The Role of Law in Climate Change Mitigation in Oil and Gas Production

A thesis submitted in fulfilment

of the requirements for the degree

of

Doctor of Philosophy in Law

at

The University of Waikato

by

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THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

2021

Abstract

Scientific evidence and ideas about climate change suggest the need for a global energy shift from oil and fossil fuels to renewables and other forms of clean energy. This transition will not be possible without understanding the dynamics and legal frameworks in petroleum-producing countries. More so, the current significant position of oil and fossil fuels in the global energy mix justifies the need to inquire into sustainability practices in the oil and gas industry, while the energy transition continues to gain momentum. Against this background, this thesis examines the role of law in climate change mitigation in oil and gas production to identify some characteristics of an effective regime for abating upstream gas flaring, venting, and fugitive emissions. It adopts a qualitative analytical approach consisting of conventional legal analysis, comparative analysis, and the theory of regulation to study the applicable regimes in twelve major petroleum-producing countries to obtain insights of a general nature. It also discusses some industry measures and private corporate initiatives of oil and gas companies as part of the overarching governance structure for mitigating upstream greenhouse gas (GHG) emissions. Findings from the comparative analysis put forward the necessity of adopting sector-specific and dedicated prescriptive regulatory arrangements and market-based instruments that send strong price signals to incentivise large-scale emissions reduction in petroleum production. The study also suggests the need for complementarity between state and industry regulatory approaches to incentivise innovative strategies to reduce upstream GHG emissions significantly. These considerations constitute a hybrid design that regulators can consider while undertaking law reforms on the topic. However, political will, dependency, rent-seeking, and corruption are some political-economy issues that most petroleum-producing states must address to ensure the effective regulation of upstream GHG emissions and, by extension, support profound energy transition.

Acknowledgements

I bow in reverence and worship to The Supreme Almighty God for the grace, courage, patience, and resilience He bestowed upon me to begin and complete the noble journey of a doctoral degree. My mentors and supervisors – Prof. Barry Barton and Prof. Trevor Drage – have been tremendous all through the period of my research. I am eternally grateful to them for their constant feedback, advice, expertise, and encouragement, which helped refine my thought and polish this thesis to an academic standard that is worthy of celebration. I am forever grateful to the University of Waikato for offering me the School's competitive doctoral scholarship and to the Section on Energy, Environment, Natural Resources, and Infrastructure Law (SEERIL) of the International Bar Association (IBA) for the additional funding it granted me in support of this inquiry. These two scholarships sustained me financially and contributed significantly to the successful completion of this rewarding academic path.

My spouse, lover, soulmate, and best friend – Miracle Abraham-Dukuma – has been an indispensable pillar of support in our memorable sojourn through life. Her consistent encouragement, wise counsel, prayers, blessings, and secret magic of the inner room were instrumental to my milestones and happy conclusion. I also thank my lovely daughters – Maya and Mirabilia – for being a part of my life these three years. Their addition to the family during my doctoral journey brought more laughter, happiness, and joy to my life and contributed to a healthy, busy, and energetic environment for my research. I am also grateful to my biological parents – Abraham (father) and Rose (mother) – for their constant sacrifices, commitments, prayers, and blessings, which have tremendously contributed to the man that I have become today. I am particularly incredibly indebted to my father for sacrificing his comforts and numerous dreams on the altar of my lofty aspirations. I will happily extend the same paternal gesture to the adorable souls that God has benevolently entrusted into my earthly care.

Further, I am profoundly grateful to my church families – the Hamilton New Life Church and the Deeper Life Bible Church – for their multidimensional support right from my arrival in Hamilton to the happy completion of this thesis. I also thank Dr Obinna Okpareke and his lovely family for giving my family our first meal in New Zealand and for their constant support all through my doctoral research journey. I also thank Dr Francis N. Okpaleke (aka The Oracle) and Dr Michelle St Jane for the collective inspiration and motivation we have offered ourselves and for the noble aspirations that we all share. My gratitude goes out to the other unnamed kind souls that are too numerous to mention. I pray that life will be benevolent to all of them for being kind to me, a fellow sojourner.

List of Abbreviations

APG	Associated Petroleum Gas
BCM	Billion Cubic Meters
BLM	Bureau of Land Management
BSER	Best System of Emissions Reduction
CAD	Canadian Dollars
CARB	California Air Resources Board
CDP	Carbon Disclosure Project
CH_4	Methane
CO_2	Carbon dioxide
COVID-19	The 2019 Coronavirus Disease
EDF	Environmental Defence Fund
EROI	Energy Return on Investment
EPA	Environmental Protection Agency
EU	European Union
EU-ETS	European Union Emissions Trading System
EV	Electric Vehicle
FLPMA	Federal Land Policy and Management Act
GGFRP	Global Gas Flaring Reduction Partnership
GHG	Greenhouse gas
$GtCO_2$	Gigatonnes of CO_2
$GtCO_2e$	Gigatonnes of Carbon Dioxide Equivalent
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
IOCs	International Oil Companies

IOGP	International Association of Oil and Gas Producers
IPCC	Intergovernmental Panel on Climate Change
IPIECA	International Petroleum Industry Environmental Conservation Association
LCFS	Low Carbon Fuel Standard
LDAR	Leak Detection and Repair
MBIs	Market-Based Instruments
Mcf	Million Cubic Feet
NDCs	Nationally Determined Contributions
NOCs	National Oil Companies
OECD	Organisation for Economic Cooperation and Development
OGCI	Oil and Gas Climate Initiative
OPEC	Organisation of the Petroleum Exporting Countries
SEI	Stockholm Environment Institute
UAE	United Arab Emirates
UK	United Kingdom
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Program
USA	United States of America
USD	United States Dollars
USEIA	The United States Energy Information Administration
USEPA	The United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WRI	World Resources Institute
ZRF	Zero Routine Flaring

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1. The Research Framework

A. General Introduction

This introductory chapter establishes the foundation and contextualises the core themes of the research. It will state the research question for investigation, review the relevant literature, and define this study's contribution to knowledge. It will also clarify the adopted methods, country selection for comparative analysis and describe the entire structure of the research.

This thesis examines the role of law in abating flaring, venting, and fugitive emissions in upstream petroleum (oil and gas) production. The examination will proceed with the research question described in Part B of this chapter and the sequence of analysis explained thereafter. Matters related to the petroleum industry are technical, but reasonable care has been taken to describe operations and issues that are related to the specific subject of inquiry. The industry can be divided into the upstream, midstream, and downstream sectors.[1] The upstream sector comprises five principal phases, namely exploration (searching for oil and gas), appraisal (feasibility study of the well or field and commercial viability of production), development planning, recovery of oil and gas, and decommissioning (field abandonment or closure).[2] Upstream petroleum (oil and gas) production means the eventual recovery or extraction of crude oil and gas, mostly found together beneath land or ocean floors and formed by a similar geological process. However, oil and gas require different processing schemes due to their physical states.[3] While oil undergoes a refining process after production, gas goes through treatment and compression for distribution.[4] Some fields or wells produce just gas, while most wells have a mixture of oil and gas, water, and numerous contaminants that all undergo separation processes.[5]

The midstream sector captures the processing and transportation of the produced petroleum products to refineries (for crude oil) and gas plants for treatment, processing, and compression (for gas) and different technical processes.[6] The downstream sector involves refining produced petroleum into derivatives (heating oil, kerosene, liquefied petroleum gas, aviation fuel, diesel,

[1] Joseph Hilyard *The Oil and Gas Industry: A Nontechnical Guide* (PennWell Corporation 2012) 226.
[2] Frank Jahn Mark Cook and Mark Graham *Developments in Petroleum Science, vol. 55: Hydrocarbon Exploration and Production* (2nd edn Elsevier 2008) 2-6.
[3] USEPA *Oil – Exploration, Production, Transport and Natural Gas* (US EPA 2010) 4.
[4] Ibid.
[5] Hâvard Davold *Oil and Gas Production Handbook: An Introduction to Oil and Gas Production, Transport, Refining and Petrochemical Industry* (Edition 3.0 Oslo, ISBN 978-82-997886-3-2 August 2013) 14.
[6] Ibid, at 16; M.A. Fahim, T.A. Al-Sahhaf and A.S. Elkilani *Fundamentals of Petroleum Refining* (Elsevier 2010) 1.

asphalt base, gasoline, and fuel oils) and marketing to end consumers.[7] Other essential derivatives in the refining process are petrochemicals, which are in three primary classifications, namely: olefins (ethylene, propylene, and butadiene), aromatics (benzene, toluene, and xylenes), and synthetic gas (syngas).[8] These three broad classifications of petrochemicals constitute raw materials for plastics, detergents, dyes, ammonia, fertiliser, and methanol.[9]

Greenhouse gas (GHG) emissions occur in the oil and gas industry's various sectors and phases.[10] In 2019 alone, fuel combustion resulted in 33,622 million tonnes of carbon dioxide (CO_2) globally.[11] Oil and gas consumption accounted for 55.4% of this figure, while coal accounted for 44%.[12] All the industry's phases – upstream, midstream, downstream, and even the end-use stage – require serious intervention, but it may be more important to channel urgent regulatory attention to the incidences that account for higher emissions. As this chapter will show, the upstream sector accounts for greater emissions compared to the downstream sector.

It is important to clearly define the boundaries of this thesis. It will focus primarily on upstream GHG emissions and narrow down to the major drivers of the sector's emissions in need of more urgent regulatory solution. The study does not consider emissions from downstream (refining) and end-use phases. Agreed, all phases and links in the industry's chain need regulatory interventions, but they would also need various approaches, which may not be exhaustively addressed in one thesis.

Masnadi and others define "upstream GHG emissions" as "all collective GHG emissions from exploration, well drilling and development, production and extraction, surface processing, and transport to the refinery gate (well-to-refinery)."[13] This definition seems to combine GHG emissions in both the traditional upstream and midstream sectors. Jing and others[14] have recently compared GHG emissions from upstream and downstream operations across multiple jurisdictions and based on different types of crude. They show that the global average carbon intensity of crude oil production, transportation, and refining stands at 17.6 grams of carbon

[7] Ibid.
[8] Davold, above n 5, at 19.
[9] Ibid.
[10] Giovanni Di Lullo, Hao Zhang and Amit Kumar "Evaluation of Uncertainty in the Well-to-Tank and Combustion Greenhouse Gas Emissions of Various Transportation Fuels" (2016) 184 Applied Energy 413, 414.
[11] IEA *Key World Energy Statistics 2021* (IEA 2021) at 54.
[12] Ibid.
[13] Mohammad S. Masnadi and others "Global Carbon Intensity of Crude Oil Production" (2018) 361 Science 851, Supplementary Material at 6.
[14] Liang Jing and others "Carbon Intensity of Global Crude Oil Refining and Mitigation Potential" (2020) 10 Nature Climate Change 526 at 529.

dioxide equivalent per megajoule of energy ($gCO_2e\ MJ^{-1}$), broken down into 10.3 $gCO_2e\ MJ^{-1}$ for upstream and 7.3 gCO_2eMJ^{-1} for refining.[15] Carbon intensity means the amount or rate of carbon dioxide (CO_2) equivalent emitted in grams of carbon dioxide equivalent (gCO_{2e}) to produce oil and gas and refine oil or process gas, normalised to an energy basis in mega joules (MJ^{-1}).[16] The volume of emissions attributable to the upstream and downstream sectors, as Jing and others[17] show, clearly demonstrates that upstream operations have higher carbon intensity and therefore account for higher GHG emissions than downstream operations. This thesis is, therefore, important as it will help in identifying a suite of regulatory interventions that can help to reduce upstream GHG emissions in the most carbon-intensive sector of the oil and gas industry, thus contributing to the global climate change mitigation agenda. Regulatory approaches such as the European Union Fuel Quality Directive[18] and the California Low Carbon Fuel Standard (LCFS)[19] seek to incentivise operators to reduce transportation fuels' carbon intensity. This thesis will identify how the LCFS relates to reducing upstream GHG emissions.

It is necessary to identify the dominant sources of upstream GHG emissions and address them with effective interventions. The Oil Production Greenhouse Gas Emissions Estimator, developed by El-Houjeiri, Brandt, and Duffy,[20] identifies exploration, drilling and development, production and extraction, surface processing, maintenance operations, waste treatment and disposal, and crude transport as the different elements that determine upstream production carbon intensity. At a global scale, carbon dioxide (CO_2), methane (CH_4), and volatile organic compounds (VOCs) from flaring and venting during the production, extraction, and surface processing phases account for approximately 75% of upstream field-level carbon intensity.[21] In the United States alone, upstream flaring accounts for an estimated 20 to 21 million metric tons in CO_2 equivalents of GHG emissions annually.[22] As of mid-2020, satellite data and estimates showed a 3% rise in global gas flaring from 145 billion cubic meters (bcm) in 2018

[15] Ibid.
[16] Masnadi and others, above n 11; Mohammed S. Masnadi and others "Well-to-Refinery Emissions and Net-Energy Analysis of China's Crude-Oil Supply" (2018) 3 Nature Energy 220 at 221-222.
[17] Liang Jing and others, above n 14.
[18] Directive 2009/30/EC of the European Parliament and of the Council of 23 April 2009.
[19] Title 17. Public Health, California Code of Regulations (CCR), Sub-chapter 10. Climate Change, Sub-article 7: Low Carbon Fuel Standard, Final Regulation Order, s. 95480
[20] Hassan M. El-Houjeiri, Adam R. Brandt, and James E. Duffy "Open-Source LCA Tool for Estimating Greenhouse Gas Emissions from Crude Oil Production Using Filed Characteristics" (2013) 47 Environmental Science and Technology 5998 at 6000.
[21] Ibid; Masnadi and others, above n 13.
[22] David T. Allen and others "Carbon Dioxide, Methane and Black Carbon Emissions from Upstream Oil and Gas Flaring in the United States" (2016) 13 Current Opinion in Chemical Engineering 119 at 121.

to 150 billion cubic meters in 2019, equivalent to the total annual gas consumption of Sub-Saharan Africa.[23] Nevertheless, flaring reduced by 5% from 150 bcm in 2019 to 142 bcm in 2020.[24] Flaring and venting account for over 400 million tons of CO_2 equivalent emissions annually.[25] Besides, fugitive emissions – equipment leaks – from petroleum operations constitute direct and indirect sources of GHG emissions across the whole industry chain in many oil and gas jurisdictions of the world,[26] and account for 5.8% of GHG emissions from energy production.[27] Fugitive emissions also raise asset integrity questions in the upstream oil and gas production sector and underscore the need to fix or replace compromised facilities and installations.[28] Industry regulators in petroleum jurisdictions need to require operators to detect and repair sources of fugitive emissions. The preceding figures show that flaring, venting, and fugitive emissions are an important aspect of GHG emissions that cannot be ignored.

For appropriate context, flaring is the process of burning off excess associated petroleum gas (APG) – also known as solution gas – during the recovery or extraction of oil and gas.[29] The APG is a by-product of oil in most reservoirs,[30] which is released on extraction of the oil because of changes in temperature and pressure.[31] The volume of APG released ranges between 5 and 1000 m^3 per tonne of oil and it is composed primarily of hydrogen, methane, ethane, propane, butane, isobutene, and other hydrocarbons with potential GHG implications in the event of inadequate re-injection or utilization.[32] It can be utilised for wellhead platform operations, re-injected or flared into the atmosphere.[33] Venting is the intentional or controlled

[23] World Bank Global Gas Flaring Reduction Partnership *Global Gas Flaring Tracker Report* (World Bank Global Gas Flaring Reduction Partnership July 2020).
[24] World Bank Global Gas Flaring Reduction Partnership *Global Gas Flaring Tracker Report* (World Bank Global Gas Flaring Reduction Partnership April 2021) at 5.
[25] World Bank, 'Zero Routine Flaring by 2030' (World Bank) <https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030> accessed 2 February 2021.
[26] David Picard "Energy, Transportation and Fugitive Emissions: Fugitive Emissions from Oil and Natural Gas Activities" (25 February 2003) IPPC <www.ipcc-nggip.iges.or.jp>.
[27] Hannah Ritchie and Max Roser "Emissions by Sector" (Our World in Data 2020) <www.ourworldindata.org>.
[28] Testo *Flue Gas Analysis in Industry* (Testo 2004) 18.
[29] Eman A. Eman "Gas Flaring in Industry: An Overview" (2015) 57:5 Petroleum and Coal 532.
[30] Cheryl L. Weyant and others "Black Carbon from Associated Natural Gas Flaring" (2016) 50 Environmental Science and Technology 2075.
[31] V.A. Kirillov and others "Experimental and Theoretical Study of Associated Petroleum Gas Processing into Normalized Gas by Soft Steam Reforming" (2017) 51:1 Theoretical Foundations of Chemical Engineering 12.
[32] A.A Solov'yanov "Associated Petroleum Gas Flaring: Environmental Issues" (2011) 81:12 Russian Journal of General Chemistry 2531; Irina Burenina "Associated Petroleum Gas: Problems, Prospects, Ways to Increase its Effective Use" (2017) 8:7 Journal of Environmental Management and Tourism 1399, 1400.
[33] M.R. Johnson, L.W. Kostiuk and J.L. Spangelo "A Characterization of Solution Gas Flaring in Alberta" (2001) 51 Journal of the Air and Waste Management Association 1167 at 1168; Petropedia "Solution Gas" <www.petropedia.com>.

release of gas and an alternative to flaring.[34] Flaring and venting occur primarily due to lack of adequate utilization infrastructure and insufficient gas markets.[35] More so, optimal gas utilization requires a pipeline network, which is expensive. Operators can flare a significant volume of APG during oil extraction if the cost of building utilization infrastructure exceeds the derivable profit of commercialising the gas.[36]

Upstream GHG emissions have a significant impact on energy return on investment (EROI) analysis. The EROI concept means the ratio of energy derived from an energy source to the energy requirement for producing that energy. Different energy sources – including fossil fuels and renewables – have EROI ratios and diverse financial and GHG implications.[37] Flaring, venting, and fugitive emissions represent wasted energy streams that operators expend to extract oil and gas.[38]

Improved energy efficiency ultimately leads to a concomitant reduction in flaring, venting, and fugitive emissions.[39] There is also a broad consensus on the usefulness of energy efficiency in planning long-term climate change policies.[40] The International Energy Agency (IEA) forecasts that an efficient world scenario can result in a 12% reduction in energy-related GHG emissions by 2040, representing about 40% of the GHG emissions abatement requirement of

[34] USEPA "Greenhouse Gas Emissions Reporting from Petroleum and Natural Gas Industry: Background Technical Support Document" (US EPA 4 December 2012) <www.epa.gov>.
[35] Abass Olajire "The Petroleum Industry and Environmental Challenges" (2014) 5:4 Journal of Petroleum and Environmental Biotechnology 1.
[36] Erin Thomas "Capping the Flame: Solving North Dakota's Natural Gas Flaring Problem through Cap and Trade" (2017) George Washington Journal of Energy and Environmental Law 137 at 141; Barry Babe, Claire Kaliban and Isabel Englehart "Taxing Flaring and the Politics of State Methane Release Policy" (2020) 37:1 Review of Policy Research 6 at 23.
[37] Charles A.S. Hall, Jessica G. Lambert and Stephen B. Balogh "EROI of Different Fuels and the Implications for Society" (2014) 64 Energy Policy 141-152; Victor Court and Florian Fizaine "Long-Term Estimates of the Energy-Return-on-Investment (EROI) of Coal, Oil, and Gas Global Productions" (2017) 138 Ecological Economics 145-159.
[38] Adam R. Brandt and others "Energy Return on Investment (EROI) for Forty Global Oilfields Using a Detailed Engineering-Based Model of Oil Production" (2015) 10:2 PLoS ONE https://doi.org/10.1371/journal.pone.0144141; Vinay S. Tripathi and Adam R. Brandt "Estimating Decades-Long Trends in Petroleum Filed Energy Return on Investment (EROI) with an Engineering-Based Model" (2017) 12:2 PLoS ONE https://doi.org/10.1371/journal.pone.0171083.
[39] IEA *The Oil and Gas Industry in Energy Transitions: Insights from IEA Analysis* (IEA 2020) at 52
[40]Uwe Deichmann and Fan Zhang *Growing Green: The Economic Benefits of Climate Action* (World Bank 2013) at 26; Vaibhav Chaturvedi and Priyadarshi R. Shukla "Role of Energy Efficiency in Climate Change Mitigation Policy for India: Assessment of Co-Benefits and Opportunities within an Integrated Assessment Modelling Framework" (2014) 123 Climatic Change 597 at 606; Robert D. Marchand, S.C. Lenny Koh and Jonathan C. Morris "Delivering Energy Efficiency and Carbon Reduction Schemes in England: Lessons from Green Deal Pioneer Places" (2015) 84 Energy Policy 96 at 97; Santiago Creuheras "The Role of Energy Efficiency in Long-Term Climate Change Mitigation Planning" (World Resources Institute 2019) <www.wri.org>.

the Paris Agreement.[41] Besides, there is an increasing emphasis by the International Petroleum Industry Environmental Conservation Association (IPIECA) on energy-efficient design across the operational chains of the upstream, midstream, and downstream sectors of the oil and gas industry.[42] The GHG emissions reduction potential of an energy-efficient design relates to savings from reduced energy input from the use of power, heat, and fuels, which will reduce the overall carbon intensity of operations.[43] Some other avenues for energy efficiency improvements in the upstream petroleum operations include ensuring energy-efficient facilities, investing in research and development, stopping flaring and venting, and refocusing operational strategy.[44] Thus, energy efficiency can help reduce the energy expended to produce oil and gas. As Brandt and others[45] have shown, flaring, venting, and fugitive emissions are part of wasted energy streams in the petroleum production process. Consequently, this thesis will also examine the regulatory designs in different jurisdictions to encourage efficiency measures to reduce GHG emissions during oil and gas production.

Turning to oil specifically, crude oil type also influences the volume of upstream GHG emissions.[46] The major categories are sweet crude, sour crude, light crude, medium crude, heavy crude, sweet light crude, and synthetic crude.[47] The physical and chemical properties of crude oil are the key determinants of the required processing methods and energy input.[48] As Masnadi and others[49] have shown, heavier crudes require more process energy and account for more wasted energy streams such as flaring, venting, and fugitive emissions. In addition, the American Petroleum Institute (API) gravity, also known as density, indicates the composition of the crude and the ratio of distillation cuts that will result from processing the crude.[50] Crude oil types have different API gravities, and the ones with heavier API gravity require more

[41] IEA *Energy Technology Perspectives 2014* (IEA 2014) at 48; IEA *Energy Efficiency 2018: Analysis and Outlook to 2040* (IEA 2018) at 13 and 17; IEA "The Often Overlooked Emissions Reducer" (IEA, The Energy Mix 23 September 2019) <www.sg-mktg.com>.
[42] IPIECA "Energy Efficient Design" (IPIECA February 2014) available at <www.ipieca.org>.
[43] Ibid.
[44] Euro Petroleum Consultants "4 Ways Oil and Gas Companies Can Improve Energy Efficiency within their Operations" (Euro Petroleum Consultants 2021) available at <www.europetro.com>.
[45] Brandt and others, above n 38.
[46] Jessica P. Abella and Joule A. Bergerson "Model to Investigate Energy and Greenhouse Gas Emissions Implications of Refining Petroleum: Impacts of Crude Quality and Refinery Configuration" (2012) 46 Environmental Science and Technology 13037 at 13039.
[47] Ibid; James G. Speight, Luca Fantacci, and James G. Speight *Introduction to Petroleum Technology, Economics, and Politics* (Wiley 2011) at 128.
[48] Abella and Bergerson, above n 46.
[49] Masnadi and others, above n 16.
[50] See McKinsey Energy Insights Reference Desk at <https://www.mckinseyenergyinsights.com>.

expended energy and account for higher GHG emissions.[51] Sulphur is an undesirable contaminant commonly found in crude oil and crude oil products and it is measured in weight percentage (wt%); thus, lower sulphur content is always desirable in crude oil requiring less energy input during processing, leading to lower GHG emissions.[52] Its presence in the different types of crude oil varies from less than 0.05 to more than 10 wt%; so, crude oil with less than 1 wt% is referred to as low sulphur or sweet, while that with more than 1 wt% sulphur is referred to as high sulphur or sour.[53] Recent studies have also shown that the shift in the make-up of oil and gas extraction influences the volume of GHG emissions.[54] For example, Howarth estimates that shale gas has contributed 33% of the global increase in CH_4 emissions in recent years, predominantly from operations in North America (the United States and Canada).[55]

Greenhouse gas emissions are externalities and represent one of the biggest market failures in the world.[56] Market settings make flaring and venting rational from a company's perspective if doing so will be cheaper than utilizing the gas. Thus, petroleum-producing countries need optimal gas infrastructure, essentially a network of pipelines, for transporting the gas to local and international markets. Sometimes, institutional arrangements, politics and international relations hinder cross-country gas pipeline projects.[57]

Upstream GHG emissions also underscore the contemporary debate on shifting from oil and fossil fuels to renewables and other cleaner forms of energy.[58] Scholars have described climate change as one of humanity's most significant concerns[59] and a super-wicked problem

[51] Jandyson M. Santos and others "Comparing Crude Oils with Different API Gravities on a Molecular Level Using Mass Spectrometric Analysis. Part 2: Resins and Asphaltenes" (2018) 11 Energies 2767; See also Masnadi and others, above n 11 and Supplementary Material at 22.
[52] A. Demirbas, H. Alidrisi and M.A. Balubaid "API Gravity, Sulfur Content, and Desulphurization of Crude Oil" (2015) 33:1 Petroleum Science and Technology 93.
[53] Fahim, Al-Sahhaf and Elkilani, above n 6, at 16.
[54] Stefan Schwietzke and others "Upward Revision of Global Fossil Fuel Methane Emissions Based on Isotope Database" (2016) 538 Nature 88; John R. Worden and others "Reduced Biomass Burning Emissions Reconcile Conflicting Estimates of the Post-2006 Atmospheric Methane Budget" (2017) 8:2227 Nature Communications https://doi.org/10.1038/s41467-017-02246-0.
[55] Robert W. Howarth "Ideas and Perspectives: Is Shale Gas a Major Driver of Recent Increase in Global Atmospheric Methane?" (2019) 16 Biogeosciences 3033 at 3038 and 3039.
[56] Nicholas Stern, 'The Economics of Climate Change' (2008) 98:2 American Economic Review 1.
[57] APEC Energy Working Group *Great Expectations: Cross-Border Natural Gas Trade in APEC Economies* (Asia-Pacific Economic Cooperation November 2004) at 26-30; Anne Neuman, Juan Rosellon and Hannes Weigt "Removing Cross-Border Capacity Bottlenecks in the European Natural Gas Market – A Proposed Merchant-Regulatory Mechanism" (2015) 15 Networks and Spatial Economics 149.
[58] Christian Ngo and Joseph Natowitz *Our Energy Future: Resources, Alternatives, and the Environment* (2nd edn Wiley 2016) at 661.
[59] Julian Cribb *Surviving the 21st Century: Humanity's Ten Great Challenges and How We Can Overcome Them* (Springer 2017) at 2,18,21,30,127, and 138.

necessitating a serious multi-dimensional and multilateral response.[60] As an unavoidable impact of climate change on the ecosystem, at the beginning of 2015, an estimated 20.4 million people were food insecure, mainly in Niger, Nigeria, Mali, and Chad.[61] Therefore, it is essential to ensure the existence of effective regulatory frameworks for mitigating different GHG emissions and their sources, including the ones that this thesis addresses.

The Paris Agreement aims to strengthen the global response to the threat of climate change by limiting global temperature increase well below 2 degrees Celsius and pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius above pre-industrial levels; increasing adaptation capabilities; and making financial flows consistent with low greenhouse gas emissions pathways and climate-resilient development.[62] This Agreement is an essential overarching framework for reducing emissions and addressing climate change. However, countries have a lot of autonomy in deciding economic areas to decarbonise. The implication is that a petroleum-producing country can target other carbon-intensive industries while avoiding upstream petroleum activities. The Paris Agreement does not directly mention oil or fossil fuels.[63] There are numerous other industries and activities that the Agreement does not directly capture or mention. So, countries may choose to meet their Paris Agreement commitments by other means or reducing GHG emissions in other sectors. However, achieving a low-carbon future requires countries to drastically reduce the carbon footprint of an industry known to be carbon-intensive. So, the thesis is relevant to all petroleum-producing countries, especially in planning their transitional measures to a low-carbon future.

It is also probable that world leaders can establish a different treaty to facilitate global cooperation to reduce the GHG emissions associated with oil and fossil fuels production. Currently, there are diverse views about the future of fossil fuels in relation to the climate goals of the Paris Agreement. Newell and Simms have proposed a fossil fuel non-proliferation treaty to phase out the production of oil, gas, and coal.[64] While this proposition seems ambitious, a lot depends on the agreement and support of petroleum-producing countries. Moreover, as will

[60] Richard J. Lazarus "Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future" (2010) 40:8 Environmental Law Reporter 10749; Kelly Levin and others "Overcoming the Tragedy of Super Wicked Problems: Constraining Our Future Selves to Ameliorate Global Climate Change" (2012) 45 Policy Sci. 123.
[61] UNEP *UNEP Frontiers 2016 Report: Emerging Issues of Environmental Concern* (UNEP 2016) at 46.
[62] The Paris Agreement under the United Nations Framework Convention on Climate Change, adopted 12 December 2015 and entered into force 4 November 2016, art 2.
[63] Thijs Van De Graaf and Benjamin K. Sovacool *Global Energy Politics* (Polity Press 2020) at 117.
[64] Peter Newell and Andrew Simms "Towards a Fossil Fuel Non-Proliferation Treaty" (2020) 20:8 Climate Policy 1043-1054. See also https://www.fossilfueltreaty.org/.

be seen in Part C of this chapter, it is indeed difficult to phase out the production of fossil fuels completely; at least not any time soon. However, one clear point of increasing relevance is the need to decarbonise oil and gas production. In this context, Graaf and Sovacool have argued that there is no way to decarbonise the global economy without tackling head-on the production and consumption of fossil fuels.[65] On the supply side, decarbonisation requires a drastic cut in GHG emissions traceable to production, while the demand side dimension focuses on energy consumption patterns, choices, and culture. This thesis addresses the supply-side aspect of decarbonising the upstream oil and gas sector.

B. Statement of Research Question and Thesis Structure

The purpose of this thesis is to examine the regulation of upstream GHG emissions in petroleum jurisdictions to understand some desirable characteristics of effective governance regimes for abating flaring, venting, and fugitive emissions. It is a common fact that climate change considerations challenge the sustainability of the oil and gas industry.[66] As Masnadi and others have shown, fugitive emissions, venting, and flaring of CO_2, CH_4, and other GHGs significantly contribute to climate change,[67] with devastating environmental and health implications.[68] Flaring and venting have continued for many decades of oil and gas exploration and production in most oil-rich countries of the world,[69] with adverse health and environmental effects, ranging from climate change to acidic rain and adverse medical conditions.[70]

GHG emissions are now commonly classified into three scopes, and it will be useful to consider where the emissions in this thesis fall. The Greenhouse Gas Protocol, introduced by the World Business Council for Sustainable Development and the World Resources Institute (WRI), is the main system used for this classification.[71] Scope 1 emissions arise from direct sources under the company's immediate ownership and control, for example, generation of electricity, heat or steam, physical chemical processing, transportation of raw materials, and fugitive

[65] Graaf and Sovacool, above n 63.
[66] Mohamad Danish Anis and Tauseef Zia Siddiqui "Issues Impacting Sustainability in the Oil and Gas Industry" (2015) 5 Journal of Management and Sustainability 115 at 118.
[67] Masnadi and others, above n 13.
[68] O. Saheed Ismail and G. Ezaina Umukoro "Global Impact of Gas Flaring" (2012) 4 Energy and Power Engineering 290 at 292.
[69] Odigie Eghon and Koso I. Idigbe "Injection of Natural Gas into Reservoirs: A Feasible Solution to Gas Flaring in Nigeria" (2013) 4:5 Academic Research International 90; World Bank Global Gas Flaring Reduction Partnership *Global Gas Flaring Tracker Report* (World Bank Global Gas Flaring Reduction Partnership July 2020).
[70] Anslem O. Ajugwo "Negative Effects of Gas Flaring: The Nigerian Experience" (2013) 1 Journal of Environment Pollution and Human Health 6 at 8.
[71] WBCSD and WRI *The Greenhouse Gas Protocol: A Corporate Reporting Standards* (2nd edn. WBCSD and WRI 2004) 25.

emissions.[72] Scope 2 emissions occur indirectly from the generation of electricity used by the company, while Scope 3 emissions occur outside the company's immediate control but are indirectly linked to its operations.[73] The International Petroleum Industry Environmental Conservation Agency (IPIECA) Joint Industry Tax Force on Greenhouse Gas[74] relies on the Greenhouse Gas Protocol's three-scope approach[75] but with oil and gas industry-specific context.[76] Accordingly, Scope 1 GHG emissions come from combustion in stationary sources; flaring, incinerators, and mobile sources (motor vehicles, trucks, and oil tankers); process emissions; venting; and fugitive emissions.[77] The emissions considered in this thesis – flaring, venting, and fugitive emissions – fall under this IPIECA Scope 1. Scope 2 GHG emissions are energy-related indirect emissions such as purchased electricity, steam, heating, and cooling systems in the industry.[78] Scope 3 GHG emissions are a different category of indirect emissions, which do not come under Scope 2 but occur in the life cycle and necessarily incidental to its operations.[79] Examples include raw materials necessary for operations, transportation, and disposal of products.[80]

The debates about GHG emissions reduction and energy transition continue, but it is equally essential to ensure a fair process through which societies shift towards an economy free of CO_2 emissions – the just transition.[81] This means moving away from fossil fuels and industrial processes that cause GHG emissions, and doing so in a fair manner, considering the collective interests of all stakeholders. It is a concept that requires substantial change across different interest groups – coal, oil and gas communities, cities, industries, and workers.[82] Some other valuable perspectives are transitioning the labour force into clean jobs and involving communities and labour unions in planning and decision-making processes.[83] This thesis does not say much about the just transition, but it fits broadly into the energy transition governance normative framework, especially regarding the mitigation of upstream GHG emissions, as oil

[72] Ibid, at 27.
[73] Ibid.
[74] This task force comprises the International Petroleum Industry Environmental Conservation Association (IPIECA), the American Petroleum Institute, and the International Association of Oil and Gas Producers (IOGP).
[75] WBCSD and WRI, above n 67.
[76] IPIECA, API and OGP *Petroleum Industry Guidelines for Reporting Greenhouse Gas Emissions* (2nd edn. IPIECA, API and OGP 2011) 5-1, at 3-14.
[77] Ibid.
[78] Ibid, at 3-15.
[79] Ibid, at 3-17
[80] Ibid.
[81] Raphael J. Heffron and Darren McCauley "What is the 'Just Transition?" (2018) 88 Geoforum 74.
[82] Samantha Smith *Just Transition: A Report for the OECD* (Just Transition Centre, OECD, May 2017) at 2.
[83] George Goddard and Megan A. Farrelly "Just Transition Management: Balancing Just Outcomes with Just Processes in Australian Renewable Energy Transitions" (2018) 225 Applied Energy 110 at 112-113.

and gas will remain a part of the global energy mix for decades. The next part of this chapter, therefore, will analyse oil and gas emissions in the energy transition.

This thesis runs into six chapters. This introductory chapter explains the research's background and objective. It also identifies the present state of knowledge on the topic and contextualises the themes for examination. Chapter 2 will discuss the theory of regulation to provide a conceptual framework for the thesis. The chapter will draw close connections between the idea of regulation and upstream GHG emissions. Regulatory measures at national and industry levels will emerge more directly in the following chapters. Chapter 3 will investigate the state of regulation in prominent petroleum-producing jurisdictions around the world. This analysis will help understand regulatory typology and practices; and identify critical issues militating against effective regulatory arrangements to address flaring, venting, and fugitive emissions. Chapter 4 will examine private industry-driven initiatives to address petroleum upstream GHG emissions, focusing on flaring, venting, and fugitive emissions. Chapter 5 will discuss the research's conceptual relevance and provide insights for law reform in petroleum-producing jurisdictions. Chapter 6 will summarise the study's key findings and state how the central research question has been addressed. It will also highlight key policy implications of the study and present directions for future inquiries.

C. Oil and Gas Emissions in the Energy Transition

Questions may arise about the relevance of conducting further research on oil and gas production, primarily because of upstream GHG emissions and their climate change implications. Such questions can be more validated by the recent report of the Intergovernmental Panel on Climate Change (IPCC).[84] In this report, the IPCC projects that the global average temperature would reach 1.5 degrees Celsius above preindustrial levels around the year 2030.[85] This is a decade earlier than the IPCC earlier predicted in its Special Report on a global warming of 1.5 degrees.[86] If carbon-intensive sectors continue to release GHG emissions, the state of the global climate will only get worse, with different parts of the world witnessing different proportions of the effects of climate change. Therefore, it may be counter-intuitive to conduct further research on oil and gas production, given that it is one of

[84] IPCC *Climate Change 2021: The Physical Science Basis: Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* (Final Government Distribution Copy, August 2021).
[85] Ibid, TS-9 and TS-28.
[86] IPCC *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 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*; report available at https://www.ipcc.ch/sr15/.

the activities that account for GHG emissions globally. This research seeks to answer such questions. While energy transition is necessary, it is also essential to meet human energy needs and provide development services.

Historically, oil and fossil fuels have been the world's dominant energy sources since the 19th century.[87] Contemporary civilisation largely depends on fossil fuels to power industries and homes.[88] During the 46 years of 1971-2017, oil, coal, and natural gas contributed about 81% of world energy consumption.[89] During this interval, the global total primary energy supply increased by more than 2.5 times – from 5,519 million tonnes of oil equivalent (Mtoe) in 1971 to 13,972 Mtoe in 2017.[90] This trend shows rising demand for and production of fossil fuels as primary energy sources. According to the United States Energy Information Administration (USEIA), fossil fuels account for the US's highest energy production and consumption.[91] In 2018 alone, fossil fuels contributed 79% of domestic energy production and 80% energy consumption.[92] This dominance is not only about transportation fuel. There are indeed other uses for oil, as this section shows later. In fact, according to the IEA, the volume of oil used for transportation fuel is approximately 50%, as petrochemicals become more relevant.[93]

Currently, it is challenging to produce alternatives to some petroleum products and materials such as asphalt and tar for road construction and feedstock (or petroleum feedstock).[94] Petroleum feedstock is a collective term for chemicals derived from petroleum and natural gas such as naphtha used as raw materials to produce other chemicals, plastics, and synthetic rubbers.[95] Other examples are solvents, dentures, films, electronics, insulation materials, lubricants, insecticides, toys, cosmetics, bandages, shampoo, paint, petroleum jelly, clothes, carpet, candles, heart valves, tyres, glasses, and cleaning products. Most of these items are everyday necessities around the world. The International Association of Oil and Gas Producers (IOGP) itemizes about 72 uses of oil in everyday life.[96]

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[87] Tina Hunter "Redefining Energy Security: The New Prize in a Time of Arctic Petroleum Resources and Technological Development" in Slawomir Raszewski (ed) *The International Political Economy of Oil and Gas* (Palgrave Macmillan 2018) 9-22.
[88] Vaclav Smil *Energy and Civilization: A History* (MIT Press 2017) at 295.
[89] IEA *World Energy Balances: An Overview* (IEA 2019) at 4.
[90] Ibid, at 5.
[91] USEIA "Fossil Fuels Continue to Account for the Highest Share of US Energy" (USEIA 18 September 2019) <www.eia.gov>.
[92] Ibid.
[93] IEA *World Energy Outlook 2018* (IEA 2018) at 136.
[94] Richard York "Do Alternative Energy Sources Displace Fossil Fuels?" (2012) 2 Nature Climate Change 441; EIA "What are Petroleum Products and what is Petroleum Used For?" (EIA 31 May 2019) <www.eia.gov>.
[95] Carl Schaschke *A Dictionary of Chemical Engineering* (OUP 2014).
[96] IOGP "Oil in Everyday Life" (IOGP) <www.iogp.org>.

The various uses of oil and fossil fuels contribute to man's well-being through energy services and materials. This dependency creates a tension between human well-being and climate change mitigation.[97] As much as the world embraces energy transition, there is also an argument that certain technologies or energy sources may have no superior or sustainable substitutes for some time.[98]

The demand for oil and fossil fuels may eventually decline but not wholly vanish anytime soon. Oil demand for cars could peak by the mid-2020s, while petrochemicals, planes, trucks, and ships will keep overall oil demand on a rising trend.[99] The IEA sustainable development scenario (SDS) charts a path that is consistent with achieving the Paris Agreement goals through sustainable energy production and consumption.[100] Under the SDS, wherein net-zero emissions are achieved by 2070, oil production will fall from approximately 100 million barrels per day (mb/d) in 2019 to about 86.5 mb/d in 2030.[101] Under new policies scenario, in which the world achieves net-zero emissions by 2050, oil production will average 65mb/d in 2030.[102] In the two scenarios, oil remains a dominant global energy source. Further, petrochemicals will account for more than a third of the growth in world oil demand by 2030 and nearly half the growth to 2050, adding almost 7 million barrels of oil a day by then.[103] Petrochemicals are also poised to consume an additional 56 billion cubic meters (bcm) of natural gas by 2030, and 83 bcm by 2050.[104] Besides, there are projections – by industry players, the IEA, World Energy Council, and the United States Energy Information Administration – of increased energy demand and between 40 to 48% oil and gas contribution to global energy supply by, and possibly beyond, 2040.[105]

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[97] Nathan Wood and Katy Roelich "Tensions, Capabilities, and Justice in Climate Change Mitigation of Fossil Fuels" (2019) 52 Energy Research and Social Science 114-122.
[98] T. W. Murphy "Beyond Fossil Fuels: Assessing Energy Alternatives" in Woodwatch Institute Staff (ed) *State of the World 2013: Is Sustainability Still Possible?* (Island Press 2013) 172 at 174.
[99] IEA *World Energy Outlook 2020* (IEA 2020); IEA, *Oil 2021: Analysis and Forecast to 2026* (IEA 2021) at 12, 18, 25, 93, 106-108.
[100] IEA *The Oil and Gas Industry in the Energy Transition: Insights from IEA Analysis* (IEA 2020) at 3.
[101] Ibid, at 57-69.
[102] Ibid.
[103] IEA *The Future of Petrochemicals: Towards More Sustainable Plastics and Fertilisers* (IEA 2018) at 3, 11 and 69; IEA "Petrochemicals Set to be the Largest Driver of World Oil Demand, Latest IEA Analysis Finds" (IEA 5 October 2018) <www.iea.org>.
[104] Ibid.
[105] ExxonMobil *2017 Outlook for Energy: A View to 2040* (ExxonMobil 2017) at 11-29; IEA *World Energy Outlook 2018* (IEA 2018) at 137; EIA *International Energy Outlook 2019 with Projections to 2050* (EIA 2019); BP *BP Energy Outlook 2019 Edition* (BP 2019) at 7, 77 and 85; World Energy Council World *Energy Scenarios 2019: Exploring Pathways to 2040* (World Energy Council 2019) at 17-47.

Transportation, electricity generation, cement manufacture, and petrochemicals are examples of specific uses of oil and fossil fuels. Substitution is a problem in some of these areas. For electricity generation, recent trends show that it is possible to displace oil and fossil fuels. Globally, the use of oil for electricity generation has fallen. However, it still accounts for between 90-100% of electricity sources in some countries such as Lebanon, Cyprus, South Sudan, Brunei, Oman, and Qatar.[106] For transportation, the penetration of electric vehicles (EVs) into the market shows that renewables can displace fossil fuels for cars and trains.[107] The global electric mobility fleet rapidly grew and exceeded 5.1 million in 2018, with China as the largest EV market.[108] One significant difficulty lies in establishing strong policy support to make EVs more affordable, strengthen production capacity, deploy more charging infrastructure, and incentivise greater uptake in society.[109] The IEA's EVs Initiative is also committed to facilitating a multi-governmental policy forum to accelerate EVs' uptake. Members of the Initiative have pledged to introduce policies to achieve their objective.[110] However, the electrification of light-duty vehicles alone will not meet climate goals without industry-wide technological innovation and complementary approaches, including measures that address the demand side issues of consumption and behavioural patterns.[111] Even with a rapid change in the global mobility fleet from internal combustion engine vehicles to EVs, the production of oil will still occur in enormous quantities for decades to come.

The difficulty in producing substitutes for aviation fuel, heavy-duty transport (trucks and ships), and petrochemicals can create doubts about the possibility of displacing oil and fossil fuels soon.[112] More so, renewables are yet to generate adequate capacity to meet global energy demand in providing cheap, plentiful, and reliable energy to the world's rising population.[113] In the future, renewables can dominate a clean energy economy with the right technology

[106] IEA *World Energy Balances: Overview* (IEA 2019) at 7.
[107] Kingsmill Bond, Ed Vaughan and Harry Benham *Nothing to Lose but Your Chains: The Emerging Market Transport Leapfrog* (Carbon Tracker November 2020).
[108] IEA *Global EV Outlook 2019: Scaling up the Transition to Electric Mobility* (IEA 2019) at 4, 6 and 32.
[109] Ibid.
[110] There were thirteen members at the time of writing. These include New Zealand, Canada, Finland, United Kingdom, India, China, Sweden, Norway, Germany, Chile, Japan and France. Information retrieved from IEA Electric Vehicles Initiative <www.iea.org>.
[111] Alexandre Milovanoff, I. Daniel Posen and Heather L. MacLean "Electrification of Light-Duty Vehicle Fleet Alone will Not Meet Mitigation Targets" (December 2020) 10 Nature Climate Change 1102; Kathryn G. Logan and others "UK and China: Will Electric Vehicle Integration Meet Paris Agreement Targets?" (2020) 8 Transportation Research Interdisciplinary Perspectives 100245.
[112] Thomas Covert, Michael Greenstone and Christopher R. Knittel, 'Will We Ever Stop Using Fossil Fuels?' (2016) 30:1 Journal of Economic Perspectives 117.
[113] David G. Victor and Charles F. Kennel "Ditch the 2 °C Warming Goal" (2014) 514 Nature 30 at 31.

mix.[114] Recent IEA analyses predict a 50% expansion in renewable energy capacity between 2019 and 2024, primarily from solar energy, accounting for approximately 60% of the expected growth.[115]

However, the International Renewable Energy Agency (IRENA) suggests global spending of approximately 27 trillion United States Dollars (USD) in installed renewables capacity from 2016 to 2050 to support the global energy transformation and achieve the Paris Agreement emissions reduction goals.[116] One can guess that the energy transition may eventually require higher investment levels globally, considering the projected span of years (over 30 years). There are always huge capital flows to fund projects in the energy sector. While this investment gap lingers, oil and fossil fuels will play an essential role in meeting global energy demand.

An important point to consider is how countries support clean energy investments while cushioning the macroeconomic shocks from the 2019 coronavirus disease (COVID-19). Some social science energy experts have argued that countries' emergency measures, including stimulus packages for economic recovery, can influence energy transition speed.[117] This point depends on whether countries give more policy and financial support to clean energy undertakings or the fossil fuel industry. Therefore, it is pertinent for governments to initiate policy measures that support renewables and encourage behavioural changes to avoid relapse to pre-COVID-19 emissions levels.[118] Energy Policy Tracker – a real-time energy policy monitor – showed that G20 leaders committed over USD 150 billion to support fossil fuel investments and over USD 88 billion to support clean energy as of July 2020, when most countries started giving stimulus packages to affected industries.[119] As of April 2021, the public money for fuel worldwide stood at USD 292 billion, with approximately 41% of this sum dedicated to fossil energy and 37% clean energy.[120] It is clear that the financial support to the energy sector currently tilts mainly in favour of oil and gas production. This observation may mask country-specific circumstances, but it clearly shows the relevance of petroleum resources

[114] Neven Duic "Is the Success of Clean Energy Guaranteed?" (2015) 17 Clean Technologies and Environmental Policy 2093-2100; Aart Heesterman "The Pace and Practicality of Decarbonisation" (2017) 19:2 Clean Technologies and Environmental Policy 295-310; Mark Z. Jacobson and others "100% Clean and Renewable Wind, Water and Sunlight All-Sector Energy Roadmaps for 139 Countries of the World" (2017) 1 Joule 108-121.
[115] IEA *Renewables 2019: Market Analysis and Forecast from 2019 to 2024* (IEA 2019).
[116] IRENA *Global Energy Transformation: A roadmap to 2050* (IRENA 2019); IRENA "Investment Needs" (IRENA 2019) <www.irena.org>.
[117] Caroline Kuzemko and others "Covid-19 and the Politics of Sustainable Energy Transitions" (2020) 68 Energy Research & Social Science 101685.
[118] Mark Diesendorf "COVID-19 and Economic Recovery in Compliance with Climate Targets" (2021) 3 Global Sustainability 1-9.
[119] See Energy Policy Tracker data at <www.energypolicytracker.org>.
[120] Ibid.

in the global energy matrix and humanity's need for energy supply from a broad range of sources, in addition to the economic interests at stake in oil and gas investments globally. In the absence of more rapid policy intervention and behavioural changes, the IEA observes that longer-term growth drivers will continue to push up oil demand and supply, leading to the longer-term relevance of the upstream petroleum sector.[121]

One other point that needs emphasis is the uncertainty about when the world would completely transition from fossil fuels to renewables.[122] According to Smil, "Energy transitions have been, and will continue to be, inherently prolonged affairs, particularly so in large nations whose high levels of per capita energy use and whose massive expensive infrastructures make it impossible to greatly accelerate their progress even if we were to resort to some highly effective interventions."[123] Graaf and Sovacool present concrete examples of decades and centuries that characterised the transition from different energy sources, leading to the incumbent fossil economy.[124] The multi-dimensional – political, economic, technological, social – support enjoyed by the incumbent oil and fossil-dominated energy system represents a governance challenge for energy transition; and creates both inertia and path dependency.[125] These prevailing circumstances result in what Meadowcroft describes as "…a messy, conflictual, and highly disjointed process."[126]

The reality of the prevalent energy dynamics – where oil and fossil fuels dominate and could remain part of the global energy mix in the future – justifies the inquiry into regulatory approaches that incentivise the reduction of the GHG footprints of petroleum production. Therefore, this study will be necessary for mitigating climate change in the upstream petroleum sector. Nevertheless, the reduction of upstream GHG emissions can be a part of a transitional process where the world moves away from fossil fuels use to a global energy mix dominated by renewables and other sources of clean energy. A lot depends on how fast that future comes,

[121] IEA *Oil 2021: Analysis and Forecasts to 2026* (IEA 2021) at 3.
[122] Benjamin K. Sovacool "How Long Will it Take? Conceptualizing the Temporal Dynamics of Energy Transitions" (2016) 13 Energy Research & Social Science 202-215.
[123] Vaclav Smil *Energy Transitions: History, Requirements, Prospects* (Praegar 2010) at 150.
[124] Graaf and Sovacool, above n 63, at 168.
[125] Andreas Goldthau and Benjamin K. Sovacool "The Uniqueness of the Energy Security, Justice, and Governance Problem" (2012) 41 Energy Policy 232-240; Janelle Knox-Hayes "Negotiating Climate Legislation: Policy Path Dependence and Coalition Stabilization" (2012) 6 Regulation and Governance 545-567; Gregory C. Unruh "Understanding Carbon Lock-in" (2000) 28 Energy Policy 817 at 828.
[126] James Meadowcroft, "What about the Politics? Sustainable Development, Transition Management, and Long Term Energy Transitions" (2009) 42:4 Policy Sciences 323.

given the uncertainty about the temporal dynamics of the energy transition, as earlier identified, and the emergence of viable substitutes to oil, gas, and coal.

Given the study's regulatory focus, the concept of regulation provides a theoretical context to underpin the research. Different kinds of regulation exist for the governance of separate spheres and issues in society. Chapter 2 will discuss the theory in more detail and highlight the types of regulation relevant to this thesis. This thesis will apply this theoretical foundation to country-specific regulatory measures and industry-driven arrangements for emissions reduction.

D. Existing Research on the Regulation of Flaring and Venting

Flaring, venting, and fugitive emissions have not received much scholarly attention from a legal perspective. Oyewunmi and others[127] have recently examined the decarbonisation of the global energy system, considering how international investment law and international oil and gas operators can play complementary roles to reduce emissions emanating from petroleum-producing operations.[128] Nonetheless, they did not investigate flaring, venting, and fugitive emissions in major petroleum-producing countries. Similarly, Palgrave Macmillan recently commissioned The Palgrave Handbook of Managing Fossil Fuels and Energy Transitions.[129] The text features an array of scholarly contributions on managing the decline of fossil fuels in the energy transition process, focusing on China, The Netherlands, the United Kingdom, Australia, India, and Africa.[130] However, much of the text focuses more on reducing the use of fossil fuels, incentivising investment in renewables, and decarbonising the global energy system. There remains the need to inquire into how regulatory regimes in petroleum-producing jurisdictions can support the mitigation agenda through effective instruments and methods that target upstream GHG emissions and their most significant sources.

Recently, modelling results by the United Nations Environmental Programme (UNEP) have shown that oil and gas extraction, processing, and distribution account for about 23% of global methane emissions.[131] The UNEP has also suggested that targeted measures, such as the recovery and utilization of vented gas, upstream gas leak detection and repair, and improved control of fugitive emissions, could reduce GHG emissions from the oil and gas sector globally

[127] Tade Oyewunmi and others (eds) *Decarbonisation and the Energy Industry: Law, Policy and Regulation in Low-Carbon Energy Markets* (Hart Publishing 2020).
[128] Ibid Chapters 6-8.
[129] Geoffrey Wood and Keith Baker (eds) *The Palgrave Handbook of Managing Fossil Fuels and Energy Transitions* (Palgrave Macmillan 2020).
[130] Ibid, Chapters 5-10.
[131] UNEP *Global Methane Assessment: Benefits and Costs of Mitigating Methane Emissions* (UNEP 2021) at 9 and 28.

by 29 to 57 million tonnes per year.[132] One essential finding of the UNEP study is the significant role of international, national, and sub-national laws and regulations for abating methane and other GHG emissions, citing measures put in place in the US states of California and New York.[133] Thus, the suggested measures and strategies may not be possible without a clear understanding of the legal frameworks and challenges prevalent in oil and gas producing countries. This thesis will play a significant role in ascertaining and analysing the regulatory circumstances of the major petroleum-producing jurisdictions and identifying vital elements for effectively mitigating upstream GHG emissions.

Some studies examine country-specific circumstances in considerable detail. For example, Allan Ingelson[134] has recently reviewed new prescriptive rules for controlling venting and fugitive emissions relating to petroleum production in the United States and Canada.[135] Chaiyapa, Esteban, and Kameyama[136] have also proposed adopting sectoral approaches for mitigating climate change in the Thai petroleum upstream sector. Their proposition accords with some of the arguments in this thesis. However, Thailand is not among the world's leading petroleum jurisdictions. There are other striking recent examples of country-specific studies on Nigeria,[137] Saudi Arabia, and the United Arab Emirates.[138] Still, such individual or stand-alone studies do not help form a comprehensive understanding of regulatory approaches for addressing upstream GHG emissions universally.

The lack of data on upstream GHG emissions explains the scarcity of studies that look beyond country-specific circumstances. Researchers recently began to investigate and quantify upstream (and downstream) GHG emissions at a global scale.[139] Even as it becomes desirable to deepen our understanding of global emissions through further research, the emerging data will provide evidence for scholars to examine regulatory interventions beyond country-specific

[132] Ibid, at 5, 9, 10, 13 and 15.
[133] Ibid, at 14 and 125.
[134] Allan Ingelson "Plugging the Holes: New Canadian and US Regulations to Reduce Upstream Methane Emissions" (2019) Journal of World Energy Law and Business 1-20.
[135] Ibid.
[136] Warathida Chaiyapa, Miguel Esteban and Yasuko Kameyama "Sectoral Approaches Establishment for Climate Change Mitigation in Thailand Upstream Oil and Gas Industry" (2016) 94 Energy Policy 204-213.
[137] Kingsley Omote Mrabure and Benedicta Ogbene Ohimor "Unabated Gas Flaring Menace in Nigeria: The Need for Proper Gas Utilization and Strict Enforcement of Applicable Laws" (2020) 46:4 Commonwealth Law Bulletin 753-779; Olusola Joshua Olujobi "Analysis of the Legal Framework Governing Gas Flaring in Nigeria's Upstream Petroleum Sector and the Need for Overhaul" (2020) 9:8 Social Sciences 132.
[138] Bhaskar Sinha and others "Sustainable Green Policy by Managing Flare Gas Recovery: A Case with Middle East Oil and Gas Industry" (2020) 24:1 Vision, Sage Publications 35-46.
[139] Masnadi and others, above n 13; Jing and others, above n 14.

boundaries. This thesis helps to provide such a measure of understanding and fix this observed gap in the literature.

Recently, Gaulin and Billon[140] published a seminal global overview of supply-side policies to constrain fossil fuel production, but their analysis tilts toward stopping oil and gas operations and not on reducing upstream GHG emissions through regulatory approaches. An earlier similar work by Erikson, Lazarus, and Piggot [141] canvassed how restricting fossil fuel production can be the next big policy approach for mitigating climate change globally, especially by petroleum-producing countries. These themes also run across earlier scholarly contributions by Hoel,[142] Fæhn and others,[143] Lazarus and Asselt.[144] More so, the idea of phasing out fossil fuel subsidies to support climate policy has also received attention in the literature.[145]

Another debate in the literature is the idea of leaving petroleum resources and coal unexploited while transitioning to renewables and other sources of clean energy.[146] Collier and Venables[147] have specifically examined the moral imperative to shut down coalmines worldwide for environmental concerns. In support of this view, Erikson[148] has argued for a lock-in of the entire fossil fuel supply infrastructure, emphasising scaling back coal production the most in a low-carbon scenario. In 2019, a consortium of environmental institutes jointly issued The Production Gap Report, suggesting the necessity for countries' fossil fuel production rates to be consistent with climate targets set under the Paris Agreement.[149] The 2020 sequel of the

[140] Nicolas Gaulin and Philippe Le Billon "Climate Change and Fossil Fuel Production Cuts: Assessing Global Supply-Side Constraints and Policy Implications" (2020) Climate Policy https://doi.org/10.1080/14693062.2020.1725409.
[141] Peter Erickson, Michael Lazarus and Georgia Piggot "Limiting Fossil Fuel Production as the Next Big Step in Climate Policy" (2018) 8 Nature Climate Change 1037-1043.
[142] Michael Hoel *Supply Side Climate Policy and the Green Paradox* (Memorandum of the Department of Economics, University of Oslo, Memo 03/2013-v1 January 2013).
[143] Taran Fæhn and others "Climate Policies in a Fossil Fuel Producing Country: Demand versus Supply Side Policies" (2-17) 38:1 The Energy Journal 77-102.
[144] Michael Lazarus and Harro van Asselt "Fossil Fuel Supply and Climate Policy: Exploring the Road Less Taken" (2018) 150 Climatic Change 1-13.
[145] Peter Erickson and others "Effect of Subsidies to Fossil Fuel Companies on United States Crude Oil Production" (2017) 2 Nature Energy 891-898; Harro van Asselt and Kati Kulovesi "Seizing the Opportunity: Tackling Fossil Fuel Subsidies under the UNFCCC" (2017) 17 International Environmental Agreements 357-370; Peter Erikson and others "Why Fossil Fuel Producer Subsidies Matter" (2020) 678 Nature E1-E7.
[146] Christophe McGlade and Paul Ekins "Un-burnable Oil: An Examination of Oil Resource Utilisation in a Decarbonised Energy System" (2014) 64 Energy Policy 102-112.
[147] Paul Collier and Anthony J. Venables "Closing Coal: Economic and Moral Incentives" (2014) 30:3 Oxford Review of Economic Policy 492-512.
[148] Peter Erikson *Carbon Lock-in from Fossil Fuel Supply Infrastructure* (Stockholm Environment Institute Discussion Brief 2015).
[149] SEI, IISD, ODI, Climate Analytics, CICERO, and UNEP *The Production Gap: The Discrepancy between Countries' Planned Fossil Fuel Production and Global Production Levels Consistent with Limiting Warming to*

Production Gap Report suggests that global production of fossil fuels needs to decline annually by 11% (for coal), 4% (for oil), and 3% (for gas) between 2020 and 2030 to keep warming below 1.5°C, but there were indications of global fossil fuels production increases by 2% per annum.[150] This trend underscores the need for firm regulatory measures to reduce GHG emissions because of increased or persistent oil and gas production.

Furthermore, the IEA has recently suggested that, as part of the key milestones for achieving net-zero emissions by 2050, there should be no new investments or extension of existing investments in oil, gas, and coal beyond projects already committed to as of 2021.[151] Then there should be a reduction in the production of coal by 90%, oil by 75%, and gas by 55%, as well as a reduction in their carbon footprints, in 2050.[152] These are ambitious and potentially realistic goals but their achievement will depend on the quality of countries' laws and regulations, especially in major petroleum-producing jurisdictions. While the IEA analysis dwells more on the development of low-carbon or near-zero emissions technologies to support carbon neutrality by 2050, it also observes that reducing GHG emissions from core oil and gas operations should be the first-order priority for oil and gas companies.[153] Yet, it does not address the question of good regulatory practices to incentivise that emissions reduction. Thus, this thesis complements the IEA's study in two ways. First, it provides the analysis that is necessary for appreciating the applicable legal regimes in major petroleum-producing countries and suggests good regulatory practices and methods for abating upstream GHG emissions. Second, the analysis in this study underscores the present and future relevance of oil and gas, and the need to advance research on mitigating oil and gas production-related emissions. An earlier study by the IEA identified the need for infrastructure, investment incentives, and timely government policy coordination for reducing equipment leaks from the entire petroleum industry, as part of the governance architecture for reducing upstream GHG emissions.[154] This thesis will discuss these strategic options in their proper contexts.

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*1.5°C or 2°C (*SEI, IISD, ODI, Climate Analytics, CICERO and UNEP, Special Report 2019); report available at <http://productiongap.org/wp-content/uploads/2019/11/Production-Gap-Report-2019.pdf> accessed 31 May 2020.

[150] SEI, IISD, ODI, Climate Analytics, CICERO, and UNEP *The Production Gap: The Discrepancy between Countries' Planned Fossil Fuel Production and Global Production Levels Consistent with Limiting Warming to 1.5°C or 2°C (*SEI, IISD, ODI, Climate Analytics, CICERO and UNEP, Special Report 2020); report available at <http://productiongap.org/wp-content/uploads/2020/12/PGR2020_FullRprt_web.pdf> accessed 4 December 2020.

[151] IEA *Net Zero by 2050: A Roadmap for the Global Energy Sector* (IEA 18 May 2021) at 20, 21, 26, 152.

[152] Ibid.

[153] Ibid, at 104 and 160.

[154] IEA *Driving Down Methane Leaks from the Oil and Gas Industry* (IEA 2021) at 7-10.

Apart from leaving petroleum resources *in situ* (underground) and unburned or unexploited, Muttitt and others[155] have proposed a moderate option to manage the gradual decline of fossil fuel production to achieve the Paris Agreement's climate targets. McGlade and Ekins[156] have precisely quantified the volume of oil that must remain *in situ* from 2015 to 2035 in a low-carbon transition scenario – 500-600 billion barrels of proven and probable reserves. In addition, a social movement has emerged against the production of oil and fossil fuels.[157] Nonetheless, one point that advocates of carbon lock-in need to consider closely is that reducing emissions from petroleum production is a function of multiple factors comprising technologies, institutional strengths, and changing energy consumption patterns.[158]

From an energy transition perspective, the nexus between petroleum production and climate change has featured in academic inquiries by social scientists and policy scholars. Ruszel, Młynarski, and Szurlej[159] have examined different states' circumstances on the transition from oil and fossil fuels to renewables. Their study reveals variations in the trajectories of countries because of ostensible energy balance structures. They show a need for re-industrialisation that supports a new clean energy architecture. However, one major limitation of their analysis is that it excludes key petroleum-producing countries in the Middle East and other jurisdictions that are part of the Organisation of the Petroleum Exporting Countries (OPEC). Overland's earlier work[160] drew attention to the geopolitical ramifications of climate policies on demand-supply imbalances of petroleum resources between exporting and importing countries. Graaf[161] has posed the question of whether OPEC is dead, considering the practical and economic implications of the energy transition to a low-carbon economy. Hastad[162] has also argued for policy and regulatory measures that eliminate free-riding in the production and supply of fossil fuels without regard for environmental concerns.

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[155] Greg Muttitt and others *The Sky's Limit: Why the Paris Climate Goals Require a Managed Decline of Fossil Fuel Production* (Oil Change International September 2016).
[156] McGlade and Ekins, above n 139, at 111.
[157] Georgia Piggot "The Influence of Social Movements on Policies that Constrain Fossil Fuel Supply" (2018) 18:7 Climate Policy 942-954.
[158] Karen C. Seto and others "Carbon Lock-In: Types, Causes and Policy Implications" (2016) 41 Annual Review of Environment and Resources 425 at 427 and 430.
[159] Marius Ruszel, Tomasz Młynarski and Adam Szurlej (eds) *Energy Policy Transition: The Perspective of Different States* (Ignacy Lukasiewicz Energy Policy Institute Rzeszów 2017).
[160] Indra Overland "Future Petroleum Geopolitics: Consequences of Climate Policy and Unconventional Oil and Gas" in Jinyue Yan (ed) *Handbook of Clean Energy Systems* (John Wiley and Sons 2015) 1-29.
[161] Thijs Van de Graaf "Is OPEC Dead? Oil Exporters, the Paris Agreement and the Transition to a Post-Carbon World" (2017) 23 Energy Research & Social Science 182-188.
[162] Bard Harstad "Buy Coal! A Case for Supply-Side Environmental Policy" (2012) 120:1 Journal of Political Economy 77-144.

Leal-Arcas and others[163] have recently examined the energy sector's decarbonisation, but with minimal focus on petroleum production and more attention to electricity. They also limited their analysis to just four European countries – Bulgaria, Poland, France, and Finland. Valentine, Brown, and Sovacool [164] have also examined the continued production and consumption of oil and fossil fuels as part of the global energy transition challenges. They argue that the energy transition will be contested by global industries that rely on the fossil economy; for example, the petroleum sector, automobile manufacturing, and electric utilities.[165] Their argument's climax is the imperative of a "faster, further, farther" energy transition.

Similarly, Graaf and Sovacool[166] have recently examined global energy politics and energy transition through the lenses of geopolitics, the economy, the environment, and social justice. Through the environment lens, they revisit the nexus between climate change and petroleum production and emphasise the necessity of tackling both the production and consumption of fossil fuels during decarbonisation and energy transition. Although they offer no specific petroleum upstream decarbonisation approaches, they emphasise a problem that needs regulatory and policy solutions and insights on the energy transition's geopolitical ramifications. Zelli and others' collection[167] investigates fossil fuel subsidy, carbon pricing, and renewable energy proliferation and adoption as three practical policy fields for governing the climate-energy connection. Although the authors explore functional themes in this collection, their analyses of these policy fields stem from political science and international relations.

These scholarly efforts are relevant for providing an interdisciplinary lens to some pressing issues surrounding energy and climate change. Still, this thesis offers an analysis that is more law- and regulatory-centric. More so, contemporary studies predominantly focus on limiting petroleum production in a carbon-constrained world without adequately relating regulatory and policy measures to the prevailing dominance of oil and fossil fuels in the global energy matrix. Therefore, this thesis will build on the existing literature on how legal and regulatory measures help reduce upstream GHG emissions.

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[163] Rafael Leal-Arcas and others "Decarbonising the Energy Sector" (2019) 15 Journal of Animal and Natural Resource Law 173-272.
[164] Scott Victor Valentine, Marilyn A. Brown and Benjamin K. Sovacool *Empowering the Great Energy Transition: Policy for a Low-Carbon Future* (Columbia University Press 2019) 1-59.
[165] Ibid at 244 and 245.
[166] Thijs Van De Graaf and Benjamin K. Sovacool *Global Energy Politics* (Polity Press 2020).
[167] Fariborz Zelli and others (eds) *Governing the Climate-Energy Nexus: Institutional Complexity and Its Challenges to Effectiveness and Legitimacy* (Cambridge University Press 2020).

E. Research Methods

This thesis is doctrinal legal research. It adopts a qualitative framework built on three pillars – conventional legal analysis, comparative analysis, and the theory of regulation – and the tests adopted for assessing effectiveness. Chapter 2 will explain the tests and other complementary criteria that can help countries in designing a good regulatory system for achieving emissions reduction in the upstream petroleum sector.

In the law domain, doctrinal legal research is the most frequent method applied by lawyers, academics, judges, and professional legal researchers.[168] Its importance (and near-indispensability) in legal education is also well-rooted in literature.[169] However, it has been difficult to explain as a research method to researchers of other disciplines and non-professionals, hence the need for legal researchers to be more explicit about their dominant approach to interrogating issues, especially when working within a sophisticated and interdisciplinary research context.[170]

In any case, what is doctrinal legal research? Holmes asserted long ago that the jurist's work involves a logical analysis of the law in doctrinal terms towards ensuring that the law is well-arranged, distributed, and in order.[171] He also argued that a similar rational lens underpins the very root of courts' legal proceedings and judgments.[172] Dworkin asserts that one of the fundamental aspects of doctrinal legal research is to examine the design of law by taking account of problems, alongside the legal and institutional measures for addressing the issues.[173] According to the Council of Australian Law Deans, doctrinal legal research, at its best, involves rigorous analysis and creative synthesis, the making of connections between seemingly disparate doctrinal strands, and the challenge of extracting general principles from an inchoate mass of primary materials.[174] Similarly, Jain explains that doctrinal legal research involves

[168] P. Ishwara Bhat *Idea and Methods of Legal Research* (OUP 2019) at 144 and 145. See also Amrit Kharel, 'Doctrinal Legal Research' (Social Science Research Network 26 February 2018) <https://dx.doi.org/10.2139/ssrn.3130525>.
[169] Vincent Kazmierski "How Much Law in Legal Studies? Approaches to Teaching Legal Research and Doctrinal Analysis in a Legal Studies Program" (2014) 29:3 Canadian Journal of Law and Society 297 at 298; Sanne Taekema "Methodologies of Rule of Law Research: Why Legal Philosophy Needs Empirical and Doctrinal Scholarship" (2020) Law and Philosophy <https://doi.org/10.1007/s10982-020-09388-1>.
[170] Terry Hutchinson and Nigel Duncan "Defining and Describing What We Do: Doctrinal Legal Research" (2012) 17:1 Deakin Law Review 83 at 84-86, 93, 99-101 and 118.
[171] Oliver Wendell Holmes *The Common Law* (Little, Brown and Company 1881) at 219
[172] Oliver Wendell Holmes "The Path of the Law" (1897) 10:8 Harvard Law Review 457 at 458.
[173] Ronald Dworkin "Legal Research" (1973) 102:2 Daedalus 53 at 56.
[174] Council of Australian Law Deans "CALD Statement on the Nature of Research" (CALD May 2005) <www.cald.anu.edu>.

analysing case law, arranging, ordering, and systematising propositions, and studying institutions through legal reasoning or rational deduction.[175]

Thus, the remit of the doctrinal legal research method is the analysis of law and legal issues using legal reasoning, partly because of the conceptual nature of law, which requires logical evaluation.[176] Sometimes, doctrinal legal research also involves examining the law's current state and methods for valuable reforms.[177] In applying these and the preceding considerations, this thesis is analytical and primarily library-based. It explores the theory of regulation and narrows down to the regimes in prominent petroleum jurisdictions to address the specific problem of upstream GHG emissions, mainly focusing on flaring, venting, and fugitive emissions. There is also a recognition of the relevance of legal and market-based instruments for environmental protection and risk governance.[178] This thesis will analyse the robustness of diverse legal and regulatory mechanisms for mitigating upstream oil and gas production flaring, venting, and fugitive emissions within these contexts.

In addition, the comparative legal method is applied to examine countries' legal regimes to understand their peculiarities and contexts.[179] It also involves learning about the similarities and differences in legal systems at both micro (within national and sub-national) and macro (international and global) levels.[180] This learning provides a good understanding of the target jurisdictions' legal cultures and internal dynamics for addressing the specific problems investigated.[181]

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[175] S.N. Jain "Doctrinal and Non-Doctrinal Legal Research" in S.K. Verma and Afzal Wani (eds) *Legal Research and methodology* (2nd edn Indian Law Institute 2010) at 68.
[176] Natalie Stoljar "What Do We Want Law to Be? Philosophical Analysis and the Concept of Law" in Wil Waluchow and Stefan Sciaraffa (eds) *Philosophical Foundations of the Nature of Law* (OUP 2013) 230 at 232.
[177] Hutchinson and Duncan, above n 170.
[178] Michael Faure and Goran Skogh *The Economic Analysis of Environmental Policy and Law* (Edward Elgar 2003) 2; Michael G. Faure "The Complementary Roles of Liability, Regulation and Insurance in Safety Management: Theory and Practice" (2014) 17:6 Journal of Risk Research 689; Michael Faure "Designing Incentives Regulation for the Environment" in Eric Brousseau and others (eds) *Global Environmental Commons: Analytical and Political Challenges in Building Governance Mechanisms* (OUP 2012) 276 at 278 and 303.
[179] Konrad Zweigert and Hein Kötz *An Introduction to Comparative Law* (3rd edn OUP 1998) at 15-73; Jaakko Husa "Comparative Law, Legal Linguistics and Methodology of Legal Doctrine" in Mark Van Hoecke (ed) *Methodologies of Legal Research: What Kind of Method for What Kind of Discipline?* (Hart Publishing) 209.
[180] Geoffrey Samuel *An Introduction to Comparative Law Theory and Method* (Hart Publishing 2014) at 17 and 18; David Nelken "Comparative Legal Research and Legal Culture: Facts, Approaches and Values" (2016) 12 The Annual Review of Law and Social Science 45 at 49.
[181] Ibid.

In contemporary legal scholarship, a comparative approach to research helps fill knowledge gaps using the insights drawn from other jurisdictions.[182] The comparative approach is also becoming more relevant as one of the legal education methods in today's world where legal scholars prepare to function in a global context and need a comparative understanding of the applicable law in their chosen domains.[183] Besides, comparative legal research helps to pool various experiences and contemporary best practices for addressing problems.[184] A legal researcher can study specific patterns and trends in overseas or multiple jurisdictions to benefit one or more national legal systems and offer insights for future developments.[185]

When applying these considerations to studying the regulatory regimes for addressing upstream GHG emissions in different petroleum jurisdictions, the focus is to understand the similarities and differences among the selected countries. Furthermore, it is necessary to look out for the differences in institutional arrangements, regulatory objectives, and the diverse methods that different jurisdictions adopt for achieving the regulatory goal of abating upstream emissions. This comparative method, coupled with the earlier described doctrinal approach, will distil some relevant characteristics of an effective regulatory regime for abating flaring, venting, and fugitive emissions in the upstream petroleum sector.

F. Country Selection

This thesis does not cover all the numerous sovereign countries in the world engaged in oil and gas production but a wide range of jurisdictions to obtain insights of a reasonably general nature. Thus, the analysis will capture two groups – six countries from the IEA-designated oil and gas producer economies and six other petroleum-producing jurisdictions with a reputation for colossal oil and gas investments and activities. The first group is mainly susceptible to industry-related economic trends and policy shifts because of high economic dependency on the oil and gas sector. The IEA lists three key variables as criteria to be designated as a producer economy, namely:

[182] John Bell "Legal Research and the Distinctiveness of Comparative Law" in Hoecke, above n 172, at 155 and 158; Muhammad Imran Ali "Comparative Legal Research: Building a Legal Attitude for a Transnational World" (2020) 26:40 Journal of Legal Studies 66.
[183] Ibid.
[184] Bhat, above n 168, at 279.
[185] Geoffrey Wilson "Comparative Legal Scholarship" in Mike McConville and others (eds), *Research Methods for Law* (Edinburgh University Press 2007) at 87.

1. Large production;
2. One-third of the goods and services exported are oil and gas; and
3. Oil and gas account for one-third of the national fiscal revenue.[186]

The IEA identifies ten countries in this category but recognises a subset of six as the bedrock of global hydrocarbons supply because of their critical role in developing and bringing oil and natural gas to the world's consumers – Iraq, Nigeria, Russia, Saudi Arabia, the United Arab Emirates and Venezuela.[187] This thesis concentrates on these six countries and the second group of countries, i.e. six other established petroleum-producing countries outside the IEA designation of producer economies. Countries under this second group are diverse, but the focus is limited to Brazil, the United States of America (the US), the United Kingdom (UK), Canada, China, and Norway. The justification for these countries' inclusion is to observe possible differences between IEA-designated producer economies and other producer economies across different geopolitical zones.

There are further issues to consider in choosing countries. According to the dataset of the United States Energy Information Administration (US EIA), some of these countries are the top oil producers in the world, with the US, Saudi Arabia, Russia, Canada and China leading respectively as first to fifth largest oil producers as of 2019.[188] In the same year (2019), total world oil production averaged 80 million barrels per day, with the top 10 producers and OPEC members accounting for 68% and 44%, respectively.[189] In addition, almost all IEA-designated producer economies are members of OPEC.[190] OPEC Member-Countries collectively held 81.89% share of world crude reserves as of 2017.[191] Apart from known production and net income estimates, there is a possibility of further drilling and production activities in these countries, especially as oil may remain relevant for decades to come. Further, some of these countries have been the top gas flaring countries in the world for the last decade. Russia, Iraq, Iran, the United States, Algeria, Venezuela and Nigeria produce 40% of the world's oil each

[186] IEA *Outlook for Producer Economies 2018* (OECD and IEA World Energy Outlook Special Report 2018) at 13.
[187] Ibid, at 15.
[188] US EIA, 'The 10 Largest Oil Producers and Share of Total World Oil Production in 2019' (US EIA 1 December 2020) <https://www.eia.gov/tools/faqs/faq.php?id=709&t=6>.
[189] Ibid.
[190] At the time of writing, OPEC Member-Countries included Algeria, Angola, Congo, Ecuador, Equatorial Guinea, Gabon, Iran, Iraq, Kuwait, Libya, Nigeria, Saudi Arabia, United Arab Emirates, and Venezuela. <www.opec.org>.
[191] OPEC *Annual Statistical Bulletin 2018* (OPEC 2018).

year and account for two-thirds (65%) of global gas flaring.[192] The choice to limit the study to the selected countries becomes apparent. However, this thesis is not an encyclopaedia or global survey of energy-climate and GHG emission reduction regulations. Although the country selection may seem diverse and broad, the scope of examination is narrow to the extent of explicitly considering key legislation and regulations for abating upstream emissions, focusing on flaring, venting, and fugitive emissions.

[192] World Bank Global Gas Flaring Reduction Partnership *Global Gas Flaring Tracker Report* (World Bank Global Gas Flaring Reduction Partnership April 2021) at 2, 5 and 7.

2. Conceptual Framework

This chapter draws on the theory of regulation to provide a conceptual context for what regulators in different jurisdictions may be seeking to accomplish. While some relationships between the theory and upstream GHG emissions may show in this chapter, subsequent chapters will reveal connections that are more direct in national and industry-specific regimes to reduce flaring, venting, and fugitive emissions.

A. The Theory of Regulation

Morgan and Yeung define the theory of regulation as "…a set of propositions or hypotheses about *why* regulation emerges, *which actors* contribute to that emergence and typical *patterns of interaction* between regulatory actors."[193] This complex phenomenon has received scholarly attention at an interdisciplinary level comprising law, economics, politics, and sociology.[194] The theory also applies to the governance of energy and natural resources and their environmental implications.[195] This brief discussion focuses on the meaning, elements, and kinds of regulation; and makes connections with the central objective of this thesis.

1. Meaning and elements of regulation

Theoretical analyses on regulation are yet to produce a particular definition of the term.[196] Daintith provides a generic meaning of the term as "…all acts of controlling, directing or governing according to a rule, principle or system."[197] This generic context comprises three key elements – rules/standards, monitoring/compliance, and enforcement mechanism. However, this standard framing leaves out other key features such as decision-making on rules/standards and specialist decision-making agencies' activities. For example, in different petroleum-producing countries, the relevant petroleum legislation vests discretionary powers in the

[193] Bronwen Morgan and Karen Yeung *An Introduction to Law and Regulation: Texts and Materials* (Cambridge University Press 2007) at 16.
[194] Some examples include Robert Baldwin, Colin Scott and Christopher Hood (eds) *A Reader on Regulation* (OUP 1998); Robert Baldwin and Martin Cave *Understanding Regulation: Theory, Strategy, and Practice* (OUP 1999); Colin Scott (ed) *Regulation* (Ashgate 2003); Robert Baldwin, Martin Cave and Martin Lodge (eds) *The Oxford Handbook of Regulation* (OUP 2010); David Levi-Faur (ed) *Handbook on the Politics of Regulation* (Edward Elgar Publishing 2011). An example of a more recent work is Peter Drahos (ed) *Regulatory Theory: Foundations and Applications* (ANU Press 2017).
[195] Barry Barton, Lila K. Barrera-Hernandez and Alastair R. Lucas and Anita Ronne (eds) *Regulating Energy and Natural Resources* (OUP 2006); Chih-kuo Kao *Environmental Regulation of Oil and Gas* (Kluwer Law International 1998); Aileen McHarg (ed) *Property and the Law in Energy and Natural Resources* (OUP 2010).
[196] Barry Barton "The Theoretical Context of Regulation" in Barry Barton, Lila K. Barrera-Hernandez and Alastair R. Lucas and Anita Ronne (eds) *Regulating Energy and Natural Resources* (OUP 2006) at 12.
[197] Terrence Daintith "Regulation, State and Economy – Some Preliminary Considerations" in Richard Buxbaum and Ferenc Mádl (eds) *International Encyclopaedia of Comparative Law. Vol. XVII* (Tübingen: Mohr Siebeck 1997) at 3.

minister of petroleum to grant or refuse applications for various upstream activities, including permit applications for flaring and venting. This point will show clearly in Chapter 3.

Daintith also provides three distinctive insights on regulation's possible meanings – as systematic control, as opposition to markets, and as a policy instrument.[198] Two strands of this distinction may be helpful for purposes of upstream GHG emissions reduction. These are the perspectives of control (controlling upstream emissions) and a policy instrument (strategy for addressing upstream emissions).

Prosser defines regulation as "…the legal rules and other measures which express such command-and-control arrangements, contrasted with other forms of law such as criminal and contract law."[199] In this context, legal rules promulgated through statutory instruments for addressing upstream petroleum emissions would qualify as regulation.

These two extremes – general and specific – may not present a solution to the difficulty of defining regulation because of possible over generalisation or limitation. Baldwin, Cave and Lodge illustrate this problem by examining three varying definitions of the concept: as a specific set of commands, as deliberate state influence, and as all forms of social control; and argue that these definitions suffer from "under- and over-inclusiveness."[200] Barton also believes that it is over-inclusive to define regulation to encompass all kinds of social control and influence.[201] Prosser says it consists of public interventions that affect the operation of markets through command and control.[202] Selznick defines the concept as sustained and focused control exercised by a public agency over community values.[203] Scott defines regulation as "… any process or set of processes by which norms are established, … monitored or fed back into the regime, and for which there are mechanisms for holding the behaviour of regulated actors within the acceptable limits of the regime (whether by enforcement action or by some other mechanism)."[204]

[198] Ibid, at 15-21.
[199] Tony Prosser *Law and The Regulators* (Clarendon Press Oxford 1997) at 4.
[200] Robert Baldwin, Martin Cave and Martin Lodge (eds) *The Oxford Handbook of Regulation* (OUP 2010) at 12.
[201] Barton, above n 196, at 12.
[202] Prosser, above n 199.
[203] Philip Selznick "Focusing Organizational Research on Regulation" in Roger G. Noll (ed) *Regulatory Policy and the Social Sciences* (University of California Press 1985) 363.
[204] Colin Scott "Analysing Regulatory Space: Fragmented Resources and Institutional Design (2001) 53 Public Law 329 at 331.

There are also scholarly examples that refer to Julia Black's work as a good illustration of the difficulty in defining regulation[205] and an excellent example of a more wide-ranging description of the concept.[206] Smith looks positively on Black's work, saying that Black rose to the definition challenge of regulation with "characteristic theoretical depth and conceptual clarity."[207] Therefore, it may be helpful to learn about Black's thinking on regulation. She defines regulation as "the sustained and focused attempt to alter the behaviour of others according to defined standards or purposes with the intention of producing a broadly identified outcome or outcomes, which may involve mechanisms of standard-setting, information-gathering and behaviour-modification."[208] She adopts this definition in a later work,[209] which Smith and Prosser referenced.[210] An earlier version of her description that Baldwin, Cave and Lodge[211] refer to is "the intentional use of authority to affect the behaviour of a different party according to set standards, involving instruments of information-gathering and behaviour modification."[212] Barton recognises Black's work as the best discussion of the definition problem, but goes ahead to describe regulation as "…a process intended to alter activity or behaviour, or to carry out an ordering, often by restricting behaviour, but at times enabling or facilitating behaviour that would otherwise not be possible."[213]

There are valuable insights to draw from the different theories of regulation for application to this thesis. First, there is the element of behaviour modification, which can be restrictive or facilitative. The objective of regulation would be to alter or modify the practices of oil and gas producing operators to reduce GHG emissions traceable to their operations. Second, there is the standard-setting element, which means the stipulation of necessary rules or standards for emissions control during petroleum production. Third, there is the feature of decision-making, which would apply especially for the approval or rejection of permit applications for flaring and venting or other operations that would discharge GHGs. The fourth point is about the operation of specialist agencies. This element can show in two forms – either as a specialist agency of the government (just like the United States Environmental Protection Agency) or as

[205] Barton, above n 196, at 13.
[206] Baldwin, Cave and Lodge, above n 187. See also Tony Prosser *The Regulatory Enterprise: Government, Regulation, and Legitimacy* (OUP 2010) at 2.
[207] Dimity Kingsford Smith "Why Regulation? A Reply to Julia Black" (2002) 27 Australian Journal of Legal Philosophy 37.
[208] Julia Black "Critical Reflections on Regulation" (2002) Australian Journal of Legal Philosophy 1 at 26.
[209] Julia Black "Regulatory Conversations" (2002) 29:2 Journal of Law and Society 163 at 170.
[210] Above, notes 192 and 200.
[211] Baldwin, Cave and Lodge, above n 194.
[212] Julia Black "Decentring Regulation: Understanding the Role of Regulation and Self-Regulation in a 'Post-Regulatory World'" (2001) 54 Current Legal Problems 103.
[213] Barton, above n 189, at 13.

a specialist industry-focused organisation (just like the Oil and Gas Climate Initiative). This second strand is a form of self-regulation, which comes up for closer examination in Chapter 4. The fifth feature is using different mechanisms or instruments and methods for monitoring and enforcement to achieve the regulatory objective of reducing flaring, venting, and fugitive emissions. Most of these elements will show clearly in different regulatory trends and practices as the thesis develops.

2. Kinds of regulation

This section considers the common types of regulation, their principal characteristics, and applications to this thesis. Prosser identifies four regulation models – rule for economic efficiency and consumer choice; law to protect rights; regulation for social solidarity; and regulation as deliberation.[214] One problem with this formulation is the restricted range of activities covered by the models. Baldwin, Cave, and Lodge identify seven kinds of regulatory strategies.[215] These are command and control; incentives; market-harnessing controls; disclosure; direct action and design solutions; rights and liabilities laws; and public compensation (social insurance).[216]

Sometimes the classifications by different authors overlap. Sometimes, it is a matter of terminology. However, the literature's common kinds of regulation are two broad classifications – conventional regulation and market-based alternatives. There is also the understanding that regulatory power spreads across different strata and entities of society, not necessarily an exclusive state tool, hence the idea of decentred understandings of regulation. A hybrid form of regulation combines different kinds of regulation to achieve regulatory objectives. The analyses in subsequent chapters will closely identify the operation of these various forms of regulation in the established regimes of petroleum jurisdictions for mitigating upstream flaring, venting, and fugitive emissions.

a) Conventional regulation

Barton presents a compact summary of conventional regulation, covering rules-based regulation; principles-based regulation; light-handed regulation; discretionary regulation; contracts; and incentives.[217] Nevertheless, the more common types of traditional regulation are rules-based and principles-based approaches. As the thesis progresses, one crucial issue for

[214] Tony Prosser *The Regulatory Enterprise: Government, Regulation, and Legitimacy* (OUP 2010) at 18.
[215] Robert Baldwin, Martin Cave and Martin Lodge *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn OUP 2012) 106.
[216] Ibid, at 134-136.
[217] Barton, above n 196, at 20-21.

examination is determining conventional regulation forms that have high potential to reduce flaring, venting, and fugitive emissions. This point will emerge from the analysis of the regulatory regimes in the case study countries.

Rules-based regulation stipulates detailed rules or prescriptions on the regulated issue. It prescribes specific actions and prohibits acts. It is also known as prescriptive or command and control regulation. It may be suitable for regulating highly contested, unfamiliar, complex, or delicate matters, especially in the absence of fixed ideas about effective risk management approaches.[218] Its key strengths are formality, transparency, predictability, and certainty. Its major weakness is its inability or slowness to address new unforeseen issues; thus, it can be inflexible in dealing with variety. It can also be a barrier to innovation.[219] For upstream GHG emissions, rules-based regulation would stipulate rules and prescriptions for industry operators to comply with. The study of national regulatory regimes in Chapter 3 will identify jurisdictions with prescriptive regulations and contribute to discussing the research's conceptual relevance in Chapter 5.

The principles-based variant establishes policy goals and allows the regulated entities to decide the best approaches to achieve the set goals. It is also known as goals-based, result-oriented, or policy-based regulation. The regulation would usually stipulate standards or tests to satisfy compliance or show achievement of the set goals. This approach's primary strength is its flexibility, making it most suitable for regulating fast-paced industries that always experience innovation.[220] However, it may not be suited to address complex and multifaceted issues, nor where compliance is a problem.[221] Therefore, the adoption of either a prescriptive or a principles-based regulatory regime would depend on the particular set of circumstances and the regulated activities.[222] In the context of the research inquiry, principles-based regulations

[218] Beatrice Junquera and Jesús Ángel Del Brío "Preventive Command and Control Regulation: A Case Analysis" (2016) 8 Sustainability 99. See also Elen Stokes "Demand for Command: Responding to Technological Risks and Scientific Uncertainties" (2013) 21 Medical Law Review 11.

[219] David Seall "Over-Prescriptive Regulations Stifle Innovation" (2004) 1 Electronics Weekly 2160; Productivity Commission, Australian Government *Review of the Regulatory Burden on the Upstream Petroleum (Oil and Gas) Sector* (Productivity Commission Research Report, April 2009); Sue Taylor, Anthony Asher and Julie Anne Tarr "Accountability in Regulatory Reform: Australia's Superannuation Industry Paradox" (2017) 45 Federal Law Review 257 at 278.

[220] Christopher Decker *Goals-Based and Rules-Based Approaches to Regulation* (The United Kingdom Department for Business, Energy and Industrial Strategy Research Paper Number 8, May 2018) at 6, 17, 21. See also Julia Black, Martin Hopper and Christa Band "Making a Success of Principles-Based Regulation" (2007) 1:3 Law and Financial Markets Review 191; Julia Black "Forms and Paradoxes of Principles-Based Regulation: (2008) 3 Capital Markets Law Journal 425-457.

[221] Barton, above n 196.

[222] Brigitte Burgemeestre, Joris Hulstijn and Yao-Hua Tan "Rule-Based Versus Principle-Based Regulatory Compliance" in Guido Governatori (ed) *Legal Knowledge and Information Systems* (IOS Press 2009) 37-46. See

would establish goals for GHG emissions reduction and leave industry operators with the discretion to implement strategies for achieving the goals. Most regulatory arrangements are a hybrid of different approaches. Chapter 5 of this thesis will discuss how petroleum-producing jurisdictions can explore a hybrid regulatory model incorporating principles-based and specific prescriptions and market-based instruments for mitigating flaring, venting, and fugitive emissions.

In addition, it is common for a regulatory agency or minister to have power to grant or approve certain types of activities or to refuse them, or to allow them subject to conditions. This is called discretionary regulation and a type of conventional regulation.[223] For example, the Minister of Petroleum Resources in a country may have powers to grant flaring permits to operators or refuse applications, or grant them subject to conditions. This discretionary power can be advantageous in circumstances requiring flexibility, but it can also be unpredictable and lead to arbitrariness. It does not also give certainty to the regulated entities. Research has shown that such a decision-making process is vital for the optimal governance of natural resources, including oil and gas.[224] This thesis will identify some petroleum jurisdictions with this kind of regulation and analyse the implications for an effective regulatory regime for mitigating upstream GHG emissions.

b) Market-based instruments

Different texts in the literature have explored the history and adoption of market-based instruments (MBIs) as alternatives to conventional state command and control regulation.[225] The MBIs are economic instruments that operate in the form of carbon pricing mechanisms (taxes, prices, and charges), subsidies, tradeable emissions rights, and eco-labelling. In addition, Ogus observes the potential of two specific instruments – the 'nudging tax' and 'rectificatory tax' – to induce behavioural change as alternatives to conventional regulatory approaches.[226]

Some scholars have argued that MBIs overcome the deficiencies of traditional command and control regulation.[227] There are also common views on using MBIs to address common

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also Pascal Frantz and Novald Instefjord "Rules vs Principle Based Financial Regulation" (Social Science Research Network 25 November 2014) <www.papers.ssrn.com>.

[223] Barton, above n 196, at 21.

[224] See Chapter 2 of Ceri Warnock and Maree Baker-Galloway *Focus on Resource Management Law* (LexisNexis 2015).

[225] Barton, above n 196, at 11; Baldwin, Cave and Lodge, above n 194, at 169 and 203. See also Glen Hepburn *Alternatives to Traditional Regulation: A Report for the OECD* (OECD 2 October 2013).

[226] Anthony Ogus "Nudging and Rectifying: The Use of Fiscal Instruments for Regulatory Purposes" (1999) 19:2 Legal Studies 245.

[227] Ibid, at 246. For detailed discussion of this, see earlier works: Richard B. Stewart "Regulation, Innovation and Administrative Law: A Conceptual Framework" (1981) 69:5 California Law Review 1263-1377; Donald N.

environmental concerns[228] and transition from oil and fossil fuels to a low-carbon economy.[229] Chapter 3 will identify the MBIs that operate in the case study countries and examine their potential to reduce flaring, venting, and fugitive emissions.

c) Decentred understandings

Julia Black introduced the terms 'decentring regulation' and 'decentred regulation' to express that governments do not have a monopoly on regulation.[230] This point means that different regulatory relationships occur amongst various societal strata and entities – for example, rules for professional organisations, technical committees, and companies.[231] Technical competence, wealth, information, and organisational capacity are also examples of power sources, apart from legal authority.[232]

For upstream GHG emissions regulation, decentred understandings can include technical industry rules, information, and procedures for mitigating flaring, venting, and fugitive emissions. Specialised industry-driven frameworks such as the Oil and Gas Climate Initiative (OGCI) and the Carbon Disclosure Project (CDP) are examples of decentred understandings on regulation. Chapter 4 will examine these industry-driven regulatory initiatives and the internal measures by oil majors to analyse how they encourage upstream GHG emissions reduction.

Responsive regulation and reflexive regulation are common forms of a decentred understanding of regulation in the literature.[233] The following parts of the chapter will discuss them briefly to determine whether they are helpful or irrelevant to the primary inquiry.

(1) Responsive regulation

Drawing on Nonet and Selznick's responsive law concept,[234] Ayres and Braithwaite canvass a responsive theory of regulation.[235] Their central idea is that governments should be responsive

Dewees (ed) *The Regulation of Quality: Products, Services, Workplaces, and the Environment* (Butterworths 1983) at 36-40.

[228] Andrew Jordan, Rudiger K.W. Wurzel, and Anthony R. Rito (eds), *New Instruments of Environmental Governance? National Experiences and Prospects* (Routledge 2003); George Rock Pring and Rick A. Feger *Alternatives to Conventional Regulation in United States Environmental Law* (OUP 2006) at 335-354.

[229] Catherine Banet, 'The Use of Market-Based Instruments in the Transition from a Carbon-Based Economy' in Donald N. Zilman and others (eds), *Beyond the Carbon Economy: Energy Law in Transition* (OUP 2008) at 207.

[230] Julia Black "Decentring Regulation: Understanding the Role of Regulation and Self-Regulation in a 'Post-Regulatory' World" (2001) 54 Current Legal Problems 102.

[231] Ibid.

[232] Barton, above n 196, at 23.

[233] Ibid.

[234] Philipe Nonet and Philip Selznick *Law and Society in Transition: Toward Responsive Law* (Harper and Row 1978). The core characteristics of responsive law in this text include dynamic legal development, purposive law, openness and flexibility, citizen participation, and the design of competent legal institutions.

[235] Ian Ayres and John Braithwaite *Responsive Regulation: Transcending the Deregulation Debate* (OUP 1992).

to the conduct of those they seek to regulate in deciding the necessity or otherwise of a more interventionist response.[236] They suggest that regulation should be responsive to industry structure in that different structures will be conducive to different degrees and forms of regulation. They offer two pyramids for governmental response in terms of regulatory strategies and punishments for an infraction. For regulatory strategies, they conceptualise a system that graduates from self-regulation, enforced self-regulation, command regulation with discretionary punishment, and command regulation with nondiscretionary punishment.[237] For punishments, they suggest persuasion, warning letter, civil penalty, criminal penalty, licence suspension, and licence revocation in ascending order depending on the gravity of regulatory infraction.[238] It is not certain whether this conceptualisation of regulation is useful or even occurs in the case study countries' frameworks for addressing upstream GHG emissions. The examination that comes in Chapter 3 will tell.

(2) Reflexive regulation

Gunther Teubner built on autopoiesis theory (self-creation and self-organisation), which Humberto Maturana, Heinz von Foerster and Niklas Luhmann propounded.[239] The central idea of Autopoiesis is that, (within systems theory, the biology of cognition and living systems), the living being or system can autonomously self-create and self-organise without recourse to external intervention.[240] Teubner propounds a self-referential system through self-regulation and openness to natural forces that systems can adapt to survive.[241] He suggests the likelihood of regulatory trilemma (or regulatory failures) in circumstances where law acts as an external intervention that unsettles self-referential structures' internal dynamics. These include (a) incongruence of law, politics, and society; (b) possible over-regulation of society; and (c) over-socialisation of law.[242] Braithwaite captures this trilemma in the context of law-corporate interaction as follows:

[236] Ibid. See also John Braithwaite *Restorative Justice and Responsive Regulation* (OUP 2002) at 29.
[237] Ayres and Braithwaite above n 235, at 39.
[238] Ibid, at 35. In addition, John Braithwaite discusses five types of responsive regulation – pyramidal responsiveness; micro-responsiveness; networked, nodal responsiveness; meta-regulatory responsiveness; socialist responsiveness. See John Braithwaite "Types of Responsiveness" in Peter Drahos (ed) *Regulatory Theory: Foundations and Applications* (ANU Press 2017) 117-130.
[239] Gunther Teubner, *Law as an Autopoietic System* (Blackwell 1993).
[240] Humberto R. Maturana and Francisco J. Varela *Autopoiesis and Cognition: The Realisation of the Living* (Dordrecht, Holland; Boston: D. Reidel Publishing Company 1980).
[241] Teubner, above n 232, at 13-99. See also Gunther Teubner "Substantive and Reflexive Elements in Modern Law" (1983) 17:2 Law and Society Review 239-286.
[242] Gunther Teubner "After Legal Instrumentalism? Strategic Models of Post-Regulatory Law" in Gunther Teubner (ed) *Dilemmas of Law in the Welfare State* (De Gruyter 1985) 299 at 309.

> [A] law that goes against the grain of business culture risks irrelevance; a law that crushes normative systems that naturally emerge in business can destroy virtue; a law that lets business norms take it over can destroy its own virtues.[243]

Other proponents of reflexive law share Teubner's views. Habermas construes the incongruence between law and the supposed intrinsic internal dynamics of systems to be a legitimation crisis and suggests avoiding overburdening social systems through excessive legal intervention.[244] Gunningham advocates a regulatory reform that transcends conventional command and control.[245] He identifies some reflexive options: process-based and meta-regulation, information regulation, ecological modernisation, smart regulation, and a new form of environmental governance.[246] Schutter and Lenoble extensively discuss suitable reflexive regulation applications to govern market structures, state institutions, corporate entities, and social rights.[247]

Vincent-Jones cautions that reflexive frameworks' success would largely depend on the tightness of the law and its manner of interpretation, implementation, and enforcement, considering the problem of the regulatory trilemma.[248] He advocates regulatory oversight to ensure that reflexive systems perform their assigned roles efficiently, effectively, and socially accountable.[249] However, Picciotto argues that legal rules constitute the order of things, such as businesses and markets.[250] This point applies explicitly to the establishment of corporate forms that determine the order and approaches to issues. In this sense, reflexivity becomes an adaptation to established legal rules.[251]

The ideas from responsive and reflexive regulation may seem abstract and of little use. Still, there are specific consequences of decentred understandings of regulation that are helpful in the present inquiry. They are self-regulation, co-regulation, voluntary measures, third party

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[243] John Braithwaite "Responsive Regulation and Developing Economies" (2006) 34 World Development 844 at 885.
[244] Jürgen Habermas *The Theory of Communicative Action* (Cambridge, England: Polity Press 1989). See also Andrew Edgar *The Philosophy of Habermas* (Routledge 2005) at 138, 156-158.
[245] Neil Gunningham "Regulatory Reform and Reflexive Regulation" in Bernd Siebenhüner, Tom Dedeurwaerdere, and Éric Brousseau (eds) *Reflexive Governance for Global Public Goods* (MIT Press 2012) 85.
[246] Ibid, at 88-97.
[247] Oliver de Schutter and Jacques Lenoble (eds) *Reflexive Governance: Redefining the Public Interest in a Pluralistic World* (Hart Publishing 2010).
[248] Peter Vincent-Jones "Competition and Contracting in the Transition from CCT to Best Value: Towards a More Reflexive Regulation" (1999) 77:2 Public Administration 273.
[249] Ibid, at 284.
[250] Sol Picciotto "Regulation: Managing the Antinomies of Economic Vice and Virtue" (2017) 26:6 Social and Legal Studies 676 at 692.
[251] Ibid. See also an earlier work on the issue: Sol Picciotto "Introduction: Reconceptualising Regulation in the Era of Globalization" (2002) 29 Journal of Law and Society 1.

regulation, enforcement measures, and environmental management and audit systems.[252] More specifically, voluntary actions, self-regulation, and environmental management initiatives of petroleum organisations and companies help understand the import of decentred understandings of regulation.

d) Hybrid approach

It is rare to see a regulatory regime that purely implements only one regulatory approach in practice. Instead, a hybrid of different methods is the norm.[253] Various scholars have also explored hybridity for regulating issues. Riaz examines a combination of state regulation and self-regulation for remuneration in Australia.[254] Lantz analyses a hybrid of revenue capping and incentive regulation to control the profit level of monopolistic firms.[255] Alexius and Furusten explore it for governing large hybrid organisations.[256] Ewert and Maggetti have also investigated hybridisation in transnational environmental governance.[257] There is also emerging literature on a hybrid of new environmental management comprising traditional regulatory models and public-private collaborations.[258] This particular hybrid is an example of a smart regulatory model that captures a broad mix of approaches to achieve the ends of regulation.[259]

However, hybridity is not a guarantee for successful regulation.[260] There may be external and remote factors for the achievement of regulatory objectives. Sometimes regulatory failure can result because of improper controls, low monitoring, and enforcement.[261] A lot depends on the design of regulatory approaches, as much as on their implementation.[262]

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[252] Barton, above n 196, at 28-31 for a summary survey of the consequences of decentred understandings.
[253] David Levi-Faur (ed) *Handbook on the Politics of Regulation* (Edward Elgar 2011) at 10 and 11. See also Larry Blank and John W. Mayo "Endogenous Regulatory Constraints and the Emergence of Hybrid Regulation" (2009) 35 Review of Industrial Organisation 233 at 235-238.
[254] Zahid Riaz "A Hybrid of State Regulation and Self-Regulation for Remuneration Governance in Australia" (2016) 16:3 Corporate Governance 539-563.
[255] Björn Lantz "Hybrid Revenue Caps and Incentive Regulation" (2008) 30 Energy Economics 688-695.
[256] Susanna Alexius and Staffan Furusten (eds) *Managing Hybrid Organisations: Governance, Professionalism and Regulation* (Palgrave Macmillan 2019).
[257] Christian Ewert and Martino Maggetti "Regulating Side by Side: The Role of Hybrid Organisations in Transnational Environmental Sustainability" (2016) 35 Policy and Society 91-102.
[258] John S. Dryzek, Richard B. Norgaard, and David Schlosberg (eds) *The Oxford Handbook of Climate Change and Society* (OUP 2011); Peter Drahos (ed) *Regulatory Theory: Foundations and Applications* (Australian National University Press 2017) 741-758.
[259] Neil Gunningham and Peter Grabosky *Smart Regulation: Designing Environmental Policy* (OUP 1998) at 187-214.
[260] Bärbel R. Dorbeck-Jung and others "Contested Hybridization of Regulation: Failure of the Dutch Regulatory System to Protect Minors from Harmful Media" (2010) 4 Regulation and Governance 154.
[261] Ibid, at 156-158.
[262] Michiel A. Heldeweg "Hybrid Regulation as a Legal Design Challenge" in A.L.B. Colombi Ciacchi and others (eds) *Law and Governance - Beyond the Public-Private Law Divide* (Eleven International Publishing 2013) 107 at 136-138.

While applying these ideas about regulation to the research inquiry, the objective will be to understand how to ensure regulatory effectiveness in achieving upstream GHG emissions reduction. Thus, it is relevant to clarify the meaning of effectiveness in this chapter as part of the overarching conceptual framework of this thesis.

B. Regulatory Effectiveness

The concept of effectiveness in law is controversial and problematic. It can lead to a lengthy exposition, but this chapter intends to keep it concise and within the research inquiry's specific context. From a strict jurisprudential perspective, effectiveness can mean the relationship between results and the social objects that legal norms set out to achieve.[263] Consequently, effectiveness relates to legal and regulatory mechanisms' real-world effects, especially about how they alter human behaviour and the physical environment.[264]

However, Maljean-Dubois summarises the multiple meanings of the term in three levels: (1) legal effectiveness, meaning respect for the law; (2) behavioural effectiveness, meaning behavioural modification because of the law; and (3) problem-solving effectiveness, focusing on the goals or aims of legal provisions (have they been set too low?) and how they spur action towards achieving the goals.[265] This third level of effectiveness fits nicely with the objective of this study.

Therefore, the fundamental considerations applicable to this thesis are the goals or aims of regulatory provisions in petroleum-producing jurisdictions and the robustness of their methods for incentivising operators to reduce upstream GHG emissions, mainly focusing on flaring, venting, and fugitive emissions. For the first test, the key question is whether petroleum-producing countries have clearly expressed an aim to regulate GHG emissions emanating from oil and gas production through the instrumentality of a law or regulation. For the second test, the key question is whether the jurisdictions have methods for spurring the regulated entities (oil and gas producing companies) to carry out production activities in such a way that they reduce GHG emissions. These two tests will underpin the evaluation of national regulatory arrangements in Chapter 3.

[263] Henk Addink *Good Governance: Concept and Context* (OUP 2019) at 143.
[264] Edward L. Rubin, 'From Coherence to Effectiveness: A Legal Methodology for the Modern World' in Rob van Gestel, Hans-W. Micklitz and Edward L. Rubin (eds), *Rethinking Legal Scholarship: A Transatlantic Dialogue* (2017 Cambridge University Press) 310 at 321.
[265] Sandrine Maljean-Dubois "The Effectiveness of Environmental Law: A Key Topic" in Sandrine Maljean-Dubois (ed) *The Effectiveness of Environmental Law* (Intersentia, Cambridge 2017) 1 at 5.

Sometimes it may be desirable for countries to initiate a law reform to reposition their governance regimes for effectiveness. This agenda needs to be carried out having regard to other essential elements for a good regulatory system. Baldwin, Cave, and Lodge have identified five of such criteria. These are legislative mandate, appropriate scheme of accountability, fair procedures, accessibility (transparency), sufficient expertise of the regulator and efficient action by the regime.[266] Legislative mandate is concerned with whether the activity of the regulator is sanctioned by law or parliament. This aligns with one of the tests established above for assessing effectiveness, i.e., whether the goals or aims of legal provisions are clearly spelt out to address problems. Accountability refers to whether there is a system to make the regulatory institution accountable for how it exercises powers for achieving regulatory goals. Fair and transparent procedures are concerned with whether the regulator follows due processes established by law and in a transparent manner that leaves no room for uncertainties and capriciousness (unpredictability). This will be a valuable feature to examine in countries' procedures for controlling flaring and venting. Sufficient expertise relates to whether the regulator or regulatory institution possesses the skills that are necessary for effectively controlling the regulated industry or activity. This is important because certain regulatory functions may require the exercise of expert judgement. Efficient action relates to whether the regulator adopts methods and measures that help to achieve the regulatory mandate set in the applicable law or regulation. This aligns with the second test explained above as to whether oil and gas jurisdictions have suitable methods for incentivising operators to reduce GHG emissions. All these five criteria have also been recognised by the New Zealand Productivity Commission[267] and the OECD[268] as vital characteristics for a good regulatory design. They are valuable and complement the two tests adopted in this thesis for assessing effectiveness. Therefore, they will be referred to when considering the materials in Chapters 3 and 4. The following chapters will provide insights that are more direct and apply these regulatory theories to the mitigation of flaring, venting, and fugitive emissions. Chapter 3 will examine the applicable regulatory frameworks of the case study countries. Chapter 4 will examine decentred understandings of regulation in the context of industry-driven initiatives for upstream GHG emissions reduction.

[266] Baldwin, Cave and Lodge, above n 194, at 26-39.
[267] New Zealand Productivity Commission *Regulatory Institutions and Practices* (New Zealand Productivity Commission Report 30 June 2014) at iv.
[268] OECD and Korea Development Institute *Improving Regulatory Governance: Trends, Practices and the Way Forward* (OECD Publishing 2017).

3. National Regulatory Regimes

This chapter will review the regimes applicable to upstream flaring, venting, and fugitive emissions in the case study countries. It will then analyse and compare the interactions between different regulatory institutions and laws, objectives, and methods of regulating upstream GHG emissions. These exercises will help in identifying some valuable answers to the research question.

A. Overview of Regulatory Regimes

1. IEA-Designated Producer Economies

a) Iraq

The Iraqi Constitution vests powers in the federal government and the legislatures of producing governorates and regions to manage petroleum extraction within their territories.[269] The Ministry of Oil is the industry regulator. Regarding the present research inquiry, different laws and institutions are at play. The constitution is silent on upstream emissions and vests powers in both the federal government and regional authorities to formulate environmental policies to address pollution.[270] The Conservation Law of 1985[271] has the principal aim of conserving hydrocarbon wealth resources from waste and damage.[272] Therefore, it obliges the operator to take necessary steps to avoid wastes and prevent any pollution harmful to the environment.[273] It also vests implementation powers in the Ministry of Oil.[274]

A draft Iraqi Hydrocarbon Law[275] has been in circulation for about 14 years (since 2007) without a conclusive parliamentary resolution. The long delay has nothing to do with regulating upstream GHG emissions. Instead, it is primarily because of an intense contest between federal and regional authorities over managing the country's petroleum resources and revenue sharing.[276] There is also a division of interests between the Kurds, Sunnis, and Shiites. While

[269] The Constitution of the Republic of Iraq 2005, arts 111 and 112; Christopher B. Strong "Iraq" in Christopher B. Strong (ed) *The Oil and Gas Review* (7th edn Law Business Research 2019) 195; Qaraman Mohammed Hasan "The Power of Constitution for Enacting Energy Law and Managing Natural Resources: The Case of the Kurdistan Regional Government's Oil Contracts" (2019) 128 Energy Policy 744-751.
[270] The Iraq Constitution, above n 263, art 114.
[271] Law No. 84 of 1985 for the Conservation of Hydrocarbons Resources.
[272] Ibid, art 1.
[273] Ibid, arts 4, 8, 49, 57.
[274] Ibid, art 2.
[275] Republic of Iraq Oil and Gas Law 2007.
[276] Susan L. Sakmar, 'The Status of the Draft Iraq Oil and Gas Law' (2008) 30:2 Houston Journal of International Law 289 at 303-208;

the Kurds prefer a more substantial regional control of petroleum resources by the governorates, the Sunnis and Shiites prefer greater control by the federal government.[277]

If (and when) the proposed law comes into force, it would vest powers in the Ministry of Oil as the competent authority for the governance of petroleum activities in Iraq.[278] It would stipulate obligations regarding resource conservation, flaring reduction, and general environmental protection. On conservation, it would require the operator to avoid waste, including preventing leaks from pipelines and other sources following good oilfield practices.[279] On gas flaring, the law would permit flaring for installation testing, commissioning, and as safety precautions, which must not exceed a maximum period of one year, to allow the setting up of utilization measures.[280] The general environmental protection provision would require companies to carry out operations applying good oilfield practices and other applicable Iraqi legislation to prevent the pollution of air, lands, and waters.[281]

The Iraqi Environmental Law requires parties involved in oil and gas extraction and production to adopt necessary procedures and take precautions to prevent pollution or damage during their operations.[282] To this extent, the Ministry of Environment in Iraq is one of the government institutions working to control upstream emissions. However, it does not play a prominent role because oil and gas companies' requirements are merely part of the environmental law's general provisions to protect the environment. The law does not go beyond those general environmental protection provisions. The Environmental Law does not vest powers in the Ministry of Environment to regulate flaring, venting, and fugitive emissions. Therefore, the Ministry of Oil prevails over the Ministry of Environment and all other government agencies regarding the regulation of petroleum activities and GHG emissions emanating from the sector.

b) Nigeria

The Petroleum Act 1969[283] is the current principal legislation governing petroleum operations in Nigeria over the years. The Act vests regulatory powers in the Ministry of Petroleum Resources.[284] The country's parliament has deliberated on a proposed law to reform the oil and

[277] Ibid; Lionel Beehner and Greg Bruno, 'Why Iraqis Cannot Agree on an Oil Law' (Council on Foreign Relations) https://www.cfr.org/backgrounder/why-iraqis-cannot-agree-oil-law
[278] Ibid, art 5 (D).
[279] Ibid, art 17 (1).
[280] Ibid, art 25.
[281] Ibid, art 31.
[282] Law No. 27 of 2009 for Protection and Improvement of the Environment, art 15.
[283] Petroleum Act, CAP P. 10 LFN 2004.
[284] Ibid, s. 9.

gas industry – the Petroleum Industry Governance Bill – for about thirteen years (after its introduction in 2008). In 2017, the Senate (the upper house of the bicameral legislature) initially passed the bill into law, requiring concurrent passage by the House of Representatives (the lower house of the legislature) and presidential assent.[285] The president did not give his consent but returned the bill to the parliament for more deliberations. The long delay in passing the bill into law is due to the lack of consensus on the revenue-sharing formula between federal and state governments, creation of host communities' endowment fund, clarifying the corporate social responsibility of operators, and ascertaining a framework for reforming the country's national oil company – the Nigerian National Petroleum Corporation – for optimal performance.[286] There is an indication that the Nigerian parliament may pass the bill into law before the end of 2021.[287] Compared to Iraq's case, one striking similarity is the tussle between federal and provincial governments for a more significant oil revenue share. However, in Nigeria's case, the proposed law says nothing about upstream GHG emissions, unlike the Iraqi proposed law that makes applicable provisions on flaring, resource conservation, and environmental protection.

The only scant provision of the Petroleum Act relating to emissions is the obligation on licensees to take precautions to prevent pollution and to initiate appropriate controls in the event of pollution.[288] The Petroleum Production Regulations, pursuant to the Petroleum Act, also require the licensee to take precautions to prevent pollution in drilling or production activities; and promptly initiate control measures if pollution occurs.[289] Additionally, the licensee is required to submit to the Minister of Petroleum Resources, within five years after the grant of a petroleum license or lease, a feasibility study, programme and proposals for gas utilization to avoid flaring.[290]

The Associated Gas Re-Injection Act[291] is a specific regulatory mechanism to address gas flaring and venting in Nigeria. It requires every oil and gas company to submit detailed plans

[285] Peter Olaoye Olalere "The Legislative Story of the Nigerian Petroleum Industry Bill" (Mondaq November 2017) <www.mondaq.com>.
[286] Barry Morgan, 'Nigeria's Long-Awaited Oil Reform Law Delayed – Yet Again' (Upstream Energy Explored 7 October 2020) <https://www.upstreamonline.com/politics/nigerias-long-awaited-oil-reform-law-delayed-yet-again/2-1-888787>.
[287] Camillus Eboh, 'Nigerian Lawmakers Target April or May to Pass Oil Reform Bill' (Reuters 26 January 2021) <https://www.reuters.com/article/uk-nigeria-oil-idUSKBN29U14M>.
[288] Petroleum Act, above n 277, at s. 25.
[289] Petroleum (Drilling and Production) Regulations 1969, s. 25.
[290] Ibid, s. 43.
[291] Associated Gas Re-injection Act Cap A. 25 LFN 2004.

for the implementation of gas re-injection.[292] It initially stipulated 1 January 1984 to end gas flaring or continuation of flaring with a monetary penalty payment.[293] There is a history around the setting and missing of different dates to end flaring in the country.[294] For example, the Nigerian Energy Policy initially set 2008 as the date to end gas flaring,[295] but without success. Similarly, the Nigerian Gas Policy stipulated 2020 as the new date to end flaring in Nigeria and mandates oil and gas companies to work towards this new date.[296] However, operators still flare and vent gas in the country.

Recently, two legal instruments have emerged to strengthen the regulatory regime for addressing flaring and venting in Nigeria. The first is the Flare Gas (Prevention of Waste and Pollution) Regulations 2018,[297] promulgated by the Minister of Petroleum Resources pursuant to the Petroleum Act and the Associated Gas Re-injection Act. The second is the 2019 flaring prohibition legislation.[298] These new laws complement the existing legal regime's relevant provisions and prohibit flaring but retain the former laws' permit and penalty regime.

The most significant changes that the 2018 regulations introduced are higher flaring penalties and a metering system for flare measurement. Unlike the ten Nigerian Naira (₦10) for every 1000 standard cubic feet of flared gas in force since 1998 under the Associated Gas Re-injection Act, the new regulations stipulate a penalty of USD2 (approximately ₦724).[299] This change outweighs the erstwhile insignificant flaring penalty sum of ₦10. The metering system requires all oil and gas lessees or licensees to install metering equipment to quantify the volume of flared gas and ensure that operators comply with set flaring limits.[300] The new legislation also criminalises failure to install metering equipment and failure to furnish correct flaring data. Liability for any of these offences attracts a fine of ten million Naira (10,000,000), the equivalent of USD 27,570, or imprisonment for not more than one year, or both.[301]

[292] Ibid, s. 1.
[293] Ibid, s.3 (1).
[294] Aminu Hassan and Reza Kouhy "Gas Flaring in Nigeria: Analysis of Changes in Its Consequent Carbon Emission and Reporting" (2013) 37:2 Accounting Forum 124 at 126
[295] Nigerian National Energy Policy 2003, s. 25.
[296] Nigerian National Gas Policy 2017, at 13 and 63.
[297] Flare Gas (Prevention of Waste and Pollution) Regulations 2018, Federal Republic of Nigeria Official Gazette No. 88 Vol. 105 Page B97-111.
[298] Gas Flaring (Prohibition) Act 2019.
[299] Above, n 297, at s. 13.
[300] Ibid, s. 6.
[301] Gas Flaring Act, above n 298, at ss. 10 and 11.

In addition, Nigeria's Nationally Determined Contributions (NDCs) under the UNFCCC and the Paris Agreement proposes to end flaring by 2030.[302] The country's National Action Plan to Reduce Short-Lived Climate Pollutants recently abridged the 2030 flaring target by an ambitious plan to achieve 100% flaring elimination by 2020 and a 50% reduction of fugitive emissions by 2030.[303] However, there is no indication that the 2020 target has materialised.

The Flare Gas Commercialization Programme,[304] established in 2016 by the Minister of State for Petroleum Resources, is another recent strategy to support flaring reduction. The programme provides a gas monetization framework by implementing a gas-to-power initiative, domestic supply obligation, and tax holidays to construct gas utilization infrastructure.[305] However, these strategies under the Flare Gas Commercialization Programme apply to third party investors[306] and do not impose an obligation on upstream oil and gas operators to reduce emissions.

Overall, Nigeria's current regulatory framework emphasizes data collection, monitoring, and a clear objective to reduce flaring, venting, and fugitive emissions. The regime also suggests a tremendous potential for enforcement. Nevertheless, there is presently a lack of data to assess whether the legislative and regulatory interventions have yielded emissions reduction ever since their introduction. Moreover, it may be too early to judge their efficacy, as the changes are still very recent.

From an environmental law perspective, the country's environmental regulator – the National Environmental Standards and Regulations Enforcement Agency – has powers to regulate effluents and emissions in different industries, excluding emissions from the oil and gas sector.[307] Therefore, the Ministry of Petroleum Resources is the principal regulatory institution regarding upstream GHG emissions.

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[302] Nigeria's Nationally Determined Contribution, submitted to the UNFCCC Secretariat 16 May 2017, available at <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Nigeria%20First/Approved%20Nigeria%27s%20INDC_271115.pdf> accessed 14 February 2021.
[303] National Action Plan to Reduce Short-Lived Climate Pollutants (SLCPs) 2018.
[304] Nigerian Gas Flare Commercialization Programme 2016, available at <https://ngfcp.dpr.gov.ng/>.
[305] Ibid.
[306] Ibid.
[307] National Environmental Standards and Regulations Enforcement Agency (Establishment) Act 2007, ss. 7,8,24,29 and 30.

c) Russia

The Russian Subsoil Law[308] is the principal legislation governing subsoil rights, including exploration and exploitation of natural resources. The Production Sharing Agreement Law complements the subsoil legislation by regulating petroleum investments in Russia, essentially between international oil companies and the Russian Federation.[309] Under the Subsoil Law,[310] the Federal Agency for Subsoil Use – an agency under the Ministry of Natural Resources and the Environment – exists as the regulator of petroleum production activities.[311] Both the subsoil law and the production sharing agreement law are silent about upstream emissions and other environmental issues. There is also a lack of regulatory intervention by the industry regulator to address upstream emissions.

In 2009, the Russian Federal Government issued a decree to restrict the volume of oil and gas production-related flaring to only 5% of APG.[312] This measure would have potentially incentivised large-scale emissions reduction, as operators could have utilized approximately 95% of APG instead of flaring. However, the Russian Federation abolished the decree in 2016.

The country's Environmental Protection Law empowers the Russian Federal Government to set rates (fees) for negative impacts on the environment, including gas flaring and other air pollutants from the upstream petroleum sector.[313] The current rates are 1094.7 Russian Rouble (approximately USD15) per ton of carbon dioxide and 108 Russian Rouble (approximately USD 1.5) per ton of methane.[314] These rates apply to industrial activities and upstream GHG emissions, whether through flaring, venting or equipment leaks. They are also like the penalty or carbon pricing regime (emission charges or taxes) existing in other jurisdictions for flaring. Some Russian legal scholars have argued that the payment for negative impacts on the environment represents the *polluter pays* principle.[315] This argument is tenable because the law

[308] Law of the Russian Federation of February 21 1992 No. 2395-1 on Subsoil.
[309] Federal Law No. 225-FZ of December 1995 on Production Sharing Agreements. See also Giuditta Cordero Moss "Contract or Licence – Regulation of Petroleum Investment in Russia and Foreign Legal Advice" (2003) 13 Transnational Law and Contemporary Problems 519.
[310] Ibid, art 3.
[311] Natalya Morozova "Russia" in Christopher B. Strong (ed) *The Oil and Gas Review* (7th edn Law Business Research 2019) 289 at 291.
[312] Government of the Russian Federation Resolution No. 7 about Measures to Stimulate Pollution Reduction, Atmospheric Air Combustion Products and Petroleum Gas in Torch Plants, 8 January 2009.
[313] Federal Law on Environmental Protection of January 10 2002 No. 7-FZ (As amended on July 29 2018), art 16.
[314] Government of the Russian Federation Resolution No. 39 about Application in 2020 Feed Rates for Negative Impacts for the Environment, 24 January 2020, Table 1: Rates of Payment for Emissions into the Air from Stationary Sources.
[315] Vadim A. Vinogradov and Larisa V. Soldatova "Implementation of the Polluter Pays Principle: Comparative Legal Issues" (2019) 3:4 Law Enforcement Review 42 at 46-48; Mikhail Ponomarev "Fees for a Negative

requires corporate entities to internalise the cost of pollution and wastes, including GHG emissions from flaring and venting.

In addition, the Russian Federation has a general climate doctrine, which has the strategic goal of ensuring safe and sustainable development of the country amidst the threat of climate change, but underscores the priority of national interest.[316] The priority of national interest hinges on Russia's global reputation as an energy superpower, hence its use of energy resources as foreign policy tools.[317] While the climate doctrine states multiple aspirations and the need to adopt preventive measures for climate change mitigation, it imposes no specific obligations on business entities or the oil and gas industry to reduce emissions.

There is a proposed bill for state regulation of greenhouse gases.[318] It is unclear what federal agency or regulatory institution would implement the proposed legislation, as the bill is silent on the issue. Although there is no specific mention of emissions from oil and gas production or the petroleum industry, the proposed law intends to set targets for direct GHG emissions in general for the entire Russian Federation.[319] There is also an objective to set targets for selected sectors of the economy.[320] It is also unclear what sectors of the economy would eventually become subject to such a selective target setting. However, the relevant agency can consider setting emissions target for the petroleum industry. Irrespective of the uncertainty, it is possible to interpret the law's general provisions to include oil and gas production activities. The proposed law would establish a carbon pricing system for economic activities that result in GHG emissions.[321] It would require the issuance of emission permits with a stated quota and impose monetary fines for all emissions that exceed permit allowance.[322] Oil and gas exploration and production are economic activities that cause GHG emissions. If construed from this literal perspective, the law captures emissions from the industry, absent direct provisions in that respect.

Impact on the Environment as a Mechanism of Economic Stimulation of Environmental Activities" (2018) 6:1 Journal of Russian Law 1.

[316] Approved Climate Doctrine of the Russian Federation December 17 2009

[317] Peter Rutland "The Political Economy of Energy in Russia" in Slawomir Raszewski (ed) *The International Political Economy of Oil and Gas* (Springer 2018) 23 at 24 and 32.

[318] The Federal Law on State Regulation of Emissions and Removal of Greenhouse Gases and on Amending Certain Legislative Acts of the Russian Federation 2019.

[319] Ibid, art 3(1).

[320] Ibid, art 3(2).

[321] Ibid, art 8.

[322] Ibid.

d) Saudi Arabia

The Basic Law of 1992[323] is the primary legislation governing oil and gas activities in the Islamic State of Saudi Arabia. It vests ownership of the natural resources in the State and provides that such resources must be exploited, protected, and developed for the State's benefit, security, and economy.[324] The Basic Law does not define an industry regulator, but the Saudi Ministry of Petroleum and Natural Resources has existed since 1960 as the industry regulator before the emergence of the Basic Law. However, in 2000, the Saudi King issued a royal decree establishing the Supreme Council for Petroleum and Mineral Affairs.[325] The Supreme Council and the Ministry of Petroleum and Natural Resources both exercise oversight and regulatory functions over the oil and gas sector in Saudi Arabia.

There is no specific regulation targeting upstream GHG emissions. The Basic Law is also silent on the issue, save the provision that the State shall endeavour to preserve, protect, and improve the environment and prevent its pollution.[326] However, there are provisions about air quality improvements in the country's environmental legislation – the General Environmental Law of 2001.[327] The law makes some specific prescriptions regarding the oil and gas industry in the Environmental Protection Standards[328]– an annexure to the Law – and read as "ambient air quality" and "air pollution source" standards. [329] The Standards cover emissions from combustion sources, fluid catalytic cracking units, and fugitive emissions. Oil and gas companies are required to utilize appropriate gas cleaning equipment to limit emissions (primarily sulphur, nitrous oxide and particulates) to 500 parts per million (ppm).

Additionally, operators must reduce fugitive emissions by adopting good maintenance and inspection procedures and efficient monitoring of volatile organic compounds emission points. [330] These provisions empower the Saudi Ministry of Environment, Water and Agriculture to play some regulatory roles regarding environmental protection in the oil and gas industry. However, the requirements are more downstream-focused and majorly address local

[323] Basic Law of Governance Royal Order No. (A/91) 27 Sha'ban 1412H – 1 March 1992 Published in Umm al-Qura Gazette No. 3397 2 Ramadan 1412H - 5 March 1992
[324] Ibid, art 14.
[325] Royal Decree to Set Up the Supreme Council for Petroleum and Mineral Affairs, Issued January 2000 by the Custodian of the Two Holy Mosques, King Fahd Bin Abdul-Aziz.
[326] Ibid, art 32.
[327] General Environmental Regulations and Rules for Implementation (Translated from the Official Arabic Version) 28 Rajab 1422 H (15 October 2001).
[328] Appendix 1 of the General Environmental Regulations 2001: Environmental Protection Standards, Presidency of Meteorology and Environment, Kingdom of Saudi Arabia Document No. 1409-01.
[329] Ibid, ss. 10 and 11.
[330] Ibid, B5.

air quality improvement and not upstream GHG emissions. There remains an opportunity to establish a regulatory regime that specifically targets petroleum production-related GHG emissions.

Nevertheless, the state-owned national oil company – Saudi Aramco – has some valuable strategies for abating flaring. The first is a master gas system.[331] This is a gas-gathering network that helps in optimal gas utilization instead of flaring or venting. It is currently the world's largest single hydrocarbon network and gathers about 100 bcm of APG per annum.[332] The company utilizes the gathered APG for generating on-site fuel and providing electricity to the country. The second is the use of technology to monitor and mitigate flaring in real-time.[333] The third is the implementation of a leak detection and repair programme to complement the 4IR technology. The fourth is the operation of a flare recovery system. Through these measures, Saudi Arabia reduced flaring by about 37% within three years (2018 to 2019).[334] The country presently has a gas flaring status of less than 1%, compared to other producing countries, and aims to achieve zero routine flaring by 2030.[335]

e) United Arab Emirates (UAE)

The UAE consists of seven emirates – Abu Dhabi, Ajman, Dubai, Fujairah, Ras Al Khaimah, Sharaj and Umm Al Quwain.[336] Abu Dhabi accounts for 95% of the proven oil reserves and almost all oil exports from the country, with negligible contributions from Dubai and the other five emirates.[337] The UAE constitution deems all natural resources and wealth, including oil and gas, in each emirate to be the public property of that emirate and requires the preservation and optimal utilization of all those resources and wealth for the national interest.[338] This thesis

[331] Saudi Aramco "The Master Gas System – Fuelling a Nation" (Saudi Aramco 2021) <https://www.aramco.com/en/magazine/elements/2020/master-gas-system-fueling-a-nation#>.
[332] Ibid.
[333] The Fourth Industrial Revolution technology refers to the automation of industrial operations using smart technologies such as artificial intelligence, robotics, genetic engineering, quantum computing and the internet of things to achieve efficiency. For more on Saudi Aramco's Digitization Transformation Program, see <https://www.aramco.com/en/creating-value/technology-development/in-house-developed-technologies/digitalization#>.
[334] Morris Greenberg and others "Middle East Gas Flaring Drops, but Zero Targets Still a Long Way Off" (S&P Global Platts 16 July 2020) <https://www.spglobal.com/platts/en/market-insights/latest-news/metals/071620-middle-east-gas-flaring-drops-but-zero-targets-still-a-long-way-off>.
[335] Saudi Aramco, above n 331.
[336] Rosemarie Said Zahla *The Origins of the United Arab Emirates: A Political and Social History of the Trucial States* (Macmillan 1978) 1.
[337] James Comyn and Patricia Tiller "Abu Dhabi" in Christopher B. Strong (ed) *The Oil and Gas Review* (7th edn Law Business Research 2019) 1.
[338] United Arab Emirate's Constitution of 1971 (as amended in 2009), art 23.

focuses predominantly on the prevalent regulatory regime in Abu Dhabi, considering the emirate's prominent position as the petroleum hub of the UAE.

The Petroleum Conservation Law 1978[339] and the Gas Law 1976[340] constitute the legal regime governing oil and gas operations in Abu Dhabi. For regulation purposes, the Supreme Petroleum Council exists as the apex institution that oversees the oil and gas industry.[341] There is also a Ministry of Energy and Infrastructure with a mandate to organize, develop and enhance competitiveness in the energy and infrastructure sectors.

Regarding the regulation of upstream emissions, the Petroleum Conservation Law[342] and the UAE Environmental Law[343] are at work. The industry regulator and the ministry of the environment play complementary roles on the issue. The Petroleum Law requires operators to re-inject associated gas or ensure optimum utilization to avoid emissions in the form of flaring or venting, and only flare upon written government consent when it is impossible or difficult to re-inject or utilize the associated gas.[344] This is like other regulatory regimes that permit flaring or venting under challenging circumstances. The Environmental Law spells out general environmental protection obligations with relevance to oil and gas production-related emissions. The law obliges operators to keep emissions related to exploration, digging, extraction, and crude oil production within permissible limits.[345] It does not state the limits but defers the implementation regulation, Cabinet Decree No. 12.[346] This Decree stipulates various air pollutants' limits without specifically mentioning flaring, venting, and equipment leaks. However, it also sets a blanket limit of 250 milligrams per cubic meter for all visible emissions resulting from petroleum operations.[347] Additionally, the Environmental Law requires operators to take all precautions to reduce the quantum of pollutants in combustion emissions, keep records of such quantity and make efforts to achieve reduction.[348]

[339] Law No. 8 of 1978 Concerning the Preservation of Petroleum Resources.
[340] Law No. 4 Concerning Abu Dhabi's Gas Ownership.
[341] Abu Dhabi Law No. 1/1988 on the Establishment of the High Council for Petroleum in Abu Dhabi, art 1.
[342] Above n 334.
[343] Federal Law No. 24 of 1999 on the Protection and Development of the Environment.
[344] Above n 339, arts 44-46.
[345] Ibid, art 53.
[346] Cabinet Decree No. 12 of 2006 Concerning the Protection of Air from Pollution.
[347] Ibid, Table 2.
[348] Above, n 343, art 53.

f) Venezuela

Different laws apply to oil and gas exploration and production activities in Venezuela – the Constitution,[349] the Organic Gaseous Hydrocarbons Law,[350] and the Organic Hydrocarbons Law.[351] The second and third are the primary regulatory instruments for the industry. The Organic Gaseous Hydrocarbons Law applies specifically to gas operations, while the Organic Hydrocarbons Law applies to oil activities. These two laws recognize the Ministry of Energy and Mines as the industry regulator.[352]

There are no direct obligations on emissions reduction in the two hydrocarbon laws, except general provisions relating to rational use, conservation of resources, preservation, and environment protection.[353] Despite the absence of specific regulation of emissions emanating from oil and gas activities, the Ministry of Environment and Renewable Natural Resources has powers to set flaring restrictions and penalties on individual cases under established decrees on air quality.[354] It is difficult to obtain data on the exact nature of flaring rules and penalties. However, the Ministry of Environment plays a more active role in regulating upstream emissions in Venezuela, unlike in some other jurisdictions where the ministry of the environment plays a complementary and less active role on the issue.

There is also a corporate criminal dimension to emissions in Venezuela. The Criminal Environmental Law[355] prohibits emissions that can lead to atmospheric deterioration of the environment. Judges have jurisdiction to adjudicate on environmental breaches and impose severe penalties, ranging from fines to imprisonment.[356]

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[349] Constitution of the Bolivarian Republic of Venezuela (Special Official Gazette No. 5.908, February 19 2009).
[350] Organic Gaseous Hydrocarbons Law (Official Gazette No. 36.793, September 23, 1999).
[351] Organic Hydrocarbons Law (Official Gazette No. 37323, November 13, 2001) Decree No. 1510.
[352] Above n 345, arts 6,7,9,10,12 and 14; Organic Hydrocarbons Law, ibid, art 5.
[353] Above n 346, arts 5 and 19; Organic Gaseous Hydrocarbons Law, above n 345, art 3.
[354] Decrees No. 638, 883 and 2673 (Special Gazette No. 4.899 of May 19, 1995; Special Gazette No. 5.021 of December 18, 1995; Official Gazette No. 36.532 of September 4, 1998).
[355] The Criminal Environmental Law (Official Gazette No. 39.913, May 2 2012).
[356] World Bank, *Regulation of Associated Gas Flaring and Venting: A Global Overview and Lessons from International Experience* (World Bank 2004) at 75 and 76; Natalija Vojvodic and Sergio Casinelli "Oil and Gas Regulation in Venezuela: Overview" (Thomas Reuters Practical Law 1 October 2014) <www.uk.practicallaw.thomsonreuters.com>.

2. Other Producer Economies

a) Brazil

The regulatory framework for oil and gas activities in Brazil consists of the Petroleum Law,[357] Gas Law,[358] and Pre-Salt Law.[359] The Petroleum Law establishes the National Council for Energy Policy under the Ministry of Mines and Energy, with the mandate to formulate national policies for the country's entire energy sector,[360] and the National Petroleum, Natural Gas and Biofuels Agency as the regulator of the petroleum, natural gas, derivatives, and biofuels industry.[361]

Regarding the regulation of upstream emissions, there are no specific provisions in the legislation. Still, the Petroleum Law requires the implementation of good practices for the conservation and rational use of petroleum resources and preserving the environment.[362] There are similar obligations in the Gas Law requiring the concessionaire to ensure resource conservation and environmental protection.[363]

In recent times, Brazil has formulated specific regulatory measures to address upstream emissions, especially gas flaring. In 2017 and 2019, the National Council for Energy Policy issued resolutions that underscore the need to reduce gas flaring in the course of petroleum exploration and production activities.[364] The National Petroleum, Natural Gas and Biofuels Agency issued Resolution No. 806 in January 2020, which establishes new procedures for reducing gas flaring and petroleum loss during exploration and production activities.[365] The Resolution prohibits unapproved gas flaring but empowers the regulator to authorize flaring in exceptional cases for safety, emergency, testing, or well cleaning.[366] It also sets an allowable monthly flaring limit of 15% for operators to achieve an associated gas utilization index of 85% per production field.[367] The associated gas utilization index is the percentage of associated gas volume monetised compared to the total volume of associated gas produced from each reservoir or area per month.[368]

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[357] Federal Law No. 9478 of August 6, 1997 DUO (Official Federal Gazette) of August 7, 1997.
[358] Federal Law No. 11909 (The Gas Act) of March 4, 2009.
[359] Federal Law No. 12351 of December 22, 2010.
[360] Federal Law No. 9478, above n 353, art 2.
[361] Ibid, art 7.
[362] Ibid, arts 1(IV), 8 (IX), and 44(I).
[363] Federal Law No. 11909, above n 353, arts 1(3), 3 and 22.
[364] CNPE Resolution No. 17 of 2017 and CNPE Resolution No. 16 of 2019.
[365] ANP Resolution No. 806 of 17 January 2020.
[366] Ibid, art 5.
[367] Ibid, art 3.
[368] Ibid, art 2(V).

However, in the wake of COVID-19, the industry regulator issued Resolutions Nos. 815[369] and 816[370] to ease the regulatory burden on operators. Two relevant provisions of Resolution No. 815 include a one-year extension for the performance of the exploration and production rules regarding emissions reduction and specifically a deviation from the set 15% monthly flaring limit without justification.[371] Therefore, within one year, operators can legally flare gas without quantified restrictions. These changes represent specific national regulatory and policy measures to support the oil and gas sector in difficult times. Impliedly, the industry regulator would revert to enforcing the regular regulatory rules after one year or possibly after the pandemic's effects on the oil and gas sector recede.

b) United States of America

The US is an example of deviation from the common practice of federal or central government ownership and governance of all the natural resources in a country.[372] Ownership and management of resources in federal lands and the outer continental shelf are vested in the federal government.[373] While this position is rarely the subject of dispute, the common issue for determination is usually the applicable law – whether federal or state law – that will govern the management of resources on federal public lands.[374] The US Constitution solves this problem with the 'Enclave Clause' and the 'Property Clause.'[375] The Enclave Clause vests exclusive legislative power in Congress to legislate and exercise authority over resources on federal public lands in many states,[376] which are substantially in the country's western parts. The Property Clause also vests power in Congress to make rules and regulations governing the property or territory that falls within the federal government's ownership. However, states have pre-existing rights over resources within their territories. In addition, the Outer Continental Shelf Lands Act vests jurisdiction in coastal states to govern offshore oil and gas operations within three nautical miles of the seaward boundary of any such coastal states.[377] The federal

[369] ANP Resolution No. 815 of 20 April 2020.
[370] ANP Resolution No. 816 of 20 April 2020.
[371] ANP Resolution No. 815, above n 364, art 4.
[372] Ernest E. Smith "World Energy Resources" in Ernest E. Smith and others (eds) *International Petroleum Transactions* (2nd edn Rocky Mountain Mineral Law Foundation 2000) 3 at 38.
[373] The Federal Land Policy and Management Act of 1976 Public Law 94-579, ss. 102 and 209; The Outer Continental Shelf Lands Act of 1953 43 U.S.C. 1331, s. 1332; George Cameron Coggins, Charles F. Wilkinson and John D. Leshy *Federal Public Land and Resources Law* (3rd edn The Foundation Press 1993) 11-13.
[374] George Cameron Coggins, Charles F. Wilkinson and John D. Leshy *Federal Public Land and Resources Law* (3rd edn The Foundation Press 1993) at 172.
[375] Ibid, at 172 and 173. See also Jan G. Laitos *Natural Resources Law: Cases and Materials* (West Publishing 1985) at 272 and 273.
[376] U.S. Constitution, art. 1, s. 8 (17).
[377] Outer Continental Shelf Lands Act 1953 (As Amended through P.L. 106-580, 29 December 2000), s. 8.

government regulates offshore resource exploitation beyond the three nautical miles of the seaward boundary.[378] A common consequence of these circumstances is the fragmentation of the legal framework governing the exploitation of natural resources in the US, which results in diverse legislative frameworks in the country. There is also a high degree of state-level regulation on environmental and energy issues.[379] This study restricts its consideration to relevant federal laws and laws of selected states – Texas, North Dakota, Alaska, and California. The reason for choosing these states is that they are the US's major oil and gas producing regions.[380] In 2017, Texas produced 1.28 billion barrels of crude oil; North Dakota, 392 million; Alaska, 180 million; California, 174 million.[381]

(1) Federal Regulatory Measures

The US has a long history of promulgating policies and legislation on air quality, emissions reduction, and environmental protection.[382] The first US legislative attempt to regulate GHGs at the federal level was arguably the Obama-presidency Clean Power Plan of 2016.[383] However, this was primarily applicable to emissions from power plants rather than upstream oil and gas operations.

The Clean Air Act addresses pollution prevention and empowers the United States Environmental Protection Agency (USEPA) to make relevant subsidiary legislation on air quality and emissions reduction.[384] USEPA also administers energy-related environmental projects and policy implementation.[385] The Agency promulgated the Emissions Reduction Standards for the Oil and Natural Gas Sector to limit flaring and minimize other oil and gas industry-related emissions.[386] To reduce gas flaring and venting, the Standards require operators to comply with a reduced emissions completion scheme, which means implementing any of four stipulated options to minimize emissions. These are (1) routing the recovered gas

[378] Ibid. See also Adam Vann *Offshore Oil and Gas Development: Legal Framework* (Congressional Research Service Report 7-5700, RL33404, 13 April 2018)
[379] Jonathan H. Adler "Climate Balkanization: Dormant Commerce and the Limits of State Energy Policy" (2014) 3 LSU Journal of Energy Law and Resources 153 at 159; Robert C. Means "The Climate Policy Landscape" (2014) 4 Wake Forest Journal of Law and Policy 319 at 321
[380] International Comparative Legal Studies "USA: Oil and Gas Regulation 2019" (ICLG January 22 2019) <www.iclg.com>.
[381] US EIA "Crude Oil Production by States" (US EIA 2019) <www.eia.gov>; Statistica "Crude Oil Production in the United States in 2017, by State (in 1,000 Barrels)" (Statistica 2019) <www.statista.com>.
[382] Arthur C. Stern "History of Air Pollution Legislation in the United States" (1982) 32:1 Journal of the Air Pollution Control Association 44 at 48.
[383] Janice Chon "Clean Power Plan" (2017) 7 Earth Jurisprudence and Environmental Justice Journal 105 at 114.
[384] Clean Air Act of 2015 (As Amended through Public Law 114-94), s. 111 (d).
[385] National Environmental Policy Act 1969 42 USC 4321-4370h, S. 4363 a (2).
[386] Oil and Natural Gas Sector: Emission Standards for New, Reconstructed, and Modified Sources Federal Register/ Vol. 81, No. 107/ Friday, June 3, 2016/ Rules and Regulations.

from the separator into a collection system; or (2) reinjecting the recovered gas into the originating production well or another well; or (3) using the recovered gas as an onsite fuel; or (4) using the recovered gas for another useful purpose that a purchased fuel or raw material would serve.[387] Operators can only flare in circumstances of technical infeasibility. The Standards do not strictly limit the definition of technical infeasibility but recognises some qualifying instances, which include quality issues such as gas contamination, non-availability of gas gathering lines and right of way issues.[388]

The Standards also stipulate USEPA's determined best system of emissions reduction (BSER).[389] While the BSER cover multiple sources of GHG emission across the upstream and downstream sectors, only fugitive emissions and emissions from pneumatic pumps[390] at well sites relate to upstream emissions. For fugitive emissions, operators must implement a leak detection and repair programme and fix leaks within 30 days after discovery.[391] For emissions from pneumatic pumps, the requirement is a 95% emissions reduction if there is an existing control or process on site. This obligation does not apply if (1) the emissions from pneumatic pumps are routed to an existing control that achieves less than 95% emissions reduction or (2) it is technically infeasible to route to the existing control device or process.[392] Operators must also comply with recordkeeping and emissions data reporting requirements to ensure compliance with the Standards.[393]

Additionally, the Federal Land Policy and Management Act of 1976 (FLPMA)[394] vests powers in the Secretary of the United States Department of the Interior to promulgate subsidiary legislation for the Act's successful administration through the Bureau of Land Management (BLM).[395] FLPMA applies only to federally owned oil and gas resources, i.e., resources on federal lands. In contrast, USEPA rules apply to both federal and state lands and resources and privately-owned resources. Pursuant to section 310 of FLPMA,[396] the BLM issued the Waste

[387] Ibid, at 35852 and 35935.
[388] Ibid.
[389] Ibid, at 35826: Table 1–Summary of BSER and Final Subpart 0000a Standards for Emission Sources.
[390] According to USEPA, pneumatic pumps are devices that use gas pressure to drive a fluid by raising or reducing the pressure of the fluid by means of a positive displacement, a piston or set of rotating impellers. Pneumatic pumps are generally used at oil and natural gas production sites where electricity is not readily available. See the Report for the 2014 Oil and Natural Gas Sector Pneumatic Devices Review Panel, prepared by USEPA, available at <https://www.ourenergypolicy.org/wp-content/uploads/2014/04/epa-devices.pdf>.
[391] See above n 386.
[392] Ibid.
[393] Ibid, at 35846.
[394] The Federal Land Policy and Management Act of 1976 Public Law 94-579.
[395] Ibid, s. 310.
[396] FLPMA, above n 389, at s. 310.

Prevention Rule of 2016[397] and further revised it in 2018.[398] The revised 2018 rule requires operators on federal lands to equip all flares or combustion devices with automatic ignition systems as a control mechanism.[399] It recognizes the difficulty in achieving zero emissions and pegs the maximum volume-flaring limit at 50 million cubic feet (MMcf) during the initial production test of each completed interval in a well.[400] These may seem reasonable regulatory requirements, but the new rule tends to entrench a weak regime compared to the 2016 rule. The 2018 rule rescinds useful emissions reduction measures of the previous rule – waste minimization plans, well drilling requirements, well completion and related operational requirements, storage vessels equipment requirement, comprehensive leak detection and repair (LDAR) programme.[401] There are three specific examples to illustrate the point. First, while the 2016 rule allowed 20 MMcf as the flaring limit during the initial production test,[402] the new rule allows 50 MMcf. Second, the 2016 rule required the operator to replace pneumatic diaphragm pumps with zero emissions pumps or route emissions for capture or low-pressure combustion device.[403] The 2018 rule rescinded this requirement, citing huge cost implication – that the cost of compliance outweighed the value of conservation effects.[404] The BLM estimates the implementation requirement over ten years (2019-2028) would impose a charge of USD30 million while only generating between USD15 million to USD19 million as cost-saving from product recovery.

In contrast, a 2014 study commissioned by the Environmental Defence Fund (EDF) observes great methane reduction potential using suitable technologies.[405] At the time of writing, there was no clarity regarding the specific technologies contemplated by the EDF. Additionally, the BLM's cost-benefit analysis may be understating methane's social cost in favour of oil and gas

[397] Waste Prevention, Production Subject to Royalties, and Resource Conservation, Final Rule. Federal Register / Vol. 81, No. 223 / Friday, November 18, 2016 / Rules and Regulations. Department of the Interior, Bureau of Land Management 43 CFR Parts 3100, 3160 and 3170.
[398] Waste Prevention, Production Subject to Royalties, and Resource Conservation, Final Rule. Federal Register / Vol. 83, No. 189 / Friday, September 28, 2018 / Rules and Regulations. Department of the Interior, Bureau of Land Management 43 CFR Parts 3160 and 3170.
[399] Ibid, s. 3179.6 (c).
[400] Ibid, s. 3179.101.
[401] Ibid, at p. 49190.
[402] Waste Prevention Rule 2016, above n 397, s. 3179.103.
[403] Ibid, s .3179.202.
[404] Waste Prevention Rule 2018, above n 398, s. 3179.202.
[405] ICF International *Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries*, Report Prepared for the Environmental Defence Fund (March 2014). Available at <www.edf.org>.

companies responsible for GHG emissions.[406] Thirdly, the 2018 rule presents similar analyses for leak detection and rescinds stringent regulatory requirements on operators for addressing fugitive emissions emanating from leaks.[407]

The foregoing discussion illustrates a policy drive to remove stringent regulatory requirements on oil and gas production companies. More so, the regulatory changes hinge on an Executive Order by President Donald Trump for ministries, departments, and agencies of the US Federal Government to review, revise, and possibly rescind regulations that present an unnecessary burden to domestic energy resources development.[408] Given the Biden administration's promise to tackle climate change and support a low carbon future, one can expect a reversal to the Trump-era lax rules on upstream GHG emissions.

(2) Regulatory Measures of Selected States

(a) Texas

The principal governance framework for oil and gas operations on Texas's state lands is the Natural Resources Code (hereafter called the Code).[409] The Code vests regulatory powers in the Railroad Commission of Texas.[410]

Regarding upstream emissions, the Code expresses an intention to prevent waste and conserve the state's natural resources.[411] Therefore, there is a general prohibition of waste.[412] The Code describes waste by multiple instances. However, one is particularly relevant to the current topic – the operation of an oil well or wells with an inefficient gas to oil ratio or permitting the burning of gas more than the amount necessary for its efficient drilling or operation.[413] The Code defines inefficient gas to oil ratio as the production of more than 100,000 standard cubic feet (scf) of gas to each barrel of crude petroleum oil.[414] There are two different options for exceeding this limit. One is to put the gas into one of the uses spelt out in the Code or unless authorized for cleaning a well of sand or acid following simulation treatment. The other is for repairing or modifying a gas-gathering system.[415] However, the allowable emission of 100,000

[406] Bradley N. Kershaw "Flames, Fixes, and the Road Forward: The Waste Prevention Rule and BLM Authority to Regulate Natural Gas Flaring and Venting" (2018) 29 Colorado Natural Resources, Energy and Environmental Law Review 115 at 156.
[407] Ibid, s. 3179.203.
[408] Executive Order 13783 Promoting Energy Independence and Economic Growth, Federal Register /Vol. 82 16093 28 March 2017.
[409] Natural Resources Code 1963 (As Amended in 2019), Title 3 Chapter 81. Oil and Gas.
[410] Ibid, ss. 81.051 and 81.052.
[411] Ibid, s. 53.117.
[412] Ibid, s. 86.011.
[413] Ibid, s. 86.012 (1) and (3).
[414] Ibid, s. 86.012 (12).
[415] Ibid, s. 86.185 (1) and (2).

scf of gas to each barrel of crude oil is high, considering Masnadi and others have shown that the mean average gas to oil ratio is between 1000-2500 scf per barrel.[416] Thus, the Texas Code points to a lax regime because it allows the emission of a large volume of gas. There remains an opportunity here to set lower allowable gas to oil ratios for reducing upstream flaring.

There is also an express prohibition of flaring from gas wells after ten days from discovery and production commencement.[417] The exceptions are to flare with the regulator's authorization, where the operator shows the necessity for prolonged flaring, flaring because of well cleaning following simulation treatment, and flaring occasioned by repair or modification of a gas-gathering system.[418] In addition to these provisions, the regulator can also make further specific rules to restrict flaring.[419] There is a subsidiary rule – the State-wide Rule 32[420] – governing flaring and the regulator's issuance of flaring permits. State-wide Rule 32 elaborates the provisions of the Code relating to flaring, waste, and conservation. Moreover, it addresses the detailed specifics regarding the issuance of flaring permits and their extension. For example, the regulator can grant a flaring exception for 45 days and more extended periods not exceeding 180 days, rather than the ten-day flaring allowance that the Code stipulates.[421]

From an environmental law perspective, the Texas Commission on Environmental Quality has powers to make rules relating to environmental protection.[422] These rules address air quality standards, pollution prevention, and oil and gas production emissions.[423] The rules cover volatile organic compounds, sulphur oxide, and particulate matter, but they exclude methane and carbon dioxide emissions emanating from the oil and gas sector.[424]

Therefore, in terms of institutional arrangement, the Railroad Commission of Texas is the principal agency for regulating upstream emissions. Simultaneously, the Texas Commission on Environmental Quality plays minor roles regarding general environmental and air quality

[416] Masnadi and others, above n 13, and Supplementary Material at 22.
[417] Ibid, s. 86.185.
[418] Ibid, s. 86.185 (1) and (2).
[419] Ibid, s. 88.011 (4).
[420] Title 16 Texas Administrative Code, Part 1. Economic Regulation, Part 1. Railroad Commission of Texas, Chapter 3: Oil and Gas Division.
[421] Ibid, Rule 32.
[422] Title 30 Texas Administrative Code, Part 1. Texas Commission on Environmental Quality, Chapter 1 – Purpose of Rules and General Provisions, s.1.1.
[423] Title 30 Texas Administrative Code, Part 1. Texas Commission on Environmental Quality, Chapter 106 – Permits by Rule, Subchapter O: Oil and Gas, ss. 106.351-106.355, 106.359 Effective September 10, 2013.
[424] Ibid, ss. 106.352 (a) (4), (b) (6) (F), 106.355, and 116.10.

standards. It is also important to restate that all oil and gas operations in Texas – on both state and federal lands – are subject to USEPA Standards for mitigating GHG emissions.

(b) North Dakota

Chapter 38 of the North Dakota Century Code[425] regulates oil and gas activities on state-owned land. As afore-highlighted, BLM rules apply only to activities on federal lands, while USEPA rules apply both to federal and state lands across the country. The North Dakota Industrial Commission is the industry regulator for operations other than on federal lands.[426] Recently, the Department of Mineral Resources under the North Dakota Industrial Commission has been created to manage some oil and gas industry segments. However, the Commission still exercises regulatory functions regarding flaring and venting.

The Century Code allows flaring for one year after first oil production from a well and prohibits continuous flaring after the initial one year.[427] Instead of continual flaring beyond one year, it requires efficient gas to oil ratios, abatement of flaring, 75% utilization for beneficial consumption and connection to a gas gathering system.[428] Flaring in violation of this provision is subject to the operator's payment of royalty, and the amount shall be equal in value to the flared gas.[429]

However, connecting the well to a gas gathering system would be termed 'economically infeasible' when the cost for the connection far exceeds the monetary benefit the operator would derive from gas utilization.[430] This point is like the economics of flaring contemplated under the BLM rules, which apply only to resources on federal lands.[431]

Apart from the Century Code, the North Dakota Industrial Commission also makes rules to regulate flaring for operations on state-owned lands. Its Gas Capture Policy of 2014 (amended in 2018)[432] establishes gas capture goals of different percentages for different periods ranging from December 2014 to November 2020.[433] The objective is to achieve 74% capture from 2014 and 91% in 2020.[434] Operators on state lands are required to submit gas capture plans alongside

[425] North Dakota Century Code, Control of Gas and Oil Resources Chapter 38-08, Effective April 1, 2010; amended April 1, 2013.
[426] Ibid, s. 38-08-04.
[427] Ibid, ss. 38-08-03, 38-08-04, 38-08-06.4.
[428] Ibid.
[429] Ibid.
[430] North Dakota Century Code, above n 425, s. 43-02-03-60.2
[431] Above n 404.
[432] North Dakota Industrial Commission Order 24665 Policy/Guidance Version 041718 of 2014 (As amended in 2018).
[433] Ibid, at 3.
[434] Ibid.

applications for a drilling permit, report semi-annual improvement plans, review goals annually, track flaring, and report capture status in comparison with set goals.[435] Strict implementation of such flaring regulation in North Dakota can have positive and negative effects. While the objective may be to reduce flaring and venting, it may also reduce production and economic benefits.[436]

(c) Alaska

The Alaska Oil and Gas Conservation Act[437] and Alaska Administrative Code[438] regulate oil and gas operations on state land. The Conservation Act prohibits any waste of oil and gas.[439] More so, it empowers the Alaska Oil and Gas Conservation Commission to impose a civil penalty double the wasted gas's fair market value.[440] Recently, the Department of Natural Resources, Division of Oil and Gas, has emerged to regulate some oil and gas industry segments. Still, the existing Conservation Commission maintains its regulatory powers regarding upstream GHG emissions.

The Administrative Code dedicates a segment to production practices.[441] There are diverse requirements for oil and gas production, but of relevance to this research are the ones on production equipment, notification of the uncontrolled release of oil or gas, and gas disposition. The producer or operator must install, operate, and maintain production equipment according to good oilfield engineering practices to ensure operational and environmental safety.[442] Second, the operator must notify the Alaska Oil and Gas Conservation Commission of any gas disposition above one thousand standard cubic feet within five days, detailing responsive actions and preventative measures against future occurrence.[443] Third, and more directly on emissions, the operator is obliged to minimise flared gas volume following good oilfield engineering practices and conservation purposes.[444] However, planned flaring for operational safety is authorised.[445]

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[435] Ibid, at 1.
[436] 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" (2014) 117 West Virginia Law Review 549 at 581 and 584.
[437] Title 31.05.160 Alaska Statutes 2018: Alaska Oil and Gas Conservation Act.
[438] Alaska Administrative Code Title 20 AAC 25.265.
[439] Above n 432, s. 31.05.195.
[440] Ibid, s.31.05.150 (d).
[441] Above n 433, art. 3.
[442] Ibid, 20 AAC 25.200. Production Equipment.
[443] Ibid, 20 AAC 25.205. Notification of Uncontrolled Release of Oil or Gas.
[444] Ibid, 20 AAC 25.235. Gas disposition.
[445] Ibid.

(d) California

The primary legislation for oil and gas regulation in California is the California Public Resources Code.[446] In 2019, Assembly Bill 1057 introduced amendments to the Resources Code, principally changing the industry regulator's name from the Division of Oil, Gas, and Geothermal Resources within the Department of Conservation to the Geologic Energy Management Division and a refocused definition of conservation.[447]The Code provides for resource conservation and prohibits emissions. On conservation, it obliges operators to achieve ultimate recovery of oil and gas and waste elimination.[448] However, the refocussed definition of conservation, which Assembly Bill 1057 introduces, is that 'resource conservation' includes protecting public health and safety and environmental quality and reducing GHG emissions associated with the development of hydrocarbon and geothermal resources.[449] This is an essential feature in California's regulatory framework because it expressly captures upstream GHG emissions reduction as part of conservation measures, unlike other jurisdictions where the term is either narrowly construed from an economic lens or subject to other different meanings. The Code expressly prohibits wilful and unnecessary waste of gas in the form of flaring and venting.[450] Wilful violation of these provisions constitutes a misdemeanour punishable by a fine not exceeding one thousand dollars, or imprisonment not exceeding one year, or both.[451]

The rechristened oil and gas regulator was yet to make any specific rules regarding upstream GHG emissions mitigation at the time of writing. Still, California has a reputation for ensuring sustainability, emissions reduction and air quality improvements through regulation.[452] As far back as 2006, California already set a state-wide climate target to reduce GHG emissions to 1990 levels by between 2008 and 2020, being a 15% reduction under a business as usual scenario.[453] In 2017, the California Air Resources Board (CARB) made regulations specifically targeting vented and fugitive methane emissions emanating from oil and gas facilities – Final Regulation Order on Greenhouse Gas Emissions Standards for Crude Oil and Natural Gas

[446] California Public Resources Code 1939 Division 3 – Oil and Gas (As modified in 2019).
[447] Assembly Bill No. 1057 Chapter 771, s. 7 amending s. 690 of the California Public Resources Code.
[448] California Public Resources Code, above n 441, s. 3106.
[449] Above n 447, s. 9 amending s 3011 of the California Public Resources Code.
[450] Above n 446 s. 3500.
[451] Ibid, s. 3502.
[452] Mary D. Nichols "Sustainable Communities for a Sustainable State: California's Efforts to Curb Sprawl and Global Warming Emissions" (2011) 12 Vermont Journal of Environmental Law 185 at 186 and 187.
[453] Assembly Bill No. 32 Chapter 488 Adding Division 25.5. California Global Warming Solutions Act of 2006 to the Health and Safety Code, relating to Air Pollution, s. 38550 and the CARB Factsheet on the AB 32 Global Warming Solutions Act of 2006, available online at <https://ww2.arb.ca.gov>.

Facilities.[454] There are detailed standards addressing separator and tanks systems, circulation tanks for well stimulation, reciprocating and centrifugal natural gas compressors, natural gas pneumatic devices and pumps, and well casing vents.[455] The regulation stipulates using a vapour collection system, ensuring critical components' safety and implementing leak detection and repair programmes for fugitive methane emissions.[456] Operators also must monitor, keep records of all vented and fugitive emissions and make such document available upon request by the CARB to verify compliance.[457]

The CARB made multiple complementary and supportive rules on emissions reduction and fuel efficiency standards in 2018.[458] One such rule is the new Low Carbon Fuel Standard (LCFS) Regulations, initially promulgated through Executive Order[459] and implemented from 2011.[460] The first LCFS regulation intended to cut GHG emissions by reducing California's transportation fuel mix's carbon intensity and complete fuel cycle.[461] While the initial LCFS provided a 10% sectoral cut in emissions below 2010 levels from 2011 to 2020, the 2019 amendment intends to achieve a 20% emissions reduction below 2010 levels by 2030.[462] Specifically, the carbon intensity benchmarks for fossil fuels and their substitutes should not exceed an average of 79.55 grams of CO_2e per mega joule (gCO_2e/MJ) from the year 2030 and beyond.[463] These provisions will incentivise a reduction in upstream GHG emissions in California and affect the Albertan oil and gas sector that sends oil to California due to the carbon intensity benchmarks for fossil fuels and their substitutes. This effect on Alberta shows how regulatory measures in one jurisdiction can have ramifications in overseas jurisdictions.

In addition, the LCFS regulation provides technical standards and methodologies for implementation. These are primarily a credit trading system,[464] calculation of fuel GHG

[454] Final Regulation Order, California Code of Regulations, Title 17, Division 3, Chapter 1, Subchapter 10: Climate Change, Article 4, Sub-article 13: Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities.
[455] Ibid, s. 95668.
[456] Ibid, ss. 95668-95670.
[457] Ibid, ss. 95672 and 95673.
[458] CARB "CARB Rulemaking Activity in 2018" (California Air Resources Board 23 October 2018) <https://ww3.arb.ca.gov>.
[459] Executive Order S-01-07 18 January 2007.
[460] Transport Policy Net "California: Fuels: Low Carbon Fuel Standard" (Transport Policy Net 2018) <www.transportpolicy.net>.
[461] Title 17. Public Health, California Code of Regulations (CCR), Sub-chapter 10. Climate Change, Sub-article 7: Low Carbon Fuel Standard, Final Regulation Order, s. 95480.
[462] Title 17. Public Health, California Code of Regulations (CCR), Sub-chapter 10. Climate Change, Sub-article 7: Low Carbon Fuel Standard, Final Regulation Order, Effective from 4 January 2019, s. 945484.
[463] Ibid, Table 1: LCFS Carbon Intensity Benchmarks for 2001 to 2030 for Gasoline and Fuels Used as a Substitute for Gasoline, at p. 48.
[464] LCFS 2019, above n 462, ss. 95486 and 95487.

intensity,[465] and a compliance mechanism, which requires mandatory annual reporting.[466] The CARB also has powers to impose penalties and injunctive reliefs for noncompliance with the rules outlined in the regulation.[467]

For a big jurisdiction like the USA, it may help to summarise the significant features of the applicable regime in the country. There is a fragmentation of regulatory powers between federal and state authorities. The BLM rules apply to oil and gas operations on federal lands in the country. In contrast, USEPA rules apply to activities on both federal and state lands, including privately owned lands. The rules made by these regulatory institutions – BLM and USEPA – target the reduction of flaring and venting and the implementation of leak detection and repair programmes to reduce fugitive emissions. The states also have similar provisions, with higher gas utilization (75%) requirement in North Dakota and new carbon intensity requirements in California from 2030. The USEPA plays a huge role in regulating upstream GHG emissions in the USA through rule-making. The industry regulators in various states also play predominant roles in reducing flaring, venting, and fugitive emissions associated with operations on state-controlled lands. These characteristics will prove significant in the comparative analysis that comes later in this chapter.

c) Canada

There are three preliminary points to note about Canada. First, Canada is another example of deviation from the common practice of central government ownership and governance of all the natural resources. Second, unlike in the USA, there is more concentration of power in the provinces in Canada.[468] Field[469] observes that there has been a departure from the original intent of the Canadian constitution of 1867, [470] which established central government predominance.[471] The Judicial Committee of the Privy Council, a precursor to the Supreme Court of Canada, "…interpreted provincial powers generously and federal powers with restraint, giving the provinces a much greater share in the balance of power than had been

[465] Ibid, s. 95488.3.
[466] Ibid, ss. 95485 and 95491.
[467] Ibid, s. 95494.
[468] Milton J. Esman "Federalism and Modernization: Canada and the United States" (1984) 14:1 Publius: Crisis and Continuity in Canadian Federalism 21.
[469] Martha A. Field "The Differing Federalisms of Canada and the United States" (1992) 55:1 Law and Common Problems 107.
[470] Originally enacted as the British North America Act 1867.
[471] Different sections outlined the distribution of powers between central and provincial governments, but federal law prevailed in most cases of conflict. See s. 95 of the British North America Act of 1867.

contemplated."[472] Therefore, the federal structure allows provincial governments to implement measures for their peculiar circumstances, [473] while the federal government exercises jurisdiction over the management of natural resources on federal lands.[474] Third, similar to the USA, resource conservation is a significant form of regulation in Canada's legislative frameworks.[475]

The Canadian Energy Regulator Act,[476] in 2019, established the Canadian Energy Regulator as federal energy regulator. The Act applies primarily to lands that the federal government controls.[477] The federal government controls much less land than its American equivalent. In the provinces, it controls only small parcels. The Act also applies to inter-provincial facilities such as pipelines and power lines. It requires operators to perform oil and gas operations safely, securely, and efficiently to protect people, property, and the environment.[478]

The Canadian Oil and Gas Operations Act[479] is the primary national law directly applicable to oil and gas production. The Act applies in respect of the exploration, drilling, production, processing, conservation and transportation of oil and gas in areas that fall within the federal government's jurisdiction.[480] The Canadian Petroleum Resources Act[481] specifically regulates interests in petroleum regarding frontier lands. The following sub-sections will discuss specific federal and provincial regulatory measures for addressing upstream GHG emissions.

(1) Federal Regulatory Measures

The Canadian Oil and Gas Operations Act prohibits waste by individuals and companies.[482] It defines waste as the escape or flaring of gas that could be economically recovered and

[472] Field, above n 469, at 107 and 108. See also W. H. McConnell "Constitution Act, 1867" (The Canadian Encyclopaedia 6 February 2006) <www.thecanadianencyclopedia.ca>.
[473] Alexander J. Black "Devolution of Oil and Gas Jurisdiction to First Nations in Canada" (2008) 45:3 Alberta Law Review 537 at 540.
[474] Alastair R. Lucas and Constance D. Hunt *Oil and Gas Law in Canada* (Carswell 1990) at 13, 39-41. See also Peter W. Hogg *Constitutional Law of Canada* (Carswell 2011) at 30-2 – 30-8. Other texts that discuss the issue include Jakub Handrlica "Oil and Gas Law in Canada: A Federal and Provincial Legal Structure" (2004) 6 Common Law Review 59-61; Katria Opalka "Oil and Gas Law: The View from Canada" (2012) 26 Natural Resources and Environment 37.
[475] Barry Sadler "Shared Resources, Common Future: Sustainable Management of Canada-United States Border Waters" (1993) 33:2 Natural Resources Journal 375 at 376. See also John Sandlos "Nature's Nations: The Shared Conservation History of Canada and the USA" (2013) 70:3 International Journal of Environmental Studies 358-371.
[476] Canadian Energy Regulator Act, S.C., 2019, c. 28, s. 10.
[477] Ibid, s. 6.
[478] Ibid.
[479] Canadian Oil and Gas Operations Act, R.S.C., 1985, c. O-7.
[480] Ibid, s. 3. The Act delineates the areas to include the onshore locations that are under the administration of the federal minister, Nunavut, Sable Island, the territorial sea of Canada, and the continental shelf of Canada.
[481] Canadian Petroleum Resources Act R. S. C. 1985, c. 36, s.5.
[482] Above n 479, s. 18(1).

processed or economically injected into an underground reservoir. [483] Pursuant to this primary legislation,[484] the Minister of Natural Resources and Minister of Indian Affairs and Northern Development jointly promulgated the Drilling and Production Regulations in 2009.[485] The Regulations expressly prohibit flaring and venting, except under prior authorisation or as a safety or emergency measure.[486] This second limb of the regulations provides an emissions permit system, as is customary with other jurisdictions.

More direct on upstream GHG emissions is the prescriptive Methane Regulations, [487] promulgated by the Minister of the Environment, under the Canadian Environmental Protection Act.[488] The Regulations apply to all operations in Canada whether on federal or provincial lands and prescribe different technical requirements for various emissions sources in upstream oil and gas operations. Regarding general production-related venting, the limit is 1,250m^3 per month (15,000m^3 annually) for each producing field.[489] However, this prescription takes effect from 1 January 2023.[490] For fugitive emissions, the operator must implement a leak detection and repair scheme, conduct a regular inspection for leaks and take corrective measures.[491] The Regulations also prescribe different limits for emissions from pneumatic devices, compressors and well completions for hydraulic fracturing operations.[492]

Besides, Canada has initiated two recent climate change measures that are relevant to upstream GHG emissions. The first is a target to achieve between 40 to 45% reduction in upstream-related methane emissions by 2025.[493] It intends to achieve this by the serious commitment and implementation of the regulations and laws relating to conservation and waste prohibition, reducing flaring, venting and fugitive emissions. The second is the enactment of the Greenhouse Gas Pollution Pricing Act.[494] The new law applies to provinces in Canada without pricing systems that meet federal standards. These provinces include Ontario, New Brunswick,

[483] Ibid, s. 18(2) (f).
[484] Ibid, s. 15(1).
[485] Canada Oil and Gas Drilling and Production Regulations, 2009 SOR/2009-315.
[486] Ibid. ss. 52(4) and 67.
[487] Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) SOR/2018-66.
[488] Canadian Environmental Protection Act S.C. 1999, c. 33, s. 332(1).
[489] Methane Regulations, above n 487, s. 26.
[490] Ibid.
[491] Ibid, ss. 28-36.
[492] Ibid, ss. 37-41; 14-19; and 11-19 respectively.
[493] Pan-Canadian Framework on Clean Growth and Climate Change 2016 Cat. No.: En4-294/2016E-PDF, ISBN: 978-0-660-07023-0 at 20, 21, and 51.
[494] Greenhouse Gas Pollution Pricing Act S.C. 2018, c. 12, s. 186.

Manitoba, Saskatchewan, Alberta, Yukon, and Nunavut.[495] The Governor in Council can make amendments for a broad application throughout Canada or a narrow application by either including or deleting provinces in the application schedule.[496]

Multiple provinces – especially Saskatchewan, Ontario, and Alberta – contested the Greenhouse Gas Pollution Pricing Act's constitutionality. The Courts of Appeal in both Saskatchewan[497] and Ontario[498] upheld the law's constitutional validity, while the Court of Appeal in Alberta[499] ruled that the law was unconstitutional. The Supreme Court of Canada heard three appeals from Saskatchewan, Ontario, and Alberta in September 2020 and upheld the law's constitutionality in March 2021.[500] The Court underscored the necessity of considering the interests that would be harmed – owing to irreversible consequences for the environment, for human health and safety and for the economy – if Parliament were unable to address the matter at a national level. This ruling can inspire valuable scholarly commentaries about countries' ability to exert national jurisdiction over climate governance matters. One key point relevant to this thesis is the need to have an ascertainable benchmark for pricing carbon emissions. Canadian provinces can set higher carbon price thresholds, but not below the national pricing levels.[501]

Two crucial questions are: (1) whether the Greenhouse Gas Pollution Pricing Act captures emissions from oil and gas production processes; and (2) the charge or price it places on these emissions. For application purposes, the law covers "…a platform anchored at sea, that is located in a province or area that is set out in Part 2 of Schedule 1 and either (a) meets the criteria set out in the regulations for that province or area; or (b) is designated by the Minister under subsection 172(1)."[502] This provision means that emissions from offshore oil and gas operations would be subject to coverage. The other possibility is for the Minister to designate places of industrial activities as covered facilities. A third deduction from the statutory

[495] Ibid, ss. 3, 166(2), 168(1), 168(2) (c), 168(3), 169, 172(1), 185 and 193, Schedule 1 Part 1, Table 1.
[496] Ibid, s. 189(1).
[497] In the Matter of the Greenhouse Gas Pollution Pricing Act, Bill C-74, Part 5 And In the Matter of A Reference by the Lieutenant Governor-in-Council to the Court of Appeal for Saskatchewan under the Constitutional Questions Act, 2012, SS 2012, c C-29.01 (2019) SKCA 40.
[498] In the Matter of A Reference to the Court of Appeal pursuant to section 8 of the Courts of Justice Act, RSO 1990, c. C.34, by Order-in-Council 1014/2018 respecting the constitutionality of the Greenhouse Gas Pollution Pricing Act, Part 5 of the Budget Implementation Act, 2018, No. 1, SC 2018, c. 12 (2019) C65807.
[499] In the Matter of the Greenhouse Gas Pollution Pricing Act, SC 2018, c. 12 And in the Matter of a Reference by the Lieutenant Governor in Council to the Court of Appeal of Alberta under the Judicature Act, RSA 2000, c. J-2, s. 26 (2020) ABCA 74.
[500] Attorney General of Saskatchewan and others v. Attorney General of Canada (2001) SCC 11.
[501] Ibid.
[502] Greenhouse Gas Pollution Pricing Act, above n 494, s. 169.

provision is for regulations to set out covered facilities expressly. This third option is adopted by regulations, as the discussion below shows.

The law requires a person responsible for a covered facility to apply to the Minister for registration in a pricing mechanism.[503] There are emission limits, compliance reporting, and charges for GHG emissions that exceed the prescribed limit for the covered facilities under this mechanism.[504] The Output-Based Pricing System Regulations,[505] made pursuant to the Act,[506] come more directly on the issue of application. The Regulations subject different emission types to quantification and pricing. These include emissions from stationary fuel combustion, industrial processes, venting, flaring, leakage, on-site transportation, waste, and wastewater.[507] The Act stipulates charges for emissions that exceed the statutory and regulatory limits for covered facilities.[508] These charges cover five calendar years – from 2018 to 2022. For 2018, the charge is 10 Canadian Dollars (CAD) per CO_2e tonne more than the limit. For 2019, 2020, 2021, and 2022, the charges are CAD20, CAD30, CAD40, and CAD50, respectively.[509]

(2) Provincial Regulatory Measures

There are multiple oil and gas producing provinces in Canada, but this chapter focuses on Alberta, Saskatchewan, Newfoundland and Labrador, and British Columbia. This limited focus is because, apart from having the most comprehensive regulations on GHG emissions, these four provinces top Canadian crude oil production statistics right from pre-1947 until present times, collectively producing almost all of Canada's oil and gas resources.[510] For example, in 2019, these four provinces' contributions to the overall Canadian liquid hydrocarbons production stood at 99% (80.5% from Alberta, 10.5% from Saskatchewan, 5.6% from Newfoundland and Labrador, and 2.4% from British Columbia.[511]

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[503] Ibid, s. 171(1).
[504] Ibid, ss. 173, 174, 178, 181(3) and 185.
[505] Output-Based Pricing System Regulations SOR/2019-266.
[506] Above n 494.
[507] Ibid, s. 5(1) and Schedule 3, Parts 1-38.
[508] Greenhouse Gas Pollution Pricing Act S.C. 2018, c. 12, s. 186, ss. 174(3) (b), 174(5), 178(2), 181(3) and 191, Schedule 4.
[509] Ibid.
[510] Cap-Op Energy Inc. "Flaring in Canada: Overview and Strategic Considerations, Part 1" (Cap-Op Energy Inc. 16 January 2017) <www.capopenergy.com>; Canadian Association of Petroleum Producers *Technical Report: Statistical Handbook for Canada's Upstream Petroleum Industry* (CAPP October 2017) Canadian Crude Oil Production Table 3.1; CAPP Frequently Used Statistics (CAPP July 2019) <www.capp.ca>. See also Canadian Association of Petroleum Producers *Technical Report: Statistical Handbook for Canada's Upstream Petroleum Industry* (CAPP February 2018) Canadian Crude Oil Production at 60, Table 3.1.
[511] Natural Resources Canada "Crude Oil Facts" (Natural Resources Canada 6 October 2020) <https://www.nrcan.gc.ca>.

(a) Alberta

There are multiple laws – Acts, Regulations and Rules – governing oil and gas activities in Alberta. The predominant ones are the Oil and Gas Conservation Act[512] with its subsidiary Rules,[513] the Gas Resources Preservation Act[514] with its accompanying Regulation,[515] and the Oil Sands Conservation Act[516] with its subsidiary Regulation.[517] The Responsible Energy Development Act established the Alberta Energy Regulator with a mandate to regulate the environmentally responsible development of energy resources and implement all energy resource enactments[518] (the principal laws identified in the preceding sentence). There are also Curtailment Rules[519] under the Oil and Gas Conservation Act, the Oil Sands Conservation Act, and the Responsible Energy Development Act.

There are requirements for operators to ensure the conservation of oil and gas resources and avoid wasteful practices.[520] The Oil and Gas Conservation Rules and the Oil Sands Conservation Rules specifically mention flaring as a wasteful practice that operators must avoid, except in cases of emergency, well testing and well cleaning and with authorization by the regulator.[521] The objective of resource conservation set out in the principal legislation and the Curtailment Rules is to ensure economic, orderly, efficient, and responsible development of Alberta's oil and gas resources and avoid waste.[522]

In addition to conservation laws, Alberta has a dedicated framework for addressing upstream GHG emissions – Directive 060.[523] The Directive sets a 45% reduction of methane emissions from the upstream oil and gas sector by 2025 from 2014 levels.[524] It also stipulates a gas flaring

[512] Oil and Gas Conservation Act, Revised Statutes of Alberta 2000 Chapter O-6.
[513] Oil and Gas Conservation Rules, Alberta Regulation 151/1971 with amendments up to and including Alberta Regulation 165/2020.
[514] Gas Resources Preservation Act, Revised Statutes of Alberta 2000 Chapter G-4.
[515] Gas Resources Preservation Regulation, Alberta Regulation 328/2002 with amendments up to and including Alberta Regulation 171/2020.
[516] Oil Sands Conservation Act, Revised Statutes of Alberta 2000 Chapter O-7.
[517] Oil Sands Conservation Rules, Alberta Regulation 76/1988 with amendments up to and including Alberta Regulation 29/2017.
[518] Responsible Energy Development Act, Statutes of Alberta, 2012 Chapter R-17.3, ss. 2-3.
[519] Curtailment Rules, Alberta Regulation 214/2018 with amendments up to and including Alberta Regulation 198/2020.
[520] Oil and Gas Conservation Act, above n 512, ss. 4, 10 and 38; Oil Sands Conservation Act, above n 516, ss. 3, 20(g) and (u), 22.
[521] Oil and Gas Conservation Rules, ss. 7.055(1) and 11.135(1); Oil Sands Conservation Rules, above n 517 s. 11.
[522] Oil and Gas Conservation Act, above n 512, at s.4; Oil Sands Conservation Act, above n 516, at s.3; Curtailment Rules, above n 519, at s.2.
[523] The Alberta Energy Regulator Directive 060: Upstream Petroleum Industry Flaring, Incineration, and Venting, Released 13 December 2018, Effective from 1 January 2020.
[524] Ibid, 10, 74 and 107.

limit of 670 million cubic meters (10^6 m^3) annually until a future review.[525] If flaring exceeds this limit, the Alberta Energy Regulator can prescribe new maximum limits for all operators to maintain the flaring reduction threshold.[526] There are also particular requirements to reduce fugitive and vented emissions.[527] Operators must limit overall venting per field or well to less than 15.0 10^3 m^3 of vent gas per month or 9.0 10^3 kg of methane per month.[528] Additionally, from 1 January 2022, operators must design and operate sites to limit flaring and venting to less than 3.0 10^3 m^3 per site or less than 1.8 10^3 kg of methane per month for each production site.[529] The Directive also requires operators to conduct emission surveys using either organic vapour analyser, gas imaging camera or any other equipment capable of detecting fugitive emissions;[530] and repair all detected sources of fugitive emissions.[531]

There are also energy efficiency and performance requirements in the Directive. Operators are required to ensure efficient use of energy and optimum performance of all upstream oil and gas industry systems for burning sour, sweet, and acid gas.[532] There are also design and operating parameters for incinerators and combustion equipment to reduce GHG emissions from fuel combustion. Key examples are proper gas-liquid separation, high-level facility shutdown alarms, and backlash control.[533]

Directive 060 exempts oil sands mining schemes and operations approved under the relevant legislation for oil sands activities.[534] However, the Oil Sands Emissions Limit Act[535] sets an overall GHG emissions limit from all oil sands site at 100 mega tonnes per annum.[536] As far as emissions reduction in oil sands production are concerned, that is all the Act says. This provision is an excellent example of result-oriented legislation. Still, its vagueness is a setback to achieving meaningful emissions reduction, especially flaring and venting, from oil sands operation. It would be desirable to promulgate schemes, mechanisms, feasible thresholds, and measurable indices to achieve the overall emissions limit.

[525] Ibid, s. 2.
[526] Ibid.
[527] Ibid, s. 8.
[528] Ibid, s. 8.3
[529] Ibid, s. 8.4.
[530] Ibid, s. 8.10.2.2
[531] Ibid, s. 8.10.4.3.
[532] Ibid, s.7
[533] Ibid, s. 7.1.3.
[534] Directive 060, above n 523, at s.1.1
[535] Oil Sands Emissions Limit Act, Statutes of Alberta, 2016, Chapter O-7.5.
[536] Ibid, s. 2

(b) Saskatchewan

In Saskatchewan, the provincial Oil and Gas Conservation Act governs oil and gas operations.[537] Regulatory powers lie with the Ministry of Energy and Resources.[538] The Conservation Act states the objectives of ensuring optimal utilization, protecting and conserving Saskatchewan's oil and gas resources, the environment, property, and public safety.[539] The Act also provides that no person shall engage in or commit any wasteful operations.[540] It defines flaring as one of the circumstances of wasteful operations if, in the Minister's opinion, the gas could be gathered, stored for future marketing or beneficially injected into a subsurface formation.[541] There are similar provisions on conservation and gas utilization in the Oil and Gas Conservation Regulations made pursuant to the Act.[542] The Act also recognizes the production of associated petroleum gas alongside crude oil and the possibility of flaring certain volumes of gas.[543] However, flaring must not exceed 900 cubic meters per day per production well unless in emergency cases (and operators must take precautions to protect human health, public safety, property and the environment) and prevent fire or explosion.[544]

There are also specific instruments for upstream emissions limits and reduction targets. In 2017, the Saskatchewan provincial government adopted a Climate Change Strategy[545] that incorporates two broad initiatives to reduce GHG emissions from the upstream oil and gas sector – the Methane Action Plan and the Output-Based Performance Standards for industrial facilities. The Methane Action Plan requires the provincial government to introduce and implement regulations to reduce methane-based emissions by 40 to 45% below 2015 levels by 2030. Similarly, the Output-Based Performance Standards target a 40% methane reduction from upstream oil and gas operations, with stationary fuel combustion accounting for 15% in emissions reduction by 2030.

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[537] Oil and Gas Conservation Act, Chapter O-2 of The Revised Statutes of Saskatchewan, 1978 (As amended by the Statutes of Saskatchewan, 1982-1093, c.1 and other successive amendments up till 2019, c.14.
[538] Ibid, ss. 5 and 6; The Ministry of Energy and Resources Regulations, Chapter E-13.1 Reg 9 2018, ss. 2 and 3, made pursuant to The Executive Government Administration Act, Chapter E-13.1 of the Statutes of Saskatchewan 2014 (As amended by the Statutes of Saskatchewan 2019, c.8
[539] Oil and Gas Conservation Act, above n 537, s. 3.
[540] Ibid, s. 54.
[541] Ibid, s. 2(p).
[542] Oil and Gas Conservation Regulations Chapter O-2 Reg 6 (effective April 1, 2012) as amended by Saskatchewan Regulations 70/2013, 14/2014, 73/2014, 19/2015, 70/2017 and 65/2018; and by the Statutes of Saskatchewan, 2014, c.21. s. 50.
[543] Ibid, s. 51(1).
[544] Ibid.
[545] Prairie Resilience: A Made-in-Saskatchewan Climate Change Strategy, adopted by the Government of Saskatchewan, 4 October 2017.

In pursuit of the climate goals, there are regulations to address different industrial emitters. The Oil and Gas Emissions Management Regulation[546] applies particularly to the upstream oil and gas sector. Unlike the prescriptive regimes of Alberta and Canadian federal measures, this regulation establishes a result-oriented regime, which sets emissions limits on an annual basis and requires operators to submit emission reduction plans subject to the Minister's approval.[547] The Minister has statutory powers to impose administrative penalties for excess emissions by any operator.[548] There are also reporting requirements for GHGs to ascertain compliance with emissions limits.[549]

(c) Newfoundland and Labrador

In Newfoundland and Labrador, oil and gas production is carried out under the Atlantic Accord between the Canadian federal government and the Newfoundland and Labrador provincial government,[550] and the Atlantic Accord Implementation Act.[551] The Accord and the Act established the Canada-Newfoundland and Labrador Offshore Petroleum Board – an independent joint resource management team consisting of federal and provincial personnel – as the industry's regulator.[552] Similarly, the Canada-Nova Scotia Offshore Petroleum Board regulates petroleum activities offshore Nova Scotia under a federal-provincial arrangement.

The Atlantic Accord Implementation Act makes provisions requiring resource conservation and environmental protection. It prohibits the flaring of gas that could be economically recovered and processed or economically injected into an underground reservoir.[553] Similar complementary provisions require efficient drilling operations and resource conservation in both the Petroleum Drilling Regulations[554] and the Petroleum Regulations,[555] made pursuant to the Petroleum and Natural Gas Act.[556]

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[546] The Oil and Gas Emissions Management Regulations, Chapter O-2 Reg 7 Effective 1 January 2019.
[547] Ibid, ss. 8 and 11.
[548] Ibid, s. 10.
[549] Ibid, ss. 6 and 8.
[550] The Atlantic Accord: Memorandum of Agreement between the Government of Canada and the Government of Newfoundland and Labrador on Offshore Oil and Gas Resource Management and Revenue Sharing, Dated at St. John's on 11 February, 1985. For a detailed discussion on this, see Alastair R. Lucas and Constance D. Hunt *Oil and Gas Law in Canada* (Carswell 1990) at 70-74. See also an earlier work on the subject: T. R. Carter and G. R. Campbell "Oil and Gas Developments in Eastern Canada in 1988" (1989) 73 The American Association of Petroleum Geologists Bulletin 45-56.
[551] Canada–Newfoundland and Labrador Atlantic Accord Implementation Act, S.C. 1987, c.3.
[552] The Atlantic Accord, above n 545, paras 3-20; The Atlantic Accord Implementation Act, ibid, s.9 (1).
[553] The Atlantic Accord Implementation Act, above n 546, ss. 135 and 154 (1) and (2) (f).
[554] Petroleum Drilling Regulations under the Petroleum and Natural Gas Act, O.C 96-225, ss. 34, 60 and 83.
[555] Petroleum Regulations under the Petroleum and Natural Gas Act, O.C. 96-935, ss. 41(b) and 44(b).
[556] Petroleum and Natural Gas Act, RSNL1990 Chapter P-10 (As amended in 2019), ss. 9, 17 and 39.

In addition, a specific regulatory framework targets upstream GHG emissions emanating from petroleum operations offshore Newfoundland and Labrador. It is the Management of Greenhouse Gas Act,[557] with its subsidiary legislation, the Greenhouse Gas Management Regulations.[558] The Act empowers the Lieutenant-Governor in Council to make regulations setting annual GHG emissions reduction targets for oil and gas operations facilities that emit 25,000 tonnes of carbon dioxide equivalent or more GHGs per annum.[559] The Regulations stipulate incremental GHG emissions reduction goals for 2019 (6%), 2020 (8%), 2021 (10%), 2022 and subsequent years (12%), relative to the baseline emissions intensity of operators.[560] The baseline emissions intensity is a system set by the Regulations to derive the emissions intensity of different upstream facilities through mathematical formulae on a case-by-case basis.[561] Thus, operators could have different emissions intensities. Still, each operator achieves the emission reduction targets for the stipulated years relative to its peculiar emissions intensity for the preceding year. There are lower targets for newer production fields that started after 2015 – 2.4% for 2019, 4.8% for 2020, 8% for 2021, and 12% for 2022 and subsequent years.[562] The second feature of the framework is mandatory annual GHG emissions reporting to ascertain compliance with emissions reduction targets.[563] Third, the Regulations establish a GHG emissions reduction system and performance credits to help operators meet their emissions reduction goals for each reporting year.[564] Fourth, there is a requirement for operators to adopt the best available control technologies for addressing emissions.[565] There are no definite prescriptions of the best available control technologies. Operators can meet the best available control technologies requirement where the Lieutenant-Governor in Council is satisfied that the machinery and equipment used for production (a) have the most effective greenhouse gas emissions control; (b) have proven performance and reliability in comparable industrial facilities; (c) are economically feasible, based on consultation with the operator; (d) comply with an Act or regulation relating to air pollution, occupational health and safety and

[557] Management of Greenhouse Gas Act, SNL2016 Chapter M-1.001 (As Amended by 2018 c40).
[558] Management of Greenhouse Gas Regulations 116/18 under the Management of Greenhouse Gas Act (As Amended by 31/19).
[559] Above n 557, at s. 5.
[560] Above n 558, at s.8.
[561] Ibid, ss. 4-6.
[562] Ibid, s. 8(2) and Schedule A.
[563] Above n 557, s. 10; above n 553, ss. 4-7.
[564] Above, n 558, ss. 99 and 10.
[565] Ibid, s. 12.

fire and life safety; and (e) are acceptable to the Board – the Canada-Newfoundland and Labrador Offshore Petroleum Board – as the best available control technologies.[566]

(d) British Columbia

The principal legislation governing petroleum exploration and production in British Columbia is the Oil and Gas Activities Act.[567] The Act establishes the British Columbia Oil and Gas Commission as the industry regulator.[568] It also makes general provisions requiring operators to ensure environmental protection and petroleum and natural gas resources conservation.[569]

The reduction of upstream emissions receives attention in other specific regulatory instruments, principally the Drilling and Production Regulation[570] and a Flaring and Venting Reduction Guideline,[571] made under the Act. The Drilling and Production Regulation requires operators to use conservation equipment to recover and utilize not less than 95% of natural gas instead of flaring at the production phase.[572] The regulation allows venting only as a safety mechanism or for minimal duration and volume.[573] It does not stipulate what the minimum duration and volume should be.

Operators must also comply with the Flaring and Venting Regulation's overall production phase emission limit to ensure a 95% gas utilization and conservation instead of flaring or venting. [574] This provision complements a similar requirement under the Drilling and Production Regulation. However, operators can apply for an exemption or discontinue conservation and utilization where their annual operating costs exceed their annual revenue.[575] There are also requirements for reducing planned flaring and venting. These are different from routine production phase emissions but still within upstream operations. For planned flaring for less than 4 hours, operators must reduce flaring by 50% of the average daily gas produced over 30 days. If the planned flaring exceeds 4 hours, the reduction rate is 75% of the average daily gas produced over 30 days. The same limit applies to flaring resulting from plant upset.[576] Operators must not engage in venting as an alternative to flaring but only vent in exceptional circumstances while complying with set operational requirements that venting must not

[566] Ibid, s.12(5).
[567] Oil and Gas Activities Act, SBC 2008 Chapter 36.
[568] Ibid, ss. 2 and 4.
[569] Ibid, ss. 4 and 103.
[570] Drilling and Production Regulation, B.C. Reg. 282/2010.
[571] BC Oil and Gas Commission Flaring and Venting Reduction Guideline, Version 5.1: May 2018.
[572] Above n 570, s. 52.02.
[573] Ibid, s. 41.
[574] Above n 571, Chapter 1, p. 14.
[575] Ibid.
[576] Above n 571, Chapter 1.9, Table 1.1.

constitute a safety hazard or result in off-site odours.[577] There is no exact limit for planned venting, but operators must keep the quantity and duration minimal.[578]

In addition to flaring and venting limits, operators must develop and implement leak detection and repair programmes to address all fugitive emissions sources.[579] There are also flaring reduction and emissions reporting schemes to monitor compliance.[580] Equally important is the fact that operators must ensure that combustion systems for all upstream activities function efficiently. Flares, incinerators and other combustion systems usually used for production or process equipment must be designed, maintained, and operated in such a manner that emissions do not exceed the air quality objectives and standards of British Columbia or cause adverse impacts to human health and vegetation.[581]

d) United Kingdom

The principal legislation governing oil and gas activities on the United Kingdom Continental Shelf (UKCS) is the Petroleum Act 1998.[582] The Energy Act 1976[583] establishes the Oil and Gas Authority and states its functions. However, different bodies regulate various aspects of onshore and offshore activities.[584]

The Petroleum Act requires appropriate arrangements for emissions monitoring and waste management plans as part of the environmental impact assessment before issuing licences.[585] The Energy Act requires the consent of the Oil and Gas Authority for flaring and venting.[586] In line with the Petroleum Act and the Energy Act, the Oil and Gas Authority expresses its commitment to eliminate unnecessary emissions from oil and gas operations, whether onshore or offshore. Its policy documents for onshore[587] and offshore[588] activities-related flaring and venting require strict flaring and venting consents. Flaring and venting are only allowed where they are necessary, for example, as a safety mechanism. Operators must also execute operations using good oilfield practices.[589]

[577] Ibid, Chapter 7.
[578] Ibid.
[579] Ibid, Chapter 7.6.
[580] Ibid, Chapters 1.11, 2.9, 3.5 and 10.
[581] Ibid, Chapter 6.1.
[582] Petroleum Act 1998 Chapter 17.
[583] Energy Act 1976 (As amended by the Energy Act 2016) Chapter 20, Part 6 – Final provisions.
[584] United Kingdom Onshore Oil and Gas "Regulation" (UKOOG 2017) <www.ukoog.org.uk>.
[585] Above n 577, s. 4, columns 1 and 2.
[586] Energy Act, above n 583, s. 12A.
[587] UK Oil and Gas Authority Policy on Flaring and Venting during the Production Phase, October 2016.
[588] UK Oil and Gas Authority Policy Position on Offshore Flaring and Venting, 2018.
[589] Ibid, at 2.

The Offshore Petroleum Production and Pipelines Regulation 1999[590] specifically regulates emissions from offshore petroleum activities and empowers the Offshore Petroleum Regulator for Environment and Decommissioning – a section of the UK Department for Business, Energy, and Industrial Strategy – to issue notices concerning emissions and discharges. The 2017 Guidance Note requires offshore operators to obtain a permit from the Offshore Petroleum Regulator for Environment and Decommissioning for any emissions to air or discharges to sea in the course of offshore exploration and production activities.[591] This obligation is in addition to the requirement for an environmental statement that must describe the proposed measures to eliminate or mitigate potential adverse environmental concerns such as emissions before the commencement of operations.[592]

The Offshore Petroleum Regulator for Environment and Decommissioning also implements the UK Offshore Combustion Installations Regulations.[593] The Regulations require an application for a permit to operate an offshore combustion installation. The application must disclose sources of emissions from the installation, the nature and quantities of foreseeable emissions, proposed technologies, or best available technology for preventing or reducing emissions from the installation.[594] The Regulator also has powers to set limits for emissions from any combustion installation.[595]

The Oil and Gas UK 2018 Environmental Assessment Report on oil and gas operations on the UKCS concludes that the industry has improved on environmental performance, production efficiency and reduced associated costs such as GHG emissions.[596] According to the report, production-related energy efficiency improved from 60% in 2012 to 74% in 2017.[597] The report also recognised the influence of emissions monitoring system and the country's collective climate governance regime.[598]

[590] Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (As Amended), Petroleum Operations Notice No. 16.
[591] Department for Business, Energy and Industrial Strategy, BEIS Offshore Petroleum Regulator for Environment and Decommissioning: The Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (As Amended) – A Guide, September 2017, at 22.
[592] Ibid, at 42.
[593] The Offshore Combustion Installations (Pollution Prevention and Control) Regulations, Statutory Instrument No. 971 of 2013.
[594] Ibid, at s. 4.
[595] Ibid, s. 10.
[596] Oil and Gas UK Environment Report 2018 at 8.
[597] Ibid, at 26.
[598] Ibid.

The United Kingdom's Climate Change Act sets binding short-term (26% below 1990 levels by 2020) and long-term (80% below 1990 levels by 2050) emissions reduction targets.[599] In addition, the United Kingdom Emissions Trading Scheme (UK ETS)[600] replaced the UK's participation in the European Union Emissions Trading System (EU-ETS)[601] from 1 January 2021 to continue a carbon pricing policy in the country in support of the country's climate targets. The UK ETS covers GHG emissions from power and heat generation, energy-intensive industries and aviation. Refining is one of the regulated activities under energy-intensive sectors,[602] but there is no mention or coverage of upstream GHG emissions. The consequence is that upstream GHG emissions are currently exempted from the UK ETS.

e) China

The Mineral Resources Law, Oil and Gas Pipeline Protection Law, and the Atmospheric Pollution Prevention and Treatment Law are the primary regulatory frameworks for China's oil and gas activities. However, there are also other laws for matters ancillary to the oil and gas industry.[603] The National Development and Reform Commission is a powerful institution with broad authority over virtually all facets of the country's economy.[604] The National Energy Administration and the Ministry of Natural Resources are two departments under the Commission that perform regulatory functions over oil and gas activities. The Commission requires conservation and comprehensive utilization of resources,[605] but it does not provide specifics on these requirements.

The Mineral Resources Law is silent on emissions, except that enterprises involved in mining mineral resources (including oil and gas operators) must observe regulatory provisions on environmental protection to avoid pollution.[606] The Environmental Protection Law allocates emissions quota for both GHGs and other pollutants to different provinces and requires operators to obtain authorisation to discharge atmospheric emissions.[607] The penalties for excess emissions range from production restrictions to suspension of operations for

[599] Climate Change Act, Cap 27 2008, s. 5.
[600] The Greenhouse Gas Emissions Trading Scheme Order 2020 No. 1265.
[601] Directive 2003/87/EC of the European Parliament and the Council of 13 October 2003 establishing a system for greenhouse gas allowance trading within the Union and amending Council Directive 96/61/EC; EU Union Registry (European Union) <https://ec.europa.eu>.
[602] Above n 600, s. 3 and Table C.
[603] Jihon Wang and others "China" in Christopher B. Strong (ed) *The Oil and Gas Review* (7th edn Law Business Research 2019) 56 at 57.
[604] NDRC "Main Functions of the NDRC" (NDRC 17 December 2008) <www.en.ndrc.gov.cn>
[605] Ibid, para. 10.
[606] Mineral Resources Law of the People's Republic of China 1986 (As amended in 1996), art 32.
[607] Environmental Protection Law of the People's Republic of China 2014, arts. 44 and 45.

rectification.[608] These environmental law provisions empower the Ministry of Ecology and Environment to play fundamental regulatory roles regarding mitigating upstream emissions.

There are also emissions reduction targets that are part of general climate governance measures. China's NDCs submitted under the UNFCCC and the Paris Agreement promise 60 to 65% emissions reduction compared to 2005 levels by 2030.[609] The Air Pollution Prevention and Control Action Plan also complements the 2030 target with a commitment of 15% reduction in emissions by 2020 compared with 2015 levels.[610] However, the Act covers only sulphur dioxide, nitrous oxides and particulate matters. There is nothing said about carbon dioxide and methane emissions from upstream oil and gas production. More so, there are no breakdowns or allocations to determine how different sectors will contribute to achieving the set target.

In a virtual broadcast to the United Nations General Assembly Seventy-Fifth Session on 22 September 2020, the Chinese President pledged China's carbon neutrality by 2060.[611] What this goal entails remains unclear. China also needs to clarify this new target's implications for earlier emission reduction goals and the contribution from different carbon-intensive sectors.[612] Some commentators have equally emphasized the necessity of unprecedented massive increase in renewables, complete shutdown of fossil fuels production and consumption, and other valuable strategies to support China's energy and climate governance regime.[613] More so, there is an opportunity for the country to develop measures that target upstream flaring, venting, and fugitive emissions as part of the overarching national plan to reduce GHG emissions leading to carbon neutrality by 2060.

China also recently launched its emissions trading scheme – China ETS [614] – after experimenting with pilot carbon pricing programmes in multiple provinces from 2013 to

[608] Ibid, art. 60.
[609] Enhanced Actions on Climate Change: China's Intended Nationally Determined Contributions 30 June 2015.
[610] Notice of the State Council on Printing and Distributing the Three-Year Action Plan for Winning the Blue Sky Defence War, Released 3 July 2018.
[611] The Virtual Address by President Xi Jinping of the People's Republic of China to the United Nations General Assembly's Seventy-Fifth Session, 22 September 2020, available at <https://news.un.org> and on YouTube at <https://www.youtube.com/watch?v=yYd6Vs_icvE>.
[612] Dennis Normile "Can China, the World's Biggest Coal Consumer, become Carbon Neutral by 2060?" (American Association for the Advancement of Science 29 September 2020) <https://www.sciencemag.org>; Ranping Song "4 Questions about China's New Climate Commitments" (World Resources Institute 30 September 2020) <https://www.wri.org>; Isabelle Gerretsen "5 Burning Questions about China's Carbon Neutrality" (Climate Home News 23 September 2020) <https://www.climatechangenews.com>
[613] Smriti Mallapaty "How China Could be Carbon Neutral by Mid-Century" (2020) 586 Nature 482-483; Josep Borrel "China Carbon Neutrality in 2060: A Possible Game Changer for Climate" (European Union External Action 23 October 2020) <https://eeas.europa.eu>.
[614] Measures for the Administration of Carbon Emissions Trading, effective from 1 February 2021.

2017.[615] The Ministry of Ecology and Environment is responsible for establishing a national carbon market and defining the scope of GHGs and industries that fall under the ETS.[616] Currently, the programme covers only power generation and the petrochemical industry.[617] The Ministry has already retrospectively allocated units to over 2225 companies for GHG emissions from 2019 to 2020.[618] As the China ETS develops, China has an opportunity to capture GHG emissions from other energy-intensive industries, including upstream oil and gas operations. The IEA suggests that, with good policy design and optimal sectoral coverage, China's ETS can emerge the largest globally and become a valuable tool to incentivise emissions reduction.[619]

f) Norway

Norway regulates oil and gas activities on the Norwegian Continental Shelf principally with the Petroleum Act 1996[620] and subsidiary regulations.[621] The Ministry of Petroleum and Energy is responsible for the overall governance of all energy resources. The Norwegian Petroleum Directorate provides advisory, technical, and administrative support to the Ministry and performs the day-to-day regulation of the oil and gas industry.

The Petroleum Act requires production and management of petroleum resources by operators in line with sound technical and economic principles to avoid waste through flaring and venting.[622] It also stipulates suspension of operations if an operator cannot guarantee prudent and safe production.[623] However, there is an exception to the rule against flaring and venting. The Pollution Control Act requires operators to obtain permits for any flaring or venting during operations.[624] The Act empowers the Pollution Control Authority (now merged with the

[615] Thomas Stoerk, Daniel J. Dudek and Jia Yang "China's National Carbon Emissions Trading Scheme: Lessons from the Pilot Emission Trading Schemes, Academic Literature, and Known Policy Details" (2019) 19:4 Climate Policy 472-486; Yifei Hua and Feng Dong "China's Carbon Market Development and Carbon Market Connection: A Literature Review" (2019) 12:1663 Energies 1-25.
[616] Measures for the Administration of Carbon Emissions Trading, art 4.
[617] MEE Release: Emission Allowances to Start E-Trading Soon, available at <http://english.mee.gov.cn/News_service/media_news/202103/t20210302_822946.shtml>.
[618] National Carbon Emissions Trading List of Key Emission Units for Quota Management for 2019-2020, available at <http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf>.
[619] IEA *China's Emissions Trading Scheme: Designing Efficient Allowance Allocation* (IEA 2020) at 5, 19, 64, 78 and 99.
[620] Act 29 November 1996 No. 72 Relating to Petroleum Activities (As Amended by Act 24 June 2011 No 38).
[621] Yngve Bustnesli "Norway" in Christopher B. Strong (ed) *The Oil and Gas Review* (7th edn Law Business Research 2019) 262 at 263.
[622] Act No. 72 Relating to Petroleum Activities 1996 (As amended by Act No. 38 of 2011), ss. 4, 9 and 10.
[623] Ibid, s. 9
[624] Act on Protection against Pollution and on Waste (the Pollution Control Act) of 1983, ss. 11 and 12.

Norwegian Environment Agency under the Ministry of Climate and Environment) to issue these permits to operators on a case-by-case basis.[625]

Norway also simultaneously implements a national carbon tax regime and participates in the EU Emissions Trading Scheme (EU-ETS). Norway was one of the earliest countries to introduce a carbon tax in the early 1990s following an OECD appraisal of market-based policy instruments' efficiency in the mid-1980s and the 1988 Toronto Conference on the Changing Atmosphere.[626] The three other Nordic countries that introduced a carbon tax alongside Norway in the 1990s are Finland, Sweden, and Denmark.[627] Norway's approach to carbon tax and emissions trading dates to its early history of using economic instruments in environmental policy (petroleum tax in 1931, SO_2 tax in 1970 and others), high climate awareness of Norwegians and the general acceptance of a quota system for emissions control.[628] The quota system arises from the country's transposition of the EU-ETS into national regulations that capture upstream oil and gas operations.[629] However, one may ponder the difficulties of implementing a double emissions taxation regime (national carbon tax and the EU-ETS). This dual regime is a unique hallmark of the Norwegian approach to emissions regulation. The country has been able to apportion appropriate emissions costs in line with the polluter-pays principle and with the aid of sound administrative practice and close monitoring.[630]

The Norwegian Carbon Tax Act requires operators to pay a CO_2 tax for burning or discharging natural gas – through either flaring or venting – in connection with petroleum production and transportation.[631] The current (2021) rates are as follows: NOK 1.27 per standard cubic meter of gas; NOK 543 per tonne of CO_2 for combustion from natural gas or its equivalent; and NOK 8.76 per standard cubic meter for emissions from natural gas.[632]

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[625] Ibid.
[626] Mikael Skou Andersen "Environmental and Economic Implications of Taxing and Trading Carbon: Some European Experiences" in Janet E. Milne and Jennifer Kuntz (eds) *The Reality of Carbon Taxes in the 21st Century* (Vermont Law School 2008) 61 at 63.
[627] Ibid.
[628] Per Schreiner, 'The Norwegian Approach to Greenhouse Gas Emissions Trading' (2000) 9:3 Review of European, Comparative and International Environmental Law 239 at 240 and 251.
[629] Regulations on Quota Duty and Trading of Allowances for Greenhouse Gas Emissions (the Greenhouse Gas Emissions Regulation) 2004.
[630] Catherine Banet "Effectiveness in Climate Regulation: Simultaneous Application of a Carbon Tax and an Emissions Trading Scheme to the Offshore Petroleum Sector in Norway" (2017) 1 Carbon and Climate Law Review 25 at 37.
[631] Act No. 72 Relating to Tax on Discharge of CO2 in the Petroleum Activities on the Continental Shelf 1990 (As amended by Act No. 65 of 2015), s. 2.
[632] Norwegian Petroleum Directorate "Emissions to Air" (Norwegian Petroleum Directorate, 3 March 2021) <https://www.norskpetroleum.no/en/environment-and-technology/emissions-to-air/#:~:text=The%20carbon%20tax,-

In addition, Norway has short- and long-term statutory emissions reduction targets set by the Climate Change Act.[633] The short-term target is a 40% reduction in GHG emissions by 2030 compared to 1990 levels.[634] The long-term target is an 80-95% reduction by 2050, thereby making the country a low-emissions society.[635] Recently, Norway has stepped up its short-term target for 2030 to at least 55% reduction in GHG emissions compared to 1990 levels. The country announced this upward revision in its updated NDCs submitted to the UNFCCC Secretariat on 7 February 2020.[636] However, it becomes necessary to amend the Climate Change Act's provisions to harmonize with the revised target communicated to the UNFCCC. While these may seem general targets without direct reference to emissions from oil and gas production, the law and the revised NDCs adopt a sectoral emissions trajectory requiring contributions from different sectors of the economy, including broad energy production and upstream oil and gas emissions.[637] By implication, this brings flaring, venting, and fugitive emissions under the purview of Norway's national climate targets.

The foregoing review has been a lengthy one, but it has provided a robust information base to compare the legal regimes existing in various jurisdictions, especially looking at whether countries have good regulatory arrangements that meet the tests and criteria for effectiveness discussed in Chapter 2. In other words, the first question to ask is whether each petroleum-producing jurisdiction has set a clear objective to reduce upstream GHG emissions? The second question is whether, by their laws and regulations, they have suitable methods to achieve the goal of emissions reduction. Along with these questions, we can also consider whether countries, by their arrangements, have incorporated other criteria for effectiveness as summarised by Baldwin, Cave and Lodge.[638] The next section furthers the analysis to help in answering these questions.

Norway%20was%20one&text=For%202021%2C%20the%20tax%20rate,8.76%20per%20standard%20cubic%20metre>.

[633] Act Relating to Norway's Climate Targets (Climate Change Act), Royal Decree of 16 June 2017 No. 7902018, Effective from 1 January 2018.

[634] Ibid, s. 3.

[635] Ibid, ss. 4 and 5.

[636] Update of Norway's Nationally Determined Contribution, available at <https://www4.unfccc.int>.

[637] Climate Change Act, above n 628, s. 6; Updated NDCs, ibid, para 3(a) and (b).

[638] Above n 194.

B. Comparative Analysis

The overview of the legal and regulatory regimes in the selected petroleum jurisdictions provides raw materials for analysis; and with a view to understand some desirable characteristics of an effective governance regime for mitigating flaring, venting, and fugitive emissions. In furtherance of the comparative analysis, this section will evaluate the dynamics and differences in institutional arrangements, regulatory objectives, and the various methods that diverse countries adopt for addressing flaring, venting, and fugitive emissions. These would also be considered alongside the tests and criteria established in Chapter 2 for determining an effective regulatory regime for mitigating upstream GHG emissions. Table 1 presents a quick summary of the circumstances in the case study countries. The table is a good way to compare the regimes of different petroleum jurisdictions and helps to distil regulatory characteristics that apply to the subject of inquiry easily. It is also a good reference point for what to expect in the detailed analysis that comes in the next couple of sections.

Table 1: Summary of regime dynamics in case study countries

S/N	Country	Designation	Institutions at Work	Dominant Institution(s)	Key Laws and Regulations	Regulatory Objectives	Regulatory Methods
01	Iraq	IEA-Designated Producer Economy	Ministry of Oil. Ministry of Environment	Ministry of Oil	Conservation Law. Iraqi Hydrocarbon Law. Iraqi Environmental Law.	Resource conservation; Environmental protection	Flaring prohibition and a permit system; General obligations on resource conservation and waste prevention; General obligations on environmental protection.
02	Nigeria	IEA-Designated Producer Economy	Ministry of Petroleum Resources	Ministry of Petroleum Resources	Petroleum Act; Associated Gas Re-injection Act. Gas Flaring (Prohibition) Act 2019. Flare Gas (Prevention of Waste and Pollution) Regulations. National Action Plan to Reduce Short-Lived Climate Pollutants	Resource conservation; Environmental protection; Specific regulation of upstream emissions and targeting flaring reduction and gas utilization.	Flaring prohibition and a permit system; General obligations on resource conservation and waste prevention; General obligations on environmental protection; Flaring limits. Pricing mechanism: monetary penalty for flaring; Metering and quantification. Emissions reporting. Pricing flared gas.
03	Russia	IEA-Designated Producer Economy	Federal Agency for Subsoil Use. Ministry of Natural Resources and the Environment.	Ministry of Natural Resources and the Environment	Russian Subsoil Law. Production Sharing Agreement Law. Resolution 39 of 2020. Environmental Protection Law.	Environmental protection. General climate doctrine requiring safe and sustainable development.	Pricing of environmental externalities. Fiscal support for gas utilization.
04	Saudi Arabia	IEA-Designated Producer Economy	The Supreme Council for Petroleum and Mineral Affairs.	Ministry of Environment, Water and Agriculture	Basic Law of 1992. General Environmental Law of 2001;	Resource conservation; Air quality improvements; Environmental protection.	General obligations on environmental protection and resource conservation. Specific technical requirements on air quality improvement.

			Ministry of Petroleum and Natural Resources Ministry of Environment, Water and Agriculture.				
05	UAE (Abu Dhabi)	IEA-Designated Producer Economy	The Supreme Petroleum Council. Ministry of Energy and Infrastructure. Ministry of Environment.	Ministry of Energy and Infrastructure	The UAE Constitution. Petroleum Conservation Law 1978. Gas Law 1976. Petroleum Conservation Law. UAE Environmental Law.	Resource conservation. Environmental protection. Associated gas flaring reduction and utilization.	Flaring prohibition and a permit system. Gas re-injection and utilization requirements. Resource conservation and environmental protection obligations.
06	Venezuela	IEA-Designated Producer Economy	Ministry of Energy and Mines. Ministry of Environment and Renewable Natural Resources.	Ministry of Environment and Renewable Natural Resources.	The Constitution. The Organic Gaseous Hydrocarbons Law. The Organic Hydrocarbons Law. Norms on Air Quality and Atmospheric Pollution. Criminal Environmental Law.	Resource conservation. Environmental protection. Atmospheric air quality. Flaring restriction	Resource conservation and environmental protection obligations. Corporate criminal liability for flaring. Flare restriction measures.
07	Brazil	Non-IEA-Designated Producer Economy	National Council for Energy Policy. Ministry of Mines and Energy.	National Petroleum, Natural Gas and Biofuels Agency.	Petroleum Law. Gas Law. Pre-Salt Law.	Resource conservation. Environmental protection.	Resource conservation and environmental protection obligations.

			National Petroleum, Natural Gas and Biofuels Agency.		ANP Resolution No. 806 of 17 January 2020 on Gas Flaring.	Flaring limitation and gas utilization.	Proportional gas utilization per production field (85% of associated gas utilization).
08	USA	Non-IEA-Designated Producer Economy					
			Institutions at Work	Dominant Institution(s)	Key Laws and Regulations	Regulatory Objectives	Regulatory Methods
			Bureau of Land Management. The United States Environmental Protection Agency	The United States Environmental Protection Agency.	Clean Air Act. Federal Land Policy and Management Act. BLM Waste Prevention Rule. USEPA Performance Standards.	Resource conservation and waste prevention. Environmental protection. Elaborate regulation specifically targeting air quality, flaring, venting, fugitive emissions and volatile organic compounds.	Resource conservation and environmental protection obligations. Emissions limitation. Technical specifications/standards on components of assets and processes of petroleum production. Implementation of leak detection and repair programmes. Gas utilization and reinjection obligations. Emissions data reporting.
		State	Dominant Institution(s)	Key Laws and Regulations		Regulatory Objectives	Regulatory Methods
	8(a)	Texas	Railroad Commission of Texas. USEPA	Natural Resources Code, Title 3 Chapter 81. State-wide Rule 32. USEPA Standards.		Resource conservation. Environmental protection. Specific flaring regulation. USEPA's elaborate standards targeting gas flaring and other emissions sources.	Resource conservation and environmental protection obligations. Efficiency in gas to oil ratio. Flaring prohibition and a permit system. In addition to USEPA measures

	8(b)	North Dakota	North Dakota Industrial Commission. USEPA	North Dakota Century Code, Chapter 38. Gas Capture Policy. USEPA Standards.	Resource conservation. Environmental protection. Specific flaring regulation. USEPA's elaborate standards targeting gas flaring and other emissions sources.	Resource conservation and environmental protection obligations. Gas capture. Efficient gas to oil rations (75% gas utilization). Price mechanism: payment of equal monetary value for flared gas. In addition to USEPA measures.
	8(c)	Alaska	Alaska Oil and Gas Conservation Commission. USEPA	Alaska Oil and Gas Conservation Act. Alaska Administrative Code. USEPA Standards.	Resource conservation. Environmental protection. Regulation targeting flaring. USEPA's elaborate standards targeting gas flaring and other emissions sources	Resource conservation and environmental protection obligations. General practice regulation: good oilfield practice for asset integrity and flaring minimization. Price mechanism: double of the fair market value for flared gas. In addition to USEPA measures
	8(d)	California	California Air Resources Board. Geologic Energy Management Division of the Department of Conservation. USEPA	California Public Resources Code. Global Warming Solutions Act. Low Carbon Fuel Standard. Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities. USEPA Standards	Resource conservation. Environmental protection. Climate change regulation. Specifically regulating petroleum sector GHG emissions. Regulation targeting vented and fugitive emissions. USEPA's elaborate standards targeting gas flaring and other emissions sources.	Resource conservation and environmental protection obligations. General and sector-specific climate targets. Technical standards covering processes and installations that are sources of GHG emissions. Energy intensity and efficiency controls. In addition to USEPA measures

09	Canada	Non-IEA-Designated Producer Economy	Institutions at Work	Dominant Institution(s)	Key Laws and Regulations	Regulatory Objectives	Regulatory Methods
			Canadian Energy Regulator. Ministry of Environment. Ministry of Natural Resources.	Ministry of Environment and Ministry of Natural Resources	Canadian Petroleum Resources Act. Oil and Gas Activities Act. Drilling and Production Regulations. Canadian Environmental Protection Act. Greenhouse Gas Pollution Pricing Act. Output-Based Pricing System Regulations.	Resource conservation. Environmental protection. Specifically regulating upstream GHGs.	Resource conservation and environmental protection obligations. General and industry-specific emission reduction targets. Emissions data reporting. Pricing mechanism. Leak detection and repair programmes.

	Province	Dominant Institution(s)	Key Laws and Regulations	Regulatory Objectives	Regulatory Methods
9(a)	Alberta	Alberta Energy Regulator	Oil and Gas Conservation Act. Oil and Gas Conservation Rules. Alberta Regulation 151/1971. Alberta Regulation 165/2020. Oil Sands Conservation Act. Oil Sands Conservation Rules. Oil Sands Emissions Limit Act. Responsible Energy Development Act. Alberta Energy Regulator Directive 060	Resource conservation. Environmental protection. Specifically regulating upstream GHGs.	Resource conservation and environmental protection obligations. Industry-specific emission reduction targets. Emissions limits and a permit system. Energy efficiency and performance requirements. Emissions data reporting. Leak detection and repair programmes.

	9(b)	Saskatchewan	Ministry of Energy and Resources	Oil and Gas Conservation Act. Oil and Gas Conservation Regulations. Saskatchewan Greenhouse Gases Act. Climate Change Strategy. Methane Action Plan. Output-Based Performance Standards. Oil and Gas Emissions Management Regulation.	Resource conservation. Environmental protection. General climate change controls. Specifically regulating upstream GHGs.	Resource conservation and environmental protection obligations. Emissions limit and a permit system. Gas utilization and reinjection requirements. Industry-specific emission reduction targets. Pricing mechanism in the form of an administrative penalty for excess emissions;
	9(c)	Newfoundland and Labrador	Canada-Newfoundland and Labrador Offshore Petroleum Board	The Atlantic Accord. The Atlantic Accord Implementation Act. Greenhouse Gas Management Act. Greenhouse Gas Management Regulations. Petroleum Drilling Regulations. Petroleum and Natural Gas Act.	Resource conservation. Environmental protection. Specifically regulating upstream GHGs.	Resource conservation and environmental protection obligations. Sector-specific incremental annual emissions reduction target – for 2019 (6%), 2020 (8%), 2021 (10%), 2022 and subsequent years (12%). Mandatory annual GHG emissions reporting. Emissions reduction and performance credit scheme. Obligation to adopt best available technologies for GHG mitigation.
	9(d)	British Columbia	British Columbia Oil and Gas Commission	Oil and Gas Activities Act. Drilling and Production Regulation. Flaring and Venting Reduction Guideline	Resource conservation. Environmental protection. Specifically regulating upstream GHGs.	Resource conservation and environmental protection obligations. Optimal gas utilization to flaring ratio: obligation to utilize 95% of gas in the petroleum recovery process. Operational flaring limits. Leak detection and repair programmes. Mandatory emissions reporting. Efficiency requirements for components and facilities

10	UK	Non-IEA-Designated Producer Economy	Oil and Gas Authority. Offshore Petroleum Regulator for Environment and Decommissioning.	The Oil and Gas Authority for the industry and the Offshore Petroleum Regulator specifically for Environment and Decommissioning for offshore operations.	Petroleum Act of 1998. Energy Act of 1976. Offshore Petroleum Production and Pipelines Regulation 1999. The 2017 Guidance Note of the Offshore Petroleum Regulator for Environment and Decommissioning. Offshore Combustion Installations Regulations.	Resource conservation. Environmental protection. General climate change governance and emission reduction targets. Sector-specific regulation of upstream GHGs	Resource conservation and environmental protection obligations. Emissions prohibition and permit system. Emissions monitoring and reporting schemes. Requirement to disclose best available technologies for GHG mitigation. Pricing mechanism
11	China	Non-IEA-Designated Producer Economy	National Energy Administration. Ministry of Natural Resources. Ministry of Ecology and Environment	Ministry of Ecology and Environment	Mineral Resources Law. Oil and Gas Pipeline Protection Law. Atmospheric Pollution Prevention and Treatment Law. Environmental Protection Law. Air Pollution Prevention and Control Action Plan	Resource conservation. Environmental protection. General climate goals. Air quality improvements.	Resource conservation and environmental protection obligations; Emissions quota system. A permit system for the discharge of atmospheric pollutants.

12	Norway	Non-IEA-Designated Producer Economy	Ministry of Petroleum and Energy. Norwegian Petroleum Directorate.	Norwegian Petroleum Directorate	Petroleum Act 1996. Climate Change Act. Carbon Tax Act. Pollution Control Act. Carbon Capture and Storage Regulations.	Resource conservation. Environmental protection. General climate goals. Regulations targeting upstream emissions	Resource conservation and environmental protection obligations; Strict carbon pricing schemes (national carbon pricing legislation and EU-ETS). Flaring avoidance obligation and emissions permit system. Close monitoring and emissions reporting.

Table 1 reveals diverse characteristics relating to the regulation of upstream GHG emissions in different petroleum-producing jurisdictions. In all the focus countries, there are different institutions at work, although some regulatory agencies wield greater powers regarding the control of flaring, venting, and fugitive emissions. The table also shows the existence of multiple laws with different regulatory objectives in the case study countries. These are petroleum (oil and gas) laws and regulations, environmental laws, conservation laws, climate change laws, and specific laws and regulations that target upstream GHG emissions. The analysis that comes later in this part of the chapter will examine these types of laws and regulations to understand which ones will be best suitable for incentivising upstream GHG emissions reduction.

What we also see summarily in Table 1 is that countries adopt different methods to control upstream GHG emissions, particularly flaring, venting, and fugitive emissions. These methods are flaring prohibition and permit systems, general obligations on resource conservation, environmental protection and waste prevention, pricing mechanisms, metering and emissions quantification, proportional gas utilization, technical specifications for emissions control, and emissions reduction targets. While these all appear in Table 1, only a few jurisdictions apply industry- and issue-specific approaches that go beyond general environmental or petroleum regulation provisions for addressing flaring, venting, and fugitive emissions particularly. The next three sub-sections will present a synthesis of Table 1 and the laws described in Part A of this chapter. The analysis will also help to distil the institutional and regulatory arrangements and methods that should characterise a good governance regime for effectively reducing upstream GHG emissions.

1. Different Institutions at Work

What we have seen in the foregoing account of the relevant laws of a number of countries is that various institutional arrangements exist for governing the oil and gas industry and for regulating upstream GHG emissions. The conventional ministries of energy or petroleum, environment, and natural resources are at work, with either ministry playing more active roles in abating flaring, venting, and fugitive emissions. Thus, this study identifies three different patterns. The first is the category of jurisdictions where the industry regulator – the ministry of energy or petroleum – plays a dominant role. The countries that show this pattern are Iraq, Nigeria, the UAE, Brazil, the UK, Norway, US states and Canadian provinces. In the second pattern, the ministry of the environment plays a more active role. This occurs in Saudi Arabia, Venezuela, China, the US, and Canadian federal levels. In the third pattern, which is seen only

in Russia, there is a fusion of industry- and environment-centric objectives to create a single regulatory institution for addressing upstream GHG emissions.

A fundamental question for consideration is whether the institutional character prevalent in a country determines the effectiveness of the regulatory regime in abating upstream GHG emissions. For example, will the industry regulator become industry-friendly and produce a bad result? Alternatively, will countries achieve better results if the ministry of environment regulates upstream GHGs? The regulation literature suggests that regulatory capture can set in when there is a closeness between an industry-centric regulator and the regulated industry.[639] Within this study's context, it can be a close relationship between the ministry of energy or petroleum and the oil and gas industry. Carpenter and Moss have defined regulatory capture as "...the result or process by which regulation, in law or application, is consistently or repeatedly directed away from the public interest and toward the interest of the regulated industry, by the intent and action of the industry itself."[640] The implication is that the oil and gas industry may get away with breaches to set standards or even operate in an atmosphere of lax rules because of a friendly regulator.[641] However, that is not always the case. For example, the industry-centric regulators in Norway, US states, and Canadian provinces have formulated more robust and suitable regulatory measures for addressing upstream GHG emissions than those in Iraq, Nigeria, Russia, Saudi Arabia, the UAE and Venezuela. This fact suggests the need to look closely at regulatory objectives in the case study countries because the regulatory institutions merely perform responsibilities and exercise powers set out in their establishing legislation or relevant statutory instruments. Hence, there is a nexus between regulatory performance and regulatory objectives.

2. Different Regulatory Objectives

The case study countries have varied regulatory objectives regarding the governance of the oil and gas industry. Even within a country, there are also multiple regulatory purposes. One central question is whether regulatory and statutory instruments clearly define the goals for which the relevant institutions should exercise regulatory powers. A corollary task is to

[639] Toni Makkai and John Braithwaite, 'In and Out the Revolving Door: Making Sense of Regulatory Capture' (1992) 12:1 Journal of Public Policy 61.
[640] Daniel Carpenter and David A. Moss (eds), *Preventing Regulatory Capture: Special Interest Influence and How to Limit It* (Cambridge University Press 2013) at 13.
[641] Marshall B. Clinard and Peter C. Yeager *Corporate Crime* (Routledge 2017) at 106; Fiona Haines, *The Paradox of Regulation: What Regulation Can Achieve and What it Cannot* (Edward Elgar 2011) at 19.

examine the policy rationales behind different regulatory regimes and their limitations. These could explain the circumstances and performance of institutions across the case study countries.

From the overview of regimes above, the principal regulatory objectives across petroleum jurisdictions include resource conservation; general industry governance; environmental protection; climate change governance; health, safety, and asset integrity controls. Some regulations particularly target air quality improvements, flaring, and other upstream-specific GHG emissions. This present analysis will identify suitable regulatory approaches for the research inquiry.

a) Resource conservation

Resource conservation embodies the core themes of maintenance, waste avoidance, preservation, and sustainable natural resources utilization.[642] From a legal perspective, there can be legislative and regulatory frameworks for conserving natural resources broadly – for plants, energy, animals, aquatic and wildlife species, birds, natural habitats, and the natural environment.[643] However, the term's contextual use here is the conservation of oil and gas resources and conservation legislation or regulation as a tool for reducing upstream petroleum emissions. In addition, we may usefully ask what regulatory theories become clear in the adoption and practice of resource conservation legislation?

In multiple oil and gas producing jurisdictions, the regulatory objective of conserving resources shows in different ways – sometimes directly as resource conservation, sometimes indirectly as waste prevention, resource preservation, optimal utilization, and sustainable development. Part A of this chapter drew attention to the prevalence and history of resource conservation as a significant form of regulation in Canada and the US's legislative frameworks. A historical context may provide a better understanding because of the connection between oil and gas conservation legislation and the petroleum industry's history. There is disagreement over the industry's commencement date, as the accounts of Saltzman[644] and Habashi[645] reveal.[646]

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[642] IUCN (ed) *World Conservation Strategy: Living Resources Conservation for Sustainable Development* (IUCN-UNEP-WWF 1980) at 1; Anil Markandya and others *Dictionary of Environmental Economics* (Earthscan, London 2001) at 45-46; Chris Park and Michael Allaby *A Dictionary of Environment and Conservation* (3rd edn OUP Online 2017 eISBN: 9780191826320) available at <https://www-oxfordreference-com>.

[643] Christopher P. Rodgers *The Law of Nature Conservation* (OUP 2013) 1-32.

[644] Martin D. Saltzman "The Art of Distillation and the Dawn of the Hydrocarbon Society" (1999) 24 Bulletin for History of Chemistry 53.

[645] Fathi Habashi "The First Oil Well in the World" (2000) 25:1 Bulletin for History of Chemistry 64.

[646] This disagreement appears in two different accounts published by the Bulletin for History of Chemistry. Saltzman (above n 644) accounts that the oil industry began when Edwin L. Drake (1819-1880) drilled the first well that produced crude at Titusville, Pennsylvania on 27 August 1859. Habashi's (above n 645) contrary account is that "the oil industry actually began one year earlier in 1858 when the Canadian entrepreneur James Miller Williams (1818-1890) drilled and successfully produced oil in the township of Enniskillen between Lake Erie and

However, this examination draws from Daintith's comprehensive text on the rule of capture and its resource conservation implications,[647] the works of Weaver and Asmus,[648] and other scholars in the field of petroleum law.

After the commercial discovery in Pennsylvania, crude oil production spread across 11 American states in the nineteenth century when the industry was largely unregulated.[649] The common law rule of capture governed production. The rule simply means that a landowner can collect crude resources flowing through or underneath his or her land. Daintith[650] refers to Hardwicke's framing of the principle, as it applies to petroleum resources, as a suitable description:

> The owner of a tract of land acquires title to the oil or gas which he produces from wells drilled thereon, though it may be proved that part of such oil or gas migrated from adjoining lands.[651]

In principle and fact, this migration of crude oil happens due to the reservoir rock's permeability and porosity. The rule of capture encouraged rapid and indiscriminate drilling by developers and landowners, who drilled within the confines of their surface and subsurface rights to properties.[652] This problem was not peculiar to the United States and featured in several countries where oil development was contemporary with that in the United States: Russia, Romania, and Austrian Galicia.[653] Williams captures the result of the drilling rush as "profligate drilling and tremendous physical waste", necessitating state legislation targeting wasteful drilling in Oklahoma, Louisiana, and Arkansas.[654] Other American states began to enact conservation statutes for waste prevention and flaring prohibition.[655] Subsequently, legislation stipulated prorationing, well spacing, and compulsory pooling and unitization by

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Lake Huron near the town later named Oil Springs in what is now Southwest Ontario." Whichever the case, it is clear that the industry began in the nineteenth century.

[647] Terence Daintith *Finders Keepers? How the Law of Capture Shaped the World Oil Industry* (Routledge 2010).

[648] Jacqueline Lang Weaver and David F. Asmus "Unitizing Oil and Gas Fields Around the World: A Comparative Analysis of National Laws and Private Contracts" (2006) 28:1 Houston Journal of International Law 3-197.

[649] Daintith, above n 642, at 171. See also Samuel D. Myres *The Permian Basin: Petroleum Empire of the Southwest: Era of Advancement, from the Depression to the Present* (1977 El Paso: Permian Press) at 51-53.

[650] Daintith, above n 647, at 7.

[651] Robert E. Hardwicke "Rule of Capture and its Implications As Applied to Oil and Gas" (1935) 13 Texas Law Review 391 at 393.

[652] Owen L. Anderson "Foreword: The Evolution of Oil and Gas Conservation Law and the Rise of Unconventional Hydrocarbon Production" (2015) 68 Arkansas Law Review 231 at 232-233.

[653] Terence Daintith "The Rule of Capture: The Least Worst Property Rule for Oil and Gas" in Aileen McHarg and others *Property and the Law in Energy and Natural Resources* (OUP 2010) 140 at 143.

[654] Howard R. Williams "Conservation of Oil and Gas" (1952) 65:7 Harvard Law Review 1156 at 1159.

[655] Laura H. Burney "A Pragmatic Approach to Decision Making in the Next Era of Oil and Gas Jurisprudence" (1996) 16: 1 Journal of Energy, Natural Resources, and Environmental Law 1 at 21.

operators.[656] Prorationing means setting production limits and the allocating of permitted production among different producers.[657] Well spacing requires the drilling of oil wells within set parameters. For example, in Oklahoma, the spacing rule prohibited drilling within 300 feet of a property line.[658] Pooling and unitization rules require multiple operators to pool acreage and resources to produce as a unit instead of indiscriminate drilling practices that brought derricks very close to each other.[659] These regulatory practices are like developments in Canada, leading up to the enactment of Canadian conservation legislation.[660]

An important question to ask, within the scope of this thesis, is whether the resource conservation objective (and by extension resource conservation legislation or regulation) is suitable to address upstream GHG emissions? As the history of conservation in the petroleum industry shows, conservation measures initially emerged to solve the problems associated with the rule of capture – indiscriminate drilling and waste. In the US, the nineteenth century's conservation movement argued the likelihood of economic problems if indiscriminate drilling and waste continued unabated.[661] One commentator observes that the original purpose of conservation legislation was "to protect the producers' correlative rights and maintain the health of the industry by prevention of waste and to seek the greatest ultimate recovery of the resource."[662]

There is some logic in the possibility of minimizing the environmental impacts of petroleum production through efficient conservation measures.[663] The identified core themes of conservation – resource maintenance, resource preservation, and sustainable utilization of resources – may help. Suppose a piece of legislation or regulation sets rules for the optimal maintenance, preservation and utilization of resources. In that case, oil producers may reduce

[656] For a comprehensive historical account on the history of legislative and regulatory solution to the rule of capture, indiscriminate drilling and waste, see Daintith *Finders Keepers*, above n 647, at 245-280; Anderson, above n 652. See also Williams, above n 654, at 1159; Gary D. Libecap and James L. Smith "Regulatory Remedies to the Common Pool: The Limits to Oil Field Unitization" (2001) 22:1 The Energy Journal 1-26.
[657] Daintith ibid, at 238.
[658] Ibid, at 259.
[659] Ibid, at 268-276.
[660] Nigel Bankes "Compulsory Pooling under the Oil and Gas Conservation Act of Alberta" (1996) 35 Alberta Law Review 945-1012. See also Greg Moores, Mark Andrews and Amanda Whitehead "Waste Not, Want Not: Waste as a Tool of Resource Conservation in the Atlantic Canadian Offshore" (2018) 56 Atlanta Law Review 315.
[661] Wm E. Colby "The Law of Oil and Gas: With Special Reference to the Public Domain and Conservation" (1942) 30:3 California Law Review 245 at 267.
[662] Thomas A. Mitchell "The Future of Oil and Gas Conservation Jurisprudence: Past as Prologue" (2010) 49 Washburn Law Journal 379 at 422.
[663] David E. Pierce "Minimizing the Environmental Impact of Oil and Gas Development by Maximizing Production Conservation" (2009) 85:4 North Dakota Law Review 759.

the extent of environmental effects associated with oil production. However, most jurisdictions use conservation for maximum resource exploitation for economic benefit and a general sense of environmental protection, without a clear target to reduce GHG emissions. This is the case in the conservation laws of Venezuela, Brazil, the US, and Canada.

The US state of California provides an excellent example of how resource conservation legislation may address upstream GHG emissions and give regulators more clarity for exercising powers. The refocused definition of resource conservation in California captures GHG emissions associated with the development of hydrocarbon and geothermal resources.[664] This notable redefinition is relevant for addressing flaring, venting, and fugitive emissions under conservation legislation. It clarifies the purposes for which regulators can exercise power to conserve resources. Other jurisdictions could adopt the California example to improve their regulatory regimes. Thus, regulators and legislatures can draft conservation legislation or regulation to be more comprehensive and specific in their coverage. The law can be comprehensive to the extent that it captures different implications of resource conservation and economic objectives. It can then be specific to the extent that it captures practicable requirements and approaches to reducing flaring, venting, and fugitive emissions in upstream petroleum operations.

b) General petroleum governance and environmental regulation

In addition to the general purpose of conservation, many petroleum jurisdictions have the predominant objective of providing general petroleum industry governance and environmental protection. These frameworks attempt to strike a balance between economic interests and environmental or climate change concerns. The quest for this balance has been more important in recent years because of heightened climate change concerns, the interconnection between energy and the environment, and the energy sector's importance to all of humanity.[665] These regimes express notions of conservation and waste avoidance as provisions in conventional petroleum and environmental laws. These laws oblige producers to reduce associated environmental issues in oil and gas upstream activities such as flaring, oil spills and black carbon emissions. Some expressly prohibit flaring. Some others capture emissions control under blanket requirements such as prevention, remediation, precaution, the polluter-pays

[664] Assembly Bill No. 1057, above n 447, at s. 9 amending s 3011 of the California Public Resources Code.
[665] Robert Falkner "Global environmental Politics and Energy: Mapping the Research Agenda" (2014) 1 Energy Research and Social Science 188-197.

principle, environmental responsibility, public participation, and environmental impact assessment.

As the regulatory overview above shows, these general frameworks are prevalent in Iraq, Russia, Brazil, China, Venezuela, the UAE, and Nigeria. Therefore, almost all IEA-designated producer economies have the objectives of general petroleum industry governance and environmental controls. However, Nigeria has recently shifted from these general frameworks by enacting regulations specifically targeting flaring and venting. There is more to say about this in subsequent sections of this chapter. These general objectives and frameworks also exist in other case study countries. While they are more predominant in IEA-designated producer economies, some non-IEA-designated producer economies, such as the US, Canada, and Norway, go beyond generalities to provide sector-specific regulatory interventions for mitigating flaring, venting, and fugitive emissions.

Environmental laws that exclude upstream emissions do not help incentivize concrete actions to reduce flaring, venting, and fugitive emissions. There is undoubtedly a relationship between general environmental controls and upstream GHGs to the extent that upstream emissions constitute an environmental menace in need of regulatory intervention. Apart from the skeletal reference to flaring and the general obligation to protect the environment, these environmental controls do not encourage the large-scale reduction of upstream GHG emissions. For example, in Nigeria, the environmental law regulates effluents and air emissions, excluding emissions from the oil and gas sector.[666] This is a clear case where more sector-specific regulatory interventions are necessary, despite the relationships between general environmental controls and upstream GHG emissions. Thus, upstream decarbonisation will need regulatory and policy frameworks that build on general environmental law principles.[667] In addition to building on these principles, such coordinated frameworks would reflect concrete and tailored measures in the context of upstream emissions. Specific prescriptive rules-based regimes may be more suitable for this purpose. The countries with more robust legal frameworks (summarized in

[666] Above n 307.

[667] Commission of the European Communities *Strategy Paper for Reducing Methane Emissions (Communication from the Commission to the Council and to the European Parliament)* Brussels, 15 January 1996 COM (96) 557 Final; James Bradbury and others *Clearing the Air: Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems* (World Resources Institute Policy Paper, April 2013); Suzi Kerr and Vicki Duscha *Going to the Source: Using an Upstream Point of Regulation for Energy in a National Chinese Emissions Trading System* (Motu Working Paper 14-09, Motu Economic and Public Policy Research, September 2014); Maria Olczak and Andris Piebalgs *How Far Should the New EU Methane Strategy Go?* (Florence School of Regulation Policy Brief, Issue 2019/07 April 2019).

Table 1) – especially the US and Canada – have clearly defined regulatory arrangements that go beyond general environmental principles and objectives to provide sector-specific technical requirements for addressing upstream GHG emissions.

c) Health, safety, and asset integrity

Like general environmental controls, all petroleum-producing jurisdictions have a regulatory objective to ensure health and safety in oil and gas operations as part of their overall industry governance framework. There is also some relationship between health, safety, and environmental (HSE) concerns and upstream GHG emissions, to the extent that emissions could occur because of breaching industry HSE standards for operations and production facilities. This can also have health implications for industry workers and inhabitants of the immediate environment surrounding production facilities. These are also the underlying rationales for avoiding oil spills, leaks, and catastrophic accidents such as the Piper Alpha explosion and the Deep-Water Horizon oil spill.

Consequently, upstream GHGs are almost certainly a HSE issue, but there is more to do beyond general health and safety obligations. Some jurisdictions ensure asset integrity of oil and gas production facilities and installations to avoid leaks (fugitive emissions). As Section A above revealed, we find such provisions and practices such as leak detection and repair obligations in the US and Canada. Other countries can follow the American and Canadian examples.

d) Specific upstream emissions regulation

There are also petroleum jurisdictions that set out to regulate upstream GHG emissions through specific binding rules, in addition to general industry governance, resource conservation and environmental protection. A measure of prescription in national legal regimes that seek to achieve emissions reduction in the upstream petroleum industry can incentivise good practices.[668] In addition, Warnock provides some useful insights about context from an environmental law perspective, when she argued that the inherent structural features of environmental problems cause environmental laws to be written in a particular way.[669] Given that upstream GHG emissions – flaring, venting, and fugitive emissions particularly – are part of contemporary environmental problems, it is important for countries to enact context-specific laws and regulations. It may be possible to repurpose environmental laws to clearly capture flaring, venting, and fugitive emissions or make new laws that are suitable. The latter part of

[668] Chris Malins and others *Reduction of Upstream Greenhouse gas Emissions from Flaring and Venting* (Report of the International Council on Clean Transportation 2014).
[669] Ceri Warnock "Environment and the Law: The Normative Force of Context and Constitutional Challenges" (2020) 32 Journal of Environmental Law 365-389.

this chapter will revisit this issue to provide more insights after a comprehensive analysis of related and relevant issues.

Regulators have an opportunity to design well-tailored frameworks for the industry. The targeted measures that the United Nations Environment Programme for mitigating upstream GHG emissions – efficient gas recovery and utilization and addressing fugitive emissions through the implementation of leak detection and repair programmes[670] – can be included in specific regulatory instruments that target flaring, venting and equipment leaks. Some other good design examples are evident in the regulatory regimes of different petroleum jurisdictions above. These are emissions reduction targets, flare prohibition and stringent permit systems, carbon pricing (taxes and emissions trading schemes), compliance reporting and monitoring. These, unlike general abstract environmental law principles, provide industry-specific solutions for reducing upstream flaring, venting, and fugitive emissions. They will receive detailed attention in the next section as specific regulatory methods.

The regulatory review in section A of this chapter reveals the US, Canada, the UK, Nigeria, and Norway as examples of petroleum-producing jurisdictions with an objective specifically to regulate upstream GHG emissions. While Nigeria's regulatory framework is emerging, in the recent effort to target gas flaring, the US, Canada, the UK, and Norway have more robust and comprehensive measures that address upstream GHG emissions. Two key elements in these countries' regulatory frameworks (especially in the US, Canada, the UK, and Norway) are specificity and prescription. Specificity means that there is a particular regulation for addressing upstream emissions. Prescription means that law stipulates rules that operators must comply with or implement to reduce upstream GHG emissions. There is an element of specificity in Saudi Arabia, but the focus is on air quality improvements and not upstream GHGs.[671] Apart from Nigeria, no other IEA-designated producer economies in this study target upstream GHG emissions, other than the skeletal reference to flaring. This observation is a clear contrast between IEA-designated producer economies and other leading producer economies. However, IEA-designated producer countries' economic peculiarities, highlighted in Chapter 1, do not exist in the jurisdictions with more structured and robust regulatory regimes. A significant positive impact for targeting upstream emissions with specific and prescriptive regimes is that they have a comparatively higher potential to influence emissions abatement. The reason is the use of well-structured requirements and strategies that are issue-

[670] UNEP, above n 131, at 5, 9, 10, 13 and 15.
[671] As seen in Part A, Section 1, sub-section (d) of this chapter.

and sector-specific, unlike the conventional provisions of petroleum legislation and general principles of environmental law.

e) General principle regulation: Good oilfield practice

A common feature in most petroleum-producing countries is to require operators to adopt 'good oilfield practice' while carrying out industry operations. This general principle has received attention in the literature, both in energy and petroleum law regulation[672] and commercial transactions between companies, for example, in joint venture arbitrations.[673] There is also a theory that this common requirement is a form of transnational petroleum law.[674] It appears as part of regulatory requirements on environmental protection in oil and gas activities in many countries' legal regimes, such as Iraq, the US, and the UK.[675] There are other common environmental jurisprudence concepts used interchangeably with good oilfield practice to express the idea of environmental safety in oil and gas operations. Some of them that recur in the literature are proper and workmanlike manner, best available control technology, good production practice, diligent and prudent operations.[676] The Association of International Petroleum Negotiators model for joint operating agreements recognises 'good and prudent industry practice.'[677] Besides, different industries have similar general practice regulation phrases. For example, a construction or engineering contract usually requires the contractor to execute the job in a good workmanlike manner, using best trade or industry practice.[678]

For present purposes, the focus is limited to 'good oilfield practice' regarding the oil and gas industry. What does it mean? What is its efficacy for incentivising upstream GHG emissions

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[672] John A.P. Chandler *Petroleum Resource Management: How Governments Manage Their Offshore Petroleum Resources* (Edward Elgar Publishing 2018) 163 at 185-195.
[673] Martin Hunter and Anthony C. Sinclair "Aminoil Revisited: Reflections on a Story of Changing Circumstances" in Todd Weiler (ed) *International Investment Law and Arbitration: Leading Cases from the ICSID, NAFTA, Bilateral Treaties and Customary International Law* (Cameron 2005) 347-381.
[674] Alfredo De Jesús O. *The Prodigious Story of the Lex Petrolea and the Rhinoceros: Philosophical Aspects of the Transnational Legal Order of the Petroleum Society* (Transnational Petroleum Law Institute Series on Transnational Petroleum Law Vol. 1 No. 1 2012) at 23; John P. Bowman "Lex petrolea: Sources and Successes of International Petroleum Law" (2015) 39 Texas State Bar Oil, Gas & Energy Res. L. Sec. Rep. 81; Alex Wawryk "Petroleum Regulation in an International Context: The Universality of Petroleum Regulation and the Concept of Lex Petrolea" in Tina Hunter (ed) *Regulation of the Upstream Petroleum Sector: A Comparative Study of Licensing and Concession Systems* (Edward Elgar Publishing 2015) 3 at 32; Terence Daintith "Against '*Lex Petrolea*'" (2017) 10 Journal of World Energy Law and Business 1 at 8-10.
[675] As identified in Part A of this chapter.
[676] Ibiba Lucky Worika "Environmental Concepts and terms in Petroleum Legislation and Contracts: A Preliminary Study" in Chih-kuo Kao and Zhiguo Gao (eds) *Environmental Regulation of Oil and Gas* (Kluwer Law International 1998) 393 at 395-403; Nicholas P. Cheremisinoff and Paul Rosenfeld *Handbook of Pollution Prevention and Cleaner Production – Best Practices in the Petroleum Industry* (Elsevier 2010) 121-177 and 179-225.
[677] AIPN Model Joint Operating Agreement 2012 Version, available at <www.aipn.org>.
[678] Axel-Volkmar Jaeger and Götz-Sebastian Hök *FIDIC: A Guide for Practitioners* (Springer, Berlin, Heidelberg 2010) at 46, 100, 192, 198-213.

reduction? For meaning, it qualifies as one of those fluid terminologies amenable to different interpretations by lawyers, academics, engineers and economists.[679] It is not a fixed standard but rather a good example of general principle phrases that engender technical and environmental standards in petroleum law and contracts.[680] Daintith and Willoughby define it as a term of art that describes objective standards for conducting oil and gas operations.[681] Ajuomo views it as the importation of the common law duty of care into petroleum industry regulation.[682] Tienhaara notes that it collectively captures practices and procedures adopted in the industry worldwide by prudent and diligent operators.[683] Bunter construes it as 'an evolving process of self-regulation by skilled men.'[684]

One problem with 'good oilfield practice' is the uncertainty about what constitutes an objective standard for oil and gas operations. The term is vague and sometimes problematic in practice.[685] What constitutes good oilfield practice will depend on different circumstances and may change as technology changes.[686] Industry operators and multiple jurisdictions may also construe things slightly differently and have their peculiarities. Chandler restates the divergence of meanings, especially in Australia, Norway and the UK.[687] The International Association of Drilling Contractors defines the term as all those things that are accepted as good and safe in the carrying on of petroleum exploration and production operations.[688] In Norway, the Petroleum Act requires operators and licensees to ensure *prudent production*.[689] The Norwegian Petroleum Act does not define the term. Still, it hints at its requirement that

[679] Alex Wawryk "Petroleum Regulation in an International Context: The Universality of Petroleum Regulation and the Concept of Lex Petrolea" in Tina Hunter (ed) *Regulation of the Upstream Petroleum Sector: A Comparative Study of Licensing and Concession Systems* (Elgar Publishing 2015) 3 at 33.
[680] Alexandra S. Wawryk "Adoption of International Environmental Standards by Transnational Oil Companies: Reducing the Impact of Oil Operations in Emerging Economies" (2002) 20:4 Journal of Energy and Natural Resources Law 402 at 431.
[681] Terence Daintith and Geoffrey Willoughby (eds) *Manual of United Kingdom Oil and Gas Law* (2nd edn. Sweet and Maxwell, London 1984) at 99.
[682] M.A. Ajuomo "An Examination of Federal Environmental Laws in Nigeria" in M.A. Ajuomo and Omobatoji Adewale (eds) *Environmental Law and Sustainable Development in Nigeria* (Nigerian Institute of Advanced Legal Studies and the British Council 1994) at 20.
[683] Kyla Tienhaara "Environmental Aspects of Host Government Contracts in the Upstream Oil and Gas Sector" (2010) 8:3 Oil, Gas and Energy Law Intelligence 1 at 5 and 6.
[684] Mike Bunter "World-Wide Standards of Good Oilfield Practice – the Impact of the Blow-out, Deaths and Spill at the BP Macondo Well, MC252/1-01, US Gulf of Mexico" (2013) 11:2 OGEL <www.ogel.org> at 3.
[685] Simon Warikiyei Amaduobogha "The Legal Regime for Petroleum Activities in Nigeria" in Tina Hunter (ed) *Regulation of the Upstream Petroleum Sector: A Comparative Study of Licensing and Concession Systems* (Edward Elgar 2015) 263 at 282.
[686] Scott C. Styles "Joint Operating Agreements" in Greg Gordon, John Paterson and Emre Üşenmez (eds) *Oil and Gas Law: Current Practice and Emerging Trends* (2nd edn Dundee University Press 2011) 359 at 377.
[687] Chandler above n 672 at 163, 185-195.
[688] IADC "Good Oilfield Practice" (IADC Lexicon) <www.iadclexicon.org>.
[689] Act No. 72 Relating to Petroleum Activities 1996 (As amended by Act No. 38 of 2011), s. 4-1. See also Chandler, above n 672, at 191-193.

"production shall take place in accordance with prudent technical and sound economic principles and in such a manner that waste of petroleum or reservoir energy is avoided."[690] In the UK, Model Clause 21 requires licensees to "execute all operations in or in connection with the licensed area in a proper and workmanlike manner in accordance with methods and practice customarily used in good oilfield practice."[691] The law does not define the term. However, the defunct United Kingdom Department of Energy and Climate Change (superseded by the Department for Business, Energy and Industrial Strategy in 2016) described it as "largely technical matters within the disciplines of geology and reservoir engineering, petroleum engineering and facilities engineering and to the impact of the development on the environment."[692]

The above definitions and descriptions further show the fluidity of the terminology. It is also appropriate to construe standards set by international petroleum industry organisations as good oilfield practice for different activities, as Daintith suggests.[693] These could include standards of the American Petroleum Institute and the Oil and Gas Producers Association.

As for relevance and efficacy, the proliferation of the terminology and similar environmental concepts evidences the influence of international industry standards on petroleum activities across multiple jurisdictions.[694] Nonetheless, its fluidity suggests an unsuitable regulatory use for upstream emissions reduction. According to the International Association of Oil and Gas Producers "…there is no agreed international definition, and hence their interpretation is up to the users at any time to select the codes and standards and good engineering practice that it is (*sic*) considered relevant to use for the task in question."[695]

The term qualifies as a general standard, just like *reasonableness* in tort. General standards may be suitable for some things, but not all things. The fluidity of 'good oilfield practice' may not effectively facilitate behavioural modification, leading to upstream emissions reduction. This is because of the ambiguity in standard-setting and decision-making, which are some core elements of regulation identified in Chapter 2. Suppose there are no ascertainable standards or rules for assessing good oilfield practice. In that case, it becomes difficult for regulators and

[690] Ibid.
[691] The Petroleum (Current Model Clauses) Order 1999, clause 21.
[692] DECC Guidance Note on the Content of Offshore Oil and Gas Field Development Plans, s 3. This captures the description of the withdrawn Chandler, above n 682, at 191.
[693] Daintith "Against '*lex petrolea*'" above n 669, at 8, especially at note 52 of the article.
[694] Kim Talus "Oil and Gas: International Petroleum Regulation" in Elisa Morgera and Kati Kulovesi (eds) *Research Handbook on International Law and Natural Resources* (Edward Elgar Publishing 2016) 243 at 255.
[695] IOGP *Regulators' Use of Standards* (IOGP Report No. 426 of March 2010) at 61.

decision-makers to ensure certainty in the regulatory regime, hence leaving room for the exercise of discretion and the risk of arbitrariness. Further, this study did not find a law or commentary suggesting that the term includes restrictions or moderation in flaring, venting, and fugitive emissions.

The use of general principle regulation such as good oilfield practice for addressing upstream GHG emissions is akin to general petroleum industry governance and environmental controls. It is unsuitable to rely on a general practice regulation that does not provide objective and tangible parameters and requirements for the regulated entities. For example, the jurisdictions that stipulate the adoption of good oilfield practice during oil and gas operations do not provide specifics on regulatory requirements for addressing emissions. This leaves room for uncertainties and renders such general practice regulation ineffective for incentivising upstream GHG emissions reduction. Therefore, regulators need to go beyond industry standards' generalisation and be precise in defining regulatory requirements. Leaving it to ambiguous phrases subject to multiple interpretations may achieve little or no results as far as GHG regulation goes. What constitutes good oilfield practice for reducing upstream emissions? What specific measures or initiatives represent international petroleum industry practice for mitigating climate change in oil and gas production? These are some examples of the specifics that regulators may need to address.

f) Climate change governance

Countries worldwide have been responding to climate change by enacting laws, promulgating mitigation and adaptation policies. There has been an increase of climate governance laws and policies from 60 in 1997 to over 1200 in 2017, covering over 164 countries.[696] The common themes that run through countries' various climate laws include setting emissions reduction goals, carbon pricing and budgeting, and establishing a climate change commission (especially in the UK, Germany and New Zealand). Table 2 below summarises these and other elements from a review of the literature.

[696] Michal Nachmany and others *Global Trends in Climate Change Legislation and Litigation* (Grantham Research Institute, London School of Economics May 2017) Report available at <www.lse.ac.uk/granthaminstitute>.

Table 2: Elements of good climate governance law and policy

Sources	*Elements*
Barton and Campion (2018)[697]	Target-setting; early action; policies/measures for reaching targets; multi-sectoral effect; rules for information base (monitoring and evaluation).
Manguiat and Raine (2018)[698]	Target-setting, oversight body, public access to information, access to justice, gender consideration, renewable energy promotion, integration with sustainable development goals, environmental impact assessment, monitoring and review of targets, carbon taxes.
Fankhauser, Averchenkova and Finnegan (2018)[699]	Emissions target, carbon budgets, independent advisory board, continual mitigation/adaptation planning, mandatory progress monitoring and accountability.
Weil (2012)[700]	Carbon (and other emissions) pricing, structured targeting (tailoring regulation/policy towards specific areas for emissions reduction), implementation/enforcement.
McHarg (2011)[701]	Urgent action, compulsion, public participation, access to justice, precautionary principle, polluter-pays principle, high-level environmental protection.
Carlarne (2008)[702]	Breadth, consistency, functionality, clarity, the balance of economic and environmental interests.
OECD (2008)[703]	Comprehensiveness, urgency, credibility, and flexibility.
Solomon and Hughey –Delphi Study (2007)[704]*; Guglyuyatyy (2010)*[705]	environmental effectiveness; transparency; minimising rent-seeking; correct price signal; policy flexibility; GHG emission minimisation; public acceptability; political acceptability/feasibility, predictability/regulatory certainty, polluter-pays principle; effect on technology development; cost-effectiveness; distribution of benefits and costs across generations; compliance costs; distribution of benefits and costs across income groups; competitiveness issues; administrative costs; international harmonisation.

[697] Barry Barton and Jennifer Campion "Climate Change Legislation: Law for Sound Climate Policy Making" in Donald Zillman and others (eds) *Innovation in Energy Law and Technology: Dynamic Solutions for Energy Transitions* (OUP 2018) 23 at 28-33.
[698] Maria Socorro Manguiat and Andy Raine "Strengthening National Legal Frameworks to Implement the Paris Agreement" (2018) 1 Carbon and Climate Law Review 15-22.
[699] Sam Fankhauser, Alina Averchenkova and Jared Finnegan "10 Years of the UK Climate Change Act" (Grantham Research Institute on Climate Change and the Environment, March 2018) <www.lse.ac.uk>.
[700] Gabriel Weil "Subnational Climate Mitigation Policy: A Framework for Analysis" (2012) 13 Colorado Journal of International Environmental Law and Policy 285 at 289-291.
[701] Aileen McHarg "Climate Change Constitutionalism: Lessons from the United Kingdom" (2011) 2 Climate Law 469 at 477 and 484.
[702] Cinnamon Pinon Carlarne "Good Climate Governance: Only a Fragmented System of International Law Away" (2008) 30 Law and Policy 450 at 455.
[703] OECD *Climate Change Mitigation: What We Do* (OECD 2008) at 31.
[704] D. S. Solomon and K. Hughey "A Proposed Multi Criteria Analysis Decision Support Tool for International Environmental Policy Issues: A Pilot Application to Emissions Control in the International Aviation Sector" (2007) 10 Environmental Science and Policy 645-653.
[705] Evgeny Guglyuvatyy "Climate Change Policy Evaluation" (2010) 40 Environmental Policy and Law 355-362.

Recently, it has become apparent that climate laws help to reduce emissions.[706] Eskander and Fankhauser suggest that the emergence and development of climate change laws and policies and their implementation contributed to a cumulative emissions savings of 38 gigatonnes of CO_2 ($GtCO_2$) from 1999 to 2016.[707] However, countries need to promulgate measures for achieving the overarching goals set by legislation or national policies on mitigation and adaptation. This is where sector-specific regulatory rules will help address flaring, venting, and fugitive emissions in the upstream oil and gas sector.

g) Working for new purposes

Despite the backgrounds and heritages of the various regulatory arrangements and objectives in the case study countries, there is an opportunity to make different types of laws and regulations to work for new purposes, including reducing flaring, venting, and fugitive emissions. In legal history, some doctrines and concepts have developed from their narrow scope to broader contexts for wider application.[708] For example, the English law doctrine of fee simple was created originally for taxation, but it is currently used to describe an estate in land or a form of freehold ownership.[709]

As the preceding analysis has shown, there are close relationships between resource conservation, regular environmental needs, health and safety concerns, climate change and upstream GHG emissions. Despite the relationships, the different laws do not provide a solid foundation to address petroleum upstream GHG emissions, apart from the specific rules and regulatory measures set out for that purpose. Most regulatory regimes predated the topical issue of climate change. Countries can improve and modify their laws to provide more relevant mitigation solutions for current times and work for new purposes.

Politically, it may be easier to modify or repurpose existing laws to address problems. For example, the Clean Air Act of the USA was enacted in the 1960s without a specific mandate to govern climate change. The country's legislature has not enacted new climate laws but the Clean Air Act is used to authorize USEPA to make rules to mitigate GHG emissions. Another valuable illustration is the refocused definition of resource conservation in California to capture

[706] Navroz K. Dubash "Climate Laws Help Reduce Emissions" (August 2020) 10 Nature Climate Change 709.
[707] Shaikh M.S.U. Eskander and Sam Fankhauser "Reduction in Greenhouse Gas Emissions from National Climate Legislation" (2020) Nature Climate Change https://doi.org/10.1038/s41558-020-0831-z
[708] Simon Gardner "Equity, Estate Contracts and the Judicature Acts: Walsh v. Lonsdale" (1987) 7 Oxford Journal of Legal Studies 60 at 99.
[709] Katrina M. Wyman "In Defense of the Fee Simple" (2017) 93 Notre Dame Law Review 1; Irena E. Sokoloff and others "Setting the Record Straight on Fee Simple" (2019) 16:2 Journal of Property Tax Assessment and Administration 5.

the reduction of GHG emissions associated with the development of hydrocarbon and geothermal resources.[710] This expanded definition makes California's resource conservation laws work for the new purpose of abating upstream GHG emissions. Arguably, other states and countries can make similar amendments, thereby repositioning and refocussing regulatory regimes.

However, countries may not need to overhaul their entire regulatory regimes because of the need to address a new problem. Existing laws are already addressing other issues. Even if there could be slight modifications to avoid conflict of laws, a more sensible option may be to promulgate new regulations designed to address the problem of upstream GHG emissions. As the analysis reveals, the US, Canada, the UK, and Norway adopt this approach (Table 1). While the HSE, general industry governance and conservation laws of these countries have close relationships with upstream GHG emissions, they also have specific regulations dedicated to targeting upstream emissions. This approach also allows countries to develop innovative methods of regulating upstream GHGs without necessarily unsettling or overhauling existing laws set up for different purposes.

Thus, clarity of regulatory objective/purpose emerges as a fundamental character of an effective regime that can drive upstream emissions reduction. The analysis also reveals that different legal and regulatory instruments often exist in petroleum-producing jurisdictions, but sometimes without precision about the specific objective of really achieving large-scale upstream GHG emissions reduction. Existing regulatory institutions exercise powers within the limits of legislative and regulatory provisions. Suppose the relevant laws and regulations clearly express an intention to regulate the upstream petroleum industry for GHGs. In that case, the applicable regulatory agencies will have the requisite mandate or authority to discharge their functions accordingly.

As the analysis reveals, the non-IEA-designated producer economies – the USA, Canada, the UK, and Norway – state a clear intention to regulate upstream GHGs in their respective regulatory frameworks. Among IEA-designated producer economies, Nigeria emerges as a jurisdiction that targets upstream emissions, especially gas flaring and venting, by the recent regulatory changes. Other IEA-designated producer economies have an opportunity to undertake suitable legal reforms in this respect.

[710] Assembly Bill No. 1057, above n 447, at s. 9 amending s 3011 of the California Public Resources Code.

Furthermore, it is clear that multiple legal and regulatory instruments exist in petroleum-producing jurisdictions for achieving set objectives. These are resource conservation laws, general industry governance legislation, general principle regulation, climate governance laws, HSE regulations and specific regulations that target upstream emissions. These all have close connections with the issue of upstream GHGs. They can also potentially work for new purposes. However, Canada, the US, the UK and Norway show that it may be more suitable to dedicate a specific and well-tailored regulation to address upstream emissions. This approach is better than leaving the issue to general industry or environmental governance measures that do not pay close attention to a particular industry problem.

The idea of specificity is to focus regulatory attention on upstream GHG emissions with comprehensive details that show a serious commitment to providing a dedicated framework for mitigation. For example, most of the relevant regulations in American and Canadian jurisdictions are resource conservation laws and waste prevention rules. However, regulatory instruments capture 'gas flaring' or 'methane' as part of their titles. Such titles can help to clarify the principal objective of the regulation, but the more important point is the focus of their substantive provisions.

This study shows that different laws and regulatory instruments exist in countries' legal systems to govern various societal affairs. Recently, policymakers are formulating new measures to address novel problems. More nations are equally initiating mitigation strategies. Addressing upstream GHG emissions also necessitates the emergence of dedicated regulatory measures, requiring the promulgation of issue-specific and industry-specific instruments or reforming existing standards to work for new purposes. The implication for petroleum-producing countries is to ensure the enactment of well-tailored regulations that encourage the reduction of gas flaring, venting, and fugitive emissions. These considerations will be referred to in answering how petroleum-producing jurisdictions can satisfy the tests for regulatory effectiveness established in Chapter 2. However, the nature of comparative analysis in this section relates more to the first test as to whether countries have stated a clear aim or objective to regulate or reduce upstream GHG emissions. The analysis in the next section will point to the second test and other criteria for effectiveness.

3. Different Regulatory Methods

The study reveals different methods for regulating upstream GHG emissions in various jurisdictions. These are flaring permit systems and pricing mechanisms (carbon taxes, fines, charges, and emissions trading schemes), emissions reduction targets and budgeting,

monitoring, and data collection (metering and quantification, leak detection and repair programmes). These are in addition to general obligations on resource conservation, waste prevention, and environmental protection.

a) Flaring permit systems and price mechanisms

Virtually all the case study countries prohibit flaring and venting without authorisation from the appropriate authority. Regulators impose monetary fines and taxes for excess flaring or flaring without the grant of a permit. Some jurisdictions such as Norway, the UK, and China implement emissions trading schemes (ETS). Fines, taxes, and mainstream ETS all operate as market-based instruments (MBIs) or price mechanisms in different regulatory regimes with various objectives, whether for resource conservation or general industry governance or specific measures targeting upstream GHG emissions.

Permit systems can help to reduce emissions, but a lot depends on their structuring and decision-making process. The practice of allowing flaring and venting on the payment of small penalties, as Section A of this chapter shows, does not help much to mitigate upstream GHG emissions. This is precisely the experience of some oil and gas-producing countries where flaring fines are insignificant compared to the commercial value of flared and vented gas.[711] A good example is Nigeria, where the law allows operators to flare over the volume stipulated by a permit on monetary penalty payment.[712] The penalty regime may be a revenue spinner for the government, to the extent that operators are willing to make financial payments to continue flaring. The reality is that the accrued revenue from penalties falls short of flared gas's actual economic value in the country. For example, according to the Nigerian National Petroleum Corporation and the Nigerian National Assembly's findings, Nigeria loses two billion US dollars annually to flaring but it only extracts three billion Naira (slightly over 8 million US dollars) in penalties.[713] It is indeed a pure waste of natural resources.

What then should be a better permit system? A helpful approach could be to set significant flaring penalties. There is evidence to show that the flaring penalty level can influence the volume of flaring by operators.[714] In Nigeria, for example, the volume of gas flaring reduced

[711] World Bank *Regulation of Associated Gas Flaring and Venting: A Global Overview and Lessons* (World Bank 2016) at 18 and 73.
[712] As identified in Part A of Chapter 3.
[713] NNPC *Nigeria Gas Flared and Cost Implication* (NNPC 30 July 2014); National Assembly Senate Committee on Gas *Report on A Bill for An Act to Prohibit Gas Flaring in Nigeria and Prescribe Appropriate Penalties and for Related Matters* (October 2018) at 3.
[714] Ladeinde Ayodeji Olaoluwa and Laniran Temitope Joseph "The Impact of Fines on the Volume of Gas Flared in Nigeria" (paper presented to the NAEE/IAEE International Conference, Nigeria, April 2015).

by 1% after the flaring penalty increased from USD0.03 per thousand cubic feet of flared gas in 1984 to USD3.50 in 2008.[715] This is not much of a reduction but the finding suggests the probability of abating flaring with an increment in penalty. Oil and gas companies would prefer to flare gas and pay fines because the cost of re-injection or utilization is higher than the penalty for flaring, especially at sites where re-injection may be limited by well pressure and safety issues. In addition, Nigeria suffers from the issues of insufficient gas markets and the necessary infrastructure for optimal gas utilization.[716] However, if regulators structure the system so that the penalty cost increases annually, companies may invest more in energy efficiency measures and gas utilization. Therefore, while other regulatory efforts targeting emissions abatement continue, regulators can also consider adopting more stringent permit terms and conditions that can influence the rate at which flaring and venting occur in the industry. Aside from the exceptions to flare or vent gas as part of emergency measures or other unplanned occurrences, regulators may stipulate technical standards for operators to satisfy before issuing flaring permits. Some specific examples from Canadian and American regimes are the requirements to route the recovered gas to a collection system, re-inject the recovered gas, or use the recovered gas as an onsite fuel or raw material. Regulators in other countries can consider incorporating these technical requirements and reduce the volume of GHG emissions that occur through flaring and venting.

Other carbon pricing tools such as taxes, charges, and ETS are familiar MBIs that can incentivise energy efficiency and GHG emissions reduction.[717] They are market-oriented, unlike traditional command and control regulation and industry-oriented technical measures such as good oilfield practice. The EU, UK, US, Australia, New Zealand, Canada, and Norway were the earliest countries to implement emissions trading in the late 1990s and early 2000s.[718] In contemporary times, different jurisdictions may have varied forms of carbon tax and

[715] Ibid.
[716] Uwem Udok and Enobong Bassey Akpan "Gas Flaring in Nigeria: Problems and Prospects" (2017) 5:1 Global Journal of Politics and Law Research 16 at 18 and 26.
[717] Sebastian R. Goers, Alexander F. Wagner and Jürgen Wegmayr "New and Old Market-Based Instruments for Climate Change Policy" (2010) 12 Environmental Economics and Policy Studies 1 at 4-8; Michael Grubb, Jean-Charles Hourcade and Karsten Neuhoff (eds) *Planetary Economics – Energy, Climate Change and the Three Domains of Sustainable Development* (Routledge, 2014); Andreas Prahl and Elena Hofmann "Market-Based Climate Policy Instruments" (Climate Policy Info Hub, 27 June 2016) <www.climatepolicyinfohub.eu>; Jeremy Freeman "Efficacy of Carbon Taxes and Recommendations for Cutting Carbon Emissions" (2015) 15 Houston Business and Tax Law Journal 268-299; Gary M. Jr. Lucas "Behavioural Public Choice and the Carbon Tax" (2017) 1 Utah Law Review 115-158.
[718] Robert Baldwin "Regulation Lite: The Rise of Emissions Trading" (2008) 2:3 Law and Financial Markets Review 262.

emissions trading schemes. Norway stands out amongst all the countries under the study. It simultaneously implements carbon tax and emissions trading to address climate change in its oil and gas industry.[719]

Hood has argued for packages of complementary energy and climate policies, whereby carbon pricing can co-exist with other governance measures.[720] Besides, research shows that multiple jurisdictions that implement carbon pricing or other MBIs also operate other regulatory mechanisms. [721] This policy and regulatory complementarity can address the diverse dimensions of climate change mitigation and the need to design sector-specific measures carefully.[722] Therefore, it is valuable to try a mix of different measures comprising social, legal, and market-based instruments while avoiding path dependencies for deep decarbonization.[723]

Nonetheless, carbon pricing schemes face serious ideological opposition and have shortcomings in changing behaviour.[724] Two key examples are the inertia of a fossil fuel-dominated economy and the risk of being regressive. It is true that the global economy presently relies mainly on fossil fuel sources, irrespective of measurable gains from renewables and other sources of clean energy.[725] On the other hand, internalizing the monetary cost of emissions, if a price signal is used, increases the price of petroleum products, goods, transportation, and social services. The high, middle-class, and low-income earners will feel the effects of carbon pricing differently, with the worst affected low-income earners. This explains the regressive nature of carbon pricing.[726] This regressive character makes it difficult to alter behaviour

[719] Banet above n 630.
[720] Christina Hood *Managing Interactions between Carbon Pricing and Existing Energy Policies: Guidance for Policymakers* (IEA Insights Series 2013) at 4,13, 16-18.
[721] Erik Haites "Carbon Taxes and Greenhouse Gas Emissions Trading Systems: What Have We Learned?" (2018) 18:8 Climate Policy 955 at 958; New Zealand Productivity Commission *Low-emissions Economy: Final Report* (New Zealand Productivity Commission August 2018) at 145-147.
[722] Ralph Sims and others *Transition to a Low-carbon Economy for New Zealand* (The Royal Society of New Zealand Report April 2016) at 72.
[723] Isabelle Martin "Tying It All Together: The Potential of Legal, Social and Market-Based Control Mechanisms to Enforce Integrated and Sustainable Decision-Making" (2014) 44 Revue Generale de Droit 230-390; Endre Tvinnereima and Michael Mehling "Carbon Pricing and Deep Decarbonisation" (2018) 121 Energy Policy 185 at 186 and 187.
[724] Robert P. Murphy, Patrick J. Michaels and Paul C. Knappenberger *The Case against a Carbon Tax* (CATO Working Paper No. 33, 4 September 2015); Anthony Patt and Johan Lilliestam "The Case against Carbon Prices" (2018) 2 Joule 2494; Jordan McGillis *The Case against a Carbon Tax* (Institute for Energy Research Policy Paper, April 2019).
[725] Wim Carton "Dancing to the Rhythms of the Fossil Fuel Landscape: Landscape Inertia and the Temporal Limits to Market-Based Climate Policy" (2017) 49:1 Antipode 43-61.
[726] Michael L. Marlow "The Perils of a Carbon Tax" (2018) 41 Regulation 28 at 32; Lukas Tank "The Unfair Burdens Argument Against Carbon Pricing" (2020) 37:4 Journal of Applied Philosophy 612; Julius Anderson and Giles Atkinson *The Distributional Effects of a Carbon Tax: The Role of Income Inequality* (Grantham Research Institute on Climate Change and the Environment, London School of Economics, Working Paper No. 349, September 2020).

through carbon pricing. Instead of behavioural change, there is the danger of social reaction and resistance to unfair policy measures. The recent French *gilets jaunes* (yellow vests) fuel tax protest is a perfect example in this respect.[727] Recycling revenues from carbon pricing – through carbon dividend payment and revenue neutrality – can help avoid carbon pricing's regressive effect.[728] Another solution, which Hood proposes, is using revenues generated from carbon pricing to stimulate the economy in different ways.[729]

An important consideration is how carbon pricing measures such as emissions trading schemes affect upstream GHG emissions. Do they cover upstream emissions? Do they send strong price signals that can incentivise a noticeable reduction in emissions? Emissions trading schemes can be spotty in their coverage. The World Bank Annual Carbon Pricing Trends Report 2019[730] finds that, as of 2019, there were 57 carbon pricing schemes around the world – 28 emissions trading systems and 29 carbon taxes. At this global level, these pricing initiatives, according to the report, cover only 11 gigatonnes of carbon dioxide equivalent ($GtCO_2e$), about 20% of global GHG emissions.[731] The report also observes the insufficiency of coverage and price levels of carbon pricing initiatives.[732] The targeted sectors are majorly electricity, transport, aviation, buildings, waste, forestry, agriculture, fossil fuels, and shipping; but pricing initiatives in countries do not cover all these areas collectively.[733] Similarly, the United Nations Environmental Programme (UNEP) Emissions Gap Report 2019 finds that, as of 2019, no country had ambitious, comprehensive CO_2 pricing in all sectors of the economy.[734] These reports show that pricing schemes are selective in their scope of coverage. In fact, as the regulatory overview shows, upstream oil and gas emissions are rarely included in countries' emissions trading schemes.

For price signals, the IPCC suggests that, by 2030, countries should charge at least US$135 per tonne of CO_2 equivalent (tCO_2e) of GHG emissions and increase the sum annually, leading to a minimum of US$690 per tCO_2e at the end of the 21st century for a 50-66% probability of

[727] The Yellow Vests Movement all started in October 2018 when French President Emmanuel Macron proposed hike in fuel tax, specifically diesel tax. Majority of French citizens rejected the proposed hike and protested through street riots.
[728] Barry Barton and Jennifer Campion "Energy Justice and the Design of Climate Change Legislation: Avoiding Regressive Measures" in Iñigo del Guayo and others (eds) *Energy Justice and Energy Law* (OUP 2020) 203 at 208-209.
[729] Hood, above n 720, at 25.
[730] World Bank *State and Trends of Carbon Pricing 2019* (World Bank, June 2019); report available at <http://documents.worldbank.org>.
[731] Ibid.
[732] Ibid.
[733] Ibid, at 17.
[734] UNEP *Emissions Gap Report 2019*, above n 149, at 32.

keeping peak temperature below 1.5°C.[735] The World Bank Carbon Pricing Trends Report also finds that initiatives worldwide fall short of the IPCC's estimates.[736] These findings show that current carbon pricing measures have insufficient price signals for climate change mitigation. At country-specific levels, some of the case study jurisdictions adopt price mechanisms as part of their regulatory methods to abate upstream GHG emissions, either in the form of direct/indirect climate charges and carbon taxes based on resource value. However, these countries' carbon prices fall short of IPCC's stipulated price level for real pressure.

The US states of North Dakota and Alaska provide examples of a good carbon pricing arrangement. In North Dakota, the law stipulates the payment of equal monetary value for flared gas.[737] In Alaska, the legal requirement is for operators to pay double the fair market value for flared gas.[738] Regulators can think along these lines when structuring monetary measures that can incentivise upstream GHG emissions reduction. This may require relevant research and modelling efforts to form an evidence base for ascertaining suitable prices. Thus, an appropriate carbon price or flaring penalty that outweighs the gas utilization cost may produce real pressure on companies to adopt better operational practices to mitigate emissions.

It is equally necessary for countries to structure pricing mechanisms in ways that avoid social inequalities.[739] Periodic reviews may help regulators ascertain feasible price thresholds to incentivise emissions reduction and avoid regressive pricing measures. Countries can also ensure good interaction between carbon pricing and other measures to promote complementarity and efficacy.[740]

b) Intensity requirements proportional to resource output

The stipulation of different intensity requirements per production well/field proportional to oil and gas output is a robust method for reducing the volume of flaring, venting, and fugitive emissions expended during oil and gas production. This is how energy efficiency measures can address the GHG emissions implications of the EROI concept. Intensity and efficiency requirements are more pronounced in the US and Canada. For example, in North Dakota, the law requires operators to utilize 75% of associated gas per field for beneficial consumption and

[735] IPCC *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 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*; report available at https://www.ipcc.ch/sr15/, at 152.
[736] World Bank, above n 730.
[737] See Part A, Section 2(b) of this chapter.
[738] See Part A, Section 2(c) of this chapter.
[739] Barton and Campion, above n 728.
[740] Hood, above n 720, at 20-25

connection to a gas gathering system.[741] In California, the Low Carbon Fuel Standard requires that the carbon intensity benchmarks for fossil fuels and their substitutes should not exceed an average of 79.55 grams of CO_2e per mega joule (gCO_2e/MJ) from the year 2030 and beyond.[742] This requirement will eventually affect the carbon intensity of upstream GHG emissions.[743] However, the regulation is silent addressing flaring, venting, and fugitive emissions particularly. There is an opportunity here for regulatory amendments to capture these types of emissions, which also account for the carbon intensity of fossil fuels that the law sets out to reduce.

There are technical requirements for upstream GHG emission sources at the federal level in Canada. In respect of general production-related flaring, the intensity requirement is a limit of $1{,}250m^3$ per month (that is $15{,}000m^3$ annually) for each producing field.[744] However, as earlier highlighted, this stipulation takes effect from 1 January 2023.[745] The provinces of Alberta, Saskatchewan and British Columbia also have different intensity requirements. In Alberta, operators must collectively keep GHG emissions emanating from oil sands operations at a maximum of 100 mega tonnes of CO_2 equivalent per annum.[746] There are no field-by-field intensity requirements. There is an opportunity to stipulate proportionate intensity requirements at a field level to contribute to the general oil sands industry requirement. In Saskatchewan, production-related emission of APG must stay below 900 cubic meters per day per production well unless in emergency cases and to prevent fire or explosion.[747] In British Columbia, operators' obligation to utilize not less than 95% of natural gas per field instead of flaring or venting is another excellent example of intensity requirement proportional to resource output.[748]

Similarly, Brazil provides another example of a flaring intensity requirement proportional to resource output. The applicable regulation limits flaring to 15% per production field and requires operators to utilize 85% of associated gas for beneficial purposes.[749] This is what the

[741] See Part A, Section 2(b) of this chapter.
[742] Ibid, Table 1: LCFS Carbon Intensity Benchmarks for 2001 to 2030 for Gasoline and Fuels Used as a Substitute for Gasoline, at p. 48.
[743] Daniel Scheitrum "Impact of Intensity Standards on Alternative Fuel Adoption: Renewable Natural Gas and California's Low Carbon Fuel Standard" (2020) 41:2 The Energy Journal 191 at 198.
[744] Methane Regulations, above n 487, at s. 26.
[745] Ibid.
[746] Oil Sands Emissions Limit Act, above n 535, at s. 2
[747] Ibid.
[748] Drilling and Production Regulation, above n 570, at s. 52.02.
[749] Above n 365, art 3.

law refers to as the associated gas utilization index.[750] Similarly, in Nigeria, the new gas flaring regulation defines the associated gas utilization factor as "…the volume of associated gas utilized as a function of the total associated gas production volumes."[751] This definition implies a regulatory intention to make operators observe intensity requirements, but the law is silent as to the specifics. Instead, it obliges the Department of Petroleum Resources under the Ministry of Petroleum Resources to release publicly the associated gas produced in association with crude oil to calculate the gas to oil ratio for the preceding two years.[752]

The preceding analysis suggests that some case study countries provide better examples of intensity requirements proportional to produced oil and gas. These include Brazil (requiring 85% gas utilization per field), the Canadian province of British Columbia (requiring 95% gas utilization per field) and the American state of North Dakota (requiring 75% of gas utilization per field). Regulators in other jurisdictions can learn from the Canadian, Brazilian, and American examples. They can also stipulate annual incremental resource output proportional to emissions intensity so that the volume of resource output increases while the rate of gas flaring and venting reduces until near-zero over time.

Nevertheless, these carbon intensity requirements are insufficient on their own to drive large-scale decarbonisation without sufficient gas utilization infrastructure. The state of the local gas market needs to improve to support the commercialization of gas, as companies would want to derive economic benefits from the gas that they produce along with oil. For example, Texas has many interstate gas pipelines that help in utilizing gas,[753] which is not the case in many other states. Nigeria's recent Gas Commercialization Programme[754] is ambitious but also a positive strategy for reducing flaring and venting. Saudi Aramco has a vast gas-gathering network of pipelines that helps in optimal gas utilization and drastically reducing flaring and venting, and helping Saudi Arabia to maintain a global gas flaring status of less than 1%, compared to other producing countries.[755] Other jurisdictions can also support low carbon-intensity requirements proportional to resource output by building gas pipeline networks or formulating policies that incentivise investors to embark on such projects. Equally, countries

[750] Ibid.
[751] Flare Gas Regulation, above n 297, s. 24.
[752] Ibid, s. 19 (b).
[753] See the Texas Pipeline System Mileage at <https://www.rrc.state.tx.us/pipeline-safety/reports/texas-pipeline-system-mileage/>.
[754] Above n 304.
[755] Saudi Aramco, above n 331.

will need to address institutional and political bottlenecks hampering the construction of cross-border pipeline networks for transporting gas to international markets.

c) Emissions reduction targets and budgeting

One of the contemporary climate governance trends worldwide is the setting of emissions reduction targets. A corollary practice is emissions budgeting. At the international level, the Paris Agreement aims to limit temperature increase below 2°C and possibly further limit the temperature increase to 1.5 °C above pre-industrial levels.[756] A key regional example is the EU's proposed 55% GHG emissions reduction, in addition to a 32.5% improvement in energy efficiency by 2030.[757] Multiple countries have also committed to GHG emissions reduction with short-term and long-term goals. Sometimes these are through legislation and official state policies on climate change mitigation. Sometimes they are in countries' communications in the form of NDCs under the UNFCCC and the Paris Agreement. It makes sense for countries' climate governance regimes to set emission reduction goals. However, it is also desirable to cover different emissions sources through sector-specific targets, which would be sectoral contributions for achieving the overall mitigation target set by policy or legislation.

Target setting is apparent in some of the countries in this study. For example, while the UK, Nigeria, Canada, and Norway set general emission reduction targets, only Canada, Nigeria, and Saudi Arabia set specific emission reduction targets for the upstream petroleum sector. See Table 3 for a summary of general and sector-specific targets of these countries.

[756] Paris Agreement, above n 62, art 2.
[757] The 2030 Climate Target Plan COM (2020) 562 final, endorsed by EU Leaders in Brussels on 17 September 2020.

Table 3: *Case study countries' emission reduction targets – general and sector-specific*

Countries	**Short-term general emission reduction target**	**Long-term general emission reduction target**	**Upstream-specific GHG emissions reduction target**
UK	26% by 2020	80% by 2050	None
Canada	N/A	40-45% by 2025	Yes, 40-45% methane reduction
Norway	40% by 2030	80-95% by 2050	None
Nigeria	N/A	45% by 2030	Yes, 100% flaring elimination by 2030
Saudi Arabia	N/A	N/A	Zero routine flaring by 2030

As part of specific regulatory measures, countries will need to set emissions reduction targets for the upstream petroleum sector to promote feasibility (realistically achievable) and equity (fairness to all parties). Setting very ambitious targets for a short period may be unrealistic and work to the operators' unfair disadvantage. For example, requiring oil and gas companies to reduce emissions by 80% within an interval of two or three years may be unrealistic and unfair, considering the industry peculiarities, the dynamics surrounding upstream GHGs and the relatively short span of years. Some fundamental constraints are constructing the required equipment for gas utilization, the time and financial implications for designing and installing the equipment and the huge logistics involved in the entire process.

A feasible and fair approach may be to set sector-specific incremental emissions reduction goals over a reasonable period. As Table 3 shows, Canada, Nigeria, and Saudi Arabia are good examples of countries with sector-specific targets to reduce upstream GHG emissions, especially flaring. More so, the Canadian province of Newfoundland and Labrador points to what an incremental emissions reduction target may look like. The province's Management of Greenhouse Gas Regulations stipulate upstream sector-specific GHG emissions reduction goals for different years, beginning from 2019, as seen earlier in the chapter. Regulators in other jurisdictions may profit from using energy modelling results to determine the level of annual incremental upstream emissions reduction targets that will be necessary for achieving a set climate goals for the industry within a given period. The general idea of using modelling results to set emissions reduction targets is an emerging policy approach for climate change

mitigation.[758] Perhaps, the model would consider factors that may influence the emission reduction potential for different onshore and offshore production sites, some of which are the required carbon abatement cost, time, technical feasibility for emissions savings, and efficiency measures.[759] These can help in setting viable targets and avoid putting a huge compliance burden on industry operators.

Besides, science-based climate targets and emissions budgeting serve as yardsticks to measure mitigation progress. They also help in instilling the consciousness of responsibility, acting, and striving for environmental leadership.[760] More so, they are valuable elements that receive wide support in the climate law literature.[761] While complementing general climate goals, specific sectoral targets would also help to capture and reduce upstream GHG emissions.

The idea of setting emissions reduction targets has close connections with carbon budgeting. The concept 'carbon budget' is central in the climate science and policy literature. Its use here is in two contexts. The first relates to its global description as the cumulative amount of allowable carbon emissions to achieve global emissions reduction and temperature target.[762] Within this context, its relevance hinges on one logic – "precisely quantifying the fate of man-made carbon dioxide is vital for reliably estimating future atmospheric CO_2 levels and the contribution of this greenhouse gas to global climatic change."[763] It is common knowledge that global warming is proportionate to the quantum of GHGs released into the atmosphere.[764] It becomes logical to set emissions reduction targets to reflect the balance in the global carbon budget.[765]

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[758] Diana Susser and others "Model-Based Policymaking or Policy-Based Modelling? How Energy Models and Energy Policy Interact" (2021) 75 Energy Research and Social Science 101984.
[759] OGUK *Upstream Oil and Gas Sector Pathway to a Net-Zero Basin: Production Emissions Targets* (OGUK 2020) at 16 and 17.
[760] Janosch Birkert and Jacob Bourgeois "Science Based Targets: Setting Climate Goals" (First Climate 2019) <www.firstclimate.com>.
[761] See Table 2: Elements of good climate governance law and policy.
[762] Bård Lahn "A History of the Global Carbon Budget" (2020) e636 WIREs Climate Change https://doi.org/10.1002/wcc.636.
[763] Ingeborg Levin "The Balance of the Carbon Budget" (2012) 488 Nature 35.
[764] H. Damon Matthews and Ken Caldeira "Stabilizing Climate Requires Near-Zero Emissions" (2008) 35 Geophysical Research Letters L04705 https://doi.org/10.1029/2007GL032388. See also Myles R. Allen and others "Warming Caused by Cumulative Carbon Emissions towards the Trillionth Tonne" (2009) 458 Nature 1163 at 1165-1166.
[765] Nicholas J. Leach and others "Current Level and Rate of Warming Determine Emissions Budgets under Ambitious Mitigation" (2018) 11 Nature Geoscience 574-580. See also M. Louise Jeffery and others "Measuring Success: Improving Assessments of Aggregate Greenhouse Gas Emissions Reduction Goals" (2018) 6 Earth's Future 1260-1274.

The second and immediate context of using the carbon budget is for regulatory and policy purposes at the national level to avoid the risk of setting climate targets that either underestimate or overestimate emission reduction limits and not knowing the true global warming implication of allowable emissions.[766] Countries need to set budgets for different periods and ascertain how sectors or industries will contribute towards staying within the budget. In this context, there could be a particular allocation to the upstream petroleum sector to control the volume of GHG emissions emanating from oil and gas production.

Among the case study countries, only the UK is a good example where climate policy frameworks require carbon budgeting, which covers successive periods of five years, beginning from 2008 to 2012, 2013 to 2017, and 2018 to 2022.[767] Yet, there remains a need to determine how the upstream petroleum sector will contribute to staying within the budget to reduce flaring, venting, and fugitive emissions.

d) Process and outcome measures

There are varying degrees of procedural and technical requirements to control emissions across the case study countries. From the regulatory overview above, the most striking examples include plans for flaring and venting; monitoring, data collection and asset integrity management; and emissions quantity disclosure through a periodic reporting scheme. A comparative analysis of these measures across the case study countries will probably reveal good practices for regulatory purposes.

(1) Plans for flaring and venting

The case study countries collectively reveal two different approaches to planning to manage flaring and venting. The regulatory regimes in some jurisdictions provide no express plans or even requirements for the grant of a flaring or venting permit. Instead, there is room for the exercise of discretion by the regulator or the minister while issuing flaring and venting permits on a case-by-case basis.

We can briefly consider the nature of discretion and ascertain how it can promote or hamper better outcomes in the regulation of upstream GHG emissions, especially in relation to granting permits for flaring and venting. Administrative law reveals that discretionary powers must be exercised reasonably and in good faith, and on proper grounds – in other words, they must not

[766] Frederick van der Ploeg "The Safe Carbon Budget" (2018) 147 Climatic Change 47 at 49, 55-57.
[767] Climate Change Act 2008 Chapter 27, s.4.

be abused.[768] It has also been argued that unchecked discretion can create opportunities for corruption and discrimination and open the regulatory agency to capture by the regulated entities.[769] These can be avoided where the exercise of discretion is governed by certain principles – legality, consistency, proportionality, non-discrimination, due process, transparency and accessibility, efficiency, and expertise.[770] By legality, there is a clear legal rationale for the exercise of discretion. Consistency requires that the regulator or institution exercising discretionary powers applies similar standards to similar cases. The applicable processes and requirements must also be in the public domain and accessible to the regulated entities. The regulator also needs to possess the requisite expertise to exercise reasonable judgement on the subject-matter in question.

When applying these considerations to the grant of flaring and venting permits, the major concern is whether countries' regulatory regimes provide enough information about the processes and requirements or standards that oil and gas operators must satisfy before being granted authorisation to flare or vent gas. This is a missing element in the legal regimes of most countries examined in this chapter, where the law vests discretionary powers on the minister of petroleum resources or any other applicable regulator to grant flaring and venting permits, without providing the standards that must be fulfilled by operators. We can point to Iraq, Nigeria, Russia, Saudi Arabia, UAE, and China, as Section A of this chapter discussed. Regulators in these jurisdictions are empowered to grant flaring permits on a case-by-case basis, with the condition to pay penalties for flaring more than authorised quantities or quotas. We can relate this approach to the earlier discussion about the use of insignificant pricing mechanisms that do not create real pressure for operators to reduce emissions, the consequence being that operators can always get permits and pay penalties for excess flaring and venting of gas. This is not a good process measure as it creates uncertainty and does not provide ascertainable benchmarks for the oil and gas industry. Good decision-making must be characterised by a regime that gives certainty and predictability to the regulated industry.[771] Uncertainties and unpredictability can also lead to the application of different standards in

[768] William Wade and Christopher Forsyth *Administrative Law* (10th edn OUP 2009) at 259 and 286.
[769] Malcolm K. Sparrow *The Regulatory Craft: Controlling Risks, Solving Problems, and Managing Compliance* (Brookings Institution Press 2000) at 238.
[770] Julia Black "Managing Discretion" (Paper presented at the ARLC Conference Papers, Law Department and Centre for the Analysis of Risk and Regulation, London School of Economics June 2001) at 27.
[771] Keith Manch "What Does Good Regulatory Decision-Making Look Like?" (2017) 13:2 Policy Quarterly 72 at 73.

similar cases. This is where the exercise of discretionary power can create rooms for corruption and discrimination.

There are better plans for flaring and venting in Brazil, the US, Canada, the UK, and Norway. This is because of the mandatory gas utilization ratios in some of these countries and explicit flaring and venting control rules that do not rely on the regulator or minister's discretion. Recently, it is becoming more important for countries to clearly specify procedural standards to limit or check the erratic exercise of discretionary powers.[772] For example, the regulations in the US states of Texas, North Dakota, Alaska, and California provide specific conditions for the grant of flaring and venting permits and technical requirements that operators must comply with as part of permit conditions. These clear provisions give certainty and predictability to oil and gas operators.

The Canadian province of Alberta provides a good example of a jurisdiction with robust flaring and venting plans and avoids the unreasonable exercise of discretion in the grant of flaring and venting permits. The Gas Flaring and Venting Decision Tree requires operators to satisfy four major tests – public concern test, safety concern test, economic alternatives test, environmental impacts/benefits test – and scale through three stages: (1) to eliminate flaring, venting and incineration; or (2) reduce flaring, venting and incineration; or (3) meet performance and venting and fugitive emissions management requirements.[773] The detailed performance requirements cover flares and incinerators in the entire upstream oil and gas systems for burning sweet, sour, and acid gas, including portable equipment used for temporary operations, including well completion, servicing, and testing.[774] This thesis does not discuss the extensive technical requirements, but the point to note here is the need to provide clear and detailed performance requirements covering upstream installations, components, and processes associated with flaring and venting. In addition to these, operators have a mandatory obligation to give notice of at least 24 hours to the Alberta Energy Regulator, residents, and schools within a close radius of the flare site in advance of any temporary flaring, venting and incineration.[775]

In the UK, the plans for flaring and venting are part of the consent application process. The regulator – the Oil and Gas Authority – usually issues flaring and venting consents to operators

[772] Rebecca Schmidt and Colin Scott "Regulatory Discretion: Structuring Power in the Era of Regulatory Capitalism" (2021) 41 Legal Studies 454 at 466.
[773] Directive 060, above n 523, at s.2
[774] Ibid, ss. 7 and 8.
[775] Ibid, s. 3.8

on an annual and field-by-field basis.[776] A fundamental component of the consenting process is considering supporting factors, which are the submission of all appropriate data and evidence, alternative uses for the gas to be flared, the best application of technology, the operator's historical performance and relevant upstream installation(s).[777] One distinctive feature of these plans for flaring is the consideration of the historical performance of the operator. This enables the regulator to exercise discretion favouring operators that show operational efficiency and incentivises operators with a poor performance record to ensure improvements, thereby promoting industry operational efficiency.

Like the UK, operators in Norway obtain flaring permits annually from the Pollution Control Authority (now merged with the Norwegian Environment Agency under the Ministry of Climate and Environment).[778] The regulatory requirement for the grant of emissions permit is for operators to prove that they can monitor and report emissions in a satisfactory manner.[779] Besides, there are no detailed technical specifications like the practice in Canada, the US, and the UK. The issuance of an emissions permit is on a case-by-case basis and without the need to specify emissions limits in the permits.[780]

Other case study countries can improve their regimes regarding plans for flaring and venting by learning from the Alberta decision tree and other explicit provisions prevalent in the US and the UK. Such express regulatory requirements and technical specifications for controlling flaring and venting will help to provide clarity to operators and reduce the arbitrariness associated with the exercise of discretion by the regulator or minister.

(2) Monitoring, data collection and asset integrity management

Frequent emissions monitoring is an essential widely acknowledged requirement for emissions reduction.[781] Also, mandatory metering and reporting help in data collection for suitable mitigation strategies. Some known approaches are spectroscopic techniques (like infrared),

[776] OGA Flaring and Venting Guidance Note 2016.
[777] OGA Policy Position on Flaring and Venting 2018.
[778] Above n 624.
[779] Ibid, at s.11.
[780] Ibid.
[781] David R. Lyon and others "Aerial Surveys of Elevated Hydrocarbon Emissions from Oil and Gas Production Sites" (2016) 50 Environmental Science Technology 4877; Tegan N. Lavoie and others "Spatiotemporal Variability of Methane Emissions at Oil and Natural Gas Operations in the Eagle Ford Basin" (2017) 51 Environmental Science Technology 8001; Daniel Zavala-Araiza and others "Methane Emissions from Oil and Gas Production Sites in Alberta, Canada" (2018) 6:27 Elemental Science of the Anthropocene https://doi.org/10.1525/elementa.284; D. J. Varon and others "Satellite Discovery of Anomalously Large Methane Point Sources from Oil and Gas Production" (2019) 46 Geophysical Research Letters 13,516.

electromechanical techniques, electronic sensors, and satellite data capturing.[782] However, methane emissions from the oil and gas industry have been historically difficult to measure.[783] Research shows that fugitive methane emissions and venting from oil and gas facilities are poorly monitored and measured, thereby increasing the uncertainty associated with estimating carbon intensity.[784]

There are some good examples of frameworks for upstream emissions monitoring and data collection. In Nigeria, the newly introduced metering system requires all oil and gas lessees or licensees to install metering equipment to quantify the volume of flared gas and ensure that operators comply with set flaring limits.[785] In Norway, there is close monitoring of industry compliance with regulatory requirements for emissions reduction.[786] In Saudi Arabia, the regulation requires monitoring VOCs,[787] but this requirement is limited, as it does not extend to GHGs. The state regulatory regime there focuses predominantly on air quality improvements. In the United Kingdom, the emissions monitoring system requires emissions monitoring and waste management plans.[788]

A contemporary regulatory practice is to prescribe leak detection and repair (LDAR) programmes by operators/licensees in some jurisdictions. LDAR is the process of detecting leaks (fugitive emissions) in oil and gas installations and repairing the defective components using recognised industry procedures or entirely changing them.[789]

The United States Environmental Protection Agency (USEPA) acknowledges the possibility of variations across jurisdictions. However, it identifies five key elements of a good LDAR programme, including component identification, leak definition, component monitoring, component repair, and record-keeping.[790] Component identification means locating the leaking component on the site of the operation physically. Leak definition envisages observing features

[782] Joanna Kamieniak, Edward P. Randviir and Craig E. Banks "The Latest Developments in the Analytical Sensing of Methane" (2015) 73 Trends in Analytical Chemistry 146-157.
[783] IEA "Methane Emissions from Oil and Gas" (IEA June 2020) <https://www.iea.org/reports/methane-emissions-from-oil-and-gas>.
[784] Masnadi and others, above n 13, at 853.
[785] Above n 297, at s. 6.
[786] See Part A, Section 2(f) of this chapter.
[787] Appendix 1 of the General Environmental Regulations 2001: Environmental Protection Standards, Presidency of Meteorology and Environment, Kingdom of Saudi Arabia Document No. 1409-01, B. 5.
[788] Petroleum Act, above n 577, at s. 4, columns 1 and 2.
[789] Nicholas P. Cheremisinoff "Leak Detection and Repair" in Nicholas P. Cheremisinoff (ed) *Pollution Control Handbook for Oil and Gas Engineering* (John Wiley & Sons 2016) 757 at 764.
[790] USEPA *Leak Detection and Repair: A Best Practices Guide* (USEPA 2007) at 9-12.

such as smell and drip. Component monitoring means to probe the observed leak. Component repair requires fixing the leak. Record-keeping entails documenting the entire process.

We find the regulatory requirement to implement LDAR programmes prominently in American and Canadian regulations. In the United States, the Bureau of Land Management Waste Prevention Rule requires comprehensive LDAR program implementation for operations on federally controlled lands.[791] USEPA also recognizes the possibility of more stringent LDAR programmes at state and local government levels.[792]

In Canada, federal regulations require operators to implement LDAR schemes, conduct a regular inspection for leaks and take corrective measures.[793] Again, these requirements apply to operations on federal lands. Provincial authorities have powers to promulgate rules at a local level. In Alberta, the applicable regulation does not explicitly mention LDAR but provides for a similar programme. It requires operators to conduct emission surveys using either organic vapour analyser, gas imaging camera or any other equipment capable of detecting fugitive emissions;[794] and repair all detected sources of fugitive emissions.[795] In British Columbia, operators must develop and implement LDAR programmes to address all sources of fugitive emissions.[796]

This chapter does not offer a comprehensive discussion of asset integrity management. However, jurisdictions with regulatory requirements to implement LDAR programmes emphasize ensuring optimal asset integrity management of oil and gas installations and components. Petroleum engineers have built a wide consensus on the necessity of using LDAR for asset integrity management and reiterated this in multiple conferences.[797] There is also a

[791] Waste Prevention Rule, above n 398, at p. 49190.
[792] USEPA *Leak Detection and Repair: A Best Practices Guide* (USEPA 2016) 1.
[793] Methane Regulations, above n 487, at ss. 28-36.
[794] Directive 060, above n 523, at s. 8.10.2.2
[795] Ibid, s. 8.10.4.3.
[796] Flaring and Venting Reduction Guideline, above n 571, at s. 7.6.
[797] Michele Hinnrichs and others "Infrared Gas Imaging and Quantification Camera for LDAR Applications" (paper presented to CP Air and Waste Management Association 99th Annual Conference and Exhibition, New Orleans, LA, United States, 21-23 June 2006); Jack Elliott, Richard Fletcher and Mike Wrigglesworth "Seeking the Hidden Threat: Applications of a New Approach in Pipeline Leak Detection" (paper presented to the Society of Petroleum Engineers - 13th Abu Dhabi International Petroleum Exhibition and Conference, ADIPEC, Abu Dhabi, United Arab Emirates, 3-6 November 2008); Shiv N. Jalan and others "Well Integrity: Application of Ultrasonic Logging, Production Logging and Corrosion Logs for Leak Detection in Wells - A Case Study" (paper presented to the Society of Petroleum Engineers - Kuwait Oil and Gas Show and Conference, KOGS, Mishref, Kuwait, 7-10 October 2013; Mark Rahmes and others "Continuous Environmentally Efficient pipeline Leak Detection" (paper presented to the Society of Petroleum Engineers - SPE Canada Heavy Oil Technical Conference, CHOC, Calgary, Canada, 9-11 June 2015; Kaushik Parmar, Chaneel Park and Simon Park "Robust Direct Hydrocarbon Sensor Based on Novel Carbon Nanotube Nanocomposites for Leakage Detection" (paper presented to the Biennial International Pipeline Conference, IPC, Calgary, Canada, 26-30 September 2016).

strong argument by USEPA for augmenting risk mitigation and climate change mitigation in the oil and gas industry with LDAR.[798] Therefore, there is credible evidence regarding LDAR programs' potential to reduce emissions in upstream operations. It is perhaps a question of which technique to adopt amongst the array of choices and regulatory prescriptions.

The implementation of LDAR programmes are by no means the only solutions to GHG emissions in the upstream petroleum sector. Nevertheless, they represent a good start for ensuring result-oriented approaches to address fugitive emissions. Regulators and relevant agencies may wish to take a cue from American and Canadian jurisdictions by incorporating LDAR programmes in rulemaking and policy processes.

(3) Emissions quantity disclosure

There is a similar annual upstream GHG emissions quantity disclosure/reporting obligation that runs through most case study countries. Countries with such an express regulatory requirement are Brazil, Nigeria, the USA, Canada, UK, Norway, and China. In contrast, there are varied approaches to emissions reporting in Iraq, Russia, Saudi Arabia, UAE, and Venezuela. Some countries in this second group do not specifically target the reporting of upstream GHG emissions but require the recording and reporting of pollutants and wastes as part of environmental protection obligations of oil and gas companies and other corporate entities. The countries that fall under this sub-category are Iraq and Russia. In Iraq, the proposed Hydrocarbons Law would require oil and gas operators and other businesses to report operational and accidental discharges, leakage, and environmental wastes.[799] In Russia, the purpose of reporting pollutants and wastes is purely for paying rates for negative impacts on the environment.[800]

There are also slight differences in Venezuela and the UAE. In Venezuela, there is no express reporting obligation. Still, the permissible flaring limits set on a case-by-case basis by the Ministry of Environment and Renewable Natural Resources presupposes the existence of a method by which the Ministry ascertains that companies keep emissions within allowed limits. In the UAE, companies must keep a record of emissions but have no reporting obligation, and the regulator can audit the recorded measurements.[801] In Saudi Arabia, there is no known

[798] Nicholas P. Cheremisinoff "Augmenting Risk Mitigation with Leak Detection and Repair" in Nicholas P. Cheremisinoff (ed) *Dust Explosion and Fire Prevention Handbook: A Guide to Good Industry Practices* (John Wiley & Sons 2014) 305-318.
[799] Above n 275, art 31(8).
[800] Russian Environmental Protection Law, above n 313, art 16.
[801] UAE Environmental Protection Law, above n 343, art 53.

reporting obligation, just as there is an absence of regulation targeting upstream GHG emissions.

The identified jurisdictions without clear emissions reporting obligations can learn from the countries with express reporting requirements. It is also necessary to target upstream GHG emissions, especially flaring, venting, and fugitive emissions, in addition to general environmental pollutants and waste reporting provisions. This express or specific approach is becoming increasingly important given the need to mitigate climate change in different energy-intensive sectors. A statutory or regulatory obligation to record and report the volume of GHG emissions from an industry is helpful to ascertain whether companies comply with permit limits and the emission reduction goals set for the sector, where applicable.[802] Research shows that compulsory carbon disclosure can influence business processes and the environmental performance of energy-intensive industries.[803] However, there is little evidence to ascertain the volume of GHG emissions reduction resulting from such a mandatory reporting obligation.[804]

This chapter has analysed the legal regimes applicable to upstream flaring, venting, and fugitive emissions in the case study countries. What comes clear is the existence of multiple objectives, institutions, choices of instruments and methods for incentivising upstream operators to reduce GHG emissions. However, sector-specific approaches and explicit technical operational requirements can be effective regulatory interventions, compared to general climate policy or energy and environmental governance frameworks. In addition, this chapter has identified how countries may repurpose their existing laws to work for new purposes with an example of the refocused definition of resource conservation in California to target upstream flaring and venting. These general threads will prove valuable while answering the research question of this thesis in the conclusions segment.

4. Alignment with regulatory effectiveness

The preceding comparative analysis of the circumstances in the case study countries can be matched against the tests and criteria for assessing effectiveness established in Chapter 2. Within the context of this thesis, the two key tests here are whether there is an express objective to address upstream GHG emissions in countries' regulatory regimes; and whether there are

[802] Y. A. Sudibyo, 'Carbon Emission Disclosure: Does it Matter?' (2018) 106 IOP Conf. Series: Earth and Environmental Science 012036.
[803] Samuel Tang and David Demeritt, 'Climate Change and Mandatory Carbon Reporting: Impacts on Business Process and Performance' (2018) 27 Business Strategy and the Environment 437-455; Yue-Jun Zhang and Jing-Yue Liu, 'Overview of Research on Carbon Information Disclosure' (2020) 7:1 Front. Eng. Manag. 47-62
[804] Ibid.

stipulated methods for incentivising oil and gas operators to reduce upstream GHG emissions, particularly flaring, venting, and fugitive emissions. The other criteria that can also inform the discussion are legislative mandate, accountability, fair and transparent procedures, sufficient expertise, efficient action. Some of the criteria and tests seem to be interwoven and can be considered together. For example, legislative mandate relates to whether there is a clear legal authority for the regulator to exercise powers for the regulation of upstream GHG emissions. This illustrates the first test, being an express objective to reduce emissions. In addition, efficient action relates to whether the regulator adopts methods and measures that help to achieve the regulatory mandate set in the applicable law or regulation. This aligns with the second test explained above as to whether oil and gas jurisdictions have suitable methods for incentivising operators to reduce GHG emissions. Thus, these criteria can be grouped and considered accordingly in the next paragraphs.

a) Clear regulatory objective or legislative mandate to reduce emissions

The analysis above shows that there are multiple regulatory goals in different jurisdictions. However, within the assessment framework of this thesis, it is desirable for countries to state an express regulatory objective to target upstream GHG emissions, especially flaring, venting and fugitive emissions. This clarity will give the relevant institution or agency a mandate or reason to exercise regulatory powers. The study reveals good examples of jurisdictions with this express mandate, and most of them having a specific legal instrument dedicated to addressing upstream GHG emissions. These are Canada, the USA, UK, Norway, and Nigeria.

b) Suitable methods or efficient action to reduce emissions

What we also see in different countries is the existence of various regulatory methods. In most cases, there are environmental and petroleum industry governance approaches; and even general principle regulation such as the requirement to adhere to good oilfield practice. The key question to ask is whether these methods really spur efficient action to reduce upstream GHG emissions.

The analysis above suggests the need for countries to go beyond general petroleum and environmental law provisions and techniques to incorporate industry-specific approaches. Petroleum and environmental law provisions may be suitable for some things, but do not provide sufficient direction and detailed provisions that address the intricacies and peculiarities of upstream GHG emissions, apart from slight mentions of flaring and environmental protection obligations.

The kinds of industry-specific methods that can spur efficient action to reduce emissions are those considered in Section B.3 of this chapter. These are emissions reduction targets for the upstream petroleum sector, strict flaring permit systems and price measures that send a strong signal to operators, intensity requirements proportional to resource output, and various technical process measures. As we have seen in the regulatory arrangements in Canada, the USA, the UK, Norway, and Nigeria, most of these industry-specific methods were introduced in addition to existing petroleum and environmental laws, and with a specific focus on upstream GHG emissions.

However, it is important to acknowledge that a jurisdiction may not be able to incorporate these industry-specific methods all together due to the lack of regulatory capacity to enforce sophisticated techniques. Thus, what this thesis has done is to present an array of suitable methods that petroleum-producing jurisdictions can use to improve their regimes based on legal culture and enforcement feasibility.

c) Accountability and fair and transparent procedures

Accountability and fair and transparent procedures relate to whether there is a system to make the regulator accountable in the exercise of powers and whether the regulator follows due processes established by law in a transparent manner that leaves no room for uncertainties and capriciousness (unpredictability). It is not easy to comprehensively assess how all these requirements play out in the entire regulatory frameworks of all jurisdictions, but one place to look at, from the review of countries' laws, is the arrangement made for granting flaring and venting permits. This goes back to the exercise of discretion, discussed in section 3 of this chapter. If there is anything to add to that discussion, it is to emphasise that laws should provide express requirements for the grant of flaring and venting permits, and not leaving the issue to the individual will or judgement of the regulator. The Alberta Decision Tree[805] illustrates how regulators can exercise discretion in ways that encourage operators to reduce emissions.

Additionally, there are ways for countries to make their regulators or regulatory institutions accountable and transparent in the exercise of powers. Two good examples are the use of ministerial oversight and inter-ministerial consultation. While these are some of the mechanisms to insulate the regulator against capture,[806] they can also prevent capriciousness in the grant of flaring and venting permits. Ministerial oversight occurs where a different office

[805] See Section A and Section B.3 of this chapter.
[806] Steven P. Croley "Beyond Capture: Towards a New Theory of Regulation" in David Levi-Flaur (ed) *Handbook on the Politics of Regulation* (Edward Elgar 2011) 50 at 61-65

performs oversight functions towards watching the regulator/agency against capture-oriented industrial activities and inconsistent decisions. For example, the minister of the environment may be empowered to monitor the regulator/regulatory agency for upstream emissions to avoid processes that do not meet established standards.

The regulatory regime can also provide for inter-ministerial consultation between the regulator for upstream emissions and other relevant ministries prior to the promulgation or amendment of emission reduction rules, including the decision-making process for granting flaring and venting permits. This may present a bureaucratic bottleneck that impedes quick decision-making and promulgation of rules, but it also provides an opportunity for well-informed rules and decisions. It also helps to avoid the regulatory trilemma, as the inter-ministerial consultative process could reveal rules and approaches that are either weak, or too rigid, or over-familiar with the regulated industry.

d) Sufficient expertise

This attribute has not surfaced explicitly or implicitly in the analysis conducted in this thesis, but it is important to note how it can inform the effectiveness of countries' regulatory regimes. The regulator or regulatory agency should comprise people with sufficient expertise regarding the subject matter, especially the specific prescriptions required for an effective regime and other complementary measures. A profound understanding of the core issues, processes that are responsible for upstream emissions and technical solutions would be helpful, if not necessary, for determining regulatory expertise. Regulatory failure can occur where the regulator is not acting with sufficient expertise, in addition to the absence of the other criteria for good regulation. Howlett and Ramesh have also argued that 'regulatory capacity deficits' can play huge roles in governance failures.

One final point to add is that sufficient expertise across different methods can help countries incorporate a larger variety of techniques in regulating upstream GHG emissions, as they would have the required technical capacity to enforce sophisticated or complex requirements.

In this chapter, we have encountered very dense materials, but they help in answering the research question. The central point to keep in mind is the fact that this thesis set out to identify some desirable regulatory characteristics that can incentivise oil and gas operators to reduce upstream GHG emissions, particularly flaring, venting, and fugitive emissions. Clearly, the analysis suggests that countries would need to expressly state an objective to reduce upstream

GHG emissions and prescribe some industry-specific methods for achieving that regulatory goal. These two elements will give a clear mandate to the relevant regulatory institution and provide ascertainable benchmarks for the oil and gas industry. Countries would also need to incorporate other regulatory criteria considered above, such as accountability, fair and transparent procedures, especially in respect of granting flaring and venting permits, and ensure that their regulators and regulatory institutions have sufficient expertise. These would avoid uncertainties and position countries' legal systems to better regulate upstream GHG emissions. These considerations will contribute significantly to answering the research question in Chapters 5 and 6.

4. Industry Initiatives

This chapter examines a decentred understanding of regulation through the lens of industry-driven measures for addressing upstream GHG emissions. The perception of complementarity between public/government regulation and private regulation is well-rooted in literature,[807] thus industry measures are not inimical to state regulation of flaring, venting, and fugitive emissions. It is becoming more important to understand how technological change affects the interactions between the two types of regulation.[808] For the oil and gas industry, this is underpinned by the emergence of new strategies to promote environmental responsibility.

Furthermore, sustainability is a cardinal concern for businesses, especially with increased climate change awareness. Sectoral frameworks and international cooperative initiatives have emerged to drive emissions reduction in the oil and gas industry, underscoring the need for transformative change. This chapter examines some of such initiatives as part of the international regulatory structure for energy and climate change governance. The chapter also discusses proposed and ongoing climate measures of oil majors for abating flaring, venting, and fugitive emissions. The technical capacities, wealth of information and experience, and rules of these organisations are clear pointers to the decentred understanding of regulation.

The tests and criteria discussed in Chapter 2 for assessing effectiveness will also contribute to informing the discussion in this chapter, especially in relation to the goals set by industry operators and methods adopted to reduce upstream GHG emissions. The chapter will turn to these considerations after a discussion of some industry initiatives.

A. Flaring Reduction Partnerships

Flaring and venting reduction initiatives have recently emerged on the international scene, with the Global Gas Flaring Reduction Partnership (GGFRP) being the most prominent.[809] The GGFRP and the 2030 Zero Routine Flaring (ZRF) are two key public-private partnership

[807] Russell W. Mills "The Interaction of Private and Public Regulatory Governance: The Case of Association-Led Voluntary Aviation Safety Programs" (2016) 35:1 Policy and Society 43-55; Emily S. Bremer "Private Complements to Public Governance" (2017) 81 Missouri Law Review 1115; Gregory Jackson and Nikolas Rathert "Private Governance as Regulatory Substitute or Complement? A Comparative Institutional Approach to CSR Adoption by Multinational Corporations" in Christoph Dörrenbächer and Mike Geppert (eds) *Multinational Corporations and Organization Theory: Post Millennium Perspectives Research in the Sociology of Organizations* (Emerald Publishing Limited 2017) 445-478.

[808] Nicolas Schmid and others "Governing Complex Societal Problems: The Impact of Private on Public Regulation through Technological Change" (2020) Regulation and Governance https://doi.org/10.1111/rego.12314.

[809] Anastasia Rodina "Burning Through: Reducing Associated Petroleum Gas Flaring to Enhance Natural Gas Resources Governance" (2016) Law in Transition Journal 82 at 89.

initiatives of the World Bank to address gas flaring and venting.[810] The GGFRP comprises 18 governments, 13 international oil companies (IOCs) and 3 international organizations totalling 34 members.[811] It started in 2002, with the key objective of catalysing optimum gas utilization by removing technical and regulatory barriers to flaring reduction through stakeholder facilitation, policy change, research, dissemination of best practices and project implementation. [812] The ZRF has over 27 states, 34 IOCs, and 34 intergovernmental organization totalling 95 participating members.[813] It began operations in the year 2015 with the set objective to end routine flaring by 2030.[814]

These initiatives – the GGFRP and the ZRF partnerships – have specific instruments through which they operate. Although the direct regulation of gas flaring falls within countries' jurisdiction and their relevant national energy and environmental authorities,[815] the GGFRP and ZFR periodically formulate complementary guidelines for GHG emissions reduction. For example, the 2008 Guidelines for Flare and Vent Measurement recommends using gas-to-oil ratios, mass balance, and process simulations as best practice for flare and vent estimation to achieve accurate measurement and mapping of suitable reduction methodologies.[816] A further 2009 guidance recommends targeted frameworks and appropriate penalties to incentivise flaring and venting reduction; and states clarity, autonomy, participation, accountability, transparency and predictability as criteria for regulators.[817] Later technical guidance on gas monetization proposes processes and new technologies to convert flared gas into chemicals and liquid fuels instead of flaring and venting.[818]

The multi-sectoral character of participants of these initiatives – comprising national oil companies (NOCs), international oil companies (IOCs), governments of sovereign states, and relevant international and intergovernmental organisations – provides a good platform for exchanging ideas amongst key stakeholders. These initiatives may have played a part in the 5%

[810] Ibid.
[811] World Bank "Global Gas Flaring Reduction Partnership" <https://www.worldbank.org/en/programs/gasflaringreduction>.
[812] Ibid; Climate Initiatives Platform "Global Gas Flaring Reduction Partnership" (Climate Initiatives Platform September 2018) <www.climateinitiativesplatform.org>
[813] Above n 811.
[814] World Bank "Zero Routine Flaring by 2030" (World Bank) <www.worldbank.org>.
[815] World Bank *Regulation of Associated Gas Flaring and Venting: A Global Overview and Lessons from International Experience* (World Bank 2004) at 6 and 7.
[816] GGFRP *Technical Report: Guidelines on Flare and Vent Management* (GGFRP 2008) at 14,15 and 16.
[817] GGFRP *Guidance on Upstream Flaring and Venting: Policy and Regulation* (GGFRP 2009) at 5-8.
[818] Theodor Hermann Fleisch *Associated Gas Monetization via miniGTL: Conversion of Flare Gas into Liquid Fuels and Chemicals 2015 GTL is a Commercial Reality for Flaring Reduction, Report III* (GGFRP 2014) at 8,16 and 35.

global flaring reduction that Chapter 1 highlighted. There could have also been country-specific measures and other factors such as the influence of oil prices and declining production levels contributing to the drop in global gas flaring. For oil prices, OPEC and the United States Energy Information Administration (EIA) statistics reveal that the oil prices for 2017 increased beyond the prices for 2016. The OPEC yearly basket prices for oil in 2016 and 2017 were USD 40.76 and USD 52.43 respectively per barrel.[819] According to the EIA, Brent Crude and West Texas Intermediate Crude reached USD 65 and USD 51 respectively per barrel in 2017, being the highest end-of-year oil prices since 2013.[820] These statistics show that oil price may have had no influence on the drop in global gas flaring. More generally, high oil and gas prices make good economic sense to utilize gas or implement gas-to-liquid initiatives to reduce flaring and venting.[821]

One would have probably expected oil production levels to grow in line with high crude prices, but the reverse was the case for the period under reference. Instead, there was a global curtailment of production inventories by OPEC and some non-OPEC member countries, leading to a world crude oil production decline by 701,000 barrels per day (b/d), or 0.9% compared to 2016, to reach 74.69 million b/d, marking the first yearly decline since 2009.[822] This difference in production levels and the quantum of economic activities between 2016 and 2017 may have contributed to the drop in global gas flaring emanating from upstream crude production. In addition, disruptions caused by COVID-19 resulted an 8% decline in global oil production from 82 million b/d in 2019 to 76 million b/d in 2020.[823] However, US production of crude grew by 5.6% within the timeframe, leading to a record production in 2018 and 2019 of 10.7 million barrels per day and 11.3 million barrels per day, respectively.[824] Libya also recorded a crude production increase by 427,000 b/d, or 109.5%, due to OPEC curtailment exemption.[825]

These flaring reduction partnerships are all reasonable measures to address upstream GHG emissions. However, host states would need to further work on incremental steps, policy milestones, and strategies to achieve zero flaring. Such actions could include annual flaring reduction targets leading up to 2030 or any other future date(s).

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[819] OPEC "Basket Price" available at <www.opec.org>.
[820] USEIA "Crude Oil Prices Increased in 2017, and Brent-WTI Spread Widened" available at <www.eia.gov>.
[821] Eman A. Emam "Gas Flaring in Industry: An Overview" (2015) 57:5 Petroleum & Coal 532 at 548.
[822] OPEC *OPEC Annual Statistical Bulletin 53rd edition* (OPEC 2018) at 8.
[823] World Bank Global Gas Flaring Reduction Partnership, above n 24, at 5 and 7.
[824] Ibid; USEIA "Annual US Crude Production", available at <www.eia.gov>.
[825] Ibid.

B. Emissions Reporting Schemes: The Carbon Disclosure Project

Carbon disclosure and reporting schemes have evolved over the years with initiatives such as the Greenhouse Gas Protocol, International Standards Organisation 14064-1:2018 for Greenhouse Gas Accounting and Verification, the United Nations Global Compact and Global Reporting Initiative and the Carbon Disclosure Project (CDP). These reporting schemes enable corporations to strategize on carbon risks and influence appropriate decision-making for climate change mitigation.[826] This thesis examines the CDP as a test case because it is one of the earliest reporting systems[827] and among the most commonly used reporting platforms.[828] The CDP, based in the United Kingdom, was founded in 2002.[829] It affords companies, regions, states, cities and investors a platform to self-measure and manage their environmental footprints.[830] Its reporting parameters include risks and opportunities, performance, GHG emissions accounting and governance.[831] Research shows that companies' strategies to address climate change may be supported by their annual corporate reports showing quadrants such as environmental asset management, loss and pollution prevention, GHG emissions and mitigating strategies.[832]

Corporate environmental awareness through carbon disclosure schemes can incentivise corporate adoption of innovative solutions for emissions reduction.[833] The environmental performance or climate compliance of oil and gas companies may add to such companies' reputation and validate their social licence to operate before shareholders, investors, the public and surrounding communities.[834] This is the central idea behind the social license to operate

[826] Jane Andrew and Corinne Cortese "Carbon Disclosures: Comparability, the Carbon Disclosure Project and the Greenhouse Gas Protocol" (2011) 5:4 Australian Accounting Business and Finance Journal 5 at 6 and 7.
[827] Romain Morel and Ian Cochran "Variant 4: Coexistence of Voluntary and Mandatory Frameworks at the Company Level – Carbon Disclosure Project, EU ETS and French Legal Requirements" in Valentin Bellassen and Nicolas Stephan (eds) *Accounting for Carbon: Monitoring, Reporting and Verifying Emissions in the Climate Economy* (Cambridge University Press 2015) 283 at 284.
[828] Ronald Whitfield and Jeanne M. McNett *A Primer on Sustainability in the Business Environment* (Business Expert Express 2013) at 32.
[829] CDP <https://www.cdp.net>.
[830] Andrea Andromidas "The Carbon Disclosure Project: Its Target is Industry – What is the Objective?" (2013) 24:5 Energy and Environment 779 at 781.
[831] Ibid.
[832] Juliano Almeida de Fara, José Célio Silveira Andrade and Sônia Maria da Silva Gomes "The Determinants Mostly Disclosed by Companies that Are Members of the Carbon Disclosure Project" (2018) 23 Mitigation and Adaptation Strategy for Global Climate Change 955 at 996.
[833] Yunhee Kim "Environmental, Sustainable Behaviours and Innovation of Firms During the Financial Crisis" (2015) 24 Business Strategy and the Environment 58 at 61, 63, 67-69.
[834] Don C. Smith and Jessica M. Richards "Social License to Operate: Hydraulic Fracturing-Related Challenges Facing the Oil and Gas Industry" (2015) 1:2 Oil and Gas, Natural Resources, and Energy Journal 81 at 89.

concept. Although it is yet to be formally entrenched into legal systems, its recurrence can spur corporate entities into changing their *modus operandi*.[835]

However, the voluntarist approach of the CDP inhibits consistency or continuity of corporate emissions disclosure by oil and gas companies. While some players may be willing to disclose their emissions profile, others may not always be willing to do so because of poor environmental profile.[836] There are also considerable variations in emissions data reporting. Some firms are comprehensive in their response to annual surveys, and others are opaque and hide their emissions profile from public scrutiny.[837] For example, according to available data, between the years 2016 to 2018, organisations reacted differently to the CDP's disclosure requests.[838] While some companies responded and attained different scores, some others failed to respond in some cases and responded partially. For example, Total participated in the years 2016, 2017 and 2018, with 'B', 'A', and 'A' ratings for the three years, respectively. Royal Dutch Shell participated in the three years under reference, with 'A', 'B', and 'C' ratings. Chevron participated in 2016 and 2017, with 'B' ratings for the two years, but declined to join in 2018. British Petroleum (BP) participated in 2016 and 2017, with 'B' and 'A' ratings for the two years but did not respond to the 2018 disclosure request. Exxon Mobil participated in 2016 and 2017, with 'C' ratings for the two years, but did not respond to the 2018 disclosure request, as BP. Sinopec did not respond to disclosure request at all for the three years under reference. Saudi Aramco and Petróleos de Venezuela, S.A. never participated in the initiative, at least from its inception until 2018, probably because they do not have shareholders and listed stock prices to worry about within the years under reference (2016-2018). The participation of these and other NOCs can improve emissions data availability and accountability of the CDP process, considering the fact that NOCs control vast amounts of oil and gas reserves and production. In 2011, the World Bank reported that NOCs controlled approximately 90% of global oil reserves and 75% of global production.[839] A more recent study finds that they account for about 55% of global production.[840] In addition, the proportion of upstream petroleum investment carried out

[835] Chilenye Nwapi "Can the Concept of Social License to Operate Find its Way into the Formal Legal System" (2016) 18 Flinders Law Journal 349 at 350, 358 and 364.
[836] Dayuan Li and others "Environmental Legitimacy, Green Innovation, and Corporate Carbon Disclosure: Evidence from CDP China 100" (2018) 150 Journal of Business Ethics 1089 at 1098 and 1100.
[837] Daniel C. Matisoff, Douglas S. Noonan and John J. O'Brien "Convergence in Environmental Reporting: Assessing the Carbon Disclosure Project" (2013) 22 Business Strategy and the Environment 285 at 287, 288 and 295.
[838] CDP, above n 829.
[839] Silvana Tordo, Brandon S. Tracy and Noora Arfaa *National Oil Companies and Value Creation* (World Bank Working Paper No. 218, 2011) at xi, 5, and 96.
[840] Natural Resource Governance Institute *The National Oil Company Database* (Natural Resource Governance Institute April 2019) at 2.

by NOCs is increasing, while that of IOCs is decreasing.[841] For example, the share of upstream investments by NOCs, IOCs, and others in 2018 and 2019 were 44%, 19%, and 37%, respectively.[842] In 2020, the figures stood at 47%, 18%, and 35%, respectively.[843] This shifting trend justifies the need for serious regulatory intervention by countries and the commitment of NOCs to reduce the carbon footprint of their increasing operations. More so, the IEA has shown that petroleum-producing countries with NOCs account for approximately 75% of global methane emissions, with 66% of global methane emissions coming from 15 NOCs,[844] covering all the case study countries in this thesis.

A vital issue to consider is whether the disclosures actually lead to reducing flaring, venting, and fugitive emissions. Scholars have asserted that the petroleum industry has increased corporate greenwashing and environmentalism in the heat of the climate change debate.[845] The annual corporate reports, carbon reporting to voluntary schemes such as the CDP, and industry-driven mitigation strategies may be symbolic of corporate environmentalism. Such corporate gestures may not necessarily guarantee emissions reduction or disclose the industry's actual environmental status or performance.[846] However, it is logical to expect that oil and gas producing companies' reported environmental indices translate into tangible and feasible investments in emissions reduction technologies. Such investments would match emissions reports with corresponding actions that translate into climate change mitigation.

C. The Oil and Gas Climate Initiative and Private Corporate Measures

The Oil and Gas Climate Initiative (OGCI) is a contemporary example of the petroleum industry's commitment to addressing climate change.[847] Ten of the world's largest oil companies, including investor-owned companies and national oil companies, launched the initiative at the UN Climate Summit in New York, September 2014.[848] The cardinal objectives of the OGCI include reducing energy footprint (energy intensity), accelerating low-carbon solutions and enabling a circular carbon model through carbon capture, use and storage,

[841] IEA *Oil 2021*, above n 121, at 56.
[842] Ibid.
[843] Ibid.
[844] See IEA Methane Tracker data at <https://www.iea.org/reports/methane-tracker-2020/methane-from-oil-gas>.
[845] Frances Brown *After Greenwashing: Symbolic Corporate Environmentalism and Society* (Cambridge University Press 2014) at 15 and 76.
[846] Le Luo and Qingliang Tang "Does Voluntary Carbon Disclosure Reflect Underlying Carbon Performance?" (2014) 10 Journal of Contemporary Accounting and Economics 191 at 196.
[847] Matthew S. Bach "Is the Oil and Gas Industry Serious About Climate Action?" (2017) 59:2 Environment: Science and Policy for Sustainable Development 4 at 6.
[848] Ibid.

improved industrial energy efficiency, methane emissions reduction, and transport emissions reduction.[849] It also plans a ten-year USD1 billion investment in these areas through USD100 million contribution from each member.[850] These programmes cover a wide range of mitigation matters, but only some concern upstream flaring, venting, and leakage.

Oil and gas companies seem to be playing active roles in mitigating climate change through the OGCI.[851] There are reasons to justify this positive perspective. Member companies of the OGCI have made financial commitments in terms of investments in technologies and research and development of innovative operation methods to reduce GHG emissions.[852] In 2017, the OGCI provided monetary and technical assistance to two studies on methane emissions and invested in Achates Power, a company researching the development of energy-efficient engines to reduce upstream GHG emissions.[853] These and similar investments have emissions reduction potentials.[854] Similarly, all its members provided emissions data at the time of writing and collectively invested USD5.5 billion in low carbon energy technologies and acquisition.[855] The unanimous willingness of its members to provide emissions data signals transparency and commitment to reducing emissions.[856]

Aside from the collective industry action by the OGCI, oil and gas majors have also independently and individually acknowledged the problem of anthropogenic climate change, their share of responsibility and enunciated self-imposed targets and GHG emissions reduction measures.[857] Table 4 summarises the net-zero targets and plans to reduce flaring and venting, set by eight OGCI members, mostly announced in 2020.

[849] OGCI "A Catalyst for Change" (OGCI 2018) <www.oilandgasclimateinitiative.com>; Climate Initiatives Platform "Oil and Gas Climate Initiative" (Climate Initiatives Platform September 2018) <www.climateinitiativesplatform.org>.
[850] Ibid.
[851] Matthew Bach "The Oil and Gas Sector: From Climate Laggard to Climate Leader?" (2019) 28:1 Environmental Politics 87 at 94 and 97.
[852] OGCI *Multinational CO_2 Storage Resource Assessment: Availability of CO_2 Storage Capacity in Key Markets* (OGCI November 2017) at 2.
[853] OGCI *Collaborating to Realize the Energy Transition: A Report from the Oil and Gas Climate Initiative* (OGCI October 2017) at 10.
[854] Ibid.
[855] OGCI *At Work Committed to Climate Action: A Report from the Oil and Gas Climate Initiative* (OGCI September 2018) at 53.
[856] Matisoff, Noonan and O'Brien, above n 837.
[857] Jon Birger Skærseth and Tora Skodvin *Climate Change and the Oil Industry: Common Problem, Different Strategies* (Manchester University Press 2003) at 43, 65 and 67.

Table 4: Net-zero targets by major oil and gas companies

Company	Climate Target	Targets for Flaring, venting and fugitive emissions	Date Announced
Repsol	Net-zero company by 2050	Part of the net-zero target	December 2019[858]
Equinor	Net-zero company by 2050	Part of the net-zero target	November 2020[859]
BP	Net-zero company by 2050	Part of the net-zero target	February 2020[860]
Eni	Net-zero company by 2050	Part of the net-zero target	February 2020[861]
Shell	Net-zero company by 2050 or sooner	Part of the net-zero target	April 2020[862]
Total	Net-zero company for European business interests by 2050	Net-zero flaring and venting by 2030 and a short-term flaring reduction target of 80 per cent from 2010 to 2020[863]	May 2020[864]
Occidental	Net-zero company between 2040-2050	Part of the net-zero target	November 2020[865]
Exxon Mobil	Net-zero company by 2050	Part of the net-zero target	February 2021

The flaring reduction partnerships, emissions reporting schemes, the work of the OGCI, and the private corporate measures by oil majors underscore a commitment by the oil and gas industry to mitigate upstream flaring, venting, and fugitive emissions. Although these initiatives are still in their early phases, they point to one of the decentred understandings of regulation theory (private regulation), which Chapter 2 discussed. However, while oil majors may have crucial roles and commendable initiatives, petroleum-producing states need to ensure effective regulatory regimes through relevant reforms. The two types of regulation – private regulation and state regulation – support each other.

In summary, it is important to say how industry measures align with the conceptual framework defined in Chapter 2. This needs to be done with an understanding that the conceptual framework primarily targets state regulatory measures. The consideration of industry initiatives

[858] Repsol Strategic Plan 2021-2025: Stepping Up the Transition: Driving Growth and Value, available at <www.repsol.com>.
[859] Equinor's Net-Zero Announcement, available at <www.equinor.com>.
[860] BP's Net-Zero Announcement, available at <www.bp.com>.
[861] Eni's Long-Term Strategic Plan to 2050 and Action Plan 2020-2023, available at <www.eni.com>.
[862] Shell's Responsible Investment Annual Briefing Updates, available at <www.shell.com>.
[863] Total "Our Commitments and Improvement Indicators" (Total 2019) <www.total.com>.
[864] Corporate Policy Announcement: Supporting EU's carbon neutrality target, Total commits to become a Net Zero Emission Company for all its European Businesses by 2050, available at <www.total.com>.
[865] Occidental's Climate Report 2020: Pathway to Net-Zero, available at <www.oxy.com>.

has been to appreciate how a decentred understanding of the theory of regulation applies to upstream GHG emissions reduction, and to identify how oil and gas companies are working to complement state approaches to the problem. However, the two fundamental questions to ask are whether there is a clear goal to reduce emissions, and whether there are specific methods adopted to achieve the set goal?

One can answer these questions in the affirmative. As the discussion shows, there is a clear intention by oil and gas operators to reduce upstream GHG emissions. Most oil majors have also set carbon-neutrality goals for 2050, as Table 4 illustrates. Secondly, this chapter has provided a good summary of various industry-driven and industry-specific initiatives that are used by operators to reduce emissions. One can also point to the presence of another element of a good regulatory regime in the various private initiatives of oil and gas companies. As Chapter 2 showed, technical expertise is one of the key elements of regulatory powers outside state control. The acumen and industry-focused solutions developed and rolled out by the oil and gas industry, either through collective or private measures, clearly evidence the exercise of independent regulatory powers.

However, it is important to recall that the primary focus of this thesis is on regulatory interventions by states. Even though there can be complementarity between state and industry regulatory measures, a lot depends on sovereign states that control a vast majority of oil and gas production and reserves. Therefore, the paramount concern is on the quality of states' regulatory interventions.

5. Insights and Law Reform

This chapter summarizes the insights drawn from this thesis and canvasses a law reform agenda to improve the legal frameworks in petroleum-producing countries. What is the point in ensuring optimal regulatory frameworks for reducing upstream GHG emissions? Why is it necessary to compare regimes across multiple petroleum jurisdictions? The conceptual significance of this thesis narrows down to 'regulatory effectiveness' regarding upstream GHG emissions reduction. The study has explored the theory of regulation and applied it to analyse the applicable regimes of twelve countries. The fundamental question to ask from the preceding chapters is what key elements constitute an effective regime for abating flaring, venting, and fugitive emissions? These questions can also be answered in relation to the tests for designing an effective regulatory regime, discussed in Chapter 2 and summarised in the concluding paragraphs of the preceding chapter.

Furthermore, one can reflect on what the analysis in this thesis suggests about the issues identified by the United Nations Environmental Programme (UNEP) and the International Energy Agency (IEA) in their methane report (for UNEP) and Net Zero report (for the IEA) discussed in Chapter 1. These institutions recognize the need for energy transition but clearly point to the urgency of abating upstream GHG emissions in core oil and gas operations by using targeted measures.[866] This thesis supports this approach to mitigating climate change in petroleum production, and this chapter goes on to summarize some relevant insights from this study to facilitate an effective regulatory regime to reduce flaring, venting, and fugitive emissions.

A. Summary of Insights

The matters discussed in this section have received more expansive and in depth analysis in different segments of Part B of Chapter 3, but they have been pulled together and presented in a summary form here to give a clear indication of the desirable characteristics that countries can use to strengthen their regulatory regimes regarding the subject matter of this thesis. In applying the concept of effectiveness defined in Chapter 2 to this research, Chapter 3 inquired into the prevalent regulatory goal or objective, relevant provisions, and institutional arrangements in petroleum-producing jurisdictions. From that analysis, some essential characteristics for ensuring an effective regime for abating flaring, venting, and fugitive emissions are as follows:

[866] See Chapter 1, Section D of this thesis.

1. The existence of a clear regulatory objective to reduce upstream GHG emissions, especially flaring, venting, and fugitive emissions. This is a direct response to the first test for effectiveness discussed in Chapter 2, i.e., whether the aim of regulatory provisions has been clearly stated. Applied to the analysis in this thesis, the key recommendation is for countries to expressly state upstream GHG emissions reduction as a strategic objective in a suitable instrument (law or regulation). The IEA suggests that reducing upstream emissions should be the first charge priority of petroleum-producing countries and companies. Achieving this goal depends significantly on the character and nature of countries' laws. One fundamental consideration in this regard is whether there is an express legal or regulatory objective to address upstream emissions. This thesis has demonstrated the existence of various governance agenda in many oil and gas provinces of the world. However, the analysis has established the essence of having clarity of a regulatory purpose to target flaring, venting, and fugitive emissions, as the cases of Canada, the United States, the United Kingdom, and Nigeria illustrate. This regulatory clarity also has an effect on how regulatory agencies exercise powers and interpret legal provisions.

2. The existence of suitable instruments for achieving the set objective of upstream emissions reduction. The choice of regulatory instrument can be crucial for achieving set objectives. One fundamental insight in this regard is the shift from the decades-long practice of general environmental and petroleum legislation, and resource conservation to the adoption of stringent and specific regulations for reducing emissions in upstream oil and gas operations in jurisdictions such as Canada, Norway, the UK, Nigeria, and the United States. Other countries can initiate similar targeted measures to mitigate upstream GHG emissions.

3. The existence of well-tailored and focused industry-specific methods that support the regulatory objective of abating upstream GHG emissions. This responds to the second test for effectiveness established in Chapter 2, i.e., whether there are suitable methods to spur the regulated entities to achieve the goal of upstream GHG emissions reduction. The expanded analysis in Part B of Chapter 3 provides examples of such industry- and issue-specific instruments. These are carbon (or emission) intensity requirements on operators, setting of emissions reduction targets, structuring emissions permit systems to reduce laxity, and the optimal use of pricing mechanisms to incentivise efficient gas utilization. These targeted measures go beyond the generalities of environmental and petroleum legislation and address the problem of upstream GHG emissions. Therefore, petroleum-

producing jurisdictions have an opportunity to reposition their regulatory regimes for effectively addressing flaring, venting, and fugitive emissions.

B. A Law Reform Agenda

Law reform becomes necessary where existing legal frameworks do not provide adequate solutions to a problem.[867] The policy cycle requires the ever-revolving processes of agenda-setting (problem definition), policy formulation/development, adoption, implementation/enforcement, and evaluation.[868] Informed by the analysis in Chapter 3, this chapter proposes legal and institutional reforms that can help regulators maintain firm regulatory control while also incentivising industry-led innovation for reducing flaring, venting, and fugitive emissions. In addition, countries need to muster the political will to undertake the necessary reforms canvassed in the following paragraphs, and address petroleum dependency and rent-seeking, especially in IEA-designated producer economies.

1. Mandatory prescriptions as part of the desirable characteristics

Iraq, Nigeria, Russia, Saudi Arabia, the United Arab Emirates, Venezuela, Brazil, and China will need to initiate regulatory reforms to reposition their regimes to provide effective solutions to flaring, venting, and fugitive emissions. Jurisdictions such as Canada, Norway, the UK, and the US show some good practices in this respect. (It should be noted that these conclusions come out of the detailed examination made in this thesis, and not from any broad-brush categorization of countries.) The specific regulations in these countries (Canada, Norway, the UK, and the US) prescribe the mandatory implementation of certain industry-centric practices that are notable for decarbonising oil and gas operations. It becomes relevant to clarify regulatory objectives and adopt sector-oriented and issue-specific prescriptions and methods to reduce upstream GHG emissions. The mandatory requirements that have been identified in this thesis, and are also part of the desirable characteristics for reducing upstream GHG emissions, are incremental emissions reduction targets for the industry, stringent emissions permit systems, well-designed price mechanisms and optimal asset integrity management to avoid fugitive emissions. These are a suite of methods that countries can consider incorporating into their regulatory frameworks based on legal culture. While some jurisdictions may have the requisite technical capacity to enforce sophisticated regulatory techniques, others may not.

[867] Commonwealth Secretariat *Changing the Law: A Practical Guide to Law Reform* (Commonwealth Secretariat 2017) at 12.
[868] Cosmo Howard "The Policy Cycle: A Model of Post-Machiavellian Policy-Making?" (2005) 64:3 Australian Journal of Public Administration 3 at 6; Marijn Janssen and Natalie Helbig "Innovating and Changing the Policy-Cycle: Policy-Makers be Prepared" (2018) 35 Government Information Quarterly 99 at 101.

Thus, a country may not consider these regulatory measures all together. Nonetheless, the world needs a mix of multiple strategies to address flaring, venting, and fugitive emissions. Countries could develop their regulatory capacities to be able to enforce complex requirements that incentivise operators to abate emissions.

2. Encouraging innovation and hybridity

To avoid the usual disadvantages of prescriptive command and control regimes, regulators can consider incorporating an element of a performance-based approach (discussed in Chapter 2) that allows the oil and gas sector to apply innovative solutions to complement regulatory provisions. It is also important to remember that it is rare to find a regulatory regime that purely implements a single approach to solving problems. Instead, a hybrid of different methods is the norm. The element of industry-specific incremental emissions reduction targets, discussed in Chapter 3, is a performance-based regulation attribute as it sets a goal for the upstream petroleum sector. Thus, countries can design their governance regimes to produce a hybrid of prescriptive and principle-based approaches.

One important task is to explain or consider how a hybrid system can work in petroleum jurisdictions. To avoid any confusions, the reference to a hybrid regulatory regime here is simply a mix of prescriptive and result-oriented approaches to achieving upstream GHG emissions reduction. The prescriptive character would mean the specification of some of the mandatory requirements considered in the preceding analysis to ensure regulatory firmness. This can also provide ascertainable benchmarks for all industry operators in a jurisdiction, instead of leaving emissions reduction to chance or to the assumption that oil and gas companies would develop suitable strategies to address the problem. That is not always the case. As we have seen in Chapter 3, operators in most jurisdictions may prefer to flare or vent gas and pay insignificant penalties or fines in the absence of stricter regulatory controls. Therefore, the use of suitable industry-specific prescriptions by the regulator can be a good way of incentivising actions that help reduce upstream GHG emissions.

From the discussion of regulatory theories in Chapter 2, we learn that one of the major drawbacks to prescriptive arrangements is that they can stifle innovation. This can be a major problem with prescribing mandatory methods for reducing upstream GHG emissions. Countries can avoid this problem by incorporating a result-oriented process that encourages operators to invest in the research and development of new emissions reduction methods to complement regulatory prescriptions. This simply means that two sets of methods can exist on a complementary basis. It is this co-existence that this thesis refers to as a hybrid approach. As

we saw in Chapter 4, there are already industry initiatives to reduce emissions. Clearly, the regulation of upstream GHG emissions is not within the exclusive purview of state authorities.

We can further illustrate the point by looking at scholarly evidence and a good example from the UK. Scholars have suggested using goal-based technology-driving approaches to promote innovation in a prescriptive regime,[869] one of which can be a provision in the regulatory instrument allowing oil and gas operators to develop alternative or complementary technical solutions to the problem of upstream emissions. Then regulators will have a chance to assess such solutions or technologies with the aid of independent experts and consider allowing their use to complement regulatory provisions.

The UK Department for Business, Energy and Industrial Strategy has recently recommended five specific regulatory approaches to encourage innovation in the oil and gas industry during the energy transition.[870] They include providing regulatory advice to innovators, supporting technological experimentation, streamlining regulatory approvals for innovators, and setting regulatory challenges to drive innovation.[871] Some of these approaches are relevant to the issue of upstream emissions. For example, setting regulatory challenges for innovation is a form of goal setting that allows operators to develop alternative or complementary solutions. The experimentation idea can also be helpful where there is an arrangement for industry operators to work closely with regulators to monitor the development and small-scale testing of new technologies for abating upstream GHG emissions. An example is the production of fertilizer from associated gas to put the gas to good use rather than simply wasting it.[872] These approaches can allow operators in different jurisdictions to adopt and implement new emerging industry-driven technologies.

The proposed oversight functions by the Oil and Gas Authority (OGA) in the UK for the successful electrification of upstream operations provide some ideas about how regulators in other jurisdictions may be able to incentivise industry-led innovation. This topic was discussed in detail in Section A of Chapter 3. To support pioneering projects, the OGA has expressly informed the oil and gas industry of a willingness to approve future technologies for addressing

[869] OECD *Regulatory Reform and Innovation* (OECD 2016) at 35; Beverly Wagner and Nusa Fain "Regulatory Influences on Innovation in the Public Sector: The Role of Regulatory Regimes" (2018) 20:8 Public Management Review 1205 at 1211.
[870] Harry Armstrong, Imre Bárd and Ebba Engström *Regulator Approaches to Facilitate, Support and Enable Innovation* (BEIS Research Paper Series Number 2020/003, January 2020) at 14-54.
[871] Ibid.
[872] See Gas as Fertilizer Feedstock at <https://petrowiki.spe.org/Gas_as_fertilizer_feedstock>.

upstream GHG emissions.[873] To enhance regulatory coordination, the OGA has also promised to use the learnings from participating in regulator-industry brainstorming sessions to align regulatory guidance and provisions with sectoral needs.[874]

3. Institutional and political economy reforms

Addressing upstream GHG emissions requires the existence of a suitable regulator. This may mean establishing a new agency or undertaking system-wide improvements to existing institutions for better performance. Similarly, petroleum-producing jurisdictions can improve their regulatory institutions to suit the specific peculiarities of the upstream sector.

Some of the attributes of a good regulatory system, identified in Chapter 2, can have implications for the proposed reform agenda, but the ones that are more relevant to the present analysis are sufficient expertise (capability), transparency, and reporting requirements. Other vital considerations are the orientation of the regulatory institution, the law, and the political economy circumstances in petroleum-dependent countries. The regulator or regulatory agency should comprise people with sufficient knowledge regarding the subject matter, especially the specific prescriptions required for an effective regime and other complementary measures. A profound understanding of the core issues and processes that are responsible for upstream GHG emissions and potential technical solutions could be helpful, especially as regulatory failure can occur where the regulator is not acting with sufficient expertise. Howlett and Ramesh have also argued that "regulatory capacity deficits can play considerable roles in governance failures."[875]

Regarding the orientation of the institution, some essential issues to consider are the relevant government body or agency that may be more suitable to regulate upstream emissions, and the underlying philosophy underpinning the existence of the regulator. Should it be the Ministry of Petroleum and Natural Resources or Energy? Alternatively, Conservation? Environment? Climate Change? Flaring, venting, and fugitive emissions are much of an environmental problem as they are a climate change problem. The legal regimes in most countries vest regulatory powers in either the Minister for the Environment (or, more recently, the Minister for Climate Change) to make rules applicable to climate change mitigation in different industries. Creating a ministry for climate change or a Climate Change Commission is a recent

[873] Above n 870.
[874] Ibid.
[875] Michael Howlett and M. Ramesh "Achilles' Heels of Governance: Critical Capacity Deficits and Their Role in Governance Failures" (2016) 10 Regulation & Governance 301-313.

practice around the world. In this general sense, only a few countries have enacted specific climate change legislation, establishing a climate change commission or a similar institution. Some leading examples are the United Kingdom,[876] Norway,[877] France,[878] Sweden,[879] Netherlands,[880] Denmark,[881] Mexico,[882] New Zealand[883] and Germany.[884] However, these climate change laws do not provide a clear answer for addressing emissions in all sectors of the economy. For upstream petroleum emissions, Chapter 3 revealed different circumstances and the peculiarities in various countries. The regulation of upstream GHG emissions predominantly falls under the powers of the industry regulator or the ministry of environment, and the institutions in different countries have various orientations and leanings. For example, in Canadian provinces, we find industry regulators and environmental regulators having a strong leaning towards a robust regime for reducing flaring, venting, and fugitive emissions. In the United States, there is a slightly different dynamic. At the federal level, the environmental regulator has a strong orientation towards reducing upstream emissions; whereas at the state level, industry regulators exercise more powers on the issue than environmental regulators. These examples suggest clearly that the orientation of regulatory agencies in different jurisdictions may vary, but it is important for countries to identify the dominant institution to regulate upstream GHG emissions and ensure that the institution has the right orientation for the job of mitigating flaring, venting, and fugitive emissions. More so, it is vital that the designated regulator acts with sufficient expertise and utilizes industry-specific technical specifications, such as the ones earlier enumerated, for incentivising upstream emissions reduction.

However, a lot depends on the law and politics involved in the governance of the industry, which influence the underlying philosophy underpinning the regulator's existence. The legal provisions of the applicable legislation and the political economy circumstances of a country can influence the orientation of the regulator. The analysis in Chapter 3 shows that many jurisdictions have no clear objective to target flaring, venting, and fugitive emissions with a sharp regulatory focus. The laws in such countries do not empower the relevant institutions to

[876] Climate Change Act 2008 (Amended in 2019).
[877] Climate Change Act 2017.
[878] Law No 2019-1147 on Energy and the Climate.
[879] The Swedish Climate Act 2017.
[880] The Dutch Climate Act 2019.
[881] The Danish Climate Law 2019.
[882] General Law on Climate Change 2012.
[883] Climate Change Response (Zero Carbon) Amendment Act No. 136-3 2019.
[884] Climate Protection Act, Federal Law Gazette Year 2019 Part 1 No. 48, issued in Bonn on December 17, 2019.

exercise powers for the drastic reduction of upstream GHG emissions. Clearly, this area needs serious consideration in petroleum-producing jurisdictions. The law should expressly state the reasons for which the regulator can exercise powers, and this should capture making rules for the reduction of upstream GHG emissions. Canada, the United States, Norway, the UK, and Nigeria are striking examples where the law clearly provides a legal mandate to regulators to address flaring, venting, and fugitive emissions. Arguably, this clarity of regulatory powers can influence an institution's orientation and disposition towards the issues that this thesis addresses. It can also provide an ascertainable basis or context for which regulators can interpret their mandates to achieve the goal of mitigating upstream GHG emissions.

On the political-economy side, there is evidence to suggest that the circumstances in petroleum-producing countries can hinder the emergence of a firm regulatory position to mitigate upstream GHG emissions. The dominant factors that come to mind are dependency, corruption, and lack of political will. In circumstances where there is a lack of political will to promulgate stringent climate policies and regulatory measures targeting emitting sectors, it becomes difficult to establish an effective regime that addresses flaring, venting, and fugitive emissions.[885] The explanation of economic dependency is understandable; hence, the logical option for petroleum-producing countries to diversify their economies. The seminal global study of supply-side policies, by Gaulin and Le Billon,[886] to address climate change in the oil and gas industry finds the most stringent and efficacious laws in countries with low dependency on oil and gas production and limited petroleum exports, except for Norway, Canada, and the United States. A corroborative study concludes that economic reliance on the fossil fuel economy and rent-seeking are significant barriers to efficacious national climate action in most petro-states.[887]

Given the climate change debate, there is a fundamental question regarding oil-producing and exporting countries' ability to adapt to a changing external environment.[888] This leaves such countries with a strategic option of diversifying their economies.[889] Less reliance on the petro-economy may help countries establish stringent regimes to incentivise deeper decarbonisation of upstream petroleum operations. Saudi Arabia, an IEA-designated producer economy, has

[885] William F. Lamb and Jan C. Minx "The Political Economy of National Climate Policy: Architectures of Constraint and a Typology of Countries" (2020) 64 Energy Research & Social Science 101429.
[886] Gaulin and Le Billon, above n 140.
[887] Above n 885.
[888] Thijs Van de Graaf "Is OPEC Dead? Oil Exporters, the Paris Agreement and the Transition to a Post-Carbon World" (2017) 23 Energy Research & Social Science 182-188.
[889] Ibid at 185 and 187.

announced a vision to diversify its economy to reduce its dependence on oil revenues by 2030.[890] This includes a plan to increase non-oil exports in non-oil GDP from 16% to 50% by 2030 and an increase in non-oil government revenue from 163 billion Saudi Riyal as of 2020 to 1 trillion Saudi Riyal by 2030.[891] Other producer economies would also need to initiate ambitious plans to wean themselves off oil revenues and firmly reposition their regulatory regimes for effectively addressing upstream GHG emissions.

Research shows that corruption is one of the barriers to the adoption of strict regulatory regimes in countries with poor environmental performance.[892] Lobbying and financial inducement of political leaders by industry players impede the formulation of stringent fossil fuel tax and reforming subsidy schemes to encourage large-scale decarbonization of the oil and gas industry. [893] Moreover, the peculiar democratic and institutional circumstances in most petroleum-producing countries provide opportunities for exploitation. In many resource-rich countries, corruption, political instability, and weak democratic institutions limit the possibility of imposing strict environmental standards on international oil companies.[894] This thesis has not investigated these issues in depth, but it affirms existing scholarship on the matters. For example, the IEA-designated producer economies of Nigeria, Russia, Venezuela, Iraq, Saudi Arabia, and the United Arab Emirates are the bedrock of global hydrocarbons supply.[895] These countries are a subset of the core jurisdictions that play critical roles in bringing oil and gas to the world's consumers. What we find about them, in relation to the political economy dynamics, are their large petroleum production, large petroleum export, and large oil and gas contribution to their national fiscal revenues. This thesis has shown that there is a weak regulatory regime regarding upstream GHG emissions in these countries. In comparison with IEA-designated countries, there is less dependence on oil and gas in the other producer economies examined in this thesis, especially the UK, Norway, Canada, and the United States. This observation confirms the position of existing scholarship about the character and strength of the laws in countries with high economic dependence on oil and gas. This thesis has also shown that there

[890] Saudi Arabia's Vision 2030 available at <www.2030vision2030.gov.sa>.
[891] Ibid, at 61 and 67.
[892] Gaulin and Billon, above n 140, at 10; Lamb and Minx, above n 885.
[893] Cees van Beers and Jon Strand *Political Determinants of Fossil Fuel Pricing* (World Bank Policy Research Working Paper May 2013); Lucy Baker, Peter Newell and Jon Phillips "The Political Economy of Energy Transitions: The Case of South Africa" (2014) 19:6 New Political Economy 791-818.
[894] P. B. Eregha and Ekundayo Peter Mesagan "Oil Resource Abundance, Institutions and Growth: Evidence from Oil Producing African Countries" (2016) 38 Journal of Policy Modeling 603-619; Marina Povitkina "The Limits of Democracy in Tackling Climate Change" (2018) 27:3 Environmental Politics 411-432.
[895] IEA *Outlook for Producer Economies*, above n 179, at 15.

is a prevalence of more robust regulatory regimes for reducing upstream GHG emissions in less petroleum-reliant jurisdictions when compared to IEA-designated producer economies.

We find further corroboration in the lack of transparency and the absence of robust GHG emissions reporting schemes in most of the major producer economies. Chapter 2 identified these issues as some of the vital elements of a good regulatory system. They are also some fundamental areas that countries can focus reform efforts to strengthen their capability to regulate flaring, venting, and fugitive emissions effectively. Regarding transparency, Chapter 3 identified the problem of unascertainable benchmarks for the grant or refusal of flaring and venting permits in most countries. Instead, the issue is predominantly at the discretion of the minister for petroleum resources. From administrative law, we learn that discretionary powers are susceptible to abuse and arbitrariness.[896] Thus, the discretionary power a regulator has to grant flaring and venting permits on a case-by-case basis, without known criteria, is a loophole for corruption. The regulator's *modus operandi* should be accessible and transparent to the industry and the public. Rules and procedures applicable to reducing upstream emissions should be clear and leave no room for the arbitrary exercise of powers. In addition, Chapter 3 revealed the lack of robust upstream GHG emissions reporting schemes in some of the IEA-designated producer economies. For example, the regulatory regime in the UAE expects operators to keep records of all combustion emissions and the quantum of air pollutants without any reporting obligations. There are also no express upstream emissions reporting obligations in Iraq and Venezuela. More so, these countries are yet to enact or promulgate laws and regulations that target flaring, venting, and fugitive emissions particularly. These are pointers to the unwillingness of the political leadership in these countries to adopt a firm regulatory position on upstream GHG emissions. Therefore, one can speculate that the regulation of flaring, venting, and fugitive emissions are susceptible to the issue of resource dependency. Only recently has Nigeria introduced regulations specifically targeting upstream emissions and stipulating strict reporting obligations on operators.

From the analysis in the preceding chapters, it is arguable that the practical alternatives to flaring and venting are re-injection, capture and utilisation. These can put gas in profitable uses to mitigate its contribution to global warming, whether as carbon dioxide or methane emissions. However, gas pipeline networks are expensive. For example, the average cost for building a

[896] Jerzy Parchomiuk "Abuse of Discretionary Powers in Administrative Law: Evolution of the Judicial Review Models from 'Administrative Morality' to the Principle of Proportionality" (2018) 26:3 Journal for Legal Science and Practice 453 at 454-460, 468 and 475.

gas pipeline in the United States is over $7 million per mile (over $4 million per kilo meter).[897] This huge cost requirement does not look good in a time when global gas demand is weak, partly due to Covid-19.[898] One can understand the spike in gas demand and prices in certain regions of the world in the third quarter of 2021. For example, due to natural gas shortage, electricity prices in France and Germany soared by about 40%, while natural gas prices soared to a seven-year high in the United States in September 2021.[899] This phenomenon cannot be taken to represent a steady growth in global gas market due to the volatility associated with the industry, and considering the fact that the momentary spike was due to harsh weather events. Therefore, it may not speed up capital-intensive projects to expand gas utilisation infrastructure globally.

In the absence of adequate pipeline network, the next option is liquefied natural gas (LNG), but this also is expensive. Recently, global investments in LNG projects have been stagnated by low gas price benchmarks and surplus supply.[900] Nonetheless, the IEA projects that Qatar, Russia, and the United States will pick up LNG construction projects, with Qatar planning to dominate the global LNG market.[901]

In addition, the production of gas-based hydrogen (in other words, fossil-based hydrogen) is gaining momentum as a transitional process to a low-carbon future.[902] This puts pressure on gas use. It is also a good example that gas is still relevant and requires regulatory attention to abate flaring and venting in the production process.

What we see here is that the commercialisation of gas through adequate pipelines and LNG projects may reduce flaring and venting, but they are not always easy options. This is primarily because of their huge cost implications, which still qualify as fossil investments. One problem with such investments is that they could make oil and gas companies resistant to climate change action until after recouping profitable returns on investments in gas utilisation infrastructure. This could adversely affect the pace of the energy transition. Therefore, regulatory pressure is important to compel oil and gas operators to reduce emissions.

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[897] See Global Energy Monitor data at <https://www.gem.wiki/Oil_and_Gas_Pipeline_Construction_Costs>.
[898] IEA Global Energy Review 2020: The Impacts of the Covid-19 Crisis on Global Energy Demand and CO2 Emissions (IEA 2020) at 4, 15, 28-30.
[899]
[900] IEA *World Energy Investments 2021* (IEA 2021) at 27.
[901] Ibid.
[902] IEA *Gas Market Report Q3-2021* (IEA 2021) at 53, 57 and 59.

6. Conclusions

This thesis set out to examine the role of law in climate change mitigation in upstream oil and gas production to distil some desirable characteristics of an effective regulatory regime for abating gas flaring, venting, and fugitive emissions in petroleum-producing jurisdictions. To answer this central research question, the study was conducted within a six-chapter structure, adopting a qualitative framework built upon three pillars – conventional legal analysis, comparative analysis, and the theory of regulation. Chapter 1 introduced and explained useful contexts for the study. Chapter 2 discussed the theory of regulation to provide a conceptual framework to underpin the entire research. Chapter 2 also contextualised the framework for assessing effectiveness in relation to the thesis, given that the subject of effectiveness can be controversial and problematic. Since this thesis focuses on the design of a regulatory system that can solve the problem of upstream GHG emissions, the thesis adopted problem-solving effectiveness. The two tests that became evident were whether countries had a clearly defined aim to reduce upstream GHG emissions, and whether they had suitable methods for achieving that aim. Other criteria that can be used for testing effectiveness are legislative mandate, appropriate scheme of accountability, fair procedures, accessibility (transparency), sufficient expertise of the regulator and efficient action by the regime. Some of these criteria intersect with the two tests. These fundamentally informed the analysis conducted in the thesis.

Chapters 3 and 4 applied the conceptual framework to examine national and industry-driven measures to reduce upstream GHG emissions. While Chapter 3 focused on the regulatory regimes of 12 major petroleum-producing countries, Chapter 4 discussed key industry initiatives to reduce upstream GHG emissions as practical examples of decentred understandings of regulation. Based on the comparative analysis of the regulatory regimes in different jurisdictions, Chapter 5 identified some conceptual insights from the research and canvassed a law reform agenda for countries to design specific regulatory instruments that provide mandatory prescriptions for upstream GHG emissions reduction while also working to incentivise industry-led innovation. Such an arrangement can create a hybrid regime that combines prescriptive command and control regulation elements and performance-based approaches to drive the large-scale reduction of flaring, venting, and fugitive emissions. These characteristics and design structure clearly respond to the question about the role of law in abating flaring, venting, and fugitive emissions in oil and gas production.

This thesis has made an original contribution to knowledge, being the first scholarly analysis that has addressed gas flaring, venting, and fugitive emissions on an international comparative scale, capturing a wide range of major producer economies, instead of the country-specific approach taken by earlier studies. It also differs from scholarly efforts in non-law disciplinary domains that focus predominantly on energy transition without reference to the likely global dominance of oil and fossil fuels and the lack of viable substitutes for decades to come. More so, this research has clearly identified the different types of laws and regulations for controlling upstream GHG emissions in petroleum-producing countries, and the analysis has suggested some essential attributes that countries can consider incorporating into their legal regimes through necessary regulatory reforms. The comprehensive consideration of these matters contributes to knowledge in the domains of energy and petroleum law, environmental law, and climate change law.

A. Key Findings and Policy Implications

1. Clarity of regulatory goal and targeted regulation

The study reveals the existence of different regulatory goals in relation to upstream GHG emissions in petroleum-producing countries. These include general industry governance; environmental protection; resource conservation; climate change governance; air quality improvements; health, safety, and asset integrity controls. One notes that these types of laws have different origins and come from different times. For example, it is evident that most petroleum-producing jurisdictions were initially concerned with governing the production of oil and gas to derive maximum economic benefits and for their various national interests. As the US example shows, and certainly in other countries, indiscriminate drilling and production of oil informed the emergence of conservation laws and the increased relevance of environmental controls in the oil and gas industry. These laws also address other issues relating to the environment and air quality. Thus, they have vital purposes in their respective merits. However, they most times do not address upstream GHG emissions with the clarity and comprehensiveness necessary to drive large-scale reduction of flaring, venting, and fugitive emissions. The analysis has shown that these types of laws can also be adapted (as are most laws) to changing circumstances. For instance, Chapter 3 demonstrated how the US state of California has redefined and repurposed its conservation law to target upstream petroleum flaring and venting specifically.

Let us recall that flaring accounts for about 75% of the carbon intensity of oil and gas production. Venting and fugitive emissions also contribute to the high emissions profile of the upstream petroleum sector, as Chapter 1 showed. This thesis has underscored the need for countries to clarify an objective of reducing upstream GHG emissions. This points to one of the fundamental tests for assessing effectiveness within the qualitative framework defined in Chapter 2, i.e., whether countries state a clear aim to reduce upstream GHG emissions in addition to all other existing governance objectives. The existence of this express regulatory objective will provide certainty to regulators about the purposes for which they can exercise powers. More so, the analysis has demonstrated that it is possible for countries to adopt expressly targeted regulation for the reduction of flaring, venting, and fugitive emissions, as we see in Canada, the UK, Norway, the US, and Nigeria.

One evident and distinctive character that accompanies targeted regulation is the use of industry-specific methods that support upstream GHG emissions reduction. This finding points to the second test for assessing effectiveness within the context of the thesis, i.e., whether countries have suitable methods to spur action by the regulated entities (oil and gas operators) towards achieving the goal of emissions reduction. Another way to look at it is whether the actions and methods adopted by the regulator are sufficient to incentivise operators to change their practices in ways that reduce emissions in oil and gas production processes. This thesis identified some striking examples (in Part B of Chapter 3) as essential design characteristics that can lead to an effective outcome for reducing flaring, venting, and fugitive emissions; but most of those specifications will have to be considered by countries based on legal culture, as not all countries will have the technical capacity to enforce complex regulatory requirements. In addition, there may be no straitjacket set of rules or methods that can apply to all jurisdictions.

Nonetheless, based on the findings of this study, there can be a suite of good methods that countries can consider and adapt to their peculiar circumstances. The first one is the use of industry-specific incremental emissions reduction targets. Most countries have set national climate goals without any indication of how different sectors of the economy are going to contribute to achieving the national emissions reduction targets. Nevertheless, this thesis has demonstrated that national climate targets can be broken into sectoral contributions. It is in this context that countries can clearly set incremental yearly targets for the upstream petroleum sector to reduce the volume of flaring, venting, and fugitive emissions. Examples of jurisdictions that set sector-specific emissions reduction targets are Canada, Nigeria, and Saudi Arabia, as seen in Chapter 3. Second, the adoption of stringent emissions permit systems can

contribute to the mitigation efforts of petroleum-producing countries. Regulators need to maintain firmness in setting strict and ascertainable conditions for the grant of flaring and venting permits. There also has to be some level of commitment to a well-planned future date for putting a stop to or achieving a drastic reduction in flaring and venting. This can avoid the trend where countries set and miss various dates to end flaring, as can be seen in Nigeria and Russia and many other petroleum jurisdictions. Third, low emissions intensity requirements can promote energy efficiency and reduce the expended cost of petroleum production. The technical literature in Chapter 1 showed that flaring, venting, and fugitive emissions are all part of the expended energy and cost for producing oil and gas, which can be reduced by improved efficiency and gas utilization measures. Chapter 3 revealed that the Canadian province of British Columbia provides an example of where to find a regulatory method that incentivises the reduction of flaring and venting. Operators in this province must utilize 95% of the gas produced alongside oil. There are other examples of gas utilization requirements, but they still leave room for the emission of large volumes of gas through flaring and venting. Countries can structure their regulatory regimes to adopt, and even exceed, British Columbia's method of intensity requirements proportional to resource output. Fourth, well-designed price mechanism that cover upstream GHG emissions and send real pressure to operators can incentivise large-scale reduction of flaring, venting, and fugitive emissions. The analysis in Chapter 3 demonstrated this point using the Norwegian example and the US states of North Dakota and Alaska. In North Dakota, operators are required to pay an equal monetary value for flared gas. In Alaska, the law requires operators to pay double of the fair market value for flared gas. These clear examples show that countries can price upstream emissions proportional to resource value to avoid setting insignificant emissions charges or monetary penalties that companies can happily liquidate and continue flaring and venting gas. The fifth method that this thesis has identified is the use of optimal asset integrity management to prevent fugitive emissions. Chapter 1 drew attention to the volume of emissions that occur globally due to gas leaks from compromised assets, also known as fugitive emissions. Chapter 3 showed that multiple jurisdictions such as Canada, Norway, the UK, and the US require operators to implement various forms of leak detection and repair (LDAR) programmes to trace and fix sources of gas leaks. Regulators in other jurisdictions can consider including some of these measures as part of their specific legal frameworks, again, based on legal culture. Countries can also ameliorate the problems associated with prescriptive regimes with a strategic design that encourages innovation while maintaining regulatory firmness, as the UK example shows.

2. Prevalent petro-economy dependency and lax regulatory regimes

The research suggests the prevalence of lax regulatory regimes, especially in IEA-designated producer economies, but less petroleum-reliant countries show a high ability to promulgate strict and high-quality regulations for addressing climate change and petroleum upstream GHG emissions. Specific examples are Canada, the US, the UK, and Norway. This observation underscores the relevance of serious and well-planned economic diversification in oil-rich countries to facilitate a firm regulatory position on flaring, venting, and fugitive emissions.

Nevertheless, the research reveals a dramatic difference between Saudi Arabia and other IEA-designated countries. Chapter 3 established the existence of a weak state governance regime for addressing upstream GHG emissions in the country, but the state-owned and controlled national oil company (NOC) – Saudi Aramco – has implemented useful strategies that have contributed to the reduction of flaring and venting significantly. The company's master gas-gathering network has supported optimal gas utilization and helped the country to reduce emissions from flaring to the extent that Saudi Arabia is currently responsible for less than 1% of the amount of gas flared globally.[903] Other countries' NOCs may learn from the Saudi example to invest more in gas-gathering and utilization infrastructure to support the decarbonisation agenda.

3. Industry commitment to reduce GHG emissions

This thesis has also established the usefulness of private regulatory initiatives by oil majors to reduce GHG emissions. Specific examples are the Oil and Gas Climate Initiative (OGCI), the Carbon Disclosure Project (CDP), and oil and gas company partnership with the World Bank gas flaring reduction programmes – the Global Gas Flaring Reduction Partnership and the 2030 Zero Flaring Initiative. Multiple oil majors have also announced general climate targets, and energy transition plans that include eliminating flaring and venting. The analysis of these initiatives in Chapter 4 suggests that oil and gas companies may have contributed to the global reduction of flaring from 2018 to 2020. This is a good development, considering the regulatory goal of incentivising operators to reduce the carbon footprint (upstream GHG emissions) of their operations.

The activities of industry-driven initiatives and the measures taken by multiple oil and gas companies clearly exemplify the decentred understanding of regulation in the context of private regulation of upstream GHG emissions. This confirms the views of Julia Black who introduced

[903] Above n 331.

the concept of decentred regulation, as Chapter 2 discussed. However, a lot still depends on state regulation and the commitment of NOCs that control a vast majority of oil and gas operations and global reserves, and account for increasing spending in oil and gas projects, as Chapter 4 showed. The large and likely larger volumes of oil and gas operations by NOCs can result in increased upstream GHG emissions absent effective regulatory interventions. Currently, NOCs account for approximately 75% of global methane emissions from the oil and gas sector.[904] Thus, this thesis underscores the importance of complementary state and private interventions to achieve large-scale GHG emissions reduction in the oil and gas industry. The two types of regulation – state and private regulation – are not inimical to each other. Rather, they can exist, and certainly do exist on a complementary basis. The preceding analysis on how regulators can encourage innovation is a typical example of how the two types of regulation can work to achieve a common goal. As the analysis in Chapters 3 (Part B) and 5 showed, the proposed activities of the Oil and Gas Authority in the UK provide an even more direct and practical illustration of how countries can encourage operators to develop and test new industry-driven measures that can be implemented alongside prescribed regulatory measures for addressing flaring, venting, and fugitive emissions. Furthermore, the international coalitions of industry, state, and other non-governmental players to address flaring and other upstream GHG emissions, considered in Chapter 4, provide good platforms for the different parties involved to seek logical approaches to incentivising innovation. State and non-state actors can also learn about feasible solutions and gain insights from good practices based on information-sharing and synergy-building.

4. Relevance of regulatory theories

What the entire analysis in Chapters 3 to 5 demonstrates about the conceptual framework discussed in Chapter 2 is that some ideas and theories of regulation are relevant to controlling upstream GHG emissions, while others do not appear to be relevant. For example, the central argument in the expositions of Nonet, Selznick, Ayres, and Braithwaite on responsive regulation is for government to be responsive to the conduct of regulated entities in deciding the necessity or otherwise of a more interventionist response.[905] The practical implications of this kind of thinking did not surface in the regulatory regimes of the countries studied. Rather, most jurisdictions adopt a proactive approach to regulating flaring, venting, and fugitive emissions. Secondly, the idea of reflexive regulation, put forward by Maturana, von Foerster,

[904] IEA Methane Tracker, above n 844.
[905] Above notes 234 and 235.

Luhmann, and amplified by Teubner, Habermas, and other theorists entails a self-referential system through self-regulation.[906] These authors suggest that entities can autonomously self-recreate and self-organise their activities without recourse to external intervention.[907] This is not the case with the regulation of flaring, venting, and fugitive emissions in petroleum-producing jurisdictions. Oil and gas companies do not conduct their operations and control upstream GHG emissions as self-referential entities without regard for state governance measures. As the analysis in Chapter 4 has shown, oil and gas operators have internal industry-driven approaches to emissions reduction, but they are also bound to comply with state regulatory interventions and prescriptions. It is in this sense that Vincent-Jones advocates for state regulatory oversight over the self-regulation of private entities, as opposed to the core ideas of reflexive regulation.[908]

Looking to the positive side, the analysis in this thesis confirms the views of regulatory theorists such as Daintith, Prosser, Selznick, Baldwin, Lodge, and Cave, and Black, as discussed in Chapter 2. It would be recalled that some fundamental elements for the governance of regulated entities are standard-setting, behaviour modification, decision-making, the operation of specialist agencies, and the adoption of suitable mechanisms and methods for achieving regulatory goals. This study has demonstrated the applicability and significance of these characteristics in the control of upstream GHG emissions, particularly focusing on flaring, venting, and fugitive emissions. First, it is apparent that upstream petroleum regulators need to set targeted and sector-specific standards for the governance of upstream GHG emissions. This is evident in the adoption of different regulatory methods obtainable in numerous jurisdictions, in addition to general petroleum and environmental governance provisions. However, as the inquiry has proved, most of those general governance regimes do not and may not incentivise the large-scale reduction of upstream GHG emissions. While they may be suitable for other purposes and have their various legitimate origins, it makes sense to design regulatory systems that can address the pressing problem of mitigating climate change in the oil and gas industry. This sector-specific state regulatory character is quite different from the self-referential approach put forward by advocates of reflexive regulation. From the analysis in Chapters 3 and 5, it is evident that countries should adopt some prescriptive requirements to serve as minimum ascertainable benchmarks for industry operators to reduce the environmental externalities of their operations – flaring, venting, and fugitive emissions particularly. The objective of

[906] Above notes 242 and 244.
[907] Ibid.
[908] Above notes 248 and 249.

incentivising emissions reduction responds to the element of behavioural modification, which the above-mentioned regulatory scholars have identified as a fundamental component of a good regulatory regime. Second, the thesis has demonstrated the reasonableness and usefulness of an optimal and transparent decision-making process for granting flaring and venting permits, as opposed to the discretionary regimes obtainable in various jurisdictions. From conceptual and empirical perspectives, we learn that such discretionary arrangements can be subject to arbitrariness and bad outcomes. Third, this thesis has demonstrated that petroleum-producing countries need specialist or dedicated agencies or institutions with suitable expertise and an express legal mandate to address upstream GHG emissions. Such bodies can be existing state ministries, departments or agencies that are repurposed to address the subject-matter of this inquiry. This also depends on whether countries are willing to initiate the necessary legal reform that Chapter 5 canvassed.

Finally, this thesis strongly confirms the views of Maljean-Dubois regarding regulatory arrangements that produce a good result. A good result, within the context of the foregoing analysis, will mean a significant reduction of upstream GHG emissions, particularly flaring, venting, and fugitive emissions, in response to the applicable regulatory regime. From the discussion in Chapter 2, one essential point in Maljean-Dubois' exposition on regulatory effectiveness is what she refers to as 'problem-solving effectiveness', which focuses on the goals of regulatory or legal provisions and how regulators spur action towards achieving regulatory goals using suitable methods and strategies.[909] This understanding fits nicely with the findings and policy implications of this study, as explained in the preceding sections of this concluding chapter and in Chapter 5. The analysis also affirms the context-specific approach to addressing environmental problems, as Warnock and Baker-Galloway explain,[910] to the extent that countries should have regulatory regimes that are designed within the context of the particular problems to be addressed – in this case, flaring, venting, and fugitive emissions (all upstream GHG emissions). Therefore, regulators in petroleum-producing jurisdictions have an opportunity to reform their regimes using the insights drawn from this inquiry, and particularly focusing on clear regulatory goals and mandates, industry-specific instruments, and methods discussed above for driving the reduction of upstream flaring, venting, and fugitive emissions significantly.

[909] Maljean-Dubois, above n 265.
[910] Above n 224.

B. Future Directions

This thesis has undertaken a qualitative examination of the potential of specific prescriptive regulatory regimes for reducing upstream petroleum GHG emissions in the context of legal effectiveness, but it has not ascertained what volume of emissions would be reduced by making such improvements in regulatory regimes. Future inquiries may quantify the probable emissions reduction traceable to regulatory changes. It is also possible to deepen the empirical analysis in the future using survey data from suitable respondents.

In addition, this thesis noted the important role of optimal gas infrastructure and viable local and international markets to aid efficient gas utilization, thereby reducing flaring and venting. It is important to acknowledge that these efforts will require huge capital investments that may not withstand scrutiny from a climate change point of view. Furthermore, the sunk capital could lead oil and gas companies to resist climate action. So, there is a degree of politics here that needs critical analysis. Future studies can inquire into legal and policy mechanisms for addressing these issues. Equally, deserving close scholarly attention is the need to research useful solutions for addressing institutional and political bottlenecks hindering the construction of gas infrastructure, especially across international boundaries.

Finally, this thesis focused on flaring, venting, and fugitive emissions in upstream oil and gas production. Other sources of GHG emissions, such as decommissioning and crude refining operations, also need strategic interventions. Future studies can inquire into regulatory design options for abating GHG emissions emanating from these and other carbon-intensive activities in the industry.

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