domestic supply of natural gas and new regulations on the energy sector have shifted near-term domestic energy production from coal to natural gas. This transition has significantly contributed to recent reductions in domestic emissions of carbon dioxide ("CO_2"), a major contributor to climate change.

Securing the climate benefits of the energy transition from coal to natural gas, however, requires a comprehensive set of regulations to reduce methane emissions from oil and natural gas development. Methane, a potent greenhouse gas and the primary component of natural gas, leaks into the atmosphere during oil and natural gas production.[3] At current levels, methane emissions from the oil and natural gas industry threaten to negate or even reverse the climate benefits of transitioning from coal to natural gas as a domestic energy source.[4]

The U.S. Environmental Protection Agency ("EPA") has taken initial steps to address methane emissions from the oil and natural gas industry. EPA issued New Source Performance Standards ("NSPS") governing methane emissions from new sources in the oil and natural gas industry in 2012 and 2015. These measures, although an important first step, are an insufficient response to the oil and natural gas industry's fugitive emissions problem.

EPA should promulgate additional strong regulations covering methane emissions from existing sources in the oil and natural gas industry under section 111(d) of the Clean Air Act ("CAA"). EPA's 2015 NSPS triggered EPA's authority to promulgate standards for existing sources under section 111(d). EPA should act on this authority and establish a federal backstop to ensure that the energy transition from coal to natural gas brings about important climate benefits.

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1. *U.S. Remained World's Largest Producer of Petroleum and Natural Gas Hydrocarbons in 2014*, U.S. ENERGY INFO. ADMIN. (Apr. 7, 2015), https://www.eia.gov/todayinenergy/detail.cfm?id=20692; Nanette Byrnes, *Cheap Natural Gas Boosts Manufacturing*, MIT TECH. REV. (Sept. 16, 2014), http://www.technologyreview.com/news/530711/cheap-natural-gas-boosts-manufacturing/.

2. INT'L ENERGY AGENCY, KEY WORLD ENERGY STATISTICS 13 (2014), http://www.iea.org/publications/freepublications/publication/KeyWorld2014.pdf.

3. *Overview of Greenhouse Gases—Methane*, EPA, https://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html (last updated Mar. 14, 2016).

4. *See, e.g.*, Robert Fares, *Methane Leakage from Natural Gas Supply Chain Could Be Higher Than Previously Estimated*, SCIENTIFIC AMERICAN—PLUGGED IN (July 13, 2015), http://blogs.scientificamerican.com/plugged-in/methane-leakage-from-natural-gas-supply-chain-could-be-higher-than-previously-estimated/ ("[M]ethane leakage could either make or break the climate benefits of fuel switching from coal-fired electricity generation to natural gas . . . [i]f [fugitive] methane emissions creep above 3 percent, fuel switching could get us nowhere.").

I. THE RISE OF NATURAL GAS ON THE DOMESTIC ENERGY LANDSCAPE

The role of natural gas on the U.S. energy landscape has fundamentally changed over the past century. Natural gas was originally an unwanted byproduct of oil extraction, and production and was generally vented into the atmosphere from oil wells.[5] Over the ensuing decades, as energy producers and utilities realized natural gas's potential as a source for heat and electricity generation, an interstate natural gas pipeline system emerged to transport and broadly distribute natural gas for industrial and residential consumption throughout the country.[6] Today, natural gas is used to generate electricity for diverse residential, industrial, and commercial uses, and to fuel vehicles.[7]

Three factors explain the surge in natural gas production and consumption in the United States over the past decade. First, the advent of new extraction technologies—horizontal drilling and hydraulic fracturing—has unlocked previously untapped oil and natural gas resources, significantly increasing domestic supply and production. The United States' proved natural gas reserves began steadily increasing in the late 1990s, after Mitchell Energy successfully demonstrated hydraulic fracturing's ability to unlock previously untapped natural gas reserves in Texas's Barnett Shale.[8] Proved reserves spiked over the ensuing decade as hydraulic fracturing made recovering shale gas technologically and economically feasible. Proved U.S. natural gas reserves reached a record high in 2014, exceeding 388 trillion cubic feet—more than double pre-hydraulic fracturing levels.[9] At current levels of domestic consumption, proved reserves can supply the U.S. market for more than one hundred years.[10]

If these recent trends continue, the domestic supply will increase further as the size of current shale reserves is better understood, new reserves are discovered, and hydraulic fracturing techniques improve.[11] Marketed production of natural

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5. ALEX PRUD'HOMME, HYDROFRACKING: WHAT EVERYONE NEEDS TO KNOW 16–17 (2014).

6. ERNEST J. MONIZ ET AL., MASS. INST. OF TECH., THE FUTURE OF NATURAL GAS 17 (2011), https://mitei.mit.edu/system/files/NaturalGas_Report.pdf.

7. PRUD'HOMME, *supra* note 5, at 17.

8. *Id.* at 28–29; *U.S. Crude Oil and Natural Gas Proved Reserves*, U.S. ENERGY INFO. ADMIN. (Nov. 23, 2015), https://www.eia.gov/naturalgas/crudeoilreserves/#3.

9. *Id.* ("Proved reserves are estimated volumes of hydrocarbon resources that analysis of geologic and engineering data demonstrates with reasonable certainty are recoverable under existing economic and operating conditions.").

10. Cathy Proctor, *U.S. Natural Gas Reserves at Record Levels, Says School of Mines Panel*, DENVER BUS. J. (Apr. 9, 2013, 5:34 PM), http://www.bizjournals.com/denver/blog/earth_to_power/2013/04/us-natural-gas-reserves-hit-record.html.

11. *See* Andrew Follett, *Birthplace of Fracking Has Twice as Much Gas as Expected*, THE DAILY CALLER (Dec. 19, 2015, 7:14 PM), http://dailycaller.com/2015/12/19/birthplace-of-fracking-has-twice-as-much-gas-as-expected/ (reporting that the Barnett Shale in Texas is now estimated to contain twice the amount of natural gas previously estimated).

gas increased forty-four percent from 2005 to 2014.[12] The U.S. Energy Information Administration ("EIA") forecasts that domestic natural gas production will continue this upward trajectory, rising sixty-six percent from 2010 levels by 2040.[13] Crude oil and natural gas liquids are additionally expected to increase by approximately twenty-five percent by 2019, with more than half of all wells drilled co-producing natural gas.[14]

Second, this increased supply has driven down domestic natural gas prices and reduced price volatility, making natural gas an economically attractive fuel for domestic energy production and other uses. Since peaking in the mid-2000s, U.S. natural gas prices have declined, with the exception of a few short-term price spikes over the past decade.[15] Hydraulic fracturing and the shale gas it brings to the market have "tilted the supply/demand equation towards bountiful supply," driving U.S. natural gas prices to a sixteen-year low in 2015.[16] This price decline has engendered a significant transition in energy production from coal to natural gas. For the first time since the EIA began collecting data on electricity generation by fuel source in 1973, natural gas briefly surpassed coal as the primary source of domestic electricity generation in April 2015.[17] If natural gas prices remain low, as projected, an increasing percentage of domestic energy production will likely come from natural gas.

The emergence of shale gas has also reduced price volatility by muting the impact of reduced offshore production due to inclement weather in the Gulf of Mexico. Prior to the mid-2000s, more than a quarter of U.S. natural gas was produced in the Gulf of Mexico.[18] This left natural gas prices vulnerable to tropical storms and hurricanes that disrupted a significant source of domestic supply. Shale gas shifted the dynamics of domestic production, bringing significant new sources of production online in Texas, Pennsylvania, Arkansas, Louisiana, and several other states.[19] Despite the shrinking of Gulf production to a mere

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12. *U.S. Natural Gas Marketed Production*, U.S. ENERGY INFO. ADMIN. (Dec. 31, 2015), http://www.eia.gov/dnav/ng/hist/n9050us2a.htm.

13. *Annual Energy Outlook 2014*, U.S. ENERGY INFO. ADMIN. (2014), http://www.eia.gov/beta/aeo/#/?id=13-AEO2014&cases=ref2015.

14. EPA OFF. OF AIR QUALITY PLANNING AND STANDARDS, OIL AND NATURAL GAS SECTOR LEAKS 2 (Apr. 2014), http://www3.epa.gov/airquality/oilandgas/2014papers/20140415leaks.pdf.

15. *Henry Hub Natural Gas Spot Price*, U.S. ENERGY INFO. ADMIN. (Jan. 6, 2016), https://www.eia.gov/dnav/ng/hist/rngwhhdm.htm.

16. Akin Oyedele, *Natural Gas Just Crashed to a 16-year Low*, BUS. INSIDER (Dec. 15, 2015, 2:47 PM), http://www.businessinsider.com/natural-gas-falls-to-16-year-low-2015-12; Myra P. Saefong, *Natural-gas Prices Aren't Done Falling Yet*, MARKETWATCH (Oct. 27, 2015), http://www.marketwatch.com/story/natural-gas-prices-arent-done-falling-yet-2015-10-27.

17. *Electricity from Natural Gas Surpasses Coal for First Time, but Just for One Month*, U.S. ENERGY INFO. ADMIN. (July 31, 2015), http://www.eia.gov/todayinenergy/detail.cfm?id=22312.

18. Myra P. Saefong, *Atlantic Hurricanes Lose Sway Over Oil-and-Gas Market*, MARKETWATCH (Aug. 28, 2015), http://www.marketwatch.com/story/atlantic-hurricanes-lose-sway-over-oil-and-gas-market-2015-08-28.

19. *Shale Gas Provides Largest Share of U.S. Natural Gas Production in 2013*, U.S. ENERGY INFO. ADMIN. (Nov. 25, 2014), https://www.eia.gov/todayinenergy/detail.cfm?id=18951.

five percent of domestic supply, the dispersal of natural gas production throughout the mainland has "reduced the vulnerability of U.S. crude-oil and natural-gas supply to hurricanes" and other inclement weather offshore.[20]

Third, concerns about climate change and accompanying federal and state regulation of emissions from the power sector have resulted in the emergence of natural gas-fired power production as a "clean" alternative to coal-fired power plants.[21] States seeking to reduce emissions of carbon dioxide and smog-forming pollutants are increasingly looking to natural gas-fired combined-cycle power plants as a short-term solution to environmental pollution from electricity generation.[22] EPA's recently finalized Clean Power Plan ("CPP"), which regulates greenhouse gas ("GHG") emissions from power plants, aims to decrease carbon pollution from the electricity sector by shifting generation away from coal and toward natural gas and renewables.[23] The CPP, released after the EIA's natural gas projections discussed above, anticipates a three to five percent increase in electricity generation from natural gas by 2020.[24] This regulation-driven shift in electricity production could thus cause domestic natural gas production to increase even further.

II. METHANE IS A POTENT GLOBAL WARMING POLLUTANT THAT REQUIRES A GREATER REGULATORY FOCUS AND RESPONSE

The environmental benefits of shifting power production from coal to natural gas will only be realized if nearly all of the methane released through drilling for oil and natural gas is captured throughout the natural gas production process and ultimately combusted. Natural gas has the potential to be a significantly cleaner energy source than coal, which, at thirty-nine percent, currently accounts for the majority of domestic energy production.[25] The carbon intensity of natural gas is

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20. *Reduced Offshore Share in U.S. Oil and Natural Gas Production Lowers Risk from Hurricanes*, U.S. ENERGY INFO. ADMIN. (Aug. 28, 2015), http://www.eia.gov/todayinenergy/detail.cfm?id=22712&src=email.

21. *See id.*

22. Concerns about the safe operation of nuclear plants, caused by the disaster at the Fukushima I Nuclear Power Plant in Japan in 2011, and the safe disposal of nuclear waste have elevated natural gas above nuclear energy as the principle short-term clean alternative to coal-fired electricity generating units. PRUD'HOMME, *supra* note 5, at 17.

23. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662, 64,927 (Oct. 23, 2015) (to be codified at 40 C.F.R. pt. 60) (predicting a short-term increase in natural gas use for electricity generation and "growing use of [energy efficiency] and renewable electricity generation" under the Clean Power Plan) [hereinafter Clean Power Plan Final Rule]. *Fact Sheet: President Obama to Announce Historic Carbon Pollution Standards for Power Plants*, THE WHITE HOUSE (Aug. 3, 2015), https://www.whitehouse.gov/the-press-office/2015/08/03/fact-sheet-president-obama-announce-historic-carbon-pollution-standards.

24. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. at 64,927. However, the fate of the Clean Power Plan is currently up in the air, given the U.S. Supreme Court's recent unprecedented decision to stay the Plan. Order in Pending Case, Chamber of Commerce et al. v. EPA, 577 U.S. (2016) (No. 15A787).

25. *Frequently Asked Questions: What Is U.S. Electricity Generation by Energy Source?*, U.S. ENERGY INFO.

substantially lower than that of coal, releasing approximately fifty percent less carbon dioxide into the atmosphere when combusted.[26] Securing this climate benefit, however, is contingent on capturing nearly all of the methane released during the oil and natural gas production process.

Methane, the primary component of natural gas, is a potent greenhouse gas with significant global warming potential. Methane's climate potential is particularly acute over the short term, with a warming potential seventy-two times greater than carbon dioxide over a twenty-year time frame.[27] Although methane has a shorter half-life than carbon dioxide, and consequently does not remain in the atmosphere for as long, its long-term warming potential still significantly outstrips that of carbon dioxide. Over a one hundred-year timeframe, the global warming potential of methane remains twenty-eight to thirty-two times greater than CO_2.[28]

But methane's global warming effects are not restricted to its direct climate impacts. Methane has additional harmful indirect impacts on the climate through its interaction with other gases in the atmosphere. Once released, methane reacts with other elements in the atmosphere to produce ozone, another potent greenhouse gas.[29] This reaction also "indirectly affect[s] aerosols in the atmosphere, likely further enhancing the warming effect of methane."[30] These indirect warming effects of methane have led to estimates that methane's warming potential may be up to 105 times greater than the warming potential of carbon dioxide.[31]

The current concentration of methane in the atmosphere is significantly greater than at any point in the past 800,000 years.[32] This is primarily the result of a significant uptick in the atmospheric methane concentration over the past century due to human activities, including oil and gas production. During this time, atmospheric methane concentrations spiked and have reached two-and-a-half times preindustrial levels.[33] These current levels, which stand at nearly 2,000

ADMIN., https://www.eia.gov/tools/faqs/faq.cfm?id=427&t=3 (last visited Jan. 31, 2016).

26. CTR. FOR CLIMATE AND ENERGY SOLS., LEVERAGING NATURAL GAS TO REDUCE GREENHOUSE GAS EMISSIONS: SUMMARY REPORT 2 (June 2013), http://www.c2es.org/docUploads/leveraging-natural-gas-reduce-ghg-emissions-summary.pdf.

27. Michael Obeiter, *How the EPA's New Oil and Gas Standards Will Reduce Greenhouse Gas Emissions*, WORLD RES. INST. (May 9, 2012), http://www.wri.org/blog/2012/05/how-epa's-new-oil-and-gas-standards-will-reduce-greenhouse-gas-emissions.

28. *Understanding Global Warming Potentials*, EPA (Dec. 11, 2015), http://www3.epa.gov/climatechange/ghgemissions/gwps.html.

29. *Id.*

30. JAMES BRADBURY ET AL., CLEARING THE AIR: REDUCING UPSTREAM GREENHOUSE GAS EMISSIONS FROM U.S. NATURAL GAS SYSTEMS (World Res. Inst. 2013), http://www.wri.org/sites/default/files/clearing_the_air_full_version.pdf.

31. *Id.*

32. *Causes of Climate Change*, EPA (Nov. 4, 2015), http://www3.epa.gov/climatechange/science/causes.html.

33. *Id.*

parts per billion, are unprecedented in human history.[34]

Methane is now the second largest domestic source of anthropogenic GHG emissions, behind only carbon dioxide.[35] In 2013, methane accounted for ten percent of anthropogenic GHG emissions in the United States.[36] Despite methane's relatively low atmospheric concentration compared to CO_2, it is a highly potent catalyst of global warming, particularly over the short-term.[37]

III. MEANINGFUL EFFORTS TO REDUCE GREENHOUSE GAS CONCENTRATIONS MUST TARGET METHANE EMISSIONS FROM THE OIL AND NATURAL GAS INDUSTRY

Regulating fugitive methane emissions from the oil and natural gas industry is essential to any meaningful effort to reduce atmospheric methane concentrations. The oil and natural gas industry is the largest industrial source of methane emissions in the United States, responsible for thirty-seven percent of all domestic anthropogenic methane emissions.[38] These emissions are "projected to rise more than 25 percent by 2025 without additional" regulatory constraints.[39] Although there is some uncertainty around the quantity of methane emitted during the oil and natural gas production process, research trends indicate that current fugitive emissions levels threaten to undercut the climate benefits of natural gas over coal as an energy source. Reducing these fugitive emissions is imperative to avert a two-degree Celsius rise in global temperatures above pre-industrial levels and meet U.S. GHG-reduction goals, while also increasing natural gas producers' profits.

A. FUGITIVE METHANE EMISSIONS ARE A SIGNIFICANT PROBLEM IN THE OIL AND NATURAL GAS INDUSTRY

Methane escapes into the atmosphere through equipment leaks and venting during oil and natural gas production, transportation, and distribution. Methane is the principal component of natural gas, constituting eighty-three percent of natural gas at extraction and ninety percent at the time of delivery.[40] When a

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34. *See id.*

35. *Overview of Greenhouse Gases—Methane*, *supra* note 3.

36. *Id.*

37. James Bradbury & Michael Obeiter, *A Close Look at Fugitive Methane Emissions from Natural Gas*, WORLD RES. INST. (Apr. 2, 2013), http://www.wri.org/blog/2013/04/close-look-fugitive-methane-emissions-natural-gas.

38. BRADBURY ET AL., *supra* note 30, at 10.

39. *Fact Sheet: Administration Takes Steps Forward on Climate Action Plan by Announcing Actions to Cut Methane Emissions*, THE WHITE HOUSE (Jan. 14, 2015), https://www.whitehouse.gov/the-press-office/2015/01/14/fact-sheet-administration-takes-steps-forward-climate-action-plan-anno-1 [hereinafter White House Fact Sheet].

40. Bradbury & Obeiter, *supra* note 37.

natural gas well is drilled, previously trapped natural gas reserves are released and flow to the well borehole.[41] Although most of the gas is captured and distributed for consumption, some gas escapes—or is intentionally released—into "the atmosphere during the production, processing, storage, transmission, and distribution of natural gas."[42] Methane emissions that escape into the atmosphere through leaks and venting in the natural gas production, transportation, and distribution processes are called "fugitive emissions."

Natural gas also escapes into the atmosphere during oil production. Many oil wells co-produce natural gas;[43] methane is often seen as an unwanted byproduct of this co-production and is flared or burned at the wellhead instead of being captured and sold.[44]

The oil and natural gas industry is highly vulnerable to fugitive-emissions releases because of the multitude of points along the production process prone to leaking methane into the atmosphere.[45] Changes in temperature or pressure may overload or wear on the system, forcing gas through connection points and moving parts of the natural gas production, processing, and transportation systems.[46] At the well site alone, these include "agitator seals, connectors, pump diaphragms, flanges, instruments, meters, open-ended lines, pressure relief devices, pump seals, valves or open thief hatches or holes in storage vessels, pressure vessels, separators, heaters and meters."[47] Methane gas may also leak from improperly fitted connection points and inadequately maintained seals and gaskets designed to prevent leaks.[48]

Additionally, natural gas is often intentionally vented into the atmosphere to control pressure throughout the production and distribution process. Pneumatic valves, "one of the largest sources of vented emissions from the natural gas industry," monitor and control gas pressure in the production, processing, and transmission sectors.[49] These devices control gas pressure by "bleeding" gas into the atmosphere to maintain a safe and operationally efficient pressure.[50] Al-

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41. PRUD'HOMME, *supra* note 5, at 90.

42. *Overview of Greenhouse Gases—Methane*, *supra* note 3.

43. U.S. GOV'T ACCOUNTABILITY OFF., FEDERAL OIL AND GAS LEASES: OPPORTUNITIES EXIST TO CAPTURE VENTED FLARED NATURAL GAS, WHICH WOULD INCREASE ROYALTY PAYMENTS AND REDUCE GREENHOUSE GASES 2 (2010), http://www.gao.gov/assets/320/311826.pdf.

44. *See id.*

45. RAMON A. ALVAREZ & ELIZABETH PARANHOS, AIR POLLUTION ISSUES ASSOCIATED WITH NATURAL GAS AND OIL OPERATIONS, EM 22–23 (June 2012), http://www.edf.org/sites/default/files/AWMA-EM-airPollutionFrom OilAndGas.pdf.

46. EPA OFF. OF AIR QUALITY PLANNING AND STANDARDS, *supra* note 14, at 3.

47. Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. 56,593, 56,634 (proposed Sept. 18, 2015) (to be codified at 40 C.F.R. pt. 60) [hereinafter EPA 2015 NSPS Proposed Rule].

48. EPA OFF. OF AIR QUALITY PLANNING AND STANDARDS, *supra* note 14, at 3–4.

49. EPA, OPTIONS FOR REDUCING METHANE EMISSIONS FROM PNEUMATIC DEVICES IN THE NATURAL GAS INDUSTRY 1–2 (2006), http://www3.epa.gov/gasstar/documents/ll_pneumatics.pdf.

50. *Id.*

though the release from each individual pneumatic device may seem relatively small, industry-wide, pneumatic devices account for more than 65 billion cubic feet of methane releases annually.[51]

Another source of leakage is storage tank "thief hatches," which vent gas when equipment is depressurized for maintenance.[52] Thief hatches, similar to pneumatic valves, are designed to open and release gas into the atmosphere when pressure inside a storage tank reaches an unsafe level. Although thief hatches play a vital role in maintaining safe operating pressure, they are often incorrectly calibrated—causing them to open during normal operation—and often fail to close after gas returns to a safe pressure point.[53]

B. RESEARCH CONCERNING THE EXTENT OF FUGITIVE METHANE EMISSIONS FROM THE OIL AND NATURAL GAS INDUSTRY BOLSTERS THE NEED FOR A REGULATORY ACCOUNTING OF FUGITIVE EMISSIONS

Recent accounting of fugitive methane emissions from the oil and natural gas industry indicates that the industry is a significant contributor to global warming.[54] Research on methane emissions from the oil and natural gas industry has progressed significantly over the last decade. As techniques to measure those emissions, access to data, and modeling have improved, estimates of the quantity of methane released by the oil and natural gas industry have increased significantly.[55] This improved accounting of the magnitude of methane released during oil and natural gas production underscores the need for a comprehensive regulatory framework to address the problem.

Initially, estimates of methane emissions from the oil and natural gas industry were generally reached "by scaling up individual ground-level [methane] measurements, mostly collected by reporting from industry."[56] This method, which has been widely criticized, produced low estimates that did not match up with atmospheric measurements of methane concentrations.[57] The "bottom-up" methodology has begun to be supplanted by top-down estimates of fugitive methane emissions, which involve inferring fugitive emissions rates from atmospheric methane observations.[58]

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51. *Id.* at 1.

52. Alvarez & Paranhos, *supra* note 45, at 22.

53. EPA OFF. OF ENFORCEMENT AND COMPLIANCE ASSURANCE, COMPLIANCE ALERT: EPA OBSERVES AIR EMISSIONS FROM CONTROLLED STORAGE VESSELS AT ONSHORE OIL AND NATURAL GAS PRODUCTION FACILITIES (Sept. 2015), http://www.epa.gov/sites/production/files/2015-09/documents/oilgascompliancealert.pdf.

54. *See* Bradbury & Obeiter, *supra* note 37.

55. *See id.*

56. *See* Touche Howard, *University of Texas Study Underestimates National Methane Emissions at Natural Gas Production Sites Due to Instrument Sensor Failure*, 3 ENERGY SCI. & ENG'G 443 (2015) (finding that the University of Texas-Austin study underreported methane emissions due to sensor failure).

57. *Id.*

58. Yu Yan Cui et al., *Top-down Estimate of Methane Emissions in California Using a Mesoscale Inverse Modeling Technique: The South Coast Air Basin*, 120 GEOPHYSICAL RES.: ATMOSPHERES 6,698 (2015).

Recent estimates of fugitive emissions reveal that the oil and natural gas industry is leaking and venting significant quantities of methane into the atmosphere. A much-cited and discussed study by Robert W. Howarth and colleagues at Cornell University concluded that "3.6 percent to 7.9 percent of the methane from shale-gas production escapes to the atmosphere in venting and leaks over the lifetime of a well."[59] Localized measurements conducted in Colorado and Utah by the National Oceanic and Atmospheric Administration and the University of Colorado at Boulder discovered leak rates of nine and four percent in those states, respectively.[60] Other recent studies have estimated fugitive-emissions rates as high as six percent for conventional onshore natural gas production operations and 5.2 percent for shale gas production.[61] Yet another study, led by Harvard University and published in the Proceedings of the National Academy of Sciences, found that methane emissions in the United States are 1.5 to 1.7 percent higher than government estimates, which have since been revised upward, with methane emissions from the oil and natural gas industry in the South Central United States nearly five times greater than government estimates.[62] These studies consistently conclude that emissions estimates on the lower end of the spectrum commonly under-predict methane concentrations observable in the atmosphere.[63]

These estimates indicate that methane emissions from the oil and natural gas industry present a climate threat that should be the target of strong regulation. An increased emphasis should be placed on developing a definitive accounting of the magnitude of fugitive methane emissions from the oil and natural gas industries. Recent studies, however, indicate that, if anything, the extent of the problem is currently underappreciated. As EPA Administrator Gina McCarthy stated when announcing that the Agency's GHG Inventory previously significantly underestimated methane emissions from the oil and natural gas industry, "[t]he data confirm that we can and must do more on methane."[64]

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59. Robert W. Howarth et al., *Methane and the Greenhouse-gas Footprint of Natural Gas from Shale Formations: A Letter*, 113 CLIMATIC CHANGE 525 (2012).

60. PRUD'HOMME, *supra* note 5, at 91.

61. BRADBURY ET AL., *supra* note 30, at 14.

62. Caroline Perry, *U.S. Methane Emissions Exceed Government Estimates*, HARVARD GAZETTE (Nov. 25, 2013), http://news.harvard.edu/gazette/story/2013/11/u-s-methane-emissions-far-exceed-government-estimates/.

63. A. R. Brandt et al., *Methane Leaks from North American Natural Gas Systems,* 343 SCI. 733 (2014) (finding methane emissions fifty percent higher than previous EPA estimates).

64. Tim Profeta, *Study, EPA Spotlight Methane Emissions from Oil and Gas Industry*, NAT'L GEOGRAPHIC (Mar. 3, 2016), http://voices.nationalgeographic.com/2016/03/03/study-epa-spotlight-methane-emissions-from-oil-and-gas-industry/.

C. UNCERTAINTY CONCERNING THE MAGNITUDE OF THE OIL AND NATURAL GAS INDUSTRY'S FUGITIVE EMISSIONS PROBLEM BOLSTERS THE NEED FOR RESPONSIBLE REGULATION OF METHANE EMISSIONS

Strong regulations aimed at reducing methane emissions from natural gas production are essential now more than ever for three reasons. First, the current transition from coal to natural gas as the primary source for domestic energy production presents a significant opportunity to reduce the climate impacts of the energy sector. This opportunity, however, will be squandered if methane emissions from the oil and natural gas industry are not reduced. Second, reducing atmospheric methane concentrations will have a significant near-term climate benefit that will help meet global and domestic climate goals. Third, capturing fugitive methane emissions is profitable for oil and natural gas producers using currently available technology. Consequently, the climate benefits from reducing fugitive emissions are readily achievable and beneficial to the oil and natural gas industry, the public, and the environment.

The environmental benefits of natural gas over coal as an energy source are contingent on capturing the methane released during the natural gas production process. As noted above, natural gas may be viewed as a cleaner energy source than coal, but the math shows that it is only a cleaner alternative as long as no more than 3.2 percent of produced natural gas is leaked into the atmosphere.[65] Other reports place this number as low as one percent.[66] Properly understood, switching from coal to natural gas only represents a cleaner energy shift if this fugitive methane emissions tipping point is avoided. For such energy transitions to make an important difference in climate terms, methane emissions should be minimized as much as possible.

If the United States is serious about its commitment to combat climate change, then action to minimize fugitive methane emissions must start now. Climate change has already "had widespread impacts on human and natural systems," and will have much graver consequences if it is not constrained.[67] The Intergovernmental Panel on Climate Change ("IPCC") forecasts that global temperatures will increase 0.3 to 0.7 degrees Celsius by 2035 and may rise by as much as 4.8 degrees Celsius by the turn of the Twenty-second century if immediate action is not taken to reduce greenhouse gas emissions.[68] These forecasts may already be outdated. Recent evidence suggests that global temperatures may be rising faster

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65. Ramon A. Alvarez et al., *Greater Focus Needed on Methane Leakage from Natural Gas Infrastructure*, 109 PROC. OF THE NAT'L ACAD. OF SCI. 6,435, 6,437 (2012).

66. James Bradbury & Michael Obeiter, *Capturing the Fugitives: Reducing Methane Emissions from Natural Gas*, WORLD RES. INST. (Apr. 4, 2013), http://www.wri.org/blog/2013/04/capturing-fugitives-reducing-methane-emissions-natural-gas.

67. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT FOR POLICYMAKERS (2014), at 2, https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf.

68. *Id.* at 10.

than the IPCC's most recent projections suggest.[69]

Reducing fugitive methane emissions will have an important near-term effect on current global warming trends. The international community has identified preventing a two-degree Celsius increase in global temperatures above preindustrial levels as the key to avoiding the most disastrous effects of climate change.[70] If current GHG emissions levels continue to rise in concert with recent trends, the two-degree Celsius threshold will be surpassed in only thirty years.[71] More than 180 countries have pledged to significantly reduce their GHG emissions to curb this trend.[72] Meeting these pledges alone, however, will not be enough to stay below this threshold.

Reducing fugitive methane emissions is a crucial step in averting the two-degree Celsius tipping point and will have an important near-term effect on global warming in two ways. First, because methane remains in the atmosphere for a significantly shorter period of time that carbon, the payoff from reducing methane emissions will be realized much more quickly than a similar reduction in carbon emissions; methane "will be cleansed from the atmosphere fairly quickly [once] emissions cease."[73] Second, because methane is a significantly more potent GHG over a twenty-year period, reducing methane emissions will have a much greater near-term effect on warming trends than a similar reduction of carbon emissions.[74] The U.N. Environment Programme found that a forty percent reduction in global methane emissions, of which the United States is the leading source, would avoid a 0.3 degree Celsius increase in global temperatures in 2050.[75] In short, reducing fugitive methane emissions will produce a significant

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69. Susan Bauer & Mary Beckman, *The Climate Is Starting to Change Faster*, PAC. NW. NAT'L LAB., U.S. DEP'T OF ENERGY (Mar. 9, 2015), http://www.pnnl.gov/news/release.aspx?id=4186; Dana Nuccitelli, *Overlooked Evidence—Global Warming May Proceed Faster Than Expected*; *Mountains Warming Faster Than Expected as Climate Changes, Scientists Report*, U. COLO.-BOULDER NEWS CTR. (Apr. 23, 2015), http://www.colorado.edu/news/releases/2015/04/23/mountains-warming-faster-expected-climate-changes-scientists-report; Dana Nuccitelli, *Overlooked Evidence—Global Warming May Proceed Faster Than Expected*; THE GUARDIAN (Apr. 30, 2015, 10:15 PM), http://www.theguardian.com/environment/climate-consensus-97-per-cent/2015/apr/30/overlooked-evidence-global-warming-may-proceed-faster-than-expected.

70. U.N. Framework Convention on Climate Change, Conference of the Parties, Copenhagen, Den., Dec. 7-19, 2009, *Copenhagen Accord*, FCCC/CP/2009/11/Add.1 (Mar. 30, 2010).

71. *Understanding the IPCC Reports*, WORLD RES. INST., http://www.wri.org/ipcc-infographics (last visited Jan. 31, 2016).

72. Adam Vaughn, *Paris Climate Deal: Key Points at a Glance*, THE GUARDIAN (Dec. 12, 2015, 11:56 AM), http://www.theguardian.com/environment/2015/dec/12/paris-climate-deal-key-points.

73. *Frequently Asked Questions*, U.N. ENV'T PROGRAMME, CLIMATE & CLEAN AIR COAL. TO REDUCE SHORT-LIVED CLIMATE POLLUTANTS, http://www.unep.org/ccac/Science/FrequentlyAskedQuestions/tabid/133368/Default.aspx (last visited Jan. 31, 2016) (finding methane's "influence will also go away fairly rapidly after cessation" of emissions because of short lifecycle).

74. *See* discussion *supra* notes 27–28 and accompanying text.

75. *Regulatory Impact Analysis: New Source Performance Standards and Amendments to the National Emissions Standards for Hazardous Air Pollutants for the Oil and Natural Gas Industry* 4-35 to 4-36, EPA (July 2011), https://www3.epa.gov/ttnecas1/regdata/RIAs/oilnaturalgasfinalria.pdf.

near-term climate benefit that will help stave off dangerous global warming trends.

Additional regulation of methane is required to meet the United States' international and domestic climate commitments designed to avert a two-degree Celsius rise in global temperatures. The Obama Administration has set a goal of reducing methane emissions from the oil and natural gas industry by forty to forty-five percent from 2012 levels by 2025.[76] The Administration announced its Climate Action Plan ("CAP" or "the Plan") to address global warming in June 2013.[77] The Plan highlighted methane's role in global temperature increases and the oil and natural gas sector's significant contribution to the rise in atmospheric concentrations of methane.[78]

In January 2015, the Obama Administration further detailed its specific goal for reducing methane emissions from the oil and gas industry.[79] Meeting the CAP's goal will require a significant reduction in fugitive methane emissions. As of 2014, there were more than 510,000 natural gas production wells in the United States—a fifty-percent increase from 2000—and an additional 536,000 producing oil wells.[80] This number will continue to rise as domestic oil and natural gas production surges over the next decade, increasing the potential quantity of fugitive methane emissions. The CAP's forty to forty-five percent reduction goal is likely unattainable without strong federal regulations that control methane emissions from the expanding domestic oil and natural gas industry.

Lastly, reducing fugitive methane emissions from oil and natural gas operations is profitable for oil and natural gas producers, and the necessary technology is already available. Because methane is the primary component of natural gas, any methane that is lost to the atmosphere during the production process equates to a loss of profit for oil and gas companies, as that methane represents gas that cannot be transported and sold to consumers. EPA estimates that more than US$1 billion worth of natural gas is lost through domestic fugitive emissions every year.[81] Other studies estimate the losses as high as US$30 billion worldwide.[82]

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76. White House Fact Sheet, *supra* note 39.

77. THE WHITE HOUSE, CLIMATE ACTION PLAN: STRATEGY TO REDUCE METHANE EMISSIONS (2013), https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf.

78. *Id.*

79. EPA OFF. OF AIR QUALITY PLANNING AND STANDARDS, *supra* note 14, at 2; *U.S. Natural Gas Number of Gas and Gas Condensate Wells*, U.S. ENERGY INFO. ADMIN. (Dec. 31, 2015), https://www.eia.gov/dnav/ng/hist/na1170_nus_8a.htm.

80. *Id.*

81. ENVTL. DEF. FUND, *EPA's Proposed Air Rules for Oil and Gas Operations: Saving Money, Saving Lives, Protecting the Climate*, https://www.edf.org/sites/default/files/content/methane_rule_fact_sheet_in_brief.pdf (last visited Mar. 23, 2016).

82. Tom Zeller Jr., *Natural Gas Leaks: A $30 Billion Opportunity and Global Warming Menace*, FORBES (Apr. 21, 2015, 11:59 AM), http://www.forbes.com/sites/tomzeller/2015/04/21/natural-gas-leaks-a-30-billion-opportunity-and-global-warming-menace/?ss=tech#2715e4857a0b2a4d04218f81 (stating that methane leakage represents a $30 billion loss of profits for the global oil and natural gas industry).

Capturing these profits by reducing fugitive methane emissions is currently possible at a low cost to oil and natural gas producers. Reducing methane emissions forty percent below projected 2018 levels will cost the industry "less than 1% of annual industry capital expenditures" while "saving the U.S. economy and consumers over $100 [million] per year."[83] This reduction can be achieved using any one of sixty-nine available technologies that "pay back within three years," and more than half of which pay for themselves within one year.[84] Despite the cost savings available from capturing fugitive methane emissions, oil and natural gas producers have shown a reluctance to implement effective best practices and controls to minimize fugitive methane emissions. Requiring such controls will ensure that they are implemented.

IV. EPA REGULATIONS FOR REDUCING METHANE EMISSIONS FROM NEW AND MODIFIED OIL AND NATURAL GAS SOURCES DO NOT GO FAR ENOUGH

The EPA has authority to regulate methane emissions from the oil and natural gas industry under the Clean Air Act ("CAA" or "the Act"). Although the CAA did not directly address GHGs when it was drafted,[85] the Act gives EPA broad authority to determine what constitutes a pollutant that poses a threat to public health and welfare, and provides a variety of regulatory schemes to regulate industrial sources of these pollutants.[86] The U.S. Supreme Court has upheld EPA's interpretation that the CAA grants it the authority to regulate GHGs from mobile and stationary emissions sources.[87]

Section 111 of the CAA sets forth the primary mechanism for EPA to regulate GHGs from stationary sources. EPA has already taken steps to control methane emissions from new oil and natural gas sources, indirectly and directly, under section 111(b)'s New Source Performance Standards ("NSPS"). These regulatory measures are an important first step toward achieving meaningful reductions of atmospheric methane, but they do not go far enough. Additional action should be taken under section 111(d) to reduce fugitive emissions from existing sources.

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83. *ICF Methane Cost Curve Report*, ENVTL. DEF. FUND (June 2015), https://www.edf.org/energy/icf-methane-cost-curve-report.

84. Zeller Jr., *supra* note 82.

85. *See* Arnold W. Reitze, Jr., *The Intersection of Climate Change and Clean Air Act Stationary Source Programs*, 43 ARIZ. ST. L.J. 901, 922–23 (2011) (arguing that carbon dioxide is not the type of toxic pollutant that the Clean Air Act was designed to regulate).

86. *See* Nathan Richardson, *Greenhouse Gas Regulation Under the Clean Air Act: Does Chevron Set the EPA Free?*, 29 STAN. ENVTL. L.J. 283, 287 (2010).

87. Massachusetts v. EPA, 549 U.S. 497 (2007); *see* Richardson, *supra* note 86, at 292 ("The Supreme Court's well-known Massachusetts v. EPA decision in 2007 opened the door for regulation of GHGs under the CAA.").

A. EPA'S METHANE ENDANGERMENT FINDING AND INDIRECT REGULATION THROUGH THE 2012 NEW SOURCE PERFORMANCE STANDARDS

EPA took its first step to reduce methane emissions from the oil and natural gas industry in 2012. CAA section 111(b)(1)(A) requires the EPA Administrator to list industries ("categories of stationary sources") that in her judgment, "cause[], or contribute[] significantly to, air pollution which may reasonably be anticipated to endanger public health or welfare."[88] In 1979, EPA promulgated a list of stationary source categories that it deemed necessary to regulate under section 111, which include crude oil and natural gas sources as regulatory priorities.[89] The oil and natural gas source category listing gave the EPA broad authority under section 111 to regulate air pollution from any and all emissions points in the oil and natural gas production, processing, transmission, and storage processes.[90]

Listing the oil and natural industry under section 111 also triggered EPA's obligation to "establish a standard of performance for any pollutant emitted by [the oil and natural gas industry] as long as the EPA has a rational basis for setting a standard for the pollutant."[91] EPA has determined that methane is an air pollutant that "may reasonably be anticipated to endanger the public health and to endanger the public welfare of current and future generations."[92] This "endangerment finding" gives EPA the authority to regulate methane from the oil and natural gas industry under CAA section 111.

EPA finalized its first set of sweeping regulations for the oil and natural gas industry in 2012.[93] The 2012 New Source Performance Standards ("2012 NSPS") for the oil and natural gas sector targeted oil and gas emissions of volatile organic compounds ("VOCs") from new sources.[94] The 2012 NSPS sought to reduce VOC emissions in four ways. First, the rule requires natural gas producers to use "reduced emissions completions," also known as "green completions," to

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88. 42 U.S.C. § 7411 (2015).

89. EPA 2015 NSPS Proposed Rule, *supra* note 47, at 56,598.

90. *See* 42 U.S.C. § 7411(b)(1)(B); Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. at 56,600 (finding that the source listing decision gives EPA broad authority to regulate any emissions source in the oil and natural gas industry).

91. Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. at 56,601.

92. 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) ("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 . . . .").

93. Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 80 Fed. Reg. at 56,598. EPA did adopt New Source Performance Standards for the oil and natural gas industries regulating emissions of volatile organic compounds and sulfur dioxide emissions from natural gas processing plants in 1985. The 2012 NSPS significantly expanded the scope and stringency of regulations covering the source category. *Id.*

94. 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).

reduce the quantity of VOCs released when a new natural gas well is prepared for production.[95] Second, it requires VOC emissions reductions of ninety-five percent from storage vessels in the oil and natural gas production process and in the natural gas processing, transmission, and storage processes, as well as from wet seal centrifugal compressors in the production and processing segments of oil and natural gas extraction and development.[96] Third, the rule sets a bleed rate limit from pneumatic controllers that leak natural gas into the atmosphere.[97] Fourth, the rule implements heightened requirements for the detection and repair of leaks from oil and natural gas processing equipment.[98]

Although the 2012 NSPS did not directly regulate methane emissions, EPA anticipated that significant methane reductions would be an indirect effect of the rule. Oil and natural gas producers are required to install control devices on new sources to reduce VOC emissions that have the co-benefit of capturing and reducing fugitive methane emissions. Due to the co-benefit of methane reduction, EPA estimated that the 2012 NSPS, when fully implemented, will reduce methane emissions from the oil and natural gas industry by one million tons annually.[99]

The environmental effects of the 2012 NSPS are just beginning to be realized. Although oil and natural gas producers were required to implement the portions of the rule governing storage tank emissions, pneumatic controllers, and leak detection and repair in October 2012, the rule slowly phased in the requirement that natural gas wells use green completions to reduce emissions at the well head.[100] Early signs, however, are promising. EPA's 2014 GHG Inventory reported that methane emissions from the oil and natural gas industry had decreased twelve percent from 2011 levels.[101] Further emissions reductions are expected now that green completions, which significantly reduce methane emissions from hydraulically fractured wells, are required for all new natural gas wells.

B. DIRECT REGULATION OF METHANE EMISSIONS THROUGH THE 2015 NEW SOURCE PERFORMANCE STANDARDS

EPA recently built on the 2012 NSPS with its first effort to directly regulate methane emissions from the oil and natural gas sector. On August 18, 2015, EPA

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95. *Id.*; *see generally* EPA, REDUCED EMISSIONS COMPLETIONS FOR HYDRAULICALLY FRACTURED NATURAL GAS WELLS (2011), http://www3.epa.gov/gasstar/documents/reduced_emissions_completions.pdf.

96. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. at 49,492.

97. *Id.*

98. *Id.*

99. *Id.*

100. *Id.*

101. *EPA Releases Greenhouse Gas Emissions Data from Large Facilities*, EPA (Sept. 30, 2014), http://yosemite.epa.gov/opa/admpress.nsf/bd4379a92ceceeac8525735900400c27/58d0225b6c4023ea85257d63005ca960!OpenDocument.

proposed revisions to the 2012 NSPS that extend the scope of the rule to specifically regulate new sources of methane emissions from the oil and natural gas sectors. This rule practically achieved very little for segments of the oil and natural gas industry already regulated under the 2012 NSPS. EPA determined that, for companies already complying with the 2012 NSPS for VOCs, the technology currently in place to regulate VOC emissions also sufficiently reduces methane emissions to comply with the revised NSPS.[102]

The rule did institute emissions standards for new oil and natural gas emissions sources and equipment not regulated under the 2012 NSPS. Specifically, EPA is proposing to: (1) require green completions for oil wells in addition to the gas wells already regulated under the 2012 NSPS; (2) regulate methane and VOC emissions from sources "downstream" from well sites, including by requiring a ninety-five percent reduction of VOC and methane emissions from all compressors and pneumatic pumps and mandating that oil and natural gas operators replace reciprocal compressors' rod packing systems after every 26,000 hours of operation or thirty-six months.[103] The rule also requires oil and gas companies to conduct fugitive-emissions surveys at well sites and compressor stations "semiannually with optical gas imaging (OGI) technology and repair the sources of fugitive emissions within 15 days that are found during those surveys."[104]

EPA's NSPS regulations are an important first step toward regulating methane emissions from the oil and natural gas industry. EPA estimates that the revised NSPS will "prevent significant new emissions, including 170,000 to 180,000 tons of methane" in 2020, and "340,000 to 400,000 tons of methane" in 2025.[105]

V. EPA SHOULD PROMULGATE STRONG REGULATIONS FOR METHANE EMISSIONS FROM EXISTING OIL AND NATURAL GAS SOURCES

EPA's 2012 and 2015 NSPS rulemakings go a long way toward stemming the increase of fugitive methane emissions from *new* oil and natural gas production facilities, but they do not address emissions from *existing* oil and natural gas operations. The NSPS for the oil and natural gas sector only governs oil and natural gas production facilities "that commence construction, reconstruction or modification after August 23, 2011."[106] Regulating new sources alone is inadequate to address methane emissions because existing sources represent a large share of the problem and will continue to for years to come.

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102. EPA 2015 NSPS Proposed Rule, *supra* note 47, at 56,595.

103. *Id.*

104. *Id.* at 56,598–99.

105. *Id.* at 56,596.

106. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. 49,490, 49,496 (Aug. 16, 2012).

The opportunity is ripe to regulate existing sources under section 111(d) of the Clean Air Act. The 2015 NSPS triggers EPA's authority to regulate existing sources under section 111(d). EPA should seize this authority to set a federal backstop for methane emissions from existing oil and natural gas sources. Under section 111(d), EPA determines a standard that reflects the best system of emissions reduction ("BSER") for methane from the oil and natural gas sector. States are then given the flexibility to tailor implementation plans to the unique circumstances of the oil and gas industry and geology in each state in order to meet the federal standard in the most efficient way possible.

A. REGULATION OF EXISTING SOURCES IS CRUCIAL TO ACHIEVING NECESSARY NEAR- AND MID-TERM METHANE EMISSIONS REDUCTIONS FROM THE OIL AND GAS SECTOR

Regulating fugitive methane emissions from new sources only addresses the tip of the iceberg. Existing oil and gas wells will continue to contribute significant fugitive methane emissions after the 2012 and 2015 NSPS rulemakings are fully implemented. Even when anticipated emissions reductions from the 2012 NSPS are accounted for, methane emissions from "oil and gas activities are projected to grow 4.5% from 2011 to 2018."[107] Although most of the 4.5% growth will be from the oil sector, all natural gas emissions reductions due to the 2012 NSPS will be offset by an equal increase in emissions due to increased natural gas exploration and production.[108] "[B]y 2018, nearly 90 percent of the oil and gas sector's methane emissions will come from sources that were already in operation by 2011."[109] Any meaningful effort to address fugitive methane emissions must include strong regulations on existing sources.

Industry opponents of regulation claim that regulating methane emissions from existing sources is unnecessary to control the oil and natural gas sector's fugitive methane emissions problem. They argue that the shift to harnessing shale resources now accounts for the majority of domestic natural gas production. The production cycle for a shale well looks very different from that of a conventional oil or natural gas well; for the latter, the production rate drops off fifty percent in the first two years, but the drop-off then slows dramatically and the well continues to provide a solid output for twenty years or more.[110] By contrast, production in shale formations is characterized by the "Red Queen" syndrome—

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107. ICF INTERNATIONAL, ECONOMIC ANALYSIS OF METHANE EMISSION REDUCTION OPPORTUNITIES IN THE U.S. ONSHORE OIL AND NATURAL GAS INDUSTRIES 1-1 (2014), https://www.edf.org/sites/default/files/methane_cost_curve_report.pdf.

108. *Id.*

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

110. Asjylyn Loder, *U.S. Shale-oil Boom May Not Last as Fracking Wells Lack Staying Power*, BLOOMBERG BUS. (Oct. 10, 2013), http://www.bloomberg.com/bw/articles/2013-10-10/u-dot-s-dot-shale-oil-boom-may-not-last-as-fracking-wells-lack-staying-power.

wells must continually be drilled to maintain the same level of production.[111] Shale wells' level of production is usually initially higher than that of conventional wells, but production then rapidly declines. After a year, production is down sixty to seventy percent, and further production is often economically infeasible—with wells producing only five to ten percent of initial production, prompting companies to retire shale wells after just four or five years.[112]

If the productive life of a shale well is no more than four years, then "old" shale wells should phase out of production by 2016 or 2017, and the majority of remaining, producing shale wells will have commenced production after 2011 and be subject to the 2012 NSPS. Industry argues that regulating existing shale wells is unnecessary because the majority of producing shale wells will be subject to the NSPS within a couple of years, which is less time than it would take to propose and finalize a standard for these existing wells.

This argument has four major flaws. First and foremost, as documented above, the 2012 and 2015 NSPS will only reduce emissions from these sources to a limited extent. Second, although shale oil and gas dominate headlines and have led to the resurgence in domestic energy production, conventional wells still produce the majority of domestic oil and just under half of domestic natural gas.[113] This means that nearly half of the more than 500,000 natural gas wells currently operating in the United States may remain in operation for up to twenty years or more—the average life of a conventional well—and continue to emit significant quantities of methane.[114] The current NSPS regime, of course, does not reach any of these existing wells at all. Opposing EPA regulations for existing sources based on *shale* well trends would leave half of all wells unregulated.

Third, there is reason to believe that shale wells' longevity will begin to increase in the years ahead. With the advent of shale production, companies are still devising how to maximize the productive life of shale gas wells. Shale wells have steadily increased their output since 2008 as producers streamline and improve drilling techniques.[115] The productive life of shale oil and gas wells may

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111. James Wells, *Chasing the Red Queen in Frackingland*, DAILY KOS (May 22, 2014), http://www.dailykos.com/story/2014/5/22/1301062/-Chasing-the-Red-Queen-in-Frackingland.

112. Loder, *supra* note 110 ("Production from wells bored into these formations declines by 60 percent to 70 percent in the first year alone, says Allen Gilmer, chairman and chief executive officer of Drillinginfo, which tracks the performance of U.S. wells."); *see also* Peter Behr, *Beyond the Boom, Unanswered Questions About the Life of New Wells*, E&E PUB. (Feb. 12, 2013), http://www.eenews.net/stories/1059976182.

113. U.S. ENERGY INFO. ADMIN., SHORT TERM ENERGY OUTLOOK SUPPLEMENT: KEY DRIVERS FOR EIA'S SHORT-TERM U.S. CRUDE OIL PRODUCTION OUTLOOK (Feb. 14, 2013), http://www.eia.gov/forecasts/steo/special/pdf/2013_sp_02.pdf); *Marcellus, Utica Provide 85% of U.S. Shale Gas Production Growth Since Start of 2012*, U.S. ENERGY INFO. ADMIN. (July 28, 2015) (stating that natural gas produced from U.S. shale basins now accounts for 56% of U.S. dry natural production).

114. *U.S. Natural Gas Number of Gas and Gas Condensate Wells*, U.S. ENERGY INFO. ADMIN. (Dec. 31, 2015), https://www.eia.gov/dnav/ng/hist/na1170_nus_8a.htm.

115. U.S. ENERGY INFO. ADMIN., DRILLING PRODUCTIVITY REPORT (2016), http://www.eia.gov/petroleum/drilling/pdf/dpr-full.pdf.

become much longer than four years. Additionally, as new technologies are developed, it is "possible that these new methods could be used to rework existing wells and renew their productivity."[116]

Fourth, even as existing oil and natural gas wells go offline, existing infrastructure, including separators, compressors, storage tanks, and piping will likely continue to operate and simply be used to process and transport much of the natural gas from new wells. Natural gas transmission and storage is the largest source of methane emissions from the oil and natural gas industry, and natural gas transmission, storage, and processing combined represent more than half of methane emissions from the oil and natural gas industry.[117] Natural gas production, or the drilling for and extraction of natural gas at the wellhead site, contributes less than a third of the oil and natural gas industry's methane emissions.[118] While replacing existing wells with new wells subject to the NSPS will decrease methane emissions, if the new wells are connected to existing transmission, storage, and process equipment, then the oil and natural gas industry will continue to produce significant levels of unregulated emissions.

Despite claims to the contrary, the oil and natural gas industry will continue to be a significant source of methane emissions for decades to come if EPA does not regulate emissions from existing sources. Doing so will ensure that methane is not emitted unchecked, be it from conventionally drilled wells, oil and natural gas infrastructure, or shale wells.

B. EPA SHOULD REGULATE METHANE EMISSIONS FROM EXISTING OIL AND NATURAL GAS SOURCES UNDER SECTION 111(D) OF THE CLEAN AIR ACT

EPA has laid the groundwork for regulating methane emissions from existing oil and natural gas sources. Section 111(d) of the Clean Air Act gives EPA the authority to establish emissions guidelines that reflect the "best system of emission reduction" for a particular air pollutant from an existing source category.[119] Section 111(d) stipulates that EPA shall establish regulations requiring each state to establish standards governing emissions from existing sources that emit any air pollutant that meets two criteria: (1) the air pollutant is neither a criteria pollutant regulated under section 108 nor regulated as a hazardous air pollutant under section 112 of the Act; and (2) the existing source of the air pollutant would, if it were a new source, be regulated under section 111(b).[120]

Methane emissions from the oil and natural gas industry will soon match both of these criteria. First, methane is not a criteria pollutant regulated under section

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116. Hobart King, *Production and Royalty Declines in a Natural Gas Well Over Time*, GEOLOGY.COM, http://geology.com/royalty/production-decline.shtml (last visited Jan. 31, 2016).

117. EPA 2015 NSPS Proposed Rule, *supra* note 47, at 56,607.

118. *Id.*

119. 42 U.S.C. § 7411(d)(1); 40 C.F.R. § 60.22(b)(5) (2015).

120. 42 U.S.C. § 7411(d)(1).

108, nor is it a hazardous air pollutant regulated under section 112.[121] Second, so long as EPA finalizes the 2015 NSPS with methane regulations for the oil and natural gas industry intact, methane emissions from new oil and natural gas processes will be regulated under section 111(b). Consequently, promulgation of a final 2015 NSPS rulemaking regulating methane emissions from new oil and natural gas industry sources will trigger EPA's authority to regulate existing sources under section 111(d).[122]

1. Section 111(d) Uses a Federal-State Partnership to Reduce Emissions from Regulated Sources

Section 111(d) relies on collaboration between states and the federal government to achieve emissions reductions from sources regulated under the section. EPA sets a federal technology-based standard that determines the minimum level of emissions reduction that states must achieve through implementation plans.

To regulate methane from the oil and natural gas industry under section 111(d), EPA must first identify the best system of emission reduction for methane from the oil and gas industry and set a federal emissions guideline reflecting the reduction achieved by that best performing system.[123] This standard, which EPA is given broad latitude to define, serves as a floor for compliance for sources within each state.[124]

Unlike other provisions of the CAA, section 111(d) does not stipulate a methodology EPA must use to determine the BSER for an industrial pollutant. EPA is given broad discretion to choose how it calculates BSER for a pollutant from a source category under section 111(d).[125] For methane emissions from the oil and natural gas industry, EPA could express BSER in a form required under other provisions of the CAA, such as a numerical limit or work practice standards applicable to individual sources. Section 111(d), however, gives the agency the discretion to express BSER as a "basin-wide or statewide emission reduction target," as it did in the CPP.[126]

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121. *See generally* 42 U.S.C. § 7412(b); 40 C.F.R. Part 50.

122. EPA is likely required to establish regulations for existing sources of a pollutant "that would be subject to a § 111(b) standard if it were a new source" and is not regulated under section 108 or 112 of the Clean Air Act. Tomas Carbonell, *EPA's Proposed Clean Power Plan: Protecting Climate and Public Health by Reducing Carbon Pollution from the U.S. Power Sector*, 33 YALE L. & POL'Y REV. 403, 407 (2015). Whether 111(d) requires, or merely authorizes, EPA to regulate existing sources of greenhouse gases regulated under 111(b) will likely be determined in litigation over the Clean Power Plan.

123. *See* Clean Power Plan Final Rule, *supra* note 23, at 64,717–64,811.

124. *Id.*

125. *See* 42 U.S.C. § 4211(d) (2015).

126. Carlos R. Romo & Nicholas Graham, *EPA Regulation of Existing Oil & Gas Sources: Immediate and Long-Term Challenges*, BLOOMBERG BNA DAILY ENV'T REP. (Sept. 25, 2015), http://www.bakerbotts.com//media/files/ideas/publications/2015/romomethaneexistingsources-article.pdf?la=en.

Regardless of the form BSER takes, the states are given the freedom to formulate specific state plans so long as they do not fall below the federal floor. States do not have to adopt the "best" system identified by EPA; they are given the latitude to devise and adopt a system tailored to the unique circumstances of the oil and gas industry in each state so as to achieve the federal standard in the most efficient and effective way possible.[127] EPA then reviews state plans to ensure that they are reasonably designed to meet the federal guideline. EPA only imposes a methane reduction plan on a state if the state fails to submit a plan to EPA that meets these requirements.[128]

2. Regulation under Section 111(d) Is Necessary Because It Permits Each State to Craft a Methane Emissions Reduction Plan that Meets Its Particular Needs While Ensuring a Federal Backstop

Section 111(d) is a particularly appropriate avenue for regulating existing sources in the oil and natural gas industry because of the federal-state partnership it uses to reduce air pollutants. Regulatory oversight of "oil and natural gas exploration and production in the United States has always been primarily a state matter," with the federal government taking a back seat to state authorities outside of federal lands.[129] Section 111(d), however, ensures that methane emissions from the oil and natural gas industry are reduced nationwide; this reduction is achieved by drawing on the expertise of state regulators to craft reduction strategies that are tailored to each state.

State primacy in oil and natural gas regulation is due partly to longstanding practice and partly to the expertise state authorities have developed over nearly one hundred years of regulating the industry. State regulation of oil and natural gas began long before the emergence of sweeping federal environmental regulation in the 1970s.[130] Concerns about the price stability of oil initially led some states, particularly Texas, to regulate the amount and pace of production.[131] States continued to regulate on their own as new problems, including environmental concerns, arose over time. The emergence of sweeping federal environmental statutes in the 1970s did lead to the imposition of some federal standards on the oil and natural gas industry, but primary regulatory authority remained at the state level due to several exemptions for the oil and natural gas industry in federal

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127. Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. at 64,717–64,811.

128. *Id.* at 64,840 ("When a state plan is unsatisfactory, section 111(d)(2) gives the EPA the 'same' authority to promulgate a federal plan as the EPA has under section 110(c).").

129. NATHAN RICHARDSON ET AL., RES. FOR THE FUTURE, THE STATE OF STATE SHALE GAS REGULATION: APPENDICES 8–9 (2013); David B. Spence, *Federalism, Regulatory Lags, and the Political Economy of Energy Production*, 161 U. PA. L. REV. 431, 447 (2013).

130. Hannah J. Wiseman, *Regulatory Islands*, 89 N.Y.U. L. REV. 1661, 1682 (2014).

131. Spence, *supra* note 129, at 448.

laws.[132]

States have also gained significant expertise from their experience regulating the oil and natural gas industry over the course of the past century, having built complex regulatory structures governing production and intellectual capital concerning how the industry functions.[133] These regulatory programs are tailored to suit each state's "geology, topography, climate, and water resources."[134]

Despite states' traditional primacy as regulators of the oil and natural gas industry, however, federal regulation to reduce methane emissions is justified. First, negative effects of methane emissions cross state lines. Some states with large reserves of oil and natural gas, such as North Dakota and Oklahoma, are not as vulnerable to the effects of climate change as coastal states, and consequently do not have the same incentive to regulate methane emissions from the oil and natural gas industry as they would if the negative consequences were concentrated locally. This scenario—where negative externalities cross state lines and are borne by other states—is a classic justification for federal regulatory intervention.[135]

Relatedly, states have hesitated to regulate methane emissions from the oil and natural gas industry. Colorado became the first state to directly regulate methane emissions from the industry when it passed regulations a little over two years ago governing methane emissions from both new and existing sources. These regulations were innovative when passed and became the model for EPA's recently promulgated NSPS for methane emissions.[136] Few states, however, have followed Colorado's lead and issued methane emissions standards for either new or existing sources.[137]

Regulating methane emissions from existing sources under section 111(d) will ensure that methane emissions from the oil and natural gas industry are reduced while permitting states to use their significant technical expertise gained through years of regulating the industry to craft regulations tailored to the local environment. Colorado's emissions rules were lauded by the oil and natural gas industry because they "came as a result of negotiations between operators, state regulators and environmentalists whose input resulted in an approach that works in Colorado."[138]A regulation for existing sources under section 111(d) will similarly

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132. Wiseman, *supra* note 130, at 1683.

133. *See generally* MICHAEL RATNER & MARY TIEMANN, AN OVERVIEW OF UNCONVENTIONAL OIL AND NATURAL GAS: RESOURCES AND FEDERAL ACTIONS (Cong. Res. Serv. 2015).

134. *Id.* at 13.

135. Spence, *supra* note 129, at 462–63.

136. Caitlin Stafford, *The Great Escape: Addressing the Problem of Fugitive Methane Emissions from the Conventional Natural Gas System Under the Clean Air Act*, 26 COLO. NAT. RES. ENERGY & ENVTL. L. REV. 351, 369–70 (2015) (stating that Colorado became the first state to directly regulate methane emissions from the oil and natural gas industry in November 2013).

137. *See id.*

138. Mike Soraghan, *Mandates in Colo., Wyo. Didn't Prevent Job Growth*, E&E PUB. (Aug. 28, 2015), http://www.eenews.net/stories/1060024037 (quoting "Randy Hildreth of Energy In Depth, an industry-funded public relations campaign").

allow each state to work with local industry and concerned citizens to craft a plan to reduce emissions in a way that works in that individual state.

States will have ample resources to draw from. First, programs such as Colorado's can serve as models for other states. Second, states can look to steps that have been taken and technologies that have been used to comply with the NSPS. Any regulations EPA issues under section 111(d) will be promulgated after the oil and natural gas industry is required to comply with the NSPS. The NSPS compliance process will help inform oil and natural gas producers' decisions on what types of technologies best, and cost-effectively, reduce methane emissions. Third, EPA has issued guidance on how to reduce fugitive methane emissions. EPA's Natural Gas STAR program highlights "cost-effective technologies and practices that improve operational efficiency and reduce methane emissions."[139] EPA has also issued guidance recommending cost-effective measures that oil and natural gas producers can take to reduce fugitive methane emissions.[140]

Lastly, states can look to innovative measures that other states are using to comply with the CPP, which was also promulgated under section 111(d).[141] The CAA provides states with substantial flexibility to design a plan to comply with a federal methane emissions guideline for existing sources, and the technology and resources are readily available to achieve compliance in a cost-effective manner.

CONCLUSION

The sharp increase in domestic oil and natural gas production presents significant economic benefits for consumers and the oil and natural gas industry, as well as potential environmental benefits. However, if fugitive methane emissions from existing sources go unchecked, they will overshadow those near-term benefits and lead to greater damage in the long run. The oil and natural gas industry is currently the largest industrial source of methane emissions in the United States, and emissions from existing sources are not directly regulated under any federal scheme. With the exception of Colorado, state regulators have similarly declined to exercise their authority to regulate methane emissions from the oil and natural gas sector.

EPA has authority under the Clean Air Act to regulate methane emissions from new and existing emissions sources in the oil and natural gas industry. EPA has already exercised its authority under section 111(b) to regulate methane emissions from new sources through its finalized 2012 NSPS and proposed 2015

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139. *Basic Information*, EPA NAT. GAS STAR PROGRAM, http://www3.epa.gov/gasstar/basic-information/index.html (last updated Jan. 29, 2016).

140. EPA OFF. OF ENFORCEMENT AND COMPLIANCE ASSURANCE, *supra* note 53.

141. Clean Power Plan Final Rule, *supra* note 23, at 64,667 (finding that affected power plants can comply with the plan through "direct investment or operational shifts or through emissions trading").

NSPS. The latter rulemaking, when finalized, will trigger EPA's authority to promulgate standards for existing sources under section 111(d).

EPA must then set methane emissions standards for existing oil and natural gas sources. Methane emissions from existing, conventional wells and oil and natural gas processing and transportation equipment will continue to emit methane unchecked if EPA neglects its obligation to protect public health and welfare by failing to regulate the release of harmful pollutants from the oil and natural gas sector. States have exhibited an unwillingness to exercise their regulatory authority over the industry. EPA must fill this gap by mandating methane emissions reductions from existing sources under section 111(d) of the Clean Air Act.