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Natural Gas in a Carbon-Constrained World: Examining the Role of Institutions in Curbing Methane and Other Fugitive Emissions

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INTRODUCTION

This Article examines how misalignments in political and economic interests among stakeholders in the gas supply industry impact the effectiveness of relevant regulatory institutions.[1] It builds on three interrelated premises. First, law and regulation provide the cognizable framework upon which institutions facilitate underlying policy objectives. Second, in the context of gas and energy supply, the overarching policy objectives typically comprise: (i) ensuring reasonable costs borne by suppliers translates into reasonably affordable prices to consumers; (ii) security and reliability of supply; and (iii) sustainability and curbing externalities arising from the production and delivery of energy that would harm the environment, health, and safety of the public. Thirdly, it is opined that these highlighted objectives of energy policy, law, and regulation are

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1. For the purpose of this Article, there are two broad classifications of stakeholders in the gas supply industry: i.e. (1) the regulatory institutions, comprised of the government and administrative agencies and lawmakers; and (2) the regulated, comprised of upstream operators, producers and energy utilities, and pipeline companies as well as social or environmental groups that participate in or are affected by the decisions and rules made by the regulatory institutions. *See* TADE OYEWUNMI, REGULATING GAS SUPPLY TO POWER MARKETS: TRANSNATIONAL APPROACHES TO COMPETITIVENESS AND SECURITY OF SUPPLY 9–14, 78–84 (2018).

not necessarily mutually exclusive or irreconcilable. The regulatory system works more efficiently and effectively when institutions function effectively and facilitate underlying objectives. In this regard, stakeholders would also need to appreciate the peculiarities of the energy context and interrelatedness of such objectives.[2]

For instance, the vast array of supply infrastructure, market structures, and regulatory initiatives adopted over the years (which arguably tend to be more focused on cost and security of supply),[3] has enabled natural gas to reliably meet a significant proportion of energy needs in key sectors of the U.S. economy.[4] Nevertheless, upstream flaring and venting often arise due to inadequate transmission pipelines or gas gathering capacity, or other downstream offtake constraints. When flaring, venting, and leaks occur, it leads to externalities such as carbon dioxide (CO2) and methane emissions. The resulting harm is typically not internalized in the cost and sales price of produced and consumed gas. The ideal scenario implies that the relevant regulator(s) tasked with addressing such issues should be able to make a rational and informed decision as to when the environmental costs imposed by the emissions are impermissible or technically unavoidable. Likewise, such decisions should (i) be without political interference and (ii) not be seen as merely from the purview of commercial and operational expediencies.[5] Also, there should be mechanisms and

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2. *Id.*

3. *See* Richard J. Pierce Jr., *Reconstituting the Natural Gas Industry from Wellhead to Burnertip*, 25 ENERGY L.J. 57 (2004) (on the evolution of the US gas market and its regulatory framework).

4. *See U.S. Energy Facts Explained*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/energyexplained/us-energy-facts/ [https://perma.cc/UKP6-YGYZ] (last updated May 7, 2020) ('U.S. energy consumption by source and sector, 2019' and 'US primary energy consumption by major sources 1950 – 2019' charts). In 2019, natural gas accounted for 40%, 44%, and 39% of energy consumed in the industrial, residential, and commercial sectors, respectively. The demand for gas is largely driven by the competitiveness of gas prices which also fosters the switch from coal to gas utilization in the power sector, thereby reducing the carbon-intensity of the power sector. The share of natural gas in power generation increased from about 21% in 2008 to 34% in 2018. *See* INT'L ENERGY AGENCY, ENERGY POLICIES OF IEA COUNTRIES: THE UNITED STATES 2019 REVIEW 155–56 (2019); U.S. ENERGY INFO. ADMIN, ANNUAL ENERGY OUTLOOK 2020, at 62–63 (2020), https://www.eia.gov/outlooks/aeo/pdf/AEO2020%20Full%20Report.pdf [https://perma.cc/KT4T-3WNG].

5. Some of the key tenets of good quality regulation and institutional frameworks which are also instrumental to the realization of energy policy objectives include: (a) independence of regulatory institutions from undue political influence and capture; (b) clarity of roles and curtailing information

incentives to enable appropriate solutions such as capturing, storing, and utilizing fugitive emissions that would otherwise be released into the atmosphere.[6]

The U.S. federal government under President Obama in 2013 initiated the Climate Action Plan. The program inspired agencies to develop new rules and regulations such as the Environmental Protection Agency's (EPA) 2012 and 2016 New Source Performance Standards (NSPS)[7] aimed at curtailing emission of methane and Volatile Organic Compounds (VOCs) from oil and gas operations. Also, the 2016 Bureau of Land Management's (BLM) rule aimed at regulating the waste of natural gas through venting, flaring, and leaks from oil and gas activities on onshore Federal and Indian (other than Osage Tribe) leases.[8] These regulatory actions are aimed at advancing the environmental protection and sustainability dimension of U.S. energy policy. The approach required the consideration of the economic, social, and cost-benefit analysis of such environmentally-inclined rules.[9] However, a few days after the Trump-led

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asymmetry between the regulator and the regulated; (c) accountability and transparency; and (d) regular stakeholder engagement and regular assessments and performance evaluations. *See* ROBERT BALDWIN ET AL., UNDERSTANDING REGULATION: THEORY, STRATEGY, AND PRACTICE 25–39 (2012).

6. *See Recommended Technologies to Reduce Methane Emissions*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/natural-gas-star-program/recommended-technologies-reduce-methane-emissions [https://perma.cc/A7MP-TYLD] (last visited Oct. 15, 2020); Heather D. Dziedzic & Tade Oyewunmi, *Decarbonization and the Integration of Renewables in Transitional Energy Markets: Examining the Power to Gas Option in the United States,* 4 OIL GAS & ENERGY L. (2020).

7. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. 49,489 (Aug. 16, 2012) [hereinafter NSPS 2012]; Oil and Natural Gas Sector: Emission Standards for New and Modified Sources, 81 Fed. Reg. 35,823 (June 3, 2016) (amending 40 C.F.R. pt. 60, subpt. 0000 and proposing new standards at subpt. OOOOa) [hereinafter NSPS 2016].

8. Waste Prevention, Production Subject to Royalties, and Resource Conservation, 81 Fed. Reg. 83,008, 83,013 (Nov. 18, 2016) (codified at 43 C.F.R. pts. 3100, 3160, 3170) [hereinafter BLM 2016 Rule]. The regulations also clarify when produced gas lost through venting, flaring, or leaks is subject to royalties, and when oil and gas production may be used royalty-free on-site. These regulations replace the existing provisions related to venting, flaring, and royalty-free use of gas contained in the 1979 Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases, Royalty or Compensation for Oil and Gas Lost (NTL-4A), which are over 3 decades old.

9. See Exec. Order No. 13,563, 76 Fed. Reg. 3821 (Jan. 21, 2011), which provides among other things that the general principles of regulation require a

administration took office, and in-line with campaign promises, the government issued Executive Order 13,783 of March 28, 2017. Executive Order 13,783, tagged as 'Promoting Energy Independence and Economic Growth,' aimed inter alia at the removal of certain regulatory burdens that "unnecessarily obstruct, delay, curtail, or otherwise impose significant costs on the siting, permitting, production, utilization, transmission, or delivery of energy resources."[10] The executive actions that followed were intriguing and depict the contentions arising mostly from the polarized political and economic interest groups. The trend created policy flip-flops between the very prescriptive approach to regulating greenhouse gases (GHGs) and methane emissions by the EPA and the BLM under the Obama administration compared to the Trump-era deregulatory approach. Also, the contentions between interested stakeholders grew, despite the plausible counter-productive implications of such controversies from an energy policy standpoint. Some of the disputes can be seen from issues leading to and arising from cases such as the *Clean Air Council v. Pruitt*[11] and *Wyoming v. U.S. Department of Interior*,[12] discussed later in Part III below.

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regulatory system that protects public health, welfare, safety, and our environment while promoting economic growth, innovation, competitiveness, and job creation. The regulatory system must be based on the best available science, allowing for public participation and an open exchange of ideas, promoting predictability, and reducing uncertainty, while identifying and adopting the most innovative, and least burdensome tools for achieving regulatory ends.

10. Exec. Order 13,783, 82 Fed. Reg. 16,093 (Mar. 28, 2017).

11. Clean Air Council v. Pruitt, 862 F.3d 1 (D.C. Cir. 2017). The D.C. Circuit vacated the Trump EPA's administrative stay of implementing portions of the methane regulations in the NSPS 2016 rule issued by the Obama-era EPA. The EPA sought to stay further judicial review and issued a temporary stay of the prior rule pending the agency's reconsideration of those methane regulations. The court held, however, that the EPA failed to comply with the requirements for reconsideration and stay contained in Clean Air Act § 307(d)(7)(B) and therefore that the agency's action was invalid.

12. Wyoming v. U.S. Dep't of Interior, 366 F. Supp. 3d 1284 (D. Wyo. 2018), *vacated*, 768 F. App'x 790 (10th Cir. 2019). See also the *Northern Alaska Environmental Center v. U.S. Department of Interior* opinion delivered on July 9, 2020 by Judge Milan D. Smith, Jr., upholding a district court's judgment in favor of the BLM and the intervenor ConocoPhillips Alaska, Inc. in a National Environmental Policy Act ("NEPA") action brought by environmental groups challenging the BLM's 2017 offer and sale of oil and gas leases in the National Petroleum Reserve-Alaska. 965 F.3d 705 (9th Cir.), *amended at* 983 F.3d 1077 (2020). It was held that BLM's issuance of the 2012 Environmental Impact Statement (EIS) under NEPA and integrated activity plan meant that it had met

The case of *Wyoming v. Zinke* also shows the Obama-era versus Trump-era rules and regulation contest that has ensued over the past three years.[13] In *Zinke*, the Tenth Circuit Court of Appeals dismissed the suit challenging the 2015 Obama-era rule. The dismissal was based on the Trump administration's comments and the BLM's July 2017 proposal to officially rescind the Obama-era 2015 Rule.[14]

Also, in the build-up towards the NSPS 2012 and 2016 rules, there were several cases and quasi-judicial contests between industry groups, states, and local governments on the one hand and environmental groups on the other hand.[15] The BLM 2016 rule aimed at curbing waste through

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its statutory obligations for the 2017 lease sale of preparing at least an initial EIS, while the action was also time barred.

13. Wyoming v. Zinke, 871 F.3d 1133 (10th Cir. 2017). The 2015 rule was aimed at tightening the regulation of hydraulic fracturing on Federal and Native American lands.

14. Ultimately, the split three-judge panel dismissed the appeals and the lower court case as "prudentially unripe" because BLM had commenced rescinding the regulation.

15. *See* LINDA TSANG, CONG. RESEARCH SERV., R44807, U.S. CLIMATE CHANGE REGULATION AND LITIGATION: SELECTED LEGAL ISSUES 2–39 (2017); Clean Air Council et al., Petition for Reconsideration on Final Rule Published at 77 Fed. Reg. 49,490 (NSPS 2012) (Oct. 15, 2012), https://downloads.regulations.gov/EPA-HQ-OAR-2010-0505-4575/attachment_2.pdf [https://perma.cc/5GQU-AG35] (petitions by environmental groups asking EPA to reconsider 2012 NSPSs to address methane emissions, leading to further reviews and eventual issuance of the NSPS 2016). Several states including Texas, Louisiana, and Oklahoma, some state agencies, and industry and natural gas associations such as the American Petroleum Institute and Interstate Natural Gas Association of America filed petitions for a review of the NSPS 2016 final rule; while nine states and Chicago filed statements to support the EPA's final NSPS 2016 rule. Notably, several environmental advocacy groups filed counter motions to intervene in the case, thus, all petitions were consolidated with the lead case. *See* Order of Consolidation, Am. Petroleum Inst. v. EPA, No. 13-1108 (D.C. Cir. Jan. 4, 2017), http://blogs2.law.columbia.edu/climate-change-litigation/wp-content/uploads/sites/16/case-documents/2017/20170104_docket-13-1108_order.pdf. [https://perma.cc/PN83-3TGC]. In a related development after the EPA issued an Information Collection Request (ICR) pursuant to the NSPS 2016 rule to oil and natural gas companies seeking information on their existing oil and gas sources as a first step to regulating their methane, the EPA under the Trump administration withdrew the ICR to assess the need for this information and to reduce the burden it places on operators. The withdrawal was made following a letter by nine state attorneys general and two governors asking that the ICR be suspended and withdrawn. *See* Proposed Information Collection Request; Comment Request; Information Collection Effort for Oil and Gas Facilities, 81 Fed. Reg. 35,763

flaring and venting of gas by imposing a cost (i.e., royalties) on practices considered to be an avoidable waste of gas that occurs through flaring and venting. It created an obligation to capture and utilize such avoidable waste which also incidentally prevents methane emissions. Despite its objectives, the BLM 2016 rule faced significant challenges from political and economic interest groups and vehement support by environmental groups and other stakeholders.[16]

It is expected that government administrations as well as the political or economic paradigms they expound can change over time. A newly elected president is fully entitled to pursue campaign promises that imply a revision or rejection of a prior president's policies. However, it is important to keep the tenets of good quality regulatory and institutional structures. In an ideal context, such good quality institutions can better facilitate the three dimensions of an energy policy and regulation. The notion of regulatory independence and accountability suggests that institutions should be apolitical enough not to "simply discard prior factual findings without a reasoned explanation."[17] Thus, this Article seeks to highlight this normative claim by discussing the challenge of curbing methane and fugitive GHG emissions from gas supply systems. It explores the role(s) of regulatory institutions in this regard and considers the framework for regulating operations subject to private ownership of resources on the one hand and those regarding publicly owned resources and operations subject to federal regulation and oversight by agencies such as the BLM on the other hand. Note that the U.S. federal licensing and regulatory framework is also akin to the domanial paradigms in

(June 3, 2016); Notice Regarding Withdrawal of Obligation to Submit Information, 82 Fed. Reg. 12,817 (Mar. 7, 2017).

16. *See* Blake A. Watson, *Nullify, Postpone, Suspend, Stay, and Replace: The Trump Administration and the Methane Waste Prevention Rule*, 44 U. DAYTON L. REV. 363 (2019); Arnold W. Reitze, Jr., *The Control of Methane and VOC Emissions from Oil and Gas Operations in the Western United States*, 54 IDAHO L. REV. 213 (2018); 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. RESOURCES ENERGY & ENVTL. L. REV. 115 (2018).

17. In *FCC v. Fox Television Stations, Inc.*, Justice Scalia opines that agencies may reconsider past decisions and, with a reasoned explanation, to revise, replace or repeal a decision that is within their discretion. 556 U.S. 502, 515 (2009). Thus, agencies cannot run from underlying facts, contested issues, or past statutory interpretations and associated reasoning explaining past policy choices for the sake of dancing to the tunes of one interest group against the other, simply because the favored interest group supported or supports the government. *See* Jody Freeman, *The 2017 Roscoe Pound Lecture, The Limits of Executive Power: The Obama-Trump Transition*, 96 NEB. L. REV. 545, 567 (2018).

jurisdictions outside the U.S. in which ownership of land and mineral resources *in situ* is vested in the government and managed by the state.

Part I explores the facts and figures on energy-related GHG emissions, in particular, methane emissions as a potent GHG. It con siders the implications of gas flaring and venting which potentially increase the release of other unwanted externalities and air pollutants. Part II discusses the typical gas supply value chain, focusing on the strains that environmental and climate change-related regulation places on relevant operators. It discusses the legal, policy, and regulatory dynamics of gas production and supply operations and matters arising in a carbon-constrained context. Part III goes further in examining the institutions and regulatory approaches to gas supply and energy; the production boom and interconnections with electricity supply; and the challenge of controlling CO2, VOCs, and methane emissions in this regard while attempting to pursue defined energy policy objectives. It concludes by examining the undue influences faced by regulatory institutions that seem to mainly arise from divergent political inclinations and the drive to protect vested economic interests. The conclusion points out that these interests can and should be aligned to enable an effective framework that fosters innovative solutions to the challenge of GHG emissions in the oil and gas context.

I. ENERGY-RELATED EMISSIONS AND ENVIRONMENTAL EXTERNALITIES

There is a growing imperative to effectively curb the atmospheric concentration of GHGs, such as CO2 and methane. In highlighting the scientific basis for the need to decarbonize, the EPA points out that:

> [C]oncentrations of heat-trapping "greenhouse gases" . . . in the atmosphere absorb some of the energy being radiated from the surface of the Earth that would otherwise be lost to space, essentially acting like a blanket that makes the Earth's surface warmer than it would be otherwise. *Greenhouse gases are necessary to life as we know it.* Without greenhouse gases to create the natural heat-trapping properties of the atmosphere, the planet's surface would be about 60 degrees Fahrenheit cooler than present . . . . Carbon dioxide is also necessary for plant growth. With emissions from biological and geological sources, there is a natural level of greenhouse gases that is maintained in the atmosphere. *Human emissions of greenhouse gases and subsequent changes in atmospheric concentrations alter the balance of energy transfers between space and the earth system* . . . . A gauge of these changes is called radiative forcing, which is a measure of a substance's total net effect on the global energy balance for which a positive number

represents a warming effect and a negative number represents a cooling effect . . . . [The Intergovernmental Panel on Climate Change (IPCC)] concluded in its most recent scientific assessment report that it is *extremely likely that human influences have been the dominant cause of warming* since the mid-20th century.[18]

Two interesting conclusions can be inferred from the above quote. First, the release and concentration of GHGs into the atmosphere is in itself not *ipso facto* dangerous, as long as such is part of the natural systemic balance. For instance, trees and plants need CO2 which is, for instance, exhaled by humans as much as humans need oxygen released by trees and plants. The earth also needs some of the warming effects created following the release and concentration of GHGs and subsequent radiative impacts. Second, and unfortunately, over the past 200 years, human activities that are simply socio-economic or industrial have led to atmospheric changes in the natural balance of GHG concentrations in the atmosphere.[19]

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18. U.S. ENVTL. PROT. AGENCY, EPA 430-R-19-001, INVENTORY OF GREENHOUSE GAS EMISSIONS AND SINKS 1990-2017, at 1-3 (2019) (emphasis added). The report further states that "If greenhouse gas concentrations continue to increase, climate models predict that the average temperature at the Earth's surface is likely to increase from 0.5 to 8.6 degrees Fahrenheit above 1986 through 2005 levels by the end of this century, depending on future emissions and the responsiveness of the climate system." *Id.* In December 2015, the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) 21 in Paris reached a significant agreement (i.e. the "Paris Agreement") which aimed inter alia to (i) accelerate and intensify the global actions and investments needed for a sustainable low carbon future, (ii) combat climate change and adapt to its effects, and (iii) drive efforts in keeping global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Considering the role of energy-related emissions, there is growing attention on decarbonization pathways that would be consistent with 2 degrees Celsius warming scenarios. All parties to the agreement are required to implement "nationally determined contributions" (NDCs), including regular reporting obligations on emissions and reduction implementation efforts. *See* INT'L ENERGY AGENCY, ENERGY, CLIMATE CHANGE, AND ENVIRONMENT: 2016 INSIGHTS 11–12 (2016).

19. It has been reported that human activities are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with a likely range of 0.8°C to 1.2°C. Global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. *See* Masson-Delmotte et al., *Summary for Policymakers* in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GLOBAL WARMING OF 1.5°C: AN IPCC SPECIAL REPORT ON THE IMPACTS OF GLOBAL WARMING OF 1.5°C ABOVE PRE-INDUSTRIAL LEVELS AND

The greenhouse effect is primarily a function of the concentration of water vapor, CO2, methane (CH4), nitrous oxide (N2O), and other trace gases in the atmosphere that absorb the terrestrial radiation leaving the surface of the Earth.[20] Some GHGs occur naturally including water vapor, CO2, CH4, N2O, and ozone (O3). Several classes of halogenated substances that contain fluorine, chlorine, or bromine are also greenhouse gases, but those are mostly a by-product of industrial activities.[21] There are also short-lived substances with climatic effects and spatially variable radiative forcing impacts, such as carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and tropospheric (ground level) ozone (O3). The tropospheric ozone is formed from chemical reactions in the atmosphere as precursor pollutants, which include VOCs and methane and nitrogen oxides (NOx), in the presence of ultraviolet light (sunlight).[22] Although GHGs, such as carbon dioxide, methane, and N2O, are continuously emitted to and removed from the atmosphere by natural processes, it is noteworthy that anthropogenic activities, like the combustion of hydrocarbon, cement production, and heavy industry (steel and aluminum), land-use, land-use change, and forestry, agriculture, or waste management lead to the release of additional quantities changing their global average atmospheric concentrations and the natural balance.[23]

Another plausible inference is that anthropogenic emissions and the concentration of GHGs are not only a result of hydrocarbon exploration, production, and combustion. Rather, such emissions arise due to a mix of almost all activities that are essential to socio-economic development and

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RELATED GLOBAL GREENHOUSE GAS EMISSION PATHWAYS, IN THE CONTEXT OF STRENGTHENING THE GLOBAL RESPONSE TO THE THREAT OF CLIMATE CHANGE, SUSTAINABLE DEVELOPMENT, AND EFFORTS TO ERADICATE POVERTY (2018) [hereinafter IPCC Summary for Policymakers 2018].

20. *See Overview of Greenhouse Gases*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/ghgemissions/overview-greenhouse-gases [https://perma.cc/2Z94-ZDKZ] (last visited Jan. 10, 2021).

21. *Id.*

22. *Id.*

23. Agriculture, Forestry and Other Land Use (AFOLU) activities accounted for around 13% of CO2, 44% of methane (CH4), and 81% of nitrous oxide (N2O) emissions from human activities globally during 2007-2016, representing 23% (12.0 ± 2.9 GtCO2eq yr-1) of total net anthropogenic emissions of GHGs during the period. *See* P.R. Shukla et al., *Summary for Policymakers* in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE AND LAND: AN IPCC SPECIAL REPORT ON CLIMATE CHANGE, DESERTIFICATION, LAND DEGRADATION, SUSTAINABLE LAND MANAGEMENT, FOOD SECURITY, AND GREENHOUSE GAS FLUXES IN TERRESTRIAL ECOSYSTEMS (2019); *see also* IPCC Summary for Policymakers 2018, *supra* note 19.

modernization such as industry, forestry, and agriculture. Hence, advocating for the shutdown of an industry as the only pathway to decarbonization and climate mitigation without any consideration of the socio-economic and other direct or indirect implications or costs could be regarded as a one-sided approach to a three-dimensional energy policy issue. A more pragmatic and holistic approach would include a consideration of pathways through which the industry can evolve towards a carbon-neutral or decarbonized character and efficiently curb the harmful externalities of its operations and keep the socio-economic benefits.[24]

To illustrate the point, assume a scenario in which Mr. (X) has a conglomerate comprised of three companies. Company (A) manages a ranch that produces beef and milk for manufacturers of sausages and yogurt respectively. Company (B) is one that engages in building large-scale solar and wind farms, and construction. Company B also invests in international mining of resources such as lithium and cobalt in South America or Central Africa. The international mining operations are integral to company B's battery energy storage requirements and reliability of its energy systems. Both companies A and B require a significant amount of land-use and activities such as beef farming that could also result in waste management issues and methane emissions. Company (C) on the other hand engages in the production and supply of oil and gas. It is noted here that Mr. X's company (C) is more likely to be singled-out, criticized, and sued for being engaged in climate change causing activities even though all three ventures and business activities have environmental implications and contribute to GHG emissions. Thus, policy-makers and all stakeholders ought to at least objectively examine the costs and benefits of such targeted campaigns and seek more balanced and pragmatic pathways towards cleaner and decarbonized energy supply systems.[25] Given the highlighted complexities of climate change

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24. *See* Tade Oyewunmi et al., *Introduction: Energy in a Carbon-Constrained World* in DECARBONIZATION AND THE ENERGY INDUSTRY: LAW, POLICY, AND REGULATION IN LOW-CARBON ENERGY MARKETS 1–12 (Tade Oyewunmi et al. eds., 2020).

25. For a discussion on a realistic approach to addressing the environmental or climatic implications of energy, oil, and gas activities in a carbon-constrained world, where calls for banning all oil and gas activities seem to gain traction, see Monika U. Ehrman, *A Call for Energy Realism: When Immanuel Kant Met the Keep it in the Ground Movement*, 2019 UTAH L. REV. 435. *See also* Richard J. Pierce, *Pipeline Opposition Impedes Climate Change Mitigation,* REG. REV. (Sept. 13, 2018), https://www.theregreview.org/2018/09/13/pipeline-opposition-impedes-climate-change-mitigation/ [https://perma.cc/Z4WZ-7FWK].

mitigation; it is worth asking whether operators in the energy and oil and gas sector should be viewed as the problem, or only part of the problem, or considered as an essential part of the solution?[26]

Based on the U.S. EPA's *Inventory of Greenhouse Gas Emissions and Sinks 1990-2017,* Figure 1 below illustrates that energy-related emissions are the most prevalent source of GHG emissions in the U.S. It follows the IPCC sectoral classifications, which are composed of land-use and land-use change and forestry, agriculture, waste, energy, and industrial processes.[27] The emissions trend started to decline in 2014 mostly due to the growing switch from coal-fired electricity to gas-fired power and other less carbon-intensive sources; the growth in zero-carbon renewables (especially solar and wind), including energy efficiency and conservation; and the electrification of various key demand sectors, such as transportation, services, and manufacturing.[28]

26. *See* INT'L ENERGY AGENCY, THE OIL AND GAS INDUSTRY IN ENERGY TRANSITIONS: WORLD ENERGY OUTLOOK SPECIAL REPORT (2020), https://www.iea.org/reports/the-oil-and-gas-industry-in-energy-transitions [https://perma.cc/4BDN-RSR5].

27. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at ES-18; INT'L ENERGY AGENCY, *supra* note 4, at 43–44. In 2017, energy-related emissions accounted for 84% of total emissions followed by the agriculture sector (8%), industrial process emissions (6%), and the waste sector (2%). Energy-related emissions, including carbon dioxide (CO2) emissions, were mostly from fossil fuel combustion, as well as other emission sources such as methane leakage from natural gas systems as shown in Figure 3 below.

28. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at ES-18; *see also* Dziedzic & Oyewunmi, *supra* note 6.

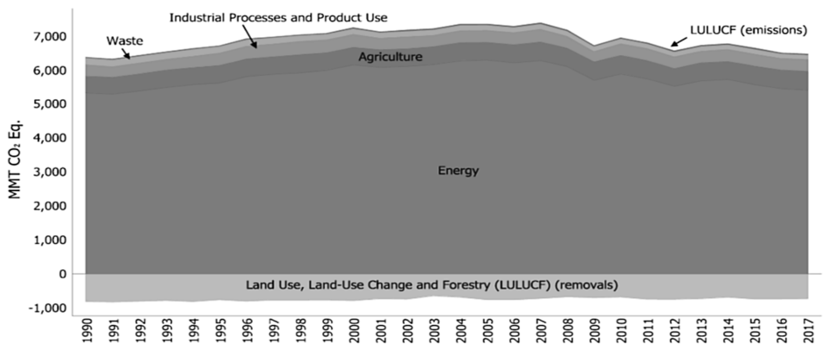

Figure 1: U.S. Greenhouse Gas Emissions and Sinks by Chapter/IPCC Sector (MMT CO2) 1990-2017[29] [see https://perma.cc/596Z-KB9V for full-color version].

The same trend can be inferred from Figure 2 below concerning the electric power sector in the U.S. Notably, GHG emissions in electricity show a steep decline from 2014 onwards compared to the rise in emissions attributable to other sectors, such as transportation, while emissions from agriculture, industrial, commercial, and residential uses remained relatively flat or the same.[30]

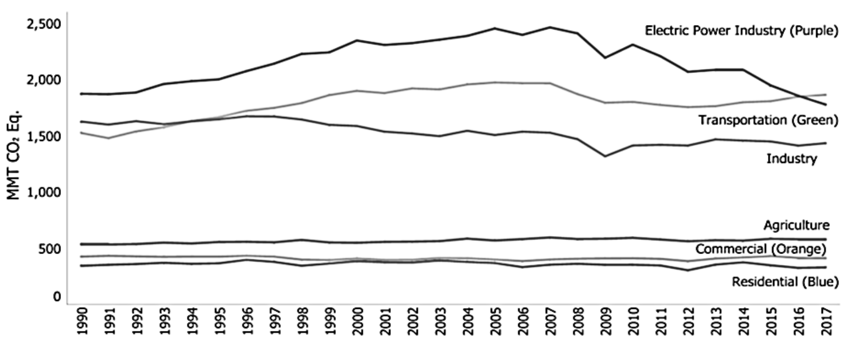

Figure 2: U.S. Greenhouse Gas Emissions by Economic Sector From 1990 to 2017[31] [https://perma.cc/596Z-KB9V].

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29. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 2-7.

30. *See* INT'L ENERGY AGENCY, *supra* note 4, at 44–46. Emissions reductions in the power sector contributed to over 70% of total reductions in energy-related emissions in the United States in the last decade. Growth in renewables and in natural gas-fired generation each accounted for roughly half of power sector emissions reductions.

31. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 2-24.

In a global context, the International Energy Agency (IEA) reports that the decrease in CO2 emissions from fossil fuel combustion is attributable in part to (i) the gradual shift from coal to natural gas in the electricity and heat sector, (ii) increased use of renewables in the electric power sector, and (iii) fluctuations in demand and energy usage and efficiency, among other reasons.[32] As the use of renewable energy increases, the carbon-intensity of energy supply systems consequently decreases. The most carbon-intensive source of electric power has been coal. Coal-fired generation accounts for 30% of global energy-related CO2 emissions.[33] Thus, it is reasonable to plan for the efficient elimination or reduction of reliance on coal by switching to cleaner primary energy sources. It is noted that a significant proportion of coal generation capacity in major emerging economies is currently just about twelve years old, even though the average economic lifespan of such coal-plants is about forty years.[34] Recent trends show that shifts in the economy and policy have driven the gradual switch from coal to gas-fired power generation thereby reducing the carbon intensity of global energy use.[35]

In the U.S., carbon-intensive coal had previously provided about half of the total primary energy for electricity generation and continues to experience a steep decline. Notwithstanding the environmental externalities,[36] a positive impact of the shale revolution is the supply of

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32. INT'L ENERGY AGENCY, GLOBAL ENERGY & CO2 STATUS REPORT 2019 (2019), https://www.iea.org/reports/global-energy-co2-status-report-2019 [https://perma.cc/YW6V-P2HF].

33. *Id.*

34. *Id.*

35. *Id.*

36. Flaring and venting of natural gas in the Permian basin in Texas and New Mexico reached an all-time record high in the third quarter of 2019, averaging more than 750 million cubic feet per day (MMcfd). Increased flaring and venting at the production wellhead is mostly attributed to higher activity levels, more production from areas with less developed gas gathering infrastructure, and basin-wide takeaway 'pipeline' capacity bottlenecks. *See Permian Gas Flaring Reaches Yet Another High*, RYSTAD ENERGY (Nov. 5, 2019), https://www.rystadenergy.com/newsevents/news/press-releases/permian-gas-flaring-reaches-yet-another-high/ [https://perma.cc/P7DK-4FTE]; Rachel Adams-Heard & Catherine Ngai, *The Permian Gas Problem is Just Getting Worse*, BLOOMBERG BUSINESS (Dec. 24, 2019), https://www.bloomberg.com/news/articles/2019-12-24/permian-gas-problem-just-gets-worse-as-shale-drilling-slows-down [https://perma.cc/V38J-APGW]. *See also* Monika U. Ehrman, *Earthquakes in the Oilpatch: The Regulatory and Legal Issues Arising Out of Oil and Gas Operation Induced Seismicity,* 33 GA. ST. U. L. REV. 609 (2017).

cheaper, less-carbon-intensive, and more abundant domestic gas.[37] Gas supply for electricity generation increased by 66% within the past ten years in the U.S.[38]

As part of the energy-sector emissions highlighted in Figure 1, it could be opined that fossil fuel combustion, natural gas systems, non-energy use of fuels, petroleum systems, coal mining, and stationary combustion all contributed to GHG emissions in the proportions highlighted in Figure 3 below. Thus, energy-related initiatives for curbing emissions should reasonably include the highlighted segments of the energy value chain.

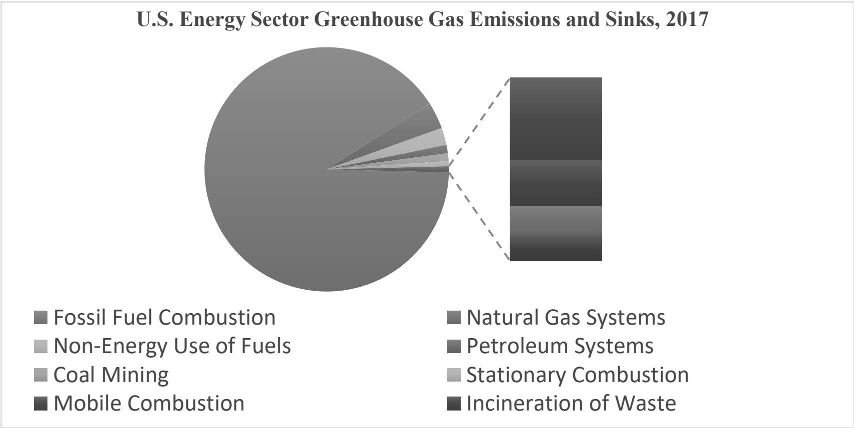

Figure 3: Sources of U.S. Energy Sector Greenhouse Gas Emissions, 2017 [see https://perma.cc/596Z-KB9V for full version].

Globally, about 15% of energy-related GHG emissions arise from oil and gas exploration, the production processes, and delivery to consumers.[39] Thus, reducing fugitive emissions and curbing avoidable leaks from oil and gas systems is a reasonable means of decarbonizing the value chain. There are ample cost-effective means of reaching such objectives. These include eliminating or minimizing gas flaring and venting, curtailing methane emissions, and integrating renewables and low-carbon electricity into new upstream and liquefied natural gas (LNG) developments. Other options include investing in carbon removal and

37. INT'L ENERGY AGENCY, *supra* note 4, at 182–83.

38. *Id.*; *see also* U.S. ENERGY INFO. ADMIN, *supra* note 4, at 62 (on 'Electricity generation from selected fuels').

39. INT'L ENERGY AGENCY, *supra* note 26.

recycling technologies,[40] carbon capture utilization and storage (CCUS),[41] or power-to-gas and hydrogen, methane gathering and reformation, bioenergy systems.[42] The oil and gas operators could also expand or transform into "energy" companies investing in and supplying an increasing amount of final, usable energy forms derivable from low or zero-carbon sources, such as hydrogen, wind, and solar.

There is now a growing trend towards climate change litigation suits against the main multinational oil operators as a means of slowing down further oil and gas development.[43] There are several reasons why such a litigious approach may not be as effective as creating an enabling environment in which the relevant firms could evolve into cleaner energy operators and more sustainable carbon-neutral or zero-carbon operators. First, there is an institutionalized web of property and economic rights, public and private contracts, international and domestic investment law, soft and hard laws, and regulatory instruments that have evolved over the past century which govern petroleum industry operations (some of which are discussed below in Part II (A) and (B) of this Article). From an international energy law and policy perspective, using one or more private firms often overlooks elements such as the built-in mechanisms for resolving energy industry-related risks and disputes which mostly have international and governmental elements involving several host governments and economies.

The International Oil Companies (IOCs) do not operate oil and gas licenses alone, rather they mostly operate under joint ventures, production sharing, and/or service or joint operating agreements with the host government and National Oil Companies (NOCs). These host governments or NOCs typically hold the majority interests under a

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40. Eli Kintisch, *Technologies*, *in* CLIMATE ENGINEERING AND THE LAW: REGULATION AND LIABILITY FOR SOLAR RADIATION MANAGEMENT AND CARBON DIOXIDE REMOVAL 28–56 (Michael B. Gerrard & Tracy Hester eds., 2018).

41. INT'L ENERGY AGENCY, *supra* note 26, at 121–60. *See also* OIL & GAS CLIMATE INITIATIVE, SCALING UP ACTION: AIMING FOR NET ZERO EMISSIONS (2019), https://oilandgasclimateinitiative.com/wp-content/uploads/2019/10/OGCI-Annual-Report-2019.pdf [https://perma.cc/W992-BWPQ].

42. *See* Dziedzic & Oyewunmi, *supra* note 6; Kintisch, *supra* note 40, at 28–56; LEGAL PATHWAYS TO DEEP DECARBONIZATION IN THE UNITED STATES (Michael B. Gerrard & John C. Dernback eds., 2019).

43. *See* Mark Clarke & Tallat Hussain, *Climate Change Litigation: A New Class of Action*, WHITE & CASE (Nov. 13, 2018), https://www.whitecase.com/publications/insight/climate-change-litigation-new-class-action [https://perma.cc/Q9XV-XF7L]. An increased sense of global urgency and public awareness around climate change-related risks, along with national laws and international commitments, is driving a new class of litigation.

contractual framework that entails the notion of "joint and several" liability.[44] Additionally, the bulk of current oil and gas reserves are held and developed by NOCs and host governments of countries whose economic development projections and socio-political programs are typically tied to revenues from oil, gas, and energy development.[45] Furthermore, it would be untenable to overlook international law principles such as "permanent sovereignty over natural resources" accorded to resource-rich countries. While a further examination of these complex issues is beyond the scope of this Article, it is useful to note Clarke and Hussain's comments that the key drivers for climate change litigation globally include: (i) compensation for the costs of adaptation to climate change; (ii) challenging climate change-related legislation and policies, or their application; (iii) preventing future emissions and contributions to climate change; (iv) requiring governments or regulators to take action to meet national or international commitments; and (v) raising awareness and exerting pressure on corporate actors, regulators or investors.[46]

A. GHGs, Methane, and VOCs

In transitional energy contexts, the issue of reliability (on the one hand) and decarbonization of natural gas exploration, production, and supply to power markets (on the other hand) are interrelated and essential. Clarifying the impact of utilizing fossil fuels (including gas, albeit to a lesser extent compared to coal) on GHG emissions is also important. So,

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44. *See* Kim Talus et al., *Lex Petrolea and the Internationalization of Petroleum Agreements: Focus on Host Government Contracts,* 5 J. WORLD ENERGY L. & BUS. 181 (2012); Terence Daintith, *Against 'Lex Petrolea'*, 10 J. WORLD ENERGY L. & BUS. 1 (2017); ERNEST E. SMITH ET AL., INTERNATIONAL PETROLEUM TRANSACTIONS 30–410 (Ernest E. Smith et al. eds., 3d ed. 2010).

45. According to the IEA, the "Majors [IOCs] account for 12% of oil and gas reserves, 15% of production and 10% of estimated emissions from industry operations. National oil companies (NOCs)—fully or majority-owned by national governments—account for well over half of global production and an even larger share of reserves. There are some high-performing NOCs, but many are poorly positioned to adapt to changes in global energy dynamics." INT'L ENERGY AGENCY, *supra* note 26.

46. Clarke & Hussain, *supra* note 43. Climate-change suits could be said to (a) hold the government to their legislative and policy commitments; (b) link the impacts of resource extraction to climate change and resilience; (c) establish that particular emissions are the proximate cause of particular adverse climate change impacts; and/or (d) establish liability for failures (of efforts) to adapt to climate change and applying the public trust doctrine to climate change.

understanding the nature of natural gas systems and how they contribute to emissions generally is useful in crafting pragmatic solutions to contain such emissions. In the U.S., natural gas systems consist of hundreds of thousands of wells, processing facilities, and over a million miles of transmission and distribution pipelines.[47] Compared to 1990 levels, there was a 14% decrease in CO2 and methane emissions from such systems in 2017, while there was a less than 1% decrease compared to 2016 emissions.[48]

Methane is the main component of natural gas, thus to design an effective decarbonization policy, understanding its occurrence alongside other relevant GHGs such as CO2 and VOCs from gas systems is essential.[49] Methane is composed of one atom of carbon and four atoms of hydrogen and typically formed through the decomposition of organic materials in the absence of oxygen.[50] Generally, it is released into the atmosphere from 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.[51] While carbon dioxide is the most prevalent GHG;[52] methane or CH4 is noted to have eighty times the global

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47. U.S. ENVTL. PROT. AGENCY, *supra* note 18; OYEWUNMI, *supra* note 1, at 85–90; Dziedzic & Oyewunmi, *supra* note 6.

48. U.S. ENVTL. PROT. AGENCY, *supra* note 18.

49. Natural gas is a combustible mixture of hydrocarbon gases that is primarily comprised of methane and could include ethane, propane, butane and pentane. Impurities such as carbon dioxide, helium, nitrogen and hydrogen sulfide can also be present. Methane is a molecule made up of one carbon atom and four hydrogen atoms, and is referred to as CH4. *See Background*, NATURALGAS.ORG, http://naturalgas.org/overview/background/ [https://perma.cc/N5MD-L3KV] (last visited Jan. 10, 2021); *Oil Field Glossary: Natural Gas*, SCHLUMBERGER, https://www.glossary.oilfield.slb.com/Terms/n/natural_gas.aspx [https://perma.cc/SD56-SSFG] (last visited Jan. 10, 2021).

50. RICHARD K. LATTANZIO, CONG. RESEARCH SERV., IF10752, METHANE EMISSIONS: A PRIMER (2018).

51. *Id.*

52. Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and other biological materials, and as a result of certain chemical reactions (e.g. manufacture of cement). Carbon dioxide is removed from the atmosphere (or "sequestered") when it is absorbed by plants as part of the biological carbon cycle. The U.S. Environmental Protection Agency (EPA) reports that in 2017 CO2 comprised 82% of GHGs, while methane was 10%, nitrous oxide was 6%, and fluorinated gases (such as hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride—synthetic,

warming potential of carbon dioxide when considered within twenty years.[53] In particular, methane stays for a much shorter period, i.e. about twelve years in the atmosphere compared to the 100 years carbon-dioxide stays in the atmosphere when emitted.[54] It reportedly has several indirect effects on human health, crop yields, and the quality and productivity of vegetation through its role as an important precursor to the formation of tropospheric ozone.[55]

Natural gas and by implication, methane, comes with several benefits as a primary source of energy. For instance, when used in power generation, the gas-fired power plant emits less than half of the amount of CO2 as a typical coal-fired power plant does and one-quarter less than oil combustion per unit of energy.[56] Additionally, using methane or gas-to-power does not lead to emissions of mercury, particulate matter, or sulfur dioxide which are emitted by coal-fired generation. Also, gas-to-power systems result in fewer nitrogen oxides per unit of energy than either coal or oil.[57] The United Kingdom (UK), for example, exemplifies the emissions-reducing impact of switching from coal to gas-fired power.[58]

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powerful greenhouse gases that are emitted from a variety of industrial processes) was 3%. *See Overview of Greenhouse Gases*, *supra* note 20.

53. LATTANZIO, *supra* note 50; Reitze, *supra* note 16, at 215.

54. Methane is a short-lived climate pollutant with an atmospheric lifetime of around 12 years. While its lifetime in the atmosphere is much shorter than carbon dioxide (CO2), it is much more efficient at trapping radiation. Per unit of mass, the impact of methane on climate change over 20 years is 84 times greater than CO2; over a 100-year period it is 28 times greater. *See* CLIMATE & CLEAN AIR COAL., 2018 ANNUAL SCIENCE UPDATE: METHANE BRIEFING REPORT 1–11 (2018), https://ccacoalition.org/en/file/4546/download?token=dnXRNg7j [https://perma.cc/WF9C-SQY4]; *see also Methane*, CLIMATE & CLEAN AIR COALITION, https://www.ccacoalition.org/en/slcps/methane [https://perma.cc/6P5E-Y8MP] (last visited Jan. 10, 2021); Reitze, *supra* note 16.

55. EPA classifies methane as both a precursor to ground-level ozone formation (commonly referred to as "smog") and a potent greenhouse gas (GHG).

56. RICHARD K. LATTANZIO, CONG. RESEARCH SERV., R42986, METHANE AND OTHER AIR POLLUTION ISSUES IN NATURAL GAS SYSTEMS 1 (updated Sept. 17, 2020).

57. *Id. See also* Richard Pierce, *The Past, Present, and Future of Energy Regulation*, 31 UTAH ENVTL L. REV. 291, 308 (2011).

58. U.K. DEP'T FOR BUS., ENERGY & INDUS. STRATEGY, 2018 UK GREENHOUSE GAS EMISSIONS, PROVISIONAL FIGURES (2019) https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/790626/2018-provisional-emissions-statistics-report.pdf. [https://perma.cc/NGZ5-85D6]. The UK's DBES reports that "Carbon dioxide emissions in the energy supply sector decreased by 7.2 per cent (7.7 Mt), between 2017 and 2018 driven by a change in the fuel mix for electricity generation . . . . Since 1990, UK

According to the UK's DBES report, even though electricity consumption was 8% higher in 2018 compared to consumption levels in 1990, the overall emissions from power stations were 68% lower in 2018 than in 1990.[59] The decline in emissions was *inter alia* attributed to the growing switch from coal to gas and renewable energy sources, such as offshore wind.[60] Advancements in energy efficiency and improvements in the technology used by energy-intensive industries were also crucial.[61] To continue playing its role in a low-carbon but the carbon-constrained world, the natural gas industry would need to deal with its emissions and environmental externalities. Such posture is also in accord with the drive for efficiently integrating the growing share of renewables in conventional and existing energy grids.[62]

The benefits of methane and natural gas include serving as a feedstock for household and industrial products such as petrochemicals, plastic, fertilizer, antifreeze, and fabrics. The value chain created along with the production, distribution and utilization of methane or natural gas comes with socio-economic impacts such as job creation and industrial development. Unfortunately, fugitive emissions from the gas production and supply chain occur mostly due to: (i) the leaks along the production, transmission, and process phases; (iii) venting and combustion of natural gas in the course of production operations; and (iii) the combustion of other fossil fuel resources or other emissions during associated operations.[63] Some methane is also emitted as a byproduct of coal mining

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carbon dioxide emissions have decreased by 39 per cent. This decrease has resulted mainly from changes in the mix of fuels being used for electricity generation, with a shift away from coal and growth in the use of renewable energy sources. This was combined with lower electricity demand, owing to greater efficiency resulting from improvements in technology and a decline in the relative importance of energy intensive industries."

59. *Id.*

60. *Id.*

61. *Id.* In 2018, coal made up only 7% of fuel used for electricity generation in the UK, down from 65% in 1990. Nuclear and renewables, which are net-zero carbon energy sources, accounted for 47% of fuels used for electricity generation in 2018, up from 22% in 1990.

62. Dziedzic & Oyewunmi, *supra* note 6.

63. LATTANZIO, *supra* note 50. Sources of emissions include road and pipeline construction; well drilling, completion, and flowback activities; and gas processing and transmission equipment such as controllers, compressors, dehydrators, pipes, and storage vessels. Pollutants include, most prominently, methane (i.e., the principal component of natural gas) and volatile organic compounds (VOCs)—of which the natural gas industry is one of the highest-

or incomplete combustion during gas flaring operations. The often suggested solutions to reduce methane emissions include pre-mining degasification, recovery, and oxidation of methane; monitoring leaks along gas transmission and distribution networks. Other initiatives are capturing, storage, gathering, and processing fugitive emissions from power generation and industrial emitters. As well as using renewable energy systems to power production operations and facilities.[64]

II. NATURAL GAS SYSTEMS UNDER CARBON CONSTRAINTS

Natural gas exploration and production occurs from associated gas fields composed of reservoirs in which oil is found together with a cap of a mixture of hydrocarbon gases including mostly methane and lesser amounts of ethane, propane, butane, pentane, and impurities such as nitrogen and helium.[65] Gas is produced from non-associated gas fields consisting of reservoirs that contain only the mixture of hydrocarbon gases and no oil. Advancements in unconventional drilling technologies, such as horizontal drilling and hydraulic fracturing, allow natural gas embedded in shale rock formations (i.e. shale gas) to be produced. The exploration and production of natural gas are capital-intensive and require significant technical expertise and resources. Likewise, the capturing, storing, gathering, and processing of gas involves a unique set of regulatory and permitting hurdles, contracting with established and creditworthy buyers, and planning.[66]

Compared to other hydrocarbons, natural gas has some peculiar features that distinguish it from oil as a primary source of energy. For example, (i) its physical properties (i.e. gas being of a lower density but higher volatility than oil), burning qualities, and thermal efficiency (gas is cleaner and relatively more efficient for power generation, especially compared to coal);[67] and (ii) the requirements for storing and marketing

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emitting industrial sectors in the United States—as well as nitrogen oxides, sulfur dioxide (SO2), and various forms of hazardous air pollutants (HAPs).

64. *Id.*; *see also* U.S. ENVTL. PROT. AGENCY, *supra* note 18; Reitze, *supra* note 16.

65. *Oil Field Glossary: Natural Gas*, *supra* note 49.

66. Pierce, *supra* note 3; Buford Pollett, *The Impact of the Interface of Regulatory Jurisdictional Issues on the Life Cycle of Natural Gas Pipelines in the United States of America*, 5 OIL GAS & ENERGY L. (2019); Tade Oyewunmi, *Examining the Role of Regulation in Restructuring and Development of Gas Supply Markets in the United States and the European Union*, 40 HOUS. J. INT'L L. 191 (2017).

67. INT'L ENERGY AGENCY, *supra* note 18.

gas are more complex. Unlike oil which can be kept in barrels and storage tanks and trucked or shipped around more easily, natural gas requires specialized tanks and shipping or pipeline transmission to get to predesignated creditworthy buyers or markets. Without such predesignated arrangements, the upstream producer (which in this general context could be the private independent producer in Oklahoma or an IOC operating together with a NOC in Mexico or Nigeria) would likely flare, vent, or keep it in the ground.[68]

Gas storage facilities are relatively more complex and expensive to maintain, requiring further costs in building processing facilities or cryogenic tanks. Operators may also use underground storage facilities such as depleted reservoirs, aquifers, and salt caverns. In the U.S. for example, there were 388 active storage fields reported with a design storage capacity of 4,791 billion cubic feet by the end of 2017 spread across 30 states.[69] The U.S. natural gas pipeline network ships gas throughout the lower 48 states via an integrated network of interstate and intrastate pipelines.[70]

Despite the already extensive gathering, transmission, and storage networks in the U.S., producers often face a challenge regarding how to treat gas whenever there is a supply boom or midstream pipeline constraint. For instance, finding available transmission pipeline capacity or assurances on timelines within which proposed processing facilities and pipelines will be completed and ready to ship the produced and processed gas to designated buyers.[71] The absence or delay in the available gas

68. OYEWUNMI, *supra* note 1.

69. INT'L ENERGY AGENCY, *supra* note 4, at 173.

70. *Id.* at 167–70. It comprises about 210 natural gas pipeline systems and over 300,000 miles (483,000 kilometers) of transmission pipelines. The state with the most developed natural gas pipelines by far is Texas (58,588 miles); the other five states with the most developed gas pipelines are Louisiana (18,900 miles), Oklahoma (18,539), Kansas (15,386), Illinois (11,900) and California (11,770). *See also* AMERICAN GAS ASSOCIATION, GAS INDUSTRY MILES OF PIPELINE AND MAIN BY STATE AND TYPE tbl.5-3 (2017) https://www.aga.org/contentassets/71fe352cf6fa4291a29be724ab0622b8/table5-3.pdf [https://perma.cc/E3SD-6K9J].

71. *See* Mark Passwaters, *Shale Has Changed Producer-Midstream Relationships, Industry Executives Say*, S&P GLOBAL PLATTS (Feb. 7, 2020), https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/020720-shale-has-changed-producer-midstream-relationships-industry-executives-say [https://perma.cc/6UQ3-JZUL]; *see also* Harry Weber, *Kinder Morgan's Tennessee Gas Proposes Infrastructure to Serve Plaquemines LNG*, S&P GLOBAL PLATTS (Feb. 7, 2020), https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/020720-kinder-morgans-tennessee-gas-proposes-infrastructure-to-serve-plaquemines-lng [https://perma.cc/WS65-J45N].

processing and pipeline capacities is often due to commercial or regulatory bottlenecks. The increasing number of protests against pipeline construction and licensing will likely worsen such delays, leaving producers with two unwholesome options, shut-in production or vent and flare associated gas.[72] As a result, the inadequacy of transmission capacity may lead to more upstream flaring or venting as a means of averting the commercial implications of a total shutdown of both the oil and gas production system.

Note also that the gas supply chain and market, especially in the U.S., comprises an unbundled sector in which:

(a) Upstream exploration and production operations are carried out in a highly competitive setting by multiple operating firms;
(b) The midstream segment involves a separate set of pipeline operators now subject to open access and its own unique economic and regulatory framework; and/or[73]
(c) Multiple downstream gas distribution networks and operators supplying gas to residential and commercial users.[74]

Understanding the dynamics and the nature of economic and property rights held by the various operators along the value chain is useful in clarifying some of the misconceptions about the real upstream and downstream implications of one-sided bottlenecks created in the different segments of the supply chain.

72. James W. Coleman, *Pipelines & Power-Lines: Building the Energy Transport Future,* 80 OHIO ST. L.J. 263 (2019); *see also* Kristi E. Swartz, *Dominion CEO Decries Legal Hurdles for Big Energy Projects*, ENERGYWIRE NEWS (July 7, 2020), https://www.eenews.net/energywire/stories/1063518465 [https:// perma.cc/U2B3-DHJU]; *Dominion Energy and Duke Energy Cancel the Atlantic Coast Pipeline*, DOMINION ENERGY (July 5, 2020), https://news. dominionenergy.com/2020-07-05-Dominion-Energy-and-Duke-Energy-Cancel-the-Atlantic-Coast-Pipeline [https://perma.cc/2F5V-YCFQ]; *see also* Arianna Skibell & Carlos Anchondo, *With Atlantic Coast Dead, Is This Pipeline Next?*, ENERGYWIRE NEWS (July 8, 2020), https://www.eenews.net/energywire/ stories/1063524537/most_read [https://perma.cc/99BG-RJQX] (on the potential delays and obstruction of the 300-mile Mountain Valley pipeline, which is being built to move natural gas from northwestern West Virginia to southern Virginia).

73. Pollett, *supra* note 66; Oyewunmi, *supra* note 66.

74. INT'L ENERGY AGENCY, *supra* note 4, at 158–63.

A. To Block or Permit the Pipelines

The controversies that led to and followed the decision in *United States Forest Service v. Cowpasture River Preservation Association* underscore the need for a holistic approach that appreciates the three dimensions of energy policy concerning project development by suppliers, rather than a one-sided and often counterproductive winner versus loser mindset amongst stakeholders regarding the permitting or blocking of projects.[75] The *Forest Service* case relates to the Atlantic Coast Pipeline designed to take gas from upstream producers in the Marcellus area in West Virginia to supply power plants and other users in Virginia and North Carolina. The sponsors decided to cancel the project *inter alia* due to ongoing delays, regulatory roadblocks, uncertainties, and hurdles that impacted the economics and feasibility of the project.[76] The crux of the dispute stems from a right-of-way granted by the National Forest Service for the pipeline sponsored by a couple of the main energy (electricity and gas) supply utilities.[77] The underground pipeline needed to "cross" the Appalachian Trail which is part of the National Park System.[78]

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75. U.S. Forest Serv. v. Cowpasture River Pres. Ass'n, 140 S. Ct. 1837 (2020).

76. *Dominion Energy and Duke Energy Cancel the Atlantic Coast Pipeline*, *supra* note 72; Iulia Gheorghiu, *Duke, Dominion Cancel $8B Atlantic Coast Pipeline*, UTILITYDIVE (July 7, 2020), https://www.utilitydive.com/news/duke-dominion-cancel-8b-atlantic-coast-pipeline/581028/ [https://perma.cc/42Y6-MC6W].

77. *Cowpasture River Pres. Ass'n*, 140 S. Ct. 1837.

78. *See Pipeline Construction Process,* ATLANTIC COAST PIPELINE, https://atlanticcoastpipeline.com/construction/construction-process.aspx [https://perma.cc/Z573-3QU5] (last visited Jan. 10, 2021); *see also* Ellen M. Gilmer, *Dominion's Atlantic Coast Pipeline Gets Supreme Court Hearing (2)*, BLOOMBERG LAW (Oct. 4, 2019), https://news.bloomberglaw.com/us-law-week/dominions-atlantic-coast-pipeline-gets-supreme-court-hearing [https://perma.cc/EMX2-JYX6]. Gilmer reports that "Dominion is developing the pipeline with Duke Energy Corp. and Southern Co. Atlantic Coast would carry as much as 1.5 billion cubic feet of natural gas per day from the Marcellus shale basin in West Virginia to customers in North Carolina and Virginia. The pipeline company says it will save consumers $377 million a year. Under the original proposal, a 0.1-mile segment would cross under the hiking trail at a depth of more than 600 feet. The exit and entry points wouldn't be visible from the trail."

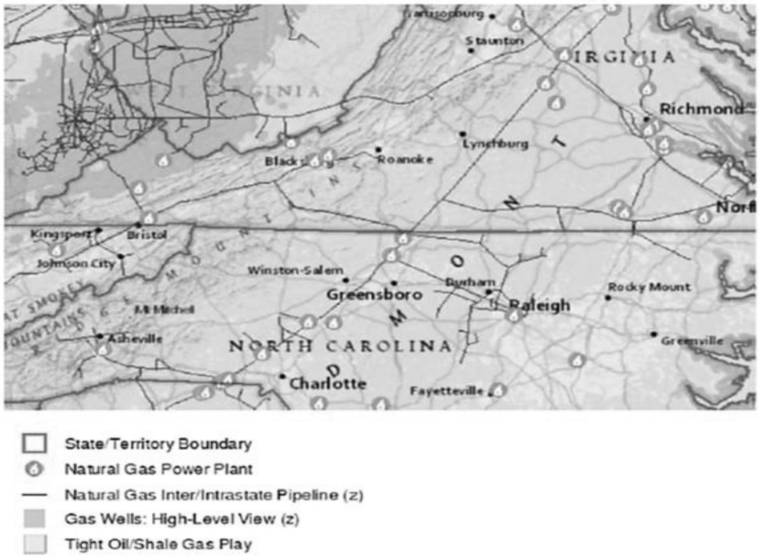

Figure 4: A Snapshot of the Appalachian Area, Gas Production Fields, Existing Transmission Lines, and Gas-Fired Power Plants from the U.S. Energy Information Administration (EIA) Energy Mapping System (last visited January 15, 2020) [https://perma.cc/596Z-KB9V].

The Fourth Circuit held that the U.S. Forest Service lacked authority under the Mineral Leasing Act (MLA) to grant the right-of-way as the trail was part of the National Park System. One of the key arguments made was that the National Park System was "expressly exempted" from the MLA's pipeline authorization provisions that empower the Forest Service to approve the right-of-way.[79] Thus, the National Park Service (as overseer of the Appalachian Trail) supposedly had the authority to grant a permit for the pipeline to cross the trail.[80] On appeal to the Supreme Court, the pipeline project sponsors argued that the Circuit Court's decision meant that a 0.1-mile section of the 600-mile pipeline would need congressional approval if found to be under the authority of the National Park Service. There was also an argument made that the Appalachian Trail should be regarded as under the jurisdiction of the National Forest Service because the National Trails System Act did not change the legal status of the lands underlying the trail, and thus, the Appalachian Trail which passes through

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79. Cowpasture River Pres. Ass'n v. Forest Service, 911 F.3d 150 (4th Cir. 2018), *rev'd*, 140 S. Ct. 1837 (2020). *See also* Taylor A. Simpson, *U.S. Forest Service v. Cowpasture River Preservation Ass'n.*, 0 PUB. LAND & RESOURCES L. REV. (2020-2021 CASE SUMMARIES) art. 7 (2020), https://scholarship.law.umt.edu/cgi/viewcontent.cgi?article=1714&context=plrlr [https://perma.cc/N6T7-VX4Y].

80. *Id.*

the George Washington National Forest is part of the jurisdiction of the Forest Service.[81] In a 7-2 decision, the Supreme Court overturned the U.S. Fourth Circuit Court of Appeals' finding that the Forest Service could not authorize the natural gas pipeline to pass hundreds of feet below the trail and held *inter alia* that since the Park Service's delegated jurisdiction over the Appalachian Trail did not transform the land over which the Trail passes into land within the National Park System, the Forest Service had the authority to issue the special use permit.[82] It was held that "[s]ometimes a complicated regulatory scheme may cause us to miss the forest for the trees, but at the bottom, these cases boil down to a simple proposition: A trail is a trail, and land is land."[83] While the Interior Department held a limited easement for establishing and administering the Appalachian Trail, the land itself remained "federal lands" under the jurisdiction of the Forest Service.[84]

The developers of the pipeline had argued that upholding the Fourth Circuit's ruling would create an impenetrable barrier to natural gas development on the East Coast, while the environmental groups opposing the project maintained that the National Park Service, which is governed by a stricter land conservation mandate than the Forest Service, is responsible for administering the scenic trail and that pipeline construction on federal lands adjacent to the trail is therefore barred. Some conservationists joined the dispute together with a group of states (particularly Delaware, New York, and Massachusetts).[85] These groups opposed the appeal and claimed that the pipeline would negatively impact the environment, aesthetics, and economic factors associated with the Trail and that there was no real justification for granting the right-of-way since gas demand is not expected to increase in the target markets.[86] Conversely, the pipeline sponsors contended in the suit that to avoid the stated environmental and aesthetic impacts to the Appalachian Trail, the pipeline was designed to be more than 600 feet below and more than a half-mile away from each side of the Trail and Parkway.[87]

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81. *Cowpasture River Pres. Ass'n*, 140 S. Ct. 1837.
82. *Id.*; *see also* Simpson, *supra* note 79.
83. *Cowpasture River Pres. Ass'n*, 140 S. Ct. at 1846.
84. *Id.*
85. Juan Carlos Rodriguez, *States Tells Justices $7B Pipeline Can't Cross Trail*, LAW360 (Jan. 23, 2020), https://www.law360.com/articles/1237115/states-tells-justices-7b-pipeline-can-t-cross-trail.
86. *Id.*
87. *Id.* More than 22,000 miles of pipelines and electric transmission lines have been safely operated through the national forests for decades.

For the sake of argument, if the Supreme Court had affirmed the Circuit Court’s decision, the sponsors of the pipeline would have needed to get congressional approval for crossing the Trail, which would add an additional layer of politicization and costs. Since the Supreme Court overturned the lower court’s decision and the right-of-way granted by the Forest Service was deemed appropriate, a lot of project planning and gas delivery contracting and arrangements would have been required as well as potential downstream energy planning, regulation, and policy implications for the respective states and end-use markets involved, while the environmental groups were also promising to continue opposing the project.

For this Article, there are useful questions worth highlighting, especially given similar disputes and issues trailing similar projects across the country. First, was there really a substantial energy policy justification for the pipeline? Second, to what extent would such energy policy justification fit into the environmental policy dimension? Is it reasonable to consider the potential for the pipeline to help in reducing gas flaring and venting that could arise upstream as well as enable a greater switch from coal to gas downstream? Are there plausible energy supply reliability and affordability benefits the pipeline could enhance to the benefit of downstream consumers and designated markets in Virginia and North Carolina even in a carbon-neutral or zero-carbon world? Will the potential impacts claimed by those opposed to the pipeline crossing the Trail outweigh the benefits or is it just a question of killing or refusing to allow gas pipelines for any possible reason? And what concrete steps and decisions can the project sponsors and relevant institutions take throughout the lifecycle of the pipeline project, i.e., from construction to decommissioning and reclamation phases to allay the fears of environmental, health, and safety harm and prevent the potential negative impacts? Lastly, how “conciliatory” was the process that led to the initial grant of a right-of-way by the Forest Service, and to what extent were the potential complainants and environmental groups and institutions such as the Park Service involved? A full consideration of these questions is beyond the scope of this Article. However, in furtherance of the aims of this Article, it is useful to examine some energy market and policy issues about Virginia and North Carolina which were the target destination for the gas volumes that were to be delivered via the pipeline.

B. More or Less Gas for Virginia and North Carolina

The U.S. Energy Information Administration (EIA) reports that in 2018, 53% of Virginia's electricity net generation was gas-fired, while zero-carbon nuclear power provided almost 31%, and carbon-intensive coal fueled about 10%, while renewable resources (mostly biomass), supplied nearly 7%.[88] Virginia is a major export hub for coal, even though local coal power plants continue to shut down nationally as discussed earlier. There certainly are energy capacity and reliability gaps to be filled if decarbonization means less coal and gas. Notably, states such as Virginia are pushing ahead with legal and policy initiatives to decarbonize electricity generation by boosting cleaner renewables. Instruments such as renewable energy portfolio standards and the Grid Transformation and Security Act of 2018 (GTSA) have been deployed.[89] However, as the transition unfolds, it is important to understand what systems are ideal for the various forms of electric power generation, i.e. baseload, intermediate, and peak loads.[90]

Considering the current mix of available technologies, including the variability and reliability constraints of renewables like solar and wind, it

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88. *Virginia State Energy Profile*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/print.php?sid=VA [https://perma.cc/2KCR-MRZA] (last updated Oct. 15, 2020).

89. The GTSA was enacted on March 9, 2018 to facilitate an additional 5,000 MW of utility-scale electric generating facilities powered by solar and wind energy in the public interest, along with up to an additional 500 MW of non-utility scale solar or wind generating facilities, including rooftop solar installations. The law also aims at encouraging electric distribution grid transformation projects and facilitating the integration of renewable generation resources into the energy systems of the energy utilities. *See* Dominion Energy, Virginia Electric and Power Company's Report of Its Integrated Resource Plan, Before the Virginia State Corporation Commission and North Carolina Utilities Commission (Public Version Case No. PUR-2018-00065 Docket No. E-100, Sub 157, May 1, 2018). Virginia's voluntary RPS goal encourages investor-owned utilities to acquire an average of 15% renewable energy sources in calendar year 2025. *See Virginia Renewable Energy and Energy Efficiency*, N.C. CLEAN ENERGY TECH. CTR., https://programs.dsireusa.org/system/program/va [https://perma.cc/L4P4-6LJP] (last visited Jan. 24, 2021).

90. Robert Walton, *Additional Gas Capacity, Baseload Generation 'Critical' to Maintaining Reliability: DOE Analysis*, UTILITYDIVE (Mar. 4, 2020), https://www.utilitydive.com/news/additional-gas-capacity-baseload-generation-critical-to-maintaining-reli/573423/ [https://perma.cc/NU94-SSC5]; *Additional Pipeline Capacity and Baseload Power Generation Needed To Secure Electric Grid*, NAT'L ENERGY TECH. LABORATORY (Feb. 20, 2020), https://netl.doe.gov/node/9516 [https://perma.cc/8HTM-Q6L3]; NAT'L ENERGY TECH. LAB., RELIABILITY, RESILIENCE, AND THE ONCOMING WAVE OF RETIRING BASELOAD UNITS, VOLUME II-A: CASE STUDY: ORGANIZED MARKETS OF THE EASTERN INTERCONNECTION (2019), https://www.netl.doe.gov/projects/files/Vol%20IIA%20-%20Markets_Case_ Study.pdf [https://perma.cc/33W4-Z96U].

can be argued that such systems are only suitable for intermediate and peak load generation rather than baseload. Thus, in resolving the energy trilemma, natural gas and nuclear generation would arguably be better options to meet capacity requirements and demand for base-load and intermediate-load facilities.[91] The long and cumbersome licensing and regulatory requirements for adding new nuclear facilities creates several drawbacks for the nuclear energy option. Thus, in an ideal scenario, natural gas power generation could meet the demands for reliability, efficiency, and relatively less or low-carbon-emissions generation systems compared to what would be if utilities continued to use coal. This is especially true if there is already a considerable number of existing pipelines and gas-fired generation facilities as shown in Figure 4 above. The alternative would be to face the challenge of building new systems that may be more expensive, subject to regulatory delays, and factor in a comprehensive plan to account for energy storage, reliability, or safety issues. Also, investing in the right carbon capturing or emission curtailing technologies for a gas-fired plant or curbing fugitive emissions, addressing communal impacts along the gas supply value chain would seem to be a more rational choice or trade-off from the energy policy trilemma purview.[92]

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91. Power generation takes three basic forms: (i) Base-load capacity generators- operated continuously to meet customer demand. These units have high capital costs but the lowest operating costs because they are in continuous use. Base-load plants are most often nuclear powered, gas- or coal-fired. (ii) Intermediate load plants are used as demand rises such as gas-fired. (iii) When demand is highest, "peak-load" generators (with low capital costs and high operating costs because of their intermittent use) are brought into operation. There must be a real-time balance between the supply of generated power and demand constantly. As the energy transition unfolds, it is becoming increasingly difficult to have enough base-load generation to meet constant and assured demand, and enough peaking capacity to meet occasional demand increases without having too much excess (and costly) capacity, i.e., unused generating capacity, at the peak. *In order to rapidly accommodate fluctuating demand, natural gas-fired plants, which have faster start up times but typically higher fuel costs, are activated gradually for peaking and intermediate demands.* Coal and nuclear plants, which can take up to 12 or more hours to start, are most effective at satisfying base-load demands. *See* JOSEPH TOMAIN & RICHARD CUDAHY, ENERGY LAW IN A NUTSHELL 382–83 (3d ed. 2016); U.S. DEP'T OF ENERGY, THE UNITED STATES ELECTRICITY INDUSTRY PRIMER 12–13 (July 2015).

92. According to the Atlantic Coast Pipeline project company, the 600-mile underground pipeline will originate in West Virginia, travel through Virginia with a lateral extending to Chesapeake, VA, and then continue south into eastern North Carolina, ending in Robeson County. Two additional, shorter laterals will connect

In Virginia, the prospects of renewables are growing considering the state has established a voluntary renewable portfolio standard (RPS) program to encourage investor-owned utilities to procure a portion of the electricity sold in Virginia from "clean" renewable energy resources.[93] The RPS goal is for 15% of the base year 2007 sales to come from eligible renewable energy sources by 2025.[94] As pointed out in Dominion Energy's IRP highlighting the GTSA it can be argued that there is a substantial

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to two Dominion Energy electric generating facilities in Brunswick and Greensville Counties. The proposed route was developed after more than three years of extensive study and meaningful engagement with landowners and communities—all with the goal of finding the best route with the least possible impact on landowners and the environment. The pipeline's main customers are five of the largest public utilities in the region and these utilities provide home heating, electricity and industrial power to millions of homes, businesses, schools and hospitals across Virginia and North Carolina. The utilities are said to need new, lower-cost supplies of natural gas to generate cleaner electricity, heat the homes of a growing population and power new industries like manufacturing. The pipelines serving our region are fully tapped and unable to keep up with consumer demand.

93. In 2007, Virginia's General Assembly established incentives to implement a RPS program. Consequently, Virginia investor-owned utilities (IOU) provide reports regarding overall generation of renewable energy and advances in renewable generation technology. In VA. ELEC. & POWER CO. D/B/A DOMINION ENERGY VA., ANNUAL REPORT TO THE STATE CORPORATION COMMISSION ON RENEWABLE ENERGY (2019), https://scc.virginia.gov/getdoc/85b96cfe-acab-4f9f-b8d1-61d2810b431b/dev_renew_19.pdf [https://perma.cc/DEH5-4T7V], Dominion for instance reports on how and to what extent it meets the approved RPS plan and commitments. *See Renewable Energy Portfolio Standards*, VA. ST. CORP. COMM'N, https://scc.virginia.gov/pages/Renewable-Energy-Portfolio-Standards [https://perma.cc/3PNK-NH4G]. Virginia's legislature passed H.B. 1526 in April 2020, which requires the development of RPS for electric utilities and suppliers. In particular, it requires Phase II Utilities to generate 100% of their power from renewable sources by 2045 and Phase I Utilities to generate 100% of their power from renewable sources by 2050. *See Renewable Portfolio Standard*, N.C. CLEAN ENERGY TECH. CTR., https://programs.dsireusa.org/system/program/detail/22133 [https://perma.cc/ AR28-622A] (last updated Aug. 27, 2020).

94. *Virginia State Energy Profile*, *supra* note 88; *See Virginia Renewable Energy and Energy Efficiency*, *supra* note 89 (stating as follows, "From 2021-2024, a Phase I and Phase II Utility may use RECs from any renewable energy facility. Renewable energy facilities, as defined by Virginia law, are energy derived from wind, sunlight, biomass, falling water, energy from waste, landfill gas, municipal solid waste, geothermal power, and wave motion. Renewable energy sources also include the proportion of electric or thermal energy from a facility that comes from the co-firing of biomass . . .").

appetite for additional energy resources falling under the definition of 'renewables' such as utility-scale and non-utility scale solar and wind energy. Looking ahead, the development and integration of such clean energy systems into existing networks and portfolios would be expected.[95] As renewable energy utilization grows, it is important to maintain the grid and off-grid energy supply reliability, affordability, and security of supply. The requirements for reliability when variable sources are increasing means that there must be more investments in advanced storage facilities, capacity adequacy, and system planning. This is especially so if gas-fired plants that currently supply most of the state's electricity are forced to shut down due to inadequate fuel (gas) supply which may arise if projects are delayed or become prohibitively uneconomic to complete.

Currently, Virginia ranks number twenty-eight in the U.S. in terms of the Average Retail Price (cents/kWh) of Electricity to Residential users at $12.39, while the state is ranked number thirteen in the U.S. in terms of Natural Gas Residential Prices ($/thousand cubic feet) at $18.71.[96] A reduction in gas supply when demand remains constant or is on the rise could lead to a corresponding increase in the pass-through-costs and then the price of gas to power and residential purposes. This is especially important for a state in which natural gas already plays a key role in electricity and energy uses. Thus, shortages and inadequacy of electricity generation capacity or supplies of reliable energy (electricity and heat) will likely harm prices consumers have to pay, especially if the scaling-up of alternative renewable energy sources is still unable to catch up at the required time and scale to meet energy and capacity adequacy requirements. In North Carolina, even though there was considerable growth in renewables (i.e. solar) in electricity generation in 2018, the trend of its existing generation mix is somewhat similar to Virginia considering the significant share of natural gas, nuclear, and coal as of 2018.[97] As more

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95. Dominion Energy, *supra* note 89.

96. *Rankings: Natural Gas Residential Prices*, *October 2019*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/rankings/?sid=NC#/series/28 [https://perma.cc/GW3Y-QVED].

97. *North Carolina State Profile and Energy Estimates*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/?sid=NC [https://perma.cc/LX8F-XTP3] (last updated Nov. 19, 2020). In 2018, natural gas fueled the largest share of North Carolina's electricity generation, surpassing nuclear power for the first time. Natural gas accounted for 33% of state generation and nuclear power contributed 31%. In 2018, North Carolina ranked second after California in its amount of installed solar power generating capacity with more than 4,100 megawatts. North Carolina ranks 30th in the US in terms of Average Retail Price of Electricity to Residential Sector, October 2019 (cents/kWh) at $12.07. The state ranks 7th in

states continue to drive the growth of cleaner and zero-carbon renewable sources through policies such as the RPS, utilities will continue to invest in a growing share of renewables as long as they can meet demand in a reasonable, affordable manner, while also meeting the sustainability of supply objectives through informed planning and investments. These three dimensions of energy policy should not be considered as mutually exclusive as stated earlier.

In Texas, which is the leading oil and gas producing state in the U.S. for example, while the production and supply of gas from the Permian basin has increased, so has the problem of gas flaring and venting. The rise in gas flaring and venting in Texas has been attributed to the ineffectiveness of the permitting process and the failure of the relevant institutions.[98] There is also the usual argument of the inadequacy of pipeline and gathering capacity. The growth in production from associated gas fields has environmental impacts on the one hand. On the other, the market-based paradigm of the gas and electricity markets in Texas also allowed zero-carbon renewable wind energy to surpass coal-fired generation and nuclear for electricity and energy over the past couple of years.[99]

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the U.S. in terms of the Natural Gas Residential Prices for 2018 which averaged $21.91 ($/thousand cu ft).

98. Colin Leyden & Scott Anderson, *To Fix Flaring, Railroad Commission Must Tackle the Incentive Problem*, ENVTL. DEF. FUND (May 29, 2020), http://blogs.edf.org/energyexchange/2020/05/29/to-fix-flaring-railroad-commission-must-tackle-the-incentive-problem/ [https://perma.cc/MPK6-CZ4A]; Colin Leyden, *Texas Oil and Gas Regulators Offer a Weak Fix to Flaring*, ENVTL. DEF. FUND (Aug. 26, 2020), http://blogs.edf.org/ energyexchange/2020/08/26/texas-oil-and-gas-regulators-offer-a-weak-fix-to-flaring/ [https://perma.cc/7AFM-XK5K].

99. *See Texas State Energy Profile*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/print.php?sid=TX [https://perma.cc/FWX9-RYZ9] (last updated Mar. 19, 2020). Although natural gas-fired power plants supplied almost half of the state's net electricity generation in 2017 and exceeded that share in 2018, more than 5,000 megawatts of Texas coal-fired generating capacity was retired in 2018 alone, while wind-powered generation has rapidly increased in the state since the first reported utility-scale generation in 2010. Thus, Texas currently leads the nation in wind-powered generation and produced one-fourth of all the U.S. wind powered electricity in 2017. Texas wind turbines have produced more electricity than both of the state's nuclear power plants since 2014.

C. From Upstream Gas to Supply Networks

Natural gas pipeline systems include gathering lines, feeder lines, transmission pipelines, and distribution lines.[100] The distribution lines, which are most common in the downstream segment, move gas to the residential, commercial, industrial, and power generation end-users.[101] The typical regulatory and operational life cycles consist of the planning phase, construction phase, operation, and maintenance phase, decommissioning and abandonment, and reclamation phases. Protracted fights over rights-of-way and/or banning new development of transmission and distribution lines, within a particular locality or state as discussed above, could have significant unintended consequences upstream and downstream. Especially when such pipeline and gathering systems are necessary to reduce upstream flaring and venting on one hand and also to supply and support downstream baseload and intermediate power generation capacity, space heating, or industrial processes on the other hand.

To decarbonize while maintaining a balanced energy policy approach, it would perhaps be less acrimonious for all stakeholders to work through the existing market systems, integrated resource planning of extant utilities, forecasting models and cost allocation, and regulatory frameworks.[102] Apart from the potential unintended consequence of flaring and venting of gas resources that cannot be commercially utilized in real-time while avoidable pipeline conflicts and bottlenecks persist, there could also be unintended consequences downstream, such as suspending investments in a less-carbon-intensive gas-fired plant. Such problems may include utilities that had planned to receive gas deliveries as these utilities may have to resort to more carbon-intensive coal-plants or less reliable energy systems to meet baseload and intermediate load capacity demands. They may also impact end-user prices, at least for the time being, while zero-carbon alternatives become cost-competitive and develop.

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100. Pollett, *supra* note 66.

101. *Id.*

102. *See* LeRoy Paddock & Karyan San Martano, *Energy Supply Planning in a Distributed Energy Resources World*, *in* INNOVATION IN ENERGY LAW AND TECHNOLOGY: DYNAMIC SOLUTIONS FOR ENERGY TRANSITIONS 371–91 (Donald Zillman et al. eds., 2018).

1. The Legal, Policy, and Regulatory Dynamics

In the U.S., private landowners have absolute or qualified ownership and property rights to oil and gas *in situ*, subject to the rule of capture.[103] Thus, oil and gas operations on privately owned land are governed by leasing arrangements between operators (lessees) and private landowners (lessors) in which the latter transfers non-possessory interests to the operator or lessee to mine, produce, and "freely" dispose of oil and gas resources. The property rights and inherent economic interests consequently created are also supported and defined by a framework of common law principles and judicial decisions involving property, contracts, and torts.[104] The scope of the structure of property rights, rules, and contractual issues is further impacted by state conservation legislation and federal statutes. Accordingly, to figure out which institutions govern particular operations and what rules apply in the context of a particular production lease or supply pipeline project's permit, it is important to distinguish activities from private-owned land and resources from publicly-owned resources on state/federal lands. The federal government owns about 30% of the land area making up the United States.[105] Such federal lands are mostly within the territories of the western states and Alaska, as well as offshore in the Outer Continental Shelf.[106] The coastal states typically own the first three miles offshore; thus, operations and resources beyond that are exclusively under the federal jurisdiction subject to the rules of international maritime boundary delimitations such as those applicable in continental shelves and exclusive economic zones.[107]

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103. M. K. Woodward, *Ownership of Interests in Oil and Gas*, 26 OHIO ST. L. REV. J. 353, 369 (1965); Bruce M. Kramer & Owen L. Anderson, *The Rule of Capture – An Oil and Gas Perspective*, 35 ENVTL. L. 899, 954 (2005).

104. JOEL EISEN ET AL., ENERGY, ECONOMICS AND THE ENVIRONMENT: CASES AND MATERIALS 149–52 (4th ed. 2015); Woodward, *supra* note 103. *See also* Keith B. Hall, *Implied Covenants and the Drafting of Oil and Gas Leases*, 7 LSU J. ENERGY L. & RESOURCES 401 (2019) (examining how the law of contract and implied contract rules have influenced the development of oil and gas and leasing).

105. CAROL HARDY VINCENT ET AL., CONG. RESEARCH SERV., R42346, FEDERAL LAND OWNERSHIP: OVERVIEW AND DATA (2020).

106. *Id.*

107. MARC HUMPHRIES & ROBERT PIROG, CONG. RESEARCH SERV., R40645, U.S. OFFSHORE OIL AND GAS RESOURCES: PROSPECTS AND PROCESSES (2012). State jurisdiction is typically limited to three nautical miles seaward of the baseline from which the breadth of the territorial sea is measured. However, the state jurisdiction off the Gulf Coast of Florida and Texas extends nine nautical miles and for Louisiana, three imperial nautical miles. Federal jurisdiction

Several federal agencies, such as BLM, implement federal laws and requirements regarding oil and gas development and production on federal lands, while each state in which oil and gas are produced has one or more regulatory agencies that administer state laws and regulations. State laws apply on federal lands except when they are preempted by federal law. Accordingly, the drilling, completion, and production operations of oil and gas on federal lands are subject to both federal and state regulations. However, if for instance, the requirements of state regulation are more stringent than those of federal regulation, the operator will comply with both the state and the federal regulation by meeting the more stringent state requirements.[108] Concerning tribal lands, the U.S. federal laws apply to oil and gas drilling, completion, and production operations.[109] Thus, operators on tribal lands will comply with both tribal and federal regulations by making sure that they comply with the stricter of those rules. Regardless of any difference in operational regulations, operators on federal lands must comply with all federal, state, and local permitting and reporting requirements. On Indian lands, they must comply with all federal and tribal permitting and reporting requirements.[110]

The U.S. Congress has the ultimate constitutional authority over the public lands and, accordingly, created a system for granting rights or licenses in federal lands under the Mineral Leasing Act of 1920 and Title V of the Federal Land Policy and Management Act of 1976.[111] The inherent "economic" interests and "property" rights conveyed in the oil and gas lease between the lessor and the lessee concerning the discovered and produced oil and gas resources arguably lies at the heart of the industry's structure and transactions. The value of such interests and its assignment is reflected in concepts such as bonuses and royalties paid to the lessor and the non-possessory rights to enter the defined land, find and take-away, and freely dispose of ("sell" or make a reasonable profit) the energy resource conveyed to the lessee. Hindrances and encumbrances to

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extends, typically, 200 nautical miles seaward of the baseline from which the breadth of the territorial sea is measured. *See also* ADAM VANN, CONG. RESEARCH SERV., R40175, WIND ENERGY: OFFSHORE PERMITTING (2012).

108. *See* U.S. BUREAU OF LAND MGMT., REGULATORY IMPACT ANALYSIS FOR THE FINAL RULE TO RESCIND OR REVISE CERTAIN REQUIREMENTS OF THE 2016 WASTE PREVENTION RULE 26–30 (2018).

109. *Id.*

110. *Id.*

111. *Mineral Leasing Act of 1920*, *in* JAMES A. HOLTKAMP, RIGHTS OF ACCESS AND SURFACE USE (1984); DAVID M. LINDAHL, CONG. RESEARCH SERV., IB82050, LEASING OF ENERGY AND MATERIAL RESOURCES ON FEDERAL LANDS (1982).

such rights and economic interests to freely dispose of discovered and produced oil and gas as a result of regulation or politically motivated activism could easily lead to claims of "expropriation" or "regulatory takings." Conversely, profit-centered actions carried out according to economic and property rights may lead to operators not taking due and just cognizance of the environmental externalities and footprints their operations create.[112] This is arguably the case in Texas and the Permian basin where gas flaring has increased sporadically in tandem with gas production.

It is important to preserve and protect economic and property rights while ensuring an affordable and secure supply of energy. However, regulation should also seek to fulfill the third dimension of energy policy, i.e. preventing or curbing the negative environmental impacts of operations in the interests of public health and safety. If regulation goes too far it could be seen as "a taking" or otherwise detrimental to the development of industry and private enterprise. The case of *WildEarth Guardians v. Zinke*[113] exemplifies the growing trend of holding regulatory institutions and operators to higher standards in balancing the pursuit of energy abundance by granting oil and gas exploration and production leases on public land and the need to consider environmental and indirect climatic implications of such awards. In *WildEarth Guardians*, the U.S. District Court for the District of Columbia barred oil and gas drilling on public lands in Wyoming, finding that the BLM failed to "sufficiently" consider climate change when authorizing the leases.[114] The court's decision signified the growing viewpoint that such "public-centered" environmental or climate change impact issues should be considered in granting rights to mine, produce, and dispose of oil and gas from public lands. The converse view is that such factors should not be considered "sufficient" grounds to enjoin or deter the awards of oil and gas leases, as long as there is a reasoned assessment of its environmental impacts vis-à-vis its costs and benefits by the designated institutions, i.e. BLM.[115] The

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112. *See Regulatory Takings*, LEGAL INFO. INST., https://www.law.cornell.edu/constitution-conan/amendment-5/regulatory-takings [https://perma.cc/PHS4-33XL] (last visited Jan. 10, 2021) (discussing the regulation and powers of the state to hinder or encumber the use of economic and property rights); Alexandra B. Klass, *Takings and Transmission*, 91 N.C. L. REV. 1079 (2013).

113. *See* WildEarth Guardians v. Zinke, 368 F. Supp. 3d 41 (D.D.C. 2019).

114. *Id.*

115. *Id.* In August 2016, WildEarth asked the Federal District Court in D.C. to vacate authorizations for almost 400 oil and gas leases on public lands granted by the BLM in in three states because BLM had not complied with the National Environmental Policy Act (NEPA) regarding the assessment of direct, indirect,

need for such a reasoned assessment of environmental impacts vis-à-vis its costs and benefits underscores the pivotal role of regulatory institutions in balancing the energy policy trilemma.

The D.C. Circuit rejected the plaintiffs' contention that BLM was required to use certain protocols, i.e. the "social cost of carbon" and the "global carbon budget" to quantify climate change impacts of oil and gas operations arising from the leases.[116] Interestingly, the court did not vacate the leasing decisions but enjoined BLM from authorizing new oil and gas drilling on the leases while the Agency conducts its additional "environmental assessments" and "analysis" of the indirect climatic impacts. BLM, later on, carried out the supplemental environmental assessment for the oil and gas leases, and thus, on July 19, 2019, the court denied a request by WildEarth to enjoin the BLM from authorizing new oil and gas drilling on Colorado and Utah leases.[117] The push for considering environmental and climatic impacts of local U.S. gas supply and commercialization projects has also spread towards export pipelines and LNG projects.[118]

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and cumulative climate effects associated with the leases. Thus, the D.C. Court was asked to enjoin BLM from approving drilling applications until it complies with NEPA. Subsequently, three oil and gas trade associations intervened in relation to leases granted in Colorado, Utah, and Wyoming. In March 19, 2019, the Court ruled that BLM did not sufficiently consider the climate change effects of oil and gas leasing in its National Environmental Policy Act (NEPA) review for 282 lease sales covering more than 303,000 acres in Wyoming. It found that BLM did not critically consider drilling-related and downstream greenhouse gas emissions associated with the leases and that BLM failed to "sufficiently compare those emissions to regional and national emissions." With respect to downstream emissions from combustion of oil and gas, the court found that such emissions were indirect effects of the oil and gas leasing under the applicable "heightened" causation standard. Regarding cumulative effects, the court ruled that BLM's refusal to quantify greenhouse gas emissions as required by NEPA rendered its cumulative impacts analysis inadequate.

116. *Id.*

117. *Id.*; Nicole A. Jensen, *U.S. District Court Decision Regarding Drilling on Federal Land*, 8 INST. FOR ENERGY L.: THE ENERGY DISPATCH 10-12 (2020).

118. D. Ryan Cordell, Jr., Sierra Club v. Federal Energy Regulatory Commission*: The D.C. Circuit Upholds FERC's Regional NEPA Analysis for Freeport Projects; Punts on Issue of LNG Export Environmental Impacts,* 30 TUL. ENVTL. L.J. 123 (2016). In the *Sierra Club v. FERC* (Freeport) case, two environmentalist groups claimed that the FERC did not adequately consider the indirect environmental effects of a possible increase in domestic natural gas production which would be induced by the approved Freeport LNG export Projects as well as the cumulative environmental impacts of the Freeport Projects

2. International Developments and Gas Commercialization

Outside the U.S. and Canada, most other jurisdictions adopt a domanial resource ownership system in which the property rights in and ownership of oil and gas or mineral resources *in situ* are vested in the state and managed by the host government.[119] Consequently, the host government grants concessions, licenses, or contracts with an administrative nature and participates directly in operations through the NOC.[120] Upon establishing a framework for exploration and production, the relevant parties enter into transportation and supply agreements between a producer(s) and a pipeline company and/or downstream buyer which establishes further entitlements, obligations, and interests along the value chain.[121] Ideally, the property rights and interests awarded via the concession or license, permit the holder to find, produce, take-away, and freely dispose of oil and gas within the defined acreage or parcel of land and subject to the applicable petroleum laws, policy, and regulations of the host country.[122]

As depicted in Figure 5 below, the typical gas supply production and supply value chain consists of gas producers in the upstream segment who hold a license to explore, find and produce gas, which is thereon, gathered through small-diameter pipelines (gathering lines) from oil and/or gas fields;[123] the gas molecules then go through the processing facilities to remove water and impurities, compressed to boost its pressure to enable it to flow into large transmission pipelines in the midstream segment, owned and operated by gas pipeline firms and then transported to storage, distribution, or marketing centers downstream.

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in light of other proposed or authorized natural gas export projects across the country.

119. YINKA OMOROGBE, OIL AND GAS LAW IN NIGERIA (2003); Tade Oyewunmi, *Natural Gas Exploration and Production in Nigeria and Mozambique: Legal and Contractual Issues*, 13 OIL GAS & ENERGY L. 1 (2015); Lanre Aladeitan, *Ownership and Control of Oil, Gas, and Mineral Resources in Nigeria: Between Legality and Legitimacy*, 38 T. MARSHALL L. REV. 159 (2012).

120. *See* OYEWUNMI, *supra* note 1, at 15–20.

121. Peter Roberts & Ruchdi Maalouf, *Contractual Isssues in International Gas Trade: LNG – The Key to the Golden Age of Gas*, *in* RESEARCH HANDBOOK ON INTERNATIONAL ENERGY LAW 329–57 (Kim Talus ed., 2014). In most cases the NOC disposes of its share of produced gas through a subsidiary national gas transmission and distribution company.

122. OYEWUNMI, *supra* note 1, at 15–20.

123. Oyewunmi, *supra* note 119; SMITH ET AL., *supra* note 44, at 1022–1101.

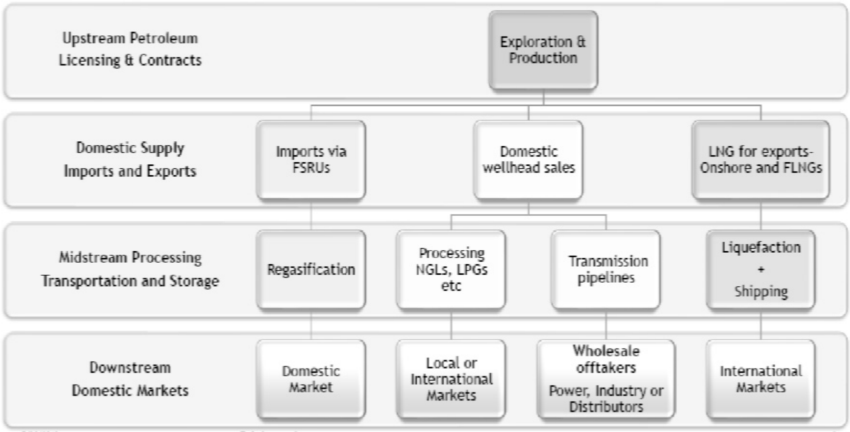

Figure 5: Gas Production and Commercialization Supply Chain [https://perma.cc/596Z-KB9V].

The main avenues to commercializing produced gas and by-products of processing, such as Natural Gas Liquids (NGLs) and LNG, is via the domestic market and exports via LNG to international buyers.[124] Depending on the objectives of the parties involved, the processed gas could be sold to the domestic market in the country where the production took place or exported via LNG or cross-border pipelines. In the U.S., the exportation of gas through LNG is subject *inter alia* to the regulatory oversight of the Federal Energy Regulatory Commission (FERC) and includes the assessment of environmental impacts as mentioned earlier.[125]

Gas processing and midstream activities could also be designed to produce NGLs and Liquefied Petroleum Gas, or cooking gas carried to residential and commercial areas through distribution pipelines and other small-scale systems. Recently, there has been an increase in the deployment of offshore Floating LNG facilities, while Floating Storage and Regasification Units are now very popular to import LNG and regasify it into a usable form in countries with limited access to cross-border pipelines and little or no domestic gas resources.[126] Over the past three

124. *See* MIKE FULWOOD & THIERRY BROS, FUTURE PROSPECTS FOR LNG DEMAND IN GHANA (2018), https://www.oxfordenergy.org/wpcms/wp-content/uploads/2018/01/Future-prospects-for-LNG-demand-in-Ghana-Insight-26.pdf [https://perma.cc/G538-RWWC]; EZEKIEL ADESINA ET AL., UNDERSTANDING NATURAL GAS AND LNG OPTIONS (2016).

125. Cordell, *supra* note 118.

126. *Id.*; Susan L. Sakmar, *Global Gas Markets: The Role of LNG in the Golden Age of Gas and the Globalization of LNG Trade,* 35 HOUS. J. INT'L L. 655 (2013); Roberts & Maalouf, *supra* note 121.

decades, these commercialization options and global gas supply trends have been enhanced by more gas discoveries; structural reforms leading to better economic regulation and pricing in major consuming markets globally; the policy-driven quest to reduce carbon-intensive and air-polluting coal.[127]

D. Sources of Emissions From the Gas Patch

Figure 6 below portrays the segments of the natural gas supply chain and the main sources of methane emissions from each sub-sector. As discussed earlier, methane is the chief constituent of natural gas, and it is a potent GHG. However, it stays in the atmosphere for a much shorter period compared to carbon dioxide.[128] Thus, curbing or eliminating methane emissions is widely regarded as a promising means of tackling near-term global warming while the necessary long-term cuts in CO2 emissions are implemented.[129]

127. Compared to 2017, global gas consumption rose by an estimated 4.6% in 2018, its highest annual growth rate since 2010. *See Global Gas Security Review*, INT'L ENERGY AGENCY (Sept. 2019), https://www.iea.org/reports/global-gas-security-review-2019 [https://perma.cc/59J3-SC8N]; *Golden Rules for a Golden Age of Gas*, INT'L ENERGY AGENCY *(Oct. 2013),* https://www.iea.org/reports/golden-rules-for-a-golden-age-of-gas [https://perma.cc/66X6-FNVY].

128. The atmospheric lifespan of methane is reported to be for about 12 years after it has been emitted, while carbon dioxide is estimated to have an atmospheric lifetime of 50-200 years. *See* U.S. ENVTL. PROT. AGENCY, *supra* note 18; Ehrman, *supra* note 25.

129. Ehrman, *supra* note 25.

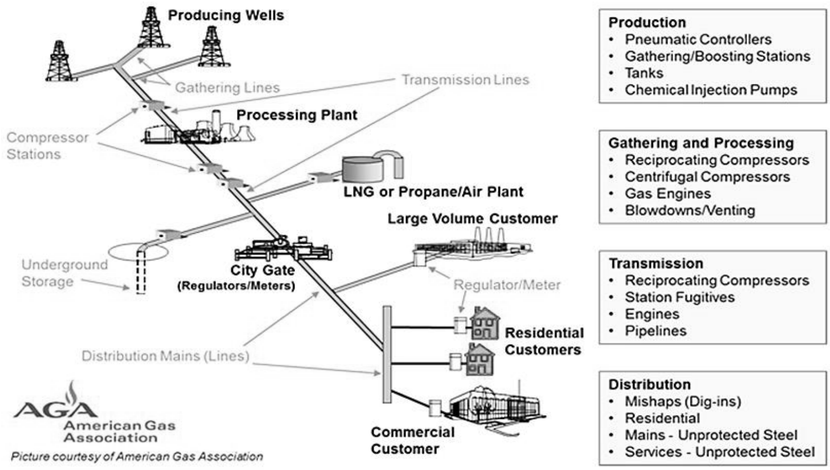

Figure 6: Gas Supply and Methane Emission Sources[130] [https://perma.cc/596Z-KB9V].

Natural gas distribution systems recorded the lowest rate of emissions, and there was a significant reduction in emissions reported from the 1990-2018 period.[131] The gas transmission and storage segment comes next and then the exploration segments of the gas supply chain. Methane emissions from oil (petroleum) production systems have decreased by five percent since 1990, due to declining emissions from tanks, hydraulically fractured oil well workovers, and offshore platforms.[132] Conversely, CO2 emissions from petroleum production systems remained relatively high with the main sources arising from the flaring of associated gas, oil tanks with flares, and miscellaneous production flaring. [133]

Regarding gas production systems, including gathering and boosting facilities,[134] the reported emissions were mostly from production wells and well-site gas treatment equipment, such as dehydrators and separators.[135] In the U.S., the pattern of methane and CO2 emissions related to natural gas systems appears in tandem with the boost in domestic oil and gas

130. *Overview of the Oil and Natural Gas Industry*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/natural-gas-star-program/overview-oil-and-natural-gas-industry [https://perma.cc/ZKQ8-QN4E] (last visited Jan. 10, 2021).

131. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 3-82.

132. *Id.* at 3-64.

133. *Id.*

134. *See supra* Fig. 6 (The gathering and boosting stations receive natural gas from production sites and transfer it via gathering pipelines to transmission pipelines or processing facilities. Custody transfer points are typically used to segregate sources between each segment.).

135. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 3-64.

production, especially from associated gas fields over the past decade. The domestic production of dry gas witnessed a 53% increase from 1990 to 2017; while methane emissions from production also increased by 62% from 1990 to 2017.[136] The main sources for the emissions are reported to be from pneumatic controllers,[137] seemingly due to an uptick in the number of controllers required as well as more gathering and boosting stations needed to enhance growing production operations and activities. The principal sources of CO2 emissions are associated gas flaring, oil tanks with flares, and miscellaneous production flaring.[138] This trend is attributable to some of the issues discussed earlier such as limited or inadequate gathering and processing facilities upstream, and connecting pipelines which may also be due to the existence of a viable wholesale market and the downstream demand, e.g., from a gas-fired power generator or utility. Also, there is the case of flaring to control tank emissions and offshore flaring.[139]

The highlighted trends and complexities of curbing emissions from petroleum and natural gas systems underscore the importance of thorough reporting and monitoring standards and rules. Such reporting requirements would enhance the ability of an independent regulatory institution to make informed decisions as well as the industry's ability to efficiently invest in the required innovative systems to curb the harmful externalities.

Emissions vary from facility to facility, thus operators may be in the best position to develop effective solutions based on reasonable standards of monitoring, reporting, and curtailments developed by relevant institutions.[140] Some of the identified cost-efficient approaches to curtailing emissions include detecting and fixing equipment leaks, deploying satellite technologies as recommended by the Oil and Gas

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136. *Id.* ("Methane and non-combustion CO2 emissions from natural gas systems include those resulting from normal operations, routine maintenance, and system upsets. Emissions from normal operations include: natural gas engine and turbine uncombusted exhaust, flaring, and leak emissions from system components. Routine maintenance emissions originate from pipelines, equipment, and wells during repair and maintenance activities. Pressure surge relief systems and accidents can lead to system upset emissions.").

137. *Id.* at 3-64.

138. *Id.* at 3-64 to 3-65.

139. *Id.* at 3-80 to 3-81.

140. INT'L ENERGY AGENCY, ENERGY SECTOR METHANE RECOVERY AND USE: THE IMPORTANCE OF POLICY (2009). Some emissions are accidental, for example because of a faulty seal or leaking valve, while others are deliberate, often carried out for safety reasons or due to the design of the facility or equipment.

Climate Initiative,[141] and implementing reduced emissions completion technologies (green completions) for unconventional gas wells. Another commercial approach is to incentivize operators or third-party users to capture gas that would ordinarily be flared (flare gas) or vented as in the case of Nigeria's recent Flare Gas Commercialization Programme.[142]

1. From Penalties to Commercializing Flare Gas in Nigeria

Earlier attempts at issuing penalties alongside a pronouncement of deadlines to stop routine flaring and venting in Nigeria failed mostly due to identifiable regulatory and institutionalized factors.[143] Firstly, like many other oil and gas-rich countries globally, the operators were more interested in oil rather than gas. Although significant commercial interests in gas have grown since the late 1990s, as well as domestic gas demand,[144] the domestic prices for gas supply to power were often not reflective of reasonable and projected costs of supplying the needed volumes. As a result, most oil and gas producers found it cheaper to flare and pay penalties rather than invest in new processing and domestic pipelines to supply at below-market prices. Although, there were bilateral domestic

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141. OIL & GAS CLIMATE INITIATIVE, AT WORK: COMMITTED TO CLIMATE ACTION 19 (Sept. 2018), https://oilandgasclimateinitiative.com/wp-content/uploads/2018/09/OGCI_Report_2018.pdf [https://perma.cc/BR6U-43KA].

142. Stephen Oluwaṣeun Ọkẹ, *Gas Flaring in Nigeria and the Flexed Muscles of the 2018 Regulations: Key Implications and Investment Considerations*, OIL GAS & ENERGY L., no. 1 (2019), www.ogel.org/article.asp?key=3806 [https://perma.cc/XAY6-HFFW].

143. The Associated Gas Re-Injection Act 1979 ('Associated Gas Act') 147 and the Associated Gas Reinjection (Continued Flaring of Gas) Regulations 1984 provided for exemptions to a general legal ban on gas flaring and applicable penalties. Unfortunately, the general ban on gas flaring and the approach of imposing penalties while announcing dates to end flaring has been ineffective over the years. In reality, most producing fields and operators were exempted from anti-gas flaring provisions, and the remaining fields were often subject to insignificant penalties which made flaring more economical than building utilization infrastructure or carrying out gas reinjection. Yinka Omorogbe, *Law and Investor Protection in the Nigerian Natural Gas Industry*, 14 J. ENERGY & NAT. RESOURCES L. 179 (1996).

144. Although several large local industries that used natural gas could afford to pay market-based rates, the gas-dependent power sector faced significant debt and liquidity issues for several years which reforms and liberalization initiatives launched in the 2000s aimed at addressing. *See* Rahmattallah Poudineh & Tade Oyewunmi, *Natural Gas in Nigeria and Tanzania: Can it Turn on Lights?*, OXFORD ENERGY FORUM, Sept. 2018, at 14–20.

wholesale supplies mostly to large buyers, industrial users, and some power generators.[145] Most of the produced and processed gas was also designed for export projects, such as the West African Gas Pipeline and the Nigerian LNG Project.[146] Secondly, like most other producing countries outside the U.S., Nigeria has a NOC with a local subsidiary responsible for gas transmission and distribution. Thus, entering into joint ventures with the private IOCs in which the government held majority participating interests under a joint and several liability frameworks in oil and gas production operations makes the role of government as the regulator more complex. Such issues led to calls for a more independent and well-equipped regulatory agency that could effectively carry out environmental, health, and safety regulation.[147]

In July 2018, the current Nigerian federal government issued the Flare Gas (Prevention of Waste and Pollution) Regulations 2018 ("Flare Gas Regulations").[148] The Flare Gas Regulations apply to all petroleum leases, licenses, and marginal fields in Nigeria and provide a framework aimed at (i) protecting affected communities from the adverse effects of gas flaring; (ii) preventing the waste of associated gas; and (iii) creating social and economic benefits by permitting interested third-parties to gain access, capture, and utilize gas that would otherwise be flared during oil production operations.[149]

E. Emissions From Oil and Gas Operations

The EPA reports that, in 2018, methane accounted for about 9.5 percent of total domestic U.S. GHG emissions.[150] The main sources of methane emissions include leaks from natural gas systems and the raising

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145. Oyewunmi, *supra* note 1, at 111–71 (competitiveness and security of supply in the Nigerian Gas-to-Power industry).

146. *Id.*

147. Dickson Omukoro, *Environmental Degradation in Nigeria: Regulatory Agencies, Conflict of Interest and the use of Unfettered Discretion,* OIL GAS & ENERGY L., no. 1 (2017), https://www.ogel.org/article.asp?key=3678 [https://perma.cc/4YUV-R56D] (last visited Mar. 3, 2018).

148. *See Flare Gas (Prevention of Waste and Pollution) Regulations 2018*, INT'L ENERGY AGENCY, https://www.iea.org/policies/8675-flare-gas-prevention-of-waste-and-pollution-regulations-2018 [https://perma.cc/74EB-F4BG] (last updated Aug. 10, 2020).

149. Oke, *supra* note 142; *see also Nigerian Gas Flare Commercialization Programme,* https://ngfcp.dpr.gov.ng/ [https://perma.cc/4MKF-VL8M] (last visited Jan. 10, 2021).

150. *Overview of Greenhouse Gases*, *supra* note 20.

of livestock.[151] Natural gas systems are the highest sources of energy-related methane emissions, followed by coal mining and petroleum systems when considered from 1990 to 2017. Emissions are generally categorized into those from stationary and mobile combustion sources or stationary and mobile non-combustion sources.[152] Leaks and fugitive emissions from abandoned coal mines and oil and gas wells or pipelines and valves in gas systems fall under the non-combustion stationary sources which are present in most parts of the gas production and supply value chain.[153] Methane emissions from stationary combustion sources depend upon fuel characteristics, size, and vintage, along with combustion technology, pollution control equipment, ambient environmental conditions, and operation and maintenance practices,[154] all of which may be subject to regulatory guidelines that would ensure regular monitoring and checks are carried out by the operators. According to the U.S. EPA's 2019 GHG inventory report:

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151. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 1-113.

152. *Id.* Combustion of fuels such as gasoline, diesel oil and jet fuel by vehicles, ships, boats, agricultural and construction equipment, and airplanes, etc. Fossil fuels are generally combusted for the purpose of producing energy and during the process the carbon (C) stored in the fuels is oxidized and emitted as CO2 and smaller amounts of other gases, including methane, carbon monoxide, and non-methane volatile organic compounds (NMVOCs).

153. CTR. FOR CORP. CLIMATE LEADERSHIP, U.S. ENVTL. PROT. AGENCY, GREENHOUSE GAS INVENTORY GUIDANCE: DIRECT EMISSIONS FROM STATIONARY COMBUSTION SOURCES (2016), https://www.epa.gov/sites/production/files/2016-03/documents/stationaryemissions_3_2016.pdf [https://perma.cc/6GJW-EC7L] (Oil and gas wells classified as "abandoned" may include wells that have: (a) no recent production, and not plugged, thus could be inactive, temporarily abandoned, shut-in, dormant, and idle; (b) no recent production and no responsible operator; or (c) been plugged to prevent migration of gas or fluids.).

154. *Id.* (Note that not all-stationary combustion sources burn fossil fuels. Biomass (non-fossil) fuels (e.g., forestry-derived, agriculture-derived, biomass-derived gases) may be combusted in stationary sources independently or co-fired with fossil fuels. Waste-derived fuels in solid, liquid, and gaseous form may be combusted in stationary sources as well. Typical waste derived fuels include, but are not limited to, used tires, used motor oils, municipal solid waste (MSW), hazardous waste, landfill gas, and by-product gases. use of natural gas may result in fugitive methane emissions from leaking gas transportation lines owned by the organization. Storage of fuels may also result in fugitive emissions. For example, methane is emitted from fuel storage tanks or from coal piles. Typically, these sources are minor compared to combustion emissions, however, organizations should account for these non-combustion sources using guidance specific to the fugitive emissions from their sector.)

> Methane emissions from petroleum systems are primarily associated with onshore and offshore crude oil production, transportation, and refining operations. During these activities, CH4 is released into the atmosphere as leak emissions, vented emissions (including emissions from operational upsets), and emissions from flaring. Carbon dioxide emissions from petroleum systems are primarily associated with crude oil production and refining operations."[155]

Although total methane emissions from petroleum systems in 2017 decreased by 10% compared to 1990 levels, it is noted that total CO2 emissions recorded a significant 161% increase when compared to 1990 levels, while N2O emissions had a 77% increase compared to 1990 levels.[156]

Based on these reports, it may be concluded that the decrease witnessed between 1990 and 2017 reflects the regulatory and operational focus on curbing methane and better technological advancements in monitoring and dealing with the menace.[157] Programs such as the Natural Gas STAR Program established in 1993,[158] the 2014 Oil & Gas Methane Partnership,[159] and the Methane Challenge Program launched in 2016

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155. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 3-64.

156. *Id.*

157. Methane and non-combustion CO2 emissions from natural gas systems include those resulting from normal operations, routine maintenance, and system upsets.

158. The Natural Gas STAR Program provides a framework for voluntary partnership that encourages oil and natural gas companies—both domestically and abroad—to adopt proven, cost-effective technologies and practices that improve operational efficiency and reduce methane emissions. *See Natural Gas STAR Program*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/natural-gas-star-program/natural-gas-star-program [https://perma.cc/57PE-QPEQ] (last visited Jan. 10, 2021).

159. The Climate and Clean Air Coalition (CCAC) created a voluntary initiative to help IOCs reduce methane emission. The initiative was launched at the UN Secretary General's Climate Summit in New York in September 2014 and currently includes IOCs such as BP, Ecopetrol, Eni, Equinor, Neptune Energy International SA, Pemex, PTT, Repsol, Shell and Total. In January 2020, participants agreed to an updated framework designed to ensure that it fosters and encourages reporting that remains directly connected to strategic action. This improved methane reporting has a performance element that focuses on reduction approaches, technology advancement and policy development, aiding the oil and gas industry in realizing deep reductions in mineral methane emissions over the next decade in a way that is transparent to civil society and governments. *See The CCAC Oil & Gas Methane Partnership*, CLIMATE & CLEAN AIR COALITION,

appear to have contributed to such a decreasing trend.[160] U.S. methane emissions from oil and gas exploration activities decreased by 69% from 1990 to 2017, with the largest decreases coming from hydraulically fractured gas well completions without reduced emissions completions (RECs) or flaring.[161] Although, emissions increased dramatically from 2016 to 2017; the levels of emissions were highest from 2006 to 2008.[162] Increases in CO2 emissions from exploration and production reportedly due to increases in gas flaring as mentioned earlier is also in line with the reported rise of gas flaring from prolific production provinces such as the Permian Basin.[163]

Natural gas liquids and various other constituents are removed in the gas processing stage, resulting in "pipeline quality" gas, which is then injected into the transmission system. In this segment, there are some cases of reported incidents of fugitive emissions from compressors and compressor seals.[164] Note that gas transmission involves high pressure, large-diameter pipelines that transport gas through long distances from production fields and processing areas to distribution systems or large volume customers, such as power plants or chemical plants. As shown in Figure 6 above, leaks from compressor stations and venting from pneumatic controllers result in emissions during transmission, including uncombusted engine exhaust and pipeline venting. Natural gas is also injected and stored in underground formations or liquefied and stored in above-ground cryogenic tanks during periods of low demand (e.g., summer), and withdrawn, processed, and distributed during periods of high demand (e.g., winter). Emissions could also arise from compressors and dehydrators from storage units.[165]

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https://www.ccacoalition.org/en/activity/ccac-oil-gas-methane-partnership [https://perma.cc/7DQJ-9TZR] (last visited Jan. 10, 2021).

160. Operators involved in the Methane Challenge Program agree to transparently report systematic and comprehensive actions to reduce methane emissions and be publicly recognized as leaders in reducing methane emissions in the U.S. Doing so reduces operational risk, increases efficiency, and demonstrates company concern for the environment, with benefits spanning from climate change to air quality improvements to conservation of a non-renewable energy resource. *See Methane Challenge Program*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/natural-gas-star-program/methane-challenge-program [https://perma.cc/9AGA-AZDC] (last visited Jan. 10, 2021).

161. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 3-64.

162. *Id.* at 3-81.

163. *See Permian Gas Flaring Reaches Yet Another High*, *supra* note 36; Adams-Heard & Ngai, *supra* note 36.

164. U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 3-81.

165. *Id.*

Methane emissions from the transmission and storage sector (which includes pipelines, storage tanks, and LNG systems) account for approximately 20% of emissions from natural gas systems, while CO2 emissions arising from this segment accounts for 2% of the non-combustion CO2 emissions from natural gas systems.[166] It is reported that methane emissions from the transmission and storage segment decreased by 43% when comparing 1990 to 2017 levels. This reduction is attributed to reduced compressor station emissions (including emissions from compressors and leaks).[167] The EPA reported increasing levels of emissions of CO2 from LNG export terminals when comparing 1990 levels to 2017 levels, but this is perhaps as a result of the increase in the number of LNG export activities and new build LNG export projects during the last three to four years of the reporting period of 1990 to 2017.[168] From 1990 until about 2010, the U.S. was a net importer of gas (e.g., from countries like Nigeria) and had import LNG regasification terminals rather than liquefaction facilities which became more prevalent following the domestic gas production boom from 2012. There are rare cases of emissions (perhaps through pipeline leaks) at the distribution stage from the "city gate" stations where gas from high-pressure transmission lines are received by local distributors and large customers and are distributed or taken-up. In the distribution system, methane and CO2 emissions in 2017 were 73% lower than the 1990 levels.[169]

III. GAS SUPPLY INSTITUTIONS AND REGULATION

As discussed in Part II above, the U.S. midstream processing, transmission, and distribution segments involve several players and operators. The market restructuring and reform efforts mainly by FERC from the 1980s to 2000 led to the unbundling of previously vertically-integrated gas supply firms and an open-access framework to foster competitive wholesale markets and non-discriminatory entry and exit to transmission systems.[170] The wholesale markets, interstate transmission, and cross-border facilities are regulated by FERC, while intrastate local distribution and retail operations and facilities are regulated at the state

166. *Id.*
167. *Id.*
168. *Id.*
169. *Id.*
170. Oyewunmi, *supra* note 1, at 85–101; *Natural Gas Regulation and Market Disorder*, 18 TULSA L.J. 619 (1983); Richard J. Pierce, Jr., *The State of the Transition to Competitive Markets in Natural Gas and Electricity*, 15 Energy L.J. 323 (1994).

level.[171] The applicable prices and entry along the value chain are typically market-based, while state public utility commissions exercise regulatory authority over retail gas prices and are responsible for consumer protection, natural gas facility construction, and environmental issues that are not covered by FERC or the Department of Transportation.

A. Gas Production Boom and Electricity

The shale gas revolution created a remarkable 40% growth in indigenous gas production in the U.S.[172] Two major plausible impacts of the production boom could be the greater inclination to flare and vent unutilized or excess gas or the need for timely investments in gas gathering and processing, new transmission, and storage capacity.[173] Such investments and timely project completion of the necessary infrastructure are key to ensuring reliability in an electricity and downstream energy market that relies significantly on natural gas.

While the U.S. became a net exporter of natural gas, domestic consumption also reached a historic high in 2018, i.e. an 18% increase in

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171. *See* Suedeen G. Kelly, *Intrastate Natural Gas Regulation: Finding Order in the Chaos*, 9 YALE J. REG. 355 (1992); Richard J. Pierce, Jr., *Intrastate Natural Gas Regulation: An Alternative Perspective*, 9 Yale J. Reg. 407 (1992).

172. INT'L ENERGY AGENCY, *supra* note 4, at 156–57.

173. Monika U. Ehrman explains that "Often used when midstream connections are not available, flaring is common practice in the oil and gas industry. *Operators may employ flaring (1) during flowback, which is the period of time in the hydraulic fracturing operation when the injected slurry of water, proppant, and chemicals flows back through the wellbore or (2) when connection timelines are delayed*-midstream companies can be notoriously uncertain with regards to construction timelines. In lieu of shutting in the well (stopping production), which delays income of saleable and more valuable hydrocarbons, operators instead send these non-connected volumes of gas (often referred to as "waste gas" or "flare gas") up through flare stacks, where those volumes are then ignited and combusted. Ideally the entire volume of flare gas combusts, resulting in the formation of carbon dioxide and water. But inefficient flaring may lead to partial combustion and the consequent exhaust of methane and other toxics into the atmosphere." Monika U. Ehrman, *Lights Out in the Bakken: A Review and Analysis of Flaring Regulation and its Potential Effect on North Dakota Shale Oil Production,* 117 W. VA. L. REV. 549, 551 (2014) (Emphasis added). Note that the inability of midstream pipeline companies to confirm or guarantee available pipeline capacity or completion of new pipeline projects may be due to other issues such as political conflicts, regulatory bottlenecks, environmental activism against pipelines, etc.

domestic consumption from 2007 to 2017.[174] The utilization of gas in the electricity sector has been a major driving force in this regard. The extensive network of interstate and intrastate gas pipelines and storage systems (as depicted in Figure 7 below) also plays a major role in the growing interconnectedness between gas production, supply, and consumption. Unlike natural gas, electricity has a particular attribute that makes it more complex and expensive to store for long periods. Electricity storage requires expensive advanced technologies, such as batteries. Even though storage technologies have been advancing in recent times, there is still the key requirement of ensuring that generation and supply must meet demand and consumption in real time.

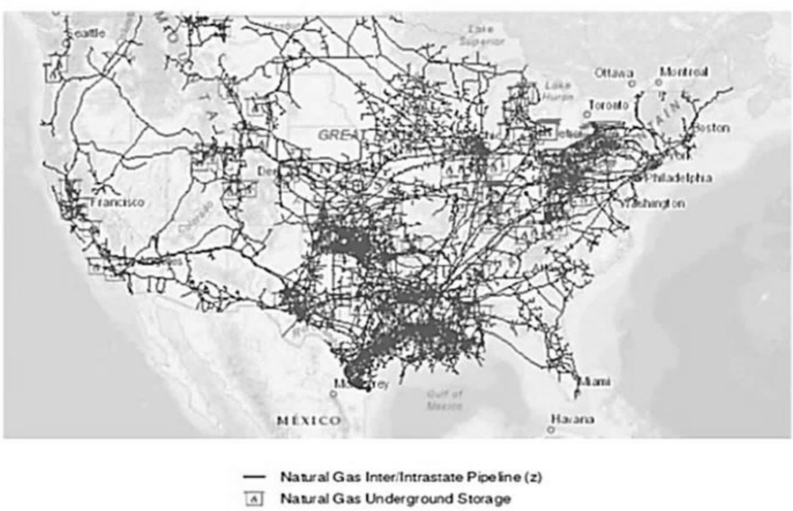

Figure 7: U.S. Natural Gas Pipeline Transmission Network and Storage Facilities[175] *[https://perma.cc/596Z-KB9V].*

174. INT'L ENERGY AGENCY, *supra* note 4. The main sectors in the domestic consumption trend as at 2017 were: (i) heat and power generation (37%), (ii) industry (23%), (iii) residential (16%), commercial and others (11%), energy (9%), and transport (3%).

175. *U.S. Energy Mapping System*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/maps.php [https://perma.cc/NCN6-T7KS] (last visited Jan. 10, 2021). For more about the U.S. natural gas pipeline network and storage, see *Natural Gas Explained*, *U.S. Energy Info. Admin.*, www.eia.gov/energy explained/natural-gas/natural-gas-pipelines.php [https://perma.cc/9JXF-MVHL] (last updated Dec. 3, 2020). The US gas pipeline network is highly integrated, moving gas volumes from upstream (onshore and offshore) sources throughout

Furthermore, if electricity supply depends on gas-fired generation, then there is no denying the importance of timely, coordinated, and reliable supplies of sufficient gas volumes to fuel the power generation capacity. Such guaranteed and coordinated supply will also be essential for grid and system reliability as utilities increasingly shut down coal plants and other conventional systems and switch to gas-fired generation and renewables, such as solar and wind. This is even more so when such renewables depend on seasonal, locational, and weather patterns. The decisions and choices to invest in one or more sources of energy will have considerable implications for the competitiveness, sustainability, or decarbonization and security of energy supply going forward.[176]

The role of the FERC, in the scheme of things, includes facilitating efficient integration and coordination between the wholesale gas and electricity markets, as well as interstate network transmission issues. For example, FERC Order 809,[177] Order 787,[178] and Order No. 757[179] respectively underscore the growing interconnectedness and coordination between gas and electricity supply. For instance, Order 787 underscores the need for interstate gas pipelines and public utilities that own, operate, or control facilities used for the transmission of electric energy in interstate commerce to share non-public, operational information to promote reliability and better operational planning.[180] As the share of distributed and decentralized renewable systems increases and the need for those systems to connect and dispose of excess energy to the existing grid and networks grow, there is still a need to have utilities and system operators that are viable enough to maintain and operate conventional networks.

In the medium to long-term, natural gas supply and networks are expected to play a key role in the reliability of energy supply in the U.S.[181]

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the lower 48 states via interstate and intrastate pipelines, while there are also significant cross-border pipelines between (i) U.S. and Mexico, and (ii) U.S. and Canada.

176. Paul Joskow*, Supply Security in Competitive Electricity and Natural Gas Markets*, *in* UTILITY REGULATION IN COMPETITIVE MARKETS: PROBLEMS AND PROGRESS (Colin Robinson ed., 2007); Oyewunmi et al., *supra* note 24.

177. Coordination of the Scheduling Processes of Interstate Natural Gas Pipelines and Public Utilities, 80 Fed. Reg. 46,979 (Aug. 6, 2015).

178. Communication of Operational Information between Natural Gas Pipelines and Electric Transmission Operators, 78 Fed. Reg. 70,163 (Nov. 22, 2013) (codified at 18 C.F.R. pt. 38 and 18 C.F.R. pt. 284).

179. Storage Reporting Requirements of Interstate and Intrastate Natural Gas Companies, 77 Fed. Reg. 4220 (Jan. 27, 2012) (codified at 18 C.F.R. pt. 284).

180. 78 Fed. Reg. 70,163.

181. *See* U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2019, at 21–22 (2019). The EIA opines that electricity generation from both coal and nuclear

Thus, there is a growing need for a coherent, critical, and pragmatic consideration of the pathways of controlling the environmental externalities and impact of existing and proposed networks and facilities.

B. Controlling Emissions Along the Gas Supply Chain

The efforts to address global warming and climate change are being undertaken via the auspices of the 1992 United Nations Framework Convention on Climate Change and subsequent protocols and agreements, such as the Kyoto Protocol and Paris Agreement.[182] In the U.S., neither the Clinton administration that signed the 1997 Kyoto Protocol nor the subsequent Bush administration made concrete efforts to regulate GHGs.[183] Rather it was the Obama-era EPA that commenced significant efforts to connect atmospheric concentration of GHGs with the endangerment of public safety and welfare, consequently justifying the need to regulate GHG emissions. The Obama-era efforts relied mostly on the framework provided under the Clean Air Act (CAA) of 1970 even though the law was originally designed to regulate air pollutants regarded as harmful to social health and wellbeing.

The CAA requires stationary sources of pollution, such as power plants, to secure a permit from state regulators before emitting criteria pollutants such as lead, carbon monoxide, ozone, SO2, particulate matter, and NOx.[184] The main objective is to encourage active measures for internalizing the external environmental costs of combustion by requiring the installation of pollution control facilities. Such permits typically include limits to the emissions and *reflect certain technology-based standards that are defined by the CAA*. The stringency of the limits or standards depends on whether the source is within an area that is regarded to have attained the national ambient air quality standards (NAAQS) for the pollutants in question. If the plant is within the attainment area, then

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is expected to decline in the outlook to 2050. From a 28% share in 2018, coal generation drops to 17% of total generation by 2050. Nuclear generation expectedly declines from a 19% share of total generation in 2018 to 12% by 2050. The share of natural gas generation rises from 34% in 2018 to 39% in 2050, and the share of renewable generation increases from 18% to 31%.

182. United Nations Framework Convention on Climate Change, *adopted* May 9, 1992, 1771 U.N.T.S. 107; Kyoto Protocol to the United Nations Framework Convention on Climate Change, *adopted* Dec. 11, 1997, 2303 U.N.T.S. 162; Paris Agreement to the United Nations Framework Convention on Climate Change, *adopted* Dec. 12, 2015, T.I.A.S. No. 16-1104.

183. EISEN ET AL., *supra* note 104, at 58–259.

184. *Id.*

the owner must obtain a Prevention of Significant Deterioration (PSD) permit and the emissions limit must reflect the best available control technology (BACT).[185] In non-attainment areas, the limits must reflect the 'lowest achievable emissions rate' (LAER).[186]

The CAA creates a framework in which the prevention and control of air pollution is the primary responsibility of individual states and local governments, even though the federal government's financial assistance and leadership are essential to accomplish these goals. The system is often referred to as a "cooperative federalism" structure under which the federal government develops baseline standards that the states individually implement and enforce. As noted earlier, states are allowed to employ standards that are more stringent than those specified by the federal agencies involved in the implementation and rulemaking process. Based on the CAA, the EPA is responsible for developing acceptable NAAQS which are meant to set a uniform level of air quality across the U.S. to protect society and the environment. The specific decisions regarding how to meet the NAAQS are left to individual states' regulatory agencies and policymakers. Also, each state is required to create and submit an Implementation Plan (SIP) to the EPA. The SIP should outline the framework for the implementation, maintenance, and enforcement of NAAQS within the state. After submitting a SIP to the EPA and receiving approval from the latter, its requirements become federal law and are fully enforceable in federal court.[187] Notably, states must also regulate all stationary sources located within the areas covered by the SIPs and implement a mandatory permit program that sets limitations to the amount and types of emissions that each stationary source is allowed to discharge. The permit issued as a result "is intended to be a source-specific compendium for Clean Air Act compliance containing in a single, comprehensive set of documents, all [Clean Air Act] requirements relevant to the particular polluting source."[188]

The CAA was originally designed to regulate toxic, hazardous, and criteria pollutants that directly impact the health and safety of human life and society.[189] It aimed primarily at addressing the emissions of such air pollutants from sources such as the increasing fleet of coal plants, industrial processes, and fossil-fuel combustion emitting pollutants like carbon monoxide, lead, and sulfur dioxide. The formation of the EPA and

185. 42 U.S.C. § 7475(a)(4) (2018).
186. 42 U.S.C. § 7503(a)(2).
187. *See* Wyoming v. U.S. Dep't of Interior, No. 2:16-CV-0285-SWS, 2017 WL 161428 (D. Wyo. Jan. 16, 2017).
188. *Id.*
189. *Id.*

the enactment of the CAA was part of a coherent national-level framework to clean up the air and deal with air pollution in the U.S.[190] As may be gathered from previous discussions in Part I and II, GHGs such as carbon dioxide are not *ipso facto* toxic or directly harmful to human health. Rather, it is the cumulative effects of the atmospheric concentration of GHGs (to the extent of altering the natural balance of such substances with the earth's ecosystem) that creates the potential adverse impacts such as global warming, rising sea levels, floods, increase in ground-level ozone (smog), and changing weather patterns that could create droughts in some regions. As a result, it is useful to consider the background and opinion of the U.S. Supreme Court in *Massachusetts v. EPA*[191] to appreciate the challenge of regulating GHGs given the current haphazard state of climate change-related statutory and regulatory framework in the U.S.

In 1999, some organizations filed a petition requesting that the EPA issue rules for the regulation of four greenhouse gases, including carbon dioxide emitted from new motor vehicles. Following public comments, the EPA (in the Republican/Bush era) denied the petition in 2003, stating that: (a) it did not have authority under the CAA to issue mandatory regulations to address the global issue of climate change because Congress would have explicitly directed EPA to do so if Congress so intended. As a result, greenhouse gases could not be considered "air pollutants" under the CAA; (b) even if it did have authority, it would be unwise to set greenhouse gas emission standards at this time because: (i) there was uncertainty regarding the link between greenhouse gases and global warming; (ii) mandatory regulation was a piecemeal approach that would interfere with the President's more comprehensive approach; and (iii) it might hamper the President's ability to persuade developing countries to limit greenhouse gas emissions.[192]

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190. The burning of coal produces particulate matter which causes respiratory problems and heart and lung disease. These particulates can also contain mercury, a toxic metal that can enter the food chain through deposition of combustion particulates into waterways. Sulfur dioxide (SO2) mixes with moisture in the upper atmosphere and forms sulfuric acid which leads to acid rain—damaging vegetation and aquatic environments. Nitrogen oxides are a precursor to acid rain and ground level ozone i.e. smog which triggers respiratory problems in some humans. *See* Coal Explained: Coal and the Environment, U.S. ENERGY INFO. ADMIN., www.eia.gov/energyexplained/coal/coal-and-the-environment.php [https://perma.cc/2A99-JQBZ] (last updated Dec. 1, 2020).

191. 549 U.S. 497 (2007).

192. *See Massachusetts v. EPA*, U.S. DEP'T OF JUST., https://www.justice.gov/enrd/massachusetts-v-epa [https://perma.cc/TX9E-DGD3] (last updated May 14, 2015).

Subsequently, Massachusetts and twelve other states challenged the EPA in the D.C. Circuit, and a divided panel upheld the EPA's decision not to dabble with GHG regulation.[193] On appeal, the U.S. Supreme Court granted certiorari and addressed *inter alia* the issue of whether the EPA had statutory authority to regulate GHG emissions from new motor vehicles, and if so, whether the reason stated for refusing to do so was consistent with the CAA.[194] In its argument to support the earlier decision that it didn't have regulatory authority, the EPA contended that (i) Congress was aware of the climate change issue when it did its last comprehensive review of the CAA in 1990 and decided not to adopt a proposed amendment that could have specifically imposed binding limitations—Congress focused more on pollutants that depleted the ozone layer; and (ii) GHGs are not air pollutants as contemplated by Congress under the CAA—arguing that if CO2 can be considered an air pollutant, the only feasible method was to impose fuel economy standards through the Department of Transportation.[195]

In delivering the majority opinion, Justice Stevens stated that the text of the CAA foreclosed the EPA's contentions due to its definition of "air pollutant" as *any* air polluting agent or combination of such agents, whether physical or chemical substances, which are emitted into the air. Thus, given the reference to all airborne compounds, CO2, methane, nitrous oxide, and hydrofluorocarbons are substances that are emitted into the air and, therefore, they are pollutants as contemplated under the CAA.[196] The Court held, further, that while Congress at the time of enacting the CAA might not have appreciated the possibility that burning fossil fuels could lead to global warming or expressly provided for the regulation of GHGs by the EPA in its 1990 amendments, Congress did understand that without regulatory flexibility, changing circumstances and scientific developments could eventually render the CAA obsolete. With this line of reasoning, the Supreme Court could be said to have adopted the "mischief rule" of statutory interpretation by attempting to (i) determine the intention of Congress, finding the defect in a statute that was enacted decades before the science of climate change gained the traction it currently has, and (ii) to implement a remedy in the context of the case under consideration.[197]

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193. EISEN ET AL., *supra* note 104, at 58–259.

194. *Id.*

195. *Id.*

196. *Id.*

197. The Mischief Rule approach to statutory interpretation by common law judges entails the doctrine that a statute should be interpreted by firstly identifying the problem or 'mischief' the law was designed to remedy and then adopting a

From a literal standpoint, one could flag some issues regarding the application of the EPA's authority to regulate GHGs, such as methane and CO2 under the CAA. However, it is also reasonable to expect science and reality to evolve past the verbatim provisions of a statute enacted as far back as the 1970s and last amended in the 1990s. The Supreme Court opined that there is a presumption that the broad language used in the CAA's § 202 (a)(1) on emission standards for new motor vehicles or new motor vehicle engines reflects the flexibility needed to prevent the CAA from becoming obsolete and inapplicable to situations where the lawmakers would have intended in the future.[198] Furthermore, the Supreme Court held that GHGs fit well within the CAA definition of "air pollutants."[199] Accordingly, the EPA has the statutory authority to regulate the emission of such gases from new motor vehicles.[200] By and large, CO2 and GHGs are now classified as pollutants under the CAA following the

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construction that will suppress the problem and advance the remedy. It is a British version of purposivism. In this approach the words of a text are expanded or contracted from their usual meaning to carry out the legislative purpose. *See Mischief rule*, BLACK'S LAW DICTIONARY (10th ed. 2014).

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

199. *Id.*

200. In his dissenting opinion, Justice Scalia pointed out inter alia that: (a) redress to grievances and questions in issue in this case is the function of Congress and the Chief Executive, rather than the federal courts; (b) when the EPA as administrator makes a judgment whether to regulate GHGs, such must relate to the whether they are "air pollutants" that cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare. The CAA says nothing about the reasons for which the administrator may defer making such a judgment or the permissible reasons for deciding not to grapple with the issues as in this case; (c) the reasons EPA gave are surely considerations the executive agencies take into account when considering new fields – the impact such entry would have on other executive branch programs or foreign policy; (d) air pollutants is defined by the CAA "as any pollution agent of any combustion of such agents" including physical or chemical that is emitted into the ambient air. The court is right about how CO2, methane, and hydrofluorocarbons fit within the second part of the definition and fails to consider the first part of the definition. In order to be an "air pollutant" the substance or matter being emitted has to be an air pollution agent or the combustion of such agents; (e) in deciding whether it had authority to regulate GHGs, the EPA had to decide whether the concentration of GHGs regarded as responsible for "global" climate change qualifies as air pollution in the US context; and (f) regulating the buildup of carbon dioxide and other GHGs in the upper reaches of the atmosphere considered to be responsible for climate change is not akin to regulating the concentration of some substances that are polluting the air.

Massachusetts v. EPA case,[201] although the EPA could still decline to regulate under Title II for permissible reasons.

In 2009, the Obama-EPA decided that GHGs from cars and trucks endanger public health and welfare, thus leading to more specific rulemaking regarding mobile and stationary sources of GHGs.[202] Furthermore, the Supreme Court in *American Electric Power Co. v. Connecticut*,[203] unanimously held that the EPA has the authority to regulate GHGs under section 111(b) of the CAA concerning stationary sources and that the CAA displaced federal common law public nuisance claims related to GHG emissions from power plants. The decision's rationale was because the U.S. Congress had delegated to the EPA the authority to decide whether and how to regulate pollutants, such as GHG emissions, from power plants under CAA section 111.[204]

This line of thought recognizes that an essential aim of regulation would be to ensure that operators act in an environmentally responsible manner, giving the externalities arising from their activities on society and its climate change forcing impact. In carrying out this role, it is essential to examine the regulatory model and approach,[205] including the costs of regulation vis-à-vis the opportunity costs of not regulating or providing a comprehensive legal and policy framework for such crucial issues with the potential for being controversial socially, economically, and politically.

In *Michigan v. EPA*, the U.S. Supreme Court held that the EPA interpreted 42 U.S.C. § 7412(n)(1)(A) of the CAA unreasonably when it refused to consider the cost of regulating power plants in the context of the case.[206] In its grant of certiorari following a decision by the U.S. Court of

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201. 549 U.S. 497.

202. *See* Endangerment and Cause or Contribute Findings for Greenhouse Gases under the Section 202(a) of the Clean Air Act, 74 Fed. Reg. 66,495 (Dec. 15, 2009).

203. 564 U.S. 410 (2011).

204. *Id.*

205. There are different approaches and models of regulation such as performance- based, market-based, incentive-based, and the more traditional and often inefficient command-and-control. In an energy context where the concept of "public-service" and commercial viability of utilities is an imperative, and the tendencies of vertical integration and regulatory capture, the choice is often very essential and the more efficient ones are more often than not the less confrontational approach where relevant stakeholders and operators focus less on being powerful and right and more on public service, innovative solutions and balancing out the energy trilemma. *See* John Gulliver & Donald N. Zillman, *Contemporary United States Energy Regulation*, *in* REGULATING ENERGY AND NATURAL RESOURCES 113–136 (Barry Barton et al., eds., 2006).

206. Michigan v. EPA, 576 U.S. 743 (2015).

Appeals for the D.C. Circuit, the Supreme Court in *Michigan v. EPA* reiterates as follows:

> [The CAA directs the EPA to regulate] emissions of hazardous air pollutants from certain stationary sources (such as refineries and factories). The Agency may regulate power plants under this program only if it concludes that "regulation is appropriate and necessary" after studying hazards to public health posed by power-plant emissions. Here, EPA found power-plant regulation "appropriate" because the plants' emissions pose risks to public health and the environment and because controls capable of reducing these emissions were available. It found regulation 'necessary' because the imposition of other [CAA] requirements did not eliminate those risks.[207]

The Supreme Court, however, discountenanced the EPA's opinion that consideration of the costs was unnecessary even when it had estimated that the cost of its regulations to power plants in the context of the case would be about $9.6 billion a year, which is more than the quantifiable benefits from the resulting reduction in the hazardous-air-pollutant arising therefrom which would be $4 to $6 million a year.[208] From a purely "environmentally conscious stakeholder's purview," the costs of not regulating emissions which could be seen as "losing the benefits" of reductions should almost always be prioritized. Conversely, the purely commercial profit-centered industry stakeholder seeks to prioritize the significant costs of compliance; thus, the average utility or operator that would be impacted by the regulation may prefer to avoid additional compliance and regulatory costs if such is higher than the overall estimated benefits (depending on whether the cost-benefit analysis was properly and comprehensively done).

From a pragmatic "energy policy" purview, the prevention of harm to the environment and society should be equally as important as meeting the reasonable returns and affordability and security of supply concerns. To align these competing interests and objectives, it is noted that the three

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207. *Id.* at 743 (internal citations omitted).

208. Note that the Supreme Court had previously held that the relevant statutory provision unambiguously precluded agency cost considerations, *see* Whitman v. Am. Trucking Ass'ns, 531 U.S. 457, 471 (2001), and later on it deferred to agency decisions to consider costs, *see* EPA v. EME Homer City Generation, L.P., 572 U.S. 489, 519 (2014); Entergy Corp. v. Riverkeeper, Inc., 556 U.S. 208, 222 (2009). *See also* Case Comment, *Constitutional Law:* Michigan v. EPA, 129 HARV. L. REV. 181, 311–20 (2015).

dimensions of the energy trilemma or policy are not necessarily mutually exclusive. The competing interests are often influenced by economics versus public-interest considerations and are usually rooted in our law and politics framework or the political economy. Hence the need for coherence, trust and accountability in the design of guidelines and applicable rules as well as an independent umpire, i.e., the relevant regulatory agency. In reality, organizational institutions and regulatory agencies are increasingly being influenced by the whims and caprices of the executive and political officeholders.

Another Supreme Court decision that exemplifies the state of complexity in the extant regulatory framework afforded under the CAA is the *Utility Air Regulatory Group v. EPA* where it was held that emissions of GHGs alone from stationary sources could not activate both the PSD program and Title V permitting requirements under the CAA framework.[209] It is, however, possible to apply the PSD program's BACT requirement to the emission of GHGs from those sources that emit sufficient quantities of other pollutants that are or would be ordinarily subject to the PSD framework.[210]

1. Influencing the Federal Agencies and Other Institutions

At least three federal agencies have the statutory authority that is relevant to the regulation of methane emissions in the U.S., including (i) the EPA under the CAA; (ii) the BLM under the Mineral Leasing Act of 1920; and (iii) the Pipeline and Hazardous Materials Safety Administration (PHMSA) under several statutes, as well as the Natural Gas Pipeline Safety Act of 1968.

a. The Environmental Protection Agency

The EPA is the federal government's principal environmental regulator and has the primary responsibility to "protect human health and the environment" in the U.S.[211] Based on the CAA, the EPA has the authority to maintain and improve the nation's air quality and protect the public from dangerous air pollutants. As discussed earlier, the EPA's

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209. Util. Air Regulatory Grp. v. EPA, 573 U.S. 302 (2014). *See also* Case Comment, *Federal Statutes and Regulations:* Utility Air Regulatory Group v. EPA, 128 HARV. L. REV. 341, 361–70 (2014).

210. *Util. Air Regulatory Grp.*, 573 U.S. 302.

211. *See Our Mission and What We Do*, U.S. Envtl. Protection Agency, https://www.epa.gov/aboutepa/our-mission-and-what-we-do [https://perma.cc/8RKN-938J] (last visited Jan. 10, 2021).

regulation of GHGs began following the decision in *Massachusetts v. EPA*, having the effect that GHGs are air pollutants as defined in the CAA.[212] The EPA is obligated to regulate any air pollutants that may "endanger public health or welfare," thus, after the EPA determined that GHGs pose an endangerment, the Agency was mandated to regulate such pollutants, including methane.[213] According to its authority under the CAA, the EPA has promulgated several regulations involving methane emissions, including reporting requirements, permitting requirements, and emission reduction standards.

b. GHG Reporting Program

In the fiscal year 2008 Consolidated Appropriations Act, Congress directed the EPA to establish the GHG Reporting Program to collect annual GHG emission data under its existing authority within the CAA.[214] The resulting rules require reporting of GHG emissions from all major sectors of the economy. [215] The "Petroleum and Natural Gas Systems" sector is subject to part 98, subpart W of the rule, and this industry sector provides the most reporters to the program: 2,253 as of 2018.[216] Subpart W requires petroleum and natural gas systems to report emissions of CH4 and CO2 from equipment leaks and venting annually, and emissions of CO2, CH4, and nitrous oxide (N2O) from flaring. The reporting requirements apply to other emissions, such as those from on-site combustion equipment. Petroleum and natural gas facilities may also be subject to further reporting under other subparts of the rule.

The data collected through the Reporting Program contributes to the EPA's *Inventory of U.S. Greenhouse Gas Emissions and Sinks*, which as shown in Parts I and II above are very instrumental in understanding the nature, scope, and sources of GHG emissions along the value chain. In 2019, this report revealed that methane emissions from petroleum and

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

213. The "endanger public health or welfare" language is found in both CAA § 202(a), which gives EPA authority over automobiles (the context of the *Massachusetts v. EPA* decision), and in CAA § 111, which gives EPA authority over stationary sources, the source of most methane emissions.

214. Consolidated Appropriations Act, 2008, Pub. L. No. 110-161, 121 Stat. 1844 (2007); LATTANZIO, *supra* note 56, at 11.

215. Mandatory Reporting of Greenhouse Gases, 40 CFR part 98, 74 Fed. Reg. 56,259 (Oct. 30, 2009) (codified at 40 C.F.R. pt. 98 et al.).

216. *GHGRP Reported Data*, U.S. Envtl. Protection Agency, https://www.epa.gov/ghgreporting/ghgrp-reported-data [https://perma.cc/96RS-RXVJ] (last visited Jan. 10, 2021).

natural gas systems decreased from 1990 to 2017, but these two sectors combined still represented the largest sources of CO2 and methane emissions in the country. Moreover, due to increases in flaring emissions, carbon dioxide emissions from the sectors increased by 27% over the same period.[217] It is also important to stress that the combustion of fossil fuels (especially oil and coal for energy e.g., for electricity and heat) comprise the vast majority of energy-related emissions, with CO2 being the main GHG.[218]

c. CAA Permitting Requirements

In 2010, the EPA issued a decision that CAA permitting requirements would apply to GHGs when such pollutants become "subject to regulation" under the Act.[219] Consequently, methane and other GHGs would be included in CAA permits when any new regulations controlling GHG emissions took effect.[220] However, in 2014, the Supreme Court decision in *Utility Air Regulatory Group v. EPA* modified EPA's interpretation of the permitting requirements.[221] As discussed earlier, the decision was to the effect that because of the ambiguities and differing interpretation and understanding of the term "air pollutants" as defined under the CAA and the extents of that interpretation and understanding regarding GHGs, the EPA could not require stationary sources to receive permits solely based on their potential to emit GHGs. Instead, if a source was otherwise required to obtain a CAA permit—based on its emissions of other pollutants—then the EPA could include GHGs in its permit.

In general, there are two types of CAA permits: preconstruction permits, which are a part of the New Source Review (NSR) program, and operating permits, also known as Title V permits. Any new stationary sources or modifications to existing stationary sources that are considered "major" must undergo NSR and receive either a Prevention of Significant Deterioration (PSD) permit or a nonattainment NSR permit. Only PSD

217. *See* U.S. ENVTL. PROT. AGENCY, *supra* note 18, at 2-14, 3-1.

218. *Id.*

219. Reconsideration of Interpretation of Regulations That Determine Pollutants Covered by Clean Air Act Permitting Programs, 75 Fed. Reg. 17,003 (April 2, 2010).

220. *See also* OFFICE OF AIR QUALITY PLANNING & STANDARDS, U.S. ENVTL. PROT. AGENCY, PSD AND TITLE V PERMITTING GUIDANCE FOR GREENHOUSE GASES 3 (2011) [hereinafter EPA PERMITTING GUIDANCE].

221. Util. Air Regulatory Grp. v. EPA, 573 U.S. 302, 331 (2014).

permits apply to GHGs.[222] Once a major source is subject to PSD, to obtain a permit and begin construction, the emitter must meet all the requirements of the program, the most relevant of which is the BACT requirement. A BACT is defined inter alia as:

> An emission limitation based on the maximum degree of reduction of each pollutant subject to regulation . . . emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant . . . .[223]

Accordingly, the PSD permit ensures that any new or modified major sources will reduce their methane and regulated emissions to the greatest extent that is technologically feasible and cost-effective by requiring such devices before construction can begin. Although the GHG mitigation technologies utilized are likely to vary based on the type of facility, processes involved, and GHGs being addressed, the devices identified by the EPA as suitable for methane reduction—such as thermal oxidizers and the repair of equipment leaks—can be found in the EPA Clean Air Technology Center - RACT/BACT/LAER Clearinghouse.[224]

Title V operating permits are required for all major sources and certain other sources under the CAA.[225] Title V permits generally do not add pollution control requirements but, rather, consolidate all CAA requirements applicable to a particular source and mandate certain procedures be followed. Required procedures include "providing a review of permits by the EPA, states, and the public, requiring permit holders to

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222. Different regions of the U.S. are classified as "attainment areas" or "nonattainment areas" depending on whether EPA's established NAAQS are exceeded for that area. The PSD program applies to attainment areas (areas not exceeding the established NAAQS), while the nonattainment NSR permits apply to nonattainment areas. Because NAAQs have not been established for GHGs, the nonattainment NSR program does not apply.

223. Clean Air Act § 169(3), 42 U.S.C. § 7479(3) (2018).

224. EPA PERMITTING GUIDANCE, *supra* note 220, at 28-29; *Technology Transfer Network, Clean Air Technology Center – RACT/BACT/LAER Clearinghouse*, U.S. ENVTL. PROTECTION AGENCY, https://cfpub.epa.gov/rblc/index.cfm?action=Search.BasicSearch&lang=en [https://perma.cc/YE8H-DR9Z] (last visited Jan. 10. 2021).

225. Clean Air Act §§ 501–507, 42 U.S.C. §§ 7661–7661f.

track, report, and annually certify their compliance status to their permit requirements and otherwise ensuring that permits contain conditions to assure compliance."[226] Therefore, the addition of GHGs to Title V permits does not appear to significantly alter their functioning. Concerning methane and other GHGs, Title V permits can be viewed as a way to improve compliance with the CAA by clarifying the exact measures that sources must perform to control GHG pollution.

d. CAA New Source Performance Standards for Oil and Gas Systems

Clean Air Act section 111 directs the EPA to regulate emissions of air pollutants from stationary sources. Industries that emit air pollutants are divided into over 70 different source categories and subcategories, such as cement plants, petroleum refineries, and sewage treatment plants.[227] The EPA included Crude Oil and Natural Gas Production, Transmission, and Distribution (Subpart OOOO) as a source category for the first time in 2012 (i.e., the 'NSPS 2012').[228] Hence, as a source category, crude oil and natural gas facilities are now subject to the New Source Performance Standards (NSPS), the air pollution emission standards of the CAA, for new or modified sources. The NSPS 2012 rule directly controlled VOCs and sulfur dioxide (SO2) emissions from the affected facilities.[229] However, the EPA recognized that methane reductions would occur as a co-benefit of the rule.

In 2016, the EPA extended the subpart OOOO regulations of the oil and natural gas source category by promulgating subpart OOOOa, which established the relevant performance standards based on the best system of emissions reduction (BSER) for reducing emissions of GHGs, specifically methane.[230] For instance, regarding fugitive emissions from well sites and compressor stations, the BSER was determined to be "monitoring and repair based on semiannual monitoring using optical gas

226. EPA PERMITTING GUIDANCE, *supra* note 220, at 50.

227. Standards of Performance for New Stationary Sources, 40 C.F.R. pt. 60 (2020).

228. Oil and Natural Gas Sector: New Source Performance Standards and National Emission Standards for Hazardous Air Pollutants Reviews, 77 Fed. Reg. 49,489 (Aug. 16, 2012) (to be codified at 40 C.F.R. pts. 60, 63).

229. 40 C.F.R. § 60.5360 (2013). The 2012 rule applied to all oil and natural gas facilities that commenced construction, modification, or reconstruction after August 23, 2011, and on or before September 18, 2015.

230. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources, 81 Fed. Reg. 35,823, 35,825 (codified at 40 C.F.R. pt. 60). This subpart applies to facilities that commence after September 18, 2015.

imaging" while the performance-standard required the monitoring and repair of fugitive emission components.[231] The BSER for leaks at gas processing plants and pneumatic controllers in natural gas processing plants was determined to be leak detection and repair and instrument air systems, respectively.[232] As discussed in Parts I and II above and depicted in Figure 5, leaks from compressor stations and venting from pneumatic controllers are a significant source of GHG emissions. Thus, it is interesting to note the specific rules and performance standards being set. Also, it is worth pointing out that during the notice-and-comment period, the EPA received comments on capturing and control of emissions from pneumatic controllers.

Specifically, commenters suggested that:

> [P]neumatic controllers should be required to capture emissions through a closed vent system and route the captured emissions to a process or a control device, similar to the approach the EPA has taken in its proposed standards for pneumatic pumps and compressors. The commenters cite recent Wyoming proposed rules for existing pneumatic controllers that allow operators of existing high-bleed controllers to route emissions to a process and the California Air Resources Board (CARB) proposed rules which require that operators capture emissions and route to a process control device. Commenters state that this approach would work for all types of pneumatic controllers and that this approach would be cost effective based on the costs identified for pneumatic pumps . . . .[233]

However, the EPA disregarded the recommendation and opined that:

> [C]apturing and routing emissions from pneumatic controllers to a processor control device [would not be] a viable control option under our BSER analysis. While the commenter stated that a few permits in Wyoming indicate that a facility is capturing emissions from controllers and routing to a control device, we believe that there [is] insufficient information and data available for the EPA to establish the control option as the BSER.[234]

There are divergent opinions on the BSER that are aimed at reducing emissions for the sake of the environment, but which equally have

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231. *Id.* at 35,826 tbl.1.
232. *Id.* at 35,826–27 tbl.1.
233. *Id.* at 35,879.
234. *Id.*

significant “cost-efficiency” implications. Perhaps, these issues could have been better resolved by asking for more data or technical evidence from the industry or further inquiries from advisors knowledgeable about the proposed system.

The EPA’s justification for the NSPS 2016 was the need to improve the effectiveness and implementation of the NSPS 2012 rules and specifically provide standards for GHGs. The 2016 rule also covers additional equipment and sources from oil and gas production systems that were not previously covered by the NSPS 2012 rule, such as hydraulically fractured oil wells. The NSPS 2016 rule among other things states:

> While the controls used to meet the VOC standards in the 2012 NSPS also reduce methane emissions incidentally, in light of the current and projected future GHG emissions from the oil and natural gas industry, reducing GHG emissions from this source category should not be treated simply as an incidental benefit to VOC reduction; rather, it is something that should be directly addressed through GHG standards in the form of limits on methane emissions under CAA section 111(b) based on direct evaluation of the extent and impact of GHG emissions from this source category and the emission reductions that can be achieved through the best system for their reduction . . . . The high quantities of methane emissions from the oil and natural gas source category demonstrate that it is rational for the EPA to set methane limitations.[235]

Given the justifications stated by the EPA, some of the key requirements of the 2016 EPA methane rule include the requirements to: (i) locate and repair leaks, also known as “fugitive emissions”; (ii) reduce natural gas venting and flaring; (iii) use reduced emissions completions (RECs, or “green completions”) to capture emissions from hydraulically fractured oil wells; (iv) route methane emissions from a pneumatic diaphragm pump to a control device; (v) continue to follow all requirements of the NSPS 2012 rule, such as limiting emissions from storage tanks; and (vi) reduce emissions that occur from the operation of centrifugal compressors and reciprocating compressors, which are used at natural gas compression stations to move natural gas along a pipeline.

The rule includes requirements that apply at every step of the production and transmission process: oil and natural gas well sites, natural

235. *Id.* at 35,841.

gas production gathering and boosting stations, gas processing plants, natural gas transmission compressor stations, and storage facilities.[236]

The NSPS 2016 and NSPS 2012 rules arguably sought to provide a performance-based framework of specific rules and requirements for the operators. It also appears to be based on the need to act on emissions information and data gathered through the reporting activities of operators as required over a period of time as discussed in Part I and II above. Therefore, to the extent that the rules aim at encouraging and guiding operators to be environmentally responsible and to take active measures to curb emissions without unreasonably hindering lawful operations or imposing avoidable costs, then the critique should not be a question of creating "unnecessary" regulatory burdens as the current political leaders seem to suggest. Rather, it appears to be a justifiable case of setting out clear, comprehensive, and coherent rules for guiding expected behavior. Such coherence and clarity are a hallmark of a good regulatory system.

The steps taken by the Obama-EPA before the amendments to NSPS 2012 were finalized with the NSPS 2016 rule seem to be well thought out and follow due process. The NSPS 2016 rules and regulations took effect on August 2, 2016.[237] According to the Agency, the main rationale was to amend the NSPS 2012 and provide updated standards.[238] The EPA notably gave due considerations to comments received during the proposal stages including having a structured engagement process with states and stakeholders. As part of the process, the EPA issued draft white papers addressing various technical issues, including public and expert reviewers' comments.[239] The rules were also designed to complement other federal actions as well as state regulations and the EPA highlights that it worked closely with the U.S. Department of Interior's BLM during the rulemaking process to avoid conflicts in requirements between the NSPS and BLM's proposed rulemaking. It was also important to evaluate existing state and local programs when developing these federal standards and attempts; thus, the EPA noted the consideration of such potential conflicts with existing state and local requirements.[240]

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236. *See EPA's Actions to Reduce Methane and Volatile Organic Compound (VOC) Emissions from the Oil and Natural Gas Industry: Final Rules and Draft Information Collection Request Fact Sheet and Presentation*, U.S. Envtl. Protection Agency (May 2016), https://www.epa.gov/stationary-sources-air-pollution/epas-actions-reduce-methane-and-volatile-organic-compound-voc [https://perma.cc/CL62-SC98].

237. NSPS 2016, *supra* note 7.

238. *Id.*

239. *Id.* at 35,825.

240. *Id.*

Notwithstanding the above and in what appears to be mainly a response to the existing rules for political reasons, it is noted that after the Trump administration came into office, the EPA, which is technically the same agency that conducted the 2016 process (but perhaps with a different political and regulatory inclination), issued a notice of proposed rulemaking on June 16, 2017, to stay the implementation of the NSPS 2016 rule for two years while the same (or perhaps in reality different) EPA reconsidered the rule.[241] This was done even though the NSPS 2016 rule explicitly states that:

> As the purpose of this action is to control and limit emissions of GHG and VOC, [the] EPA seeks to confirm that all regulatory standards are met. *Any owner or operator claiming technical infeasibility, nonapplicability, or exemption from the regulation has the burden to demonstrate the claim is reasonable based on the relevant information. In any subsequent review of a technical infeasibility or nonapplicability determination, or a claimed exemption, EPA will independently assess the basis for the claim* to ensure flaring is limited and emissions are minimized, in compliance with the rule. Well-designed rules ensure fairness among industry competitors and are essential to the success of future enforcement efforts.[242]

Hence, the NSPS 2016 Rule had an in-built mechanism through which "any owner or operator claiming technical infeasibility, non-applicability, or exemption from the regulation has the burden" could seek exemptions or make claims requiring a review.[243]

Following the Trump-EPA's stay decision, the D.C. Circuit vacated EPA's administrative stay of the rule because it was unlawful under the CAA.[244] Nonetheless, the court did emphasize that even though the stay

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241. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources: Three Month Stay of Certain Requirements, 82 Fed. Reg. 27,641 (June 16, 2017).

242. *Id.* (emphasis added).

243. NSPS 2016, *supra* note 7, at 35,844. The purpose of the rule is to enable the EPA to control and limit emissions of GHG and VOC. Any owner or operator claiming technical infeasibility, non-applicability, or exemption from the regulation has the burden to demonstrate the claim is reasonable. Additionally, in the event of any subsequent review of a technical infeasibility or non-applicability determination, or a claimed exemption, the EPA will independently assess the basis for the claim to ensure flaring is limited and emissions are minimized, in compliance with the NSPS rule.

244. Clean Air Council v. Pruitt, 862 F.3d 1 (D.C. Cir. 2017).

was unlawful, the EPA can still substantially modify the rule via the normal notice-and-comment rulemaking under the Administrative Procedure Act. The Trump-EPA began this process on October 15, 2018, by issuing a proposed rule.[245] The public comment period for this proposal closed on December 17, 2018, and interestingly enough, ExxonMobil, a major oil and gas corporation, expressed support for maintaining the key elements of the underlying Obama-EPA NSPS 2016 rule, such as leak detection and repair programs.[246] However, Exxon also applauded Trump-EPA's efforts to make the regulations "more cost-effective."[247] Some of the changes proposed by the Trump-EPA include (a) weakening of the leak detection and repair rules allowing longer intervals between inspections; (b) a change from requiring that leaks be fixed within 30 days to requiring that a "first attempt at the repair" be made within 30 days, with repairs made within 60 days; (c) allowing broader use of the "technical infeasibility" exception; and (d) allowing in-house engineers to certify system designs and declarations of technical infeasibility.[248]

On August 28, 2019, the EPA signed proposed amendments to the 2012 and 2016 NSPS rules based on removing "regulatory duplication and sav[ing] the industry millions of dollars in compliance costs each year, while maintaining health and environmental protection from oil and gas sources that the Agency considers appropriate to regulate."[249] The 2019 reviews under the Trump administration aimed at, among other things, revising the inclusion of sources in transmission and storage as part of the source category and the inclusion of GHGs, in the form of methane, as a regulated pollutant in NSPS 2016. The Regulatory Impact Assessment

245. Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration, 83 Fed. Reg. 52,056 (Oct. 15, 2018).

246. Exxon Mobil Corporation, Comment Letter Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Reconsideration: Proposed Rule (Dec. 17, 2018), https://www.dropbox.com/s/a1c6z3wxhvgkzu2/ExxonMobil_Comment_Letter.pdf?dl=0 [https://perma.cc/2Z8K-27Y4].

247. *Id.*

248. *Proposed Policy Amendments 2012 and 2016 New Source Performance Standards for the Oil and Natural Gas Industry*, U.S. ENVTL. PROTECTION AGENCY, https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/proposed-policy-amendments-2012-and-2016-new [https://perma.cc/WWT9-WNMS] (last visited Jan. 10, 2021).

249. *See also* U.S. ENVTL. PROT. AGENCY, REGULATORY IMPACT ANALYSIS FOR THE PROPOSED OIL AND NATURAL GAS SECTOR: EMISSION STANDARDS FOR NEW, RECONSTRUCTED, AND MODIFIED SOURCES REVIEW (2019), https://www.epa.gov/sites/production/files/2019-08/documents/oil_and_natural_gas_review_proposal_ria.pdf [https://perma.cc/RRH2-HHB3].

(RIA) of the NSPS 2012 and 2016 that accompanied the 2019 proposed rules suggest that the proposed rules will aim among other things at rescinding the requirements of NSPS 2016, i.e., OOOOa, for: (i) sources in the transmission and storage segment, as well as (ii) methane regulation requirements from sources in the production and processing segments, while leaving VOC regulations in place for the production and processing sources. The alternative co-proposed option considered is to rescind the methane requirements for all affected sources.[250]

The RIA states that methane control options are redundant or seemingly unnecessary because there are VOC control options, thus, there are no expected cost or emissions effects from removing the methane requirements in the production and processing segments. It states further that there are no expected cost or emissions impacts for the alternative co-proposed option for the same reason because methane control options on all sources would be redundant since they are already with VOC control options.[251]

According to the Trump-EPA, the proposed amendments are estimated to save the oil and gas industry $17 to 19 million a year, for a total of $97 to $123 million from 2019 through 2025.[252] Hence, a vital question here is: was the objective to save the industry some or a lot of money, i.e. to be cost-efficient while dealing with emissions or to reduce "unnecessary" regulatory burdens? And would such be justifiable enough vis-à-vis the imperative of curbing emissions coherently and requiring environmentally responsible action from the industry? It appears the need to save costs and deregulate even if gaps in regulation are created was prioritized by the Trump-era EPA. Unfortunately, the plausibility of political and commercial influences and by implication "regulatory capture" on an agency's ability to independently decide when and how to regulate goes against the tenets of good quality regulatory systems.

e. The Bureau of Land Management

The BLM manages public lands and subsurface estate under its jurisdiction under the Federal Land Policy and Management Act 1976.[253] Its core mandate relates to conservation and regulation of multiple-use and sustained yield while ensuring an environmentally responsible development of energy resources and mining on Federal lands (comprising

250. *Id.*
251. *Id.*
252. *Id.*
253. Federal Land Policy and Management Act of 1976, Pub. L. No. 94-579, 90 Stat. 2743 (codified as amended at 43 U.S.C. §§ 1701-1787 (2018)).

about 245 million acres of land and 700 million acres of a mineral estate).[254] The BLM 2016 Rule was issued under the MLA which requires the BLM to ensure that lessees use all reasonable precautions to prevent waste of oil or gas developed in the land. Furthermore, it requires that leases issued by the BLM must ensure that operations are conducted with reasonable diligence, skill, and care and that lessees comply with rules for the prevention of undue waste. The main focus is on waste prevention, both in terms of wasting gas as a resource and preventing loss of accruable revenues such as royalties and taxable income as a result of avoidable waste, venting, and flaring.[255] In stating its rationale or background to the 2016 Rule, it was therefore apt to pursue the objectives of ensuring that operators act in ways that (a) promote the economical, cost-effective, and reasonable measures to minimize gas waste, and (b) enhance the nation's natural gas supplies, boost royalty receipts for American taxpayers, tribes, and states. However, when the BLM's rationale starts to speak of reducing pollution and preventing climate change due to venting, flaring, and leaks of gas, then it raises the question of potential encroachment on the jurisdiction of the EPA under the CAA.[256]

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254. The BLM 2016 Rule notes that "Domestic production from 96,000 Federal onshore oil and gas wells accounts for 11 percent of the Nation's natural gas supply and 5 percent of its oil. In Fiscal Year (FY) 2015, operators produced 183.4 million barrels (bbl) of oil, 2.2 trillion cubic feet (Tcf) of natural gas, and 3.3 billion gallons of natural gas liquids (NGLs) from onshore Federal and Indian oil and gas leases. The production value of this oil and gas exceeded $20.9 billion and generated over $2.3 billion in royalties, which were shared with tribes, Indian allottee owners, and States." BLM 2016 Rule, *supra* note 8, at 83,009.

255. The Mineral Leasing Act, 30 U.S.C. § 225 (2018), requires that leases granted by the BLM include a provision that such rules for the prevention of undue waste shall be observed.

256. In the Background Statement to the BLM 2016 Rule it was stated that: "BLM is not the only regulator with the responsibility to oversee aspects of onshore oil and gas production, and throughout this rulemaking the BLM has focused on potential interactions of this rule with other Federal, State, or tribal regulatory requirements. For example, the U.S. Environmental Protection Agency (EPA) issued rules in 2012 and early 2016 to control emissions of methane and volatile organic compounds (VOCs) from new, modified and reconstructed oil and gas wells and production equipment, and many States and tribes regulate aspects of the oil and gas production process to address safety, waste, production accountability, and/or air quality concerns. *Regulatory agencies often have overlapping authority and may adopt very similar measures to realize those complementary goals, such as improving air quality and reducing waste. For example, measures in this rule that aim to avoid the waste of methane gas through*

During the Obama administration, the BLM 2016 Rule was effective from January 17, 2017. The objective was to effectively replace the previously applicable framework for regulating venting, flaring, and royalty-free use of gas on Federal Land, i.e. the 1979 Notice to Lessees and Operators of Onshore Federal and Indian Oil and Gas Leases, Royalty or Compensation for Oil and Gas Lost (NTL-4A). Furthermore, it aimed at stipulating the rules for the "waste" of natural gas due to venting, flaring, and leaks during oil and gas production operations on onshore Federal and Indian (other than Osage Tribe) leases, as well as define the contexts in which such lost or wasted gas could be subject to royalties or when it would be considered royalty-free on-site. Although the regulations aimed at stopping or reducing "waste" through flaring, venting, and leaks, it would have the indirect impact of reducing the pollution and GHG emissions attributable to such activities as discussed previously in Parts I and II.

The elaborate process undertaken before the issuance of the BLM 2016 rule requires carrying out consultations with tribal leaders, state authorities, companies and NGOs, and relevant stakeholders, including public meetings in Colorado, New Mexico, North Dakota, and Washington, DC.[257] In the build-up to the 2016 rule, the BLM received and considered approximately 330,000 public comments on the proposed rule, including approximately 1,000 unique comments.[258] It is therefore interesting to note the different actions taken by the Trump administration and the 115th Congress to target the BLM 2016 Rule as part of an elaborate deregulatory drive.

f. Dismantling of the "Obama" 2016 BLM Methane Rule

First, the rule was slated for revocation by the Congressional Review Act (CRA). Under the CRA, Congress has 60 days to review major regulations before they go into effect; if both houses disapprove of a rule, then it can be repealed by a joint resolution signed by the President.[259] Because a president can simply veto a resolution attempting to overturn a regulation promulgated by his administration, the CRA is viewed as a protection against "midnight" legislation by a president about to leave the

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venting or leaks will also reduce methane pollution." BLM 2016 Rule, *supra* note 8, at 83,010 (emphasis added).

257. *Id.*

258. *Id.* Such unique comments came from the oil and gas industry and trade associations, NGOs representing over 37 organizations, government officials or elected representatives, and from private citizens.

259. Congressional Review Act, 5 U.S.C. §§ 801–808 (2018).

office.[260] Before President Trump, the CRA had only been successfully used once, at the beginning of the Bush presidency in 2001.[261] During the first months of Trump's term, however, Congress considered 33 regulations for repeal under the CRA.[262] The CRA resolution addressing the BLM 2016 Rule narrowly failed in the Senate, losing by only one vote.[263]

After the attempted repeal via the CRA, the BLM issued a postponement of most of the provisions of the rules.[264] However, because the rule had already gone into effect and BLM did not engage in proper rulemaking, the postponement was vacated following a suit brought by California, New Mexico, and a coalition of seventeen conservation and tribal citizens groups against BLM which claimed that the latter violated the Administrative Procedures Act publishing a notice postponing the compliance dates for certain sections of the BLM 2016 Rules on Waste Prevention, Production Subject to Royalties.[265] Thus, the BLM 2016 rule was back in place. Thereafter, the Trump-BLM commenced a notice-and-comment rulemaking to suspend the rule,[266] but this suspension was also

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260. Susan E. Dudley, *Don't Write Off the Congressional Review Act Yet*, YALE J. ON REG.: NOTICE & COMMENT (Nov. 6, 2017), https://www.yalejreg.com/nc/dont-write-off-the-congressional-review-act-yet-by-susan-e-dudley/ [https://perma.cc/L8TD-DDW6].

261. *Id.* However, before Trump's term, Congress had passed five other resolutions of disapproval, but each were vetoed by President Obama. *See* MAEVE P. CAREY & CHRISTOPHER M. DAVIS, CONG. RESEARCH SERV., R43992, THE CONGRESSIONAL REVIEW ACT (CRA): FREQUENTLY ASKED QUESTIONS 5 (2020).

262. Eric Lipton & Jasmine C. Lee, *Which Obama-Era Rules Are Being Reversed in the Trump Era*, N.Y. TIMES (May 18, 2017), https://www.nytimes.com/interactive/2017/05/01/us/politics/trump-obama-regulations-reversed.html [https://perma.cc/PA74-HKKJ].

263. Valerie Volcovici, *Bid to Revoke Obama Methane Rule Fails in Surprise U.S. Senate Vote*, REUTERS (May 10, 2017, 9:40 AM), https://www.reuters.com/article/us-usa-congress/bid-to-revoke-obama-methane-rule-fails-in-surprise-u-s-senate-vote [https://perma.cc/W57K-KSMN]. The resolution failed 49 to 51, but it can be assumed that Vice President Pence would have sided with Trump to break the 50-50 vote in favor of disapproval.

264. Waste Prevention, Production Subject to Royalties, and Resource Conservation; Postponement of Certain Compliance Dates, 82 Fed. Reg. 27,430 (June 15, 2017).

265. California v. U.S. Bureau of Land Mgmt., 277 F. Supp. 3d 1106 (N.D. Cal. 2017).

266. Waste Prevention, Production Subject to Royalties, and Resource Conservation; Delay and Suspension of Certain Requirements, 82 Fed. Reg. 58,050 (Dec. 8, 2017).

invalidated when it was enjoined by the court.[267] The same day the Suspension Rule was enjoined, the BLM released a Revised Rule which repealed most of the BLM 2016 Rule as promulgated by the Obama administration.[268] After issuance of the proposed rule, the Wyoming District Court in *Wyoming v. U.S. Dep't of Interior* ordered a stay of the implementation of major provisions of the original BLM 2016 Rule, preventing the rule from going into effect.[269] On September 28, 2018, BLM issued its Final Rule modifying the 2016 Methane Rule, and this new rule went into effect on November 27, 2018.[270] The Wyoming Case exemplifies some of the issues discussed earlier in this Article, especially about properly defining and effectively implementing the roles of various institutions.

On January 16, 2017, a Wyoming federal court declined to issue a preliminary injunction staying the effective date of the BLM 2016 Rule.[271] In this case, the states of Wyoming, Montana, and North Dakota requested that the court enjoin the rule before it takes effect on January 17, 2017, because according to them, the rule represents unlawful agency action since it exceeds BLM's statutory authority and is otherwise arbitrary and capricious.[272] It was held that the petitioners had not shown a "clear and unequivocal right to relief" because the court was unable to conclude that the rule's provisions "lack a legitimate, independent waste prevention purpose or are otherwise so inconsistent with the [Clean Air Act] as to exceed BLM's authority and usurp that of the EPA, states, and tribes."[273] Though the court questioned whether the "social cost of methane" was an appropriate factor to consider in issuing a "resource conservation rule" under the Mineral Leasing Act, the court said it could not conclude "at this point" that the rule was arbitrary and capricious.[274]

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267. California v. Bureau of Land Mgmt., 286 F. Supp. 3d 1054, 1076 (N.D. Cal. 2018).

268. Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements, 83 Fed. Reg. 7924 (Feb. 22, 2018) (to be codified at 43 C.F.R. pts. 3160, 3170).

269. Wyoming v. U.S. Dep't of Interior, 366 F. Supp. 3d 1284 (D. Wyo. 2018), *vacated by* 768 F. App'x. 790 (10th Cir. 2019).

270. Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements, 83 Fed. Reg. 49,184 (Sep. 28, 2018) (codified at 43 C.F.R. pts. 3160, 3170).

271. Wyoming v. U.S. Dep't of Interior, No. 2:16-CV-0285-SWS, 2017 WL 161428 (D. Wyo. Jan. 16, 2017) (Order on Motions for Preliminary Injunction).

272. *Id.*

273. *Id.*

274. *Id.* at *10.

g. Comparison of BLM's 2016 and 2018 Final Rules

In examining the key implications of the Trump-BLM's 2018 rule it is opined here that the following requirements of the 2016 rule were removed in their entirety: (i) waste minimization plans; (ii) well drilling and completion requirements; (iii) pneumatic controller and diaphragm pump requirements; (iv) storage vessels requirements; and (v) leak detection and repair requirements. The following requirements of the 2016 rule were modified and/or replaced: (i) Gas-capture requirement –The BLM will now defer to state or tribal regulations in determining when the flaring of associated gas from oil wells will be royalty-free; (ii) Downhole good maintenance and liquids unloading requirements; and (iii) Measuring and reporting volumes of gas vented and flared.

By and large, the final 2018 BLM Methane Rule eliminated key requirements of the 2016 Rule and reinstated the previous regulations (known as "NTL-4A") that date back to the 1970s. The 2016 rule applied to both new and existing oil and natural gas activities on federal lands, meaning that it covered some facilities not regulated by the EPA rules, which only cover new and modified sources. Natural gas at oil wells (associated gas) is often vented or flared, resulting in substantial waste, and the 2016 BLM Rule had set reasonable "capture targets" to require producers to capture an increasing percentage of all associated gas: 85% in 2018 and up to 98% in 2026. The capture targets have been completely eliminated in the 2018 Final Rule issued by the Trump-BLM, and producers will only be forced to capture associated gas where required by state regulations. Similar to the EPA requirement, the 2016 regulations required regular inspections for methane leaks and the repair of any leaks detected. However, the 2018 BLM rule also completely rescinded these requirements.

After BLM released the language of the final 2018 rule, the states of California and New Mexico sued the Agency, alleging the regulation was unlawfully promulgated in the case *California v. Bernhardt*.[275] If the new

275. 472 F. Supp. 3d 573 (N.D. Cal. 2020). The case of *California v. Bernhardt*, Case No. 4:18-cv-05712-YGR (N.D. Cal.) was consolidated with the Complaint, *Sierra Club v. Zinke*, 3:18-cv-05984 (N.D. Cal., Sept. 18, 2018). Note that on July 15, 2020, the court ordered that the 2018 Revision Rule be vacated. *Id.* Furthermore, on October 29, 2020, the Northern District of California entered judgment vacating the 2018 final rule rescinding the BLM 2016 Rule. The federal defendants and trade group intervenor-defendants have appealed the court's July 2020 decision vacating much of the 2018 rule. On October 8, the District of Wyoming vacated the 2016 rule, with judgment entered on October 23. No appeals have been filed yet as at the time of writing. For updates see

rules stay in place, the drastic changes made to both the BLM Methane and Waste Prevention Rule and the EPA NSPS related to methane are likely to weaken the regulations' ability to limit methane and relevant GHG emissions.

h. Pipeline and Hazardous Materials Safety Administration

The U.S. Department of Transportation's PHMSA has the authority to regulate the safety of pipelines and underground natural gas storage facilities. President Obama provided some additional mandates to the Agency, including some affecting GHG emissions, when he signed the Pipeline Safety, Regulatory Certainty, and Job Creation Act of 2011 and the Protecting our Infrastructure of Pipelines and Enhancing Safety Act of 2016. However, all of these mandates have not been fulfilled.[276] In response to Southern California Gas Company's large natural gas leak that remained out of control from October 2015 to February 2016, PHMSA was authorized to issue safety standards for underground natural gas storage facilities. PHMSA also has the authority to set standards for the use of pipeline leak detection systems, automatic shut-off valves, and accident notification systems which can all help to lower methane emissions from the nation's pipeline infrastructure.

i. State Actions on Methane Emissions

Most state regulations regarding methane focus on other sources of emissions, such as landfills and local distribution infrastructure,[277] but as the Trump administration rolls back federal protections, some states have attempted to use state regulations to fill in the gaps. Only six states (California, Colorado, Ohio, Pennsylvania, Utah, and Wyoming) currently have regulations or permit requirements regarding methane or VOC emissions from the oil and gas sector.[278] New Mexico may soon be added to this list, as the governor has ordered state regulators to develop similar

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http://climatecasechart.com/case/california-v-zinke/?cn-reloaded=1 [https://perma.cc/K4WA-S8XZ].

276. LATTANZIO, *supra* note 50, at 13–14.

277. *State Methane Policies*, NAT'L CONF. OF ST. LEGISLATURES, (Feb. 11, 2014), http://www.ncsl.org/research/environment-and-natural-resources/state-methane-policies.aspx [https://perma.cc/NKZ2-BJ86].

278. ENVTL. DEF. FUND, LEADING REGULATORY PRACTICES TO ABATE OIL AND GAS METHANE EMISSIONS: LESSONS LEARNED FROM MEXICO (2018), https://www.edf.org/sites/default/files/documents/MX%20Methane%20Regs_FactSheet_English.pdf [https://perma.cc/EL24-4L32].

rules.[279] In Pennsylvania, the state Department of Environmental Protection proposed a new rule limiting methane and VOC emissions in April 2019, and the State Senate Democratic Policy Committee was discussing making the regulations even tighter.[280] Colorado has been considered the leader in methane leak reduction because it passed the first regulations in the country requiring producers to routinely check oil and gas wells for methane leaks and to fix leaky equipment. Colorado's regulations in 2014 actually preceded the EPA's 2016 methane standards and were considered to be more protective than the EPA rule. Two years after Colorado's rule went into effect, the Colorado Department of Public Health and Environment announced a 75% drop in oil and gas sites with detected methane leaks.[281]

Advocates for stronger federal standards have argued that the federal government should at least set a regulatory floor to avoid a race to the bottom approach among some states hoping to attract production companies with the promise of limited regulation. However, the Trump administration has often espoused the opposing view that any actions by the federal government would only add confusion and complexity because of duplicative state regulations.[282] However, this argument seems to ignore the fact that many federal environmental rules, for example, the Obama BLM's 2016 methane rule, allow states to formulate their regulations and

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279. Laila Kearny & Jennifer Hiller, *New Mexico Governor Moves to Limit Methane Emissions, Combat Climate Change*, REUTERS (Jan. 29, 2019), https://www.reuters.com/article/us-new-mexico-regulation-energy/new-mexico-governor-moves-to-limit-methane-emissions-combat-climate-change-idUSKCN1PN35R [https://perma.cc/33PN-DPDD].

280. Elizabeth Hardison, *Environmental Proponents to State Senate Panel: Pa. Needs Better Methane Regulations*, PA. CAPITAL-STAR (Apr. 23, 2019), https://www.penncapital-star.com/blog/environmental-proponents-to-state-senate-panel-pa-needs-better-methane-regulations/ [https://perma.cc/XV3B-VZEY].

281. Cathy Proctor, *EPA Follows Colorado Lead in Targeting Methane Leaks From Oil & Gas*, DENVER BUS. J. (May 12, 2016), https://www.bizjournals.com/denver/blog/earth_to_power/2016/05/epa-follows-colorado-lead-in-targeting-methane.html [https://perma.cc/P669-R3PM].

282. *See, e.g.*, Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements, 83 Fed. Reg. 49,184, 49,188 (Sep. 28, 2018) ("The existence of methane emissions regulations in these states highlights the unnecessary regulatory overlap and duplication created by the 2016 rule.").

receive a variance from the appropriate federal agency, as long as the state or local rules are as effective as the federal regulation.[283]

CONCLUSION

This Article builds on the premise that in the most ideal scenarios policy and regulatory frameworks should: (i) exemplify coherence rather than uncertainty; (ii) protect regulatory independence and accountability rather than susceptibility to the dictates of various interest groups in the energy spectrum; and (iii) support efficient communication and information sharing between the regulator and industry. In a carbon-constrained world where energy supply systems and markets are facing increasing scrutiny and justifiable calls for greater environmental responsibility and accountability, the development of such high-quality regulatory and policy frameworks should be a priority. As discussed above, especially in Parts I and II, the "cleaner" energy and environmental case for gas compared to other hydrocarbons do not depend on beating the emissions performance of these other carbon-intensive energy sources; rather, it is more likely to depend on the willingness of the relevant operators and institutions to work together to ensure the emissions attributable to the gas production and supply chain is as low as practicable or competes favorably with the increasing array of net-zero carbon or zero-carbon sources. This presupposes the development, investments in, and implementation of necessary innovations and technologies exemplified in concepts such as the BSER and the BACT and also leading to the large-scale cost-efficient deployment of emissions removal technologies, such as CCUS and methane reformation. Unfortunately, such investments and innovations are unlikely to develop at the right pace and scale without clarity and coherence in applicable rules, regulations, and incentives. Another important reason to tackle GHG and methane emissions from oil and gas operations (compared to other anthropogenic sources) is that in many cases there is a readily available path to market for the captured methane or recycled carbon to be sold or stored safely for future use. Thus, about 40-50% of current methane emissions could be avoided at no net cost. Arguably, reducing oil and gas methane emissions, in particular, remains a cost-efficient way of reducing greenhouse gas emissions compared with other mitigation strategies.

283. *See* Waste Prevention, Production Subject to Royalties, and Resource Conservation, 81 Fed. Reg. 83,008, 83,035 (codified at 43 C.F.R. pts. 3100, 3160, 3170) (Nov. 18, 2016).

Energy policy typically revolves around the need to ensure reasonable costs and prices, reliability, and the protection of public health, safety, and the environment. In reality, vested interests are working through the political economy of energy supply operations and institutions as well as the economic interests created further to property rights held by the public and private corporations in the energy space. These interests have a considerable impact on the processes for realizing the dimensions of energy policy and regulation discussed in this Article.[284] Being able to identify these misaligned interests and prevent the avoidable bottlenecks is becoming increasingly vital in a carbon-constrained world and transitional energy contexts.[285] If energy law and regulation are approached from a functional standpoint as a means to a reasonable end, then, the objectives of managing costs, reliability, and sustainability are not inherently incompatible.

284. INNOVATION IN ENERGY LAW AND TECHNOLOGY: DYNAMIC SOLUTIONS FOR ENERGY TRANSITIONS 2–7 (Donald Zillman et al. eds., 2018); Waste Prevention, Production Subject to Royalties, and Resource Conservation; Rescission or Revision of Certain Requirements, 83 Fed. Reg. 49,184.

285. DECARBONIZATION AND THE ENERGY INDUSTRY: LAW, POLICY, AND REGULATION IN LOW-CARBON ENERGY MARKETS 401–09 (Tade Oyewunmi et al. eds., 2020).