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Improving Regulatory Approaches for Abating Upstream Gas Emissions in a Low Carbon Era: Case Study of Algeria, Egypt, and Nigeria

by M.C. Abraham-Dukuma, O.C. Aholu, and S. Nakanwagi

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Improving Regulatory Approaches for Abating Upstream Gas Emissions in a Low Carbon Era: Case Study of Algeria, Egypt, and Nigeria

Magnus C. Abraham-Dukuma[*], *Okechukwu C. Aholu*[**], *and Susan Nakanwagi*[***]

Abstract

The oil and gas industry has played an integral role in driving the world's economy, but gas venting and flaring when developing oil and gas resources contribute to the emission of greenhouse gases such as methane and carbon dioxide. The world is stepping up efforts towards clean energy transitions to meet global climate change goals. However, petroleum resources will continue to be a big part of the energy mix for many years. Consequently, soft and hard instruments are crucial in oil and gas producing countries to curtail and stop the gas flaring enigma. This study uses a doctrinal and comparative legal methodology in analysing the applicable regulatory regimes in Africa's prominent petro-states of Algeria, Egypt, and Nigeria to identify the weaknesses and opportunities for abating flare-related emissions. Drawing on best practices in Canada and the United States of America, the study identifies margins of analysis and regulatory improvement areas. These include adopting sector-specific incremental emission reduction targets, gas monetisation and flaring intensity requirements, and the implementation of leak detection and repair programmes for addressing critical components that contribute to emissions. These can be adapted to be context-specific in addressing Africa's gas flaring dilemma. The study also stretches into a socio-legal dimension by reflecting briefly on the political economy issues of oil dependence, rent-seeking, and corruption as some of the major hurdles to the effective regulation of gas flaring in Africa's petro-states.

1. Introduction

The climate change conversation challenges the continued existence of the oil and gas industry, ostensibly because of greenhouse gases (GHG) emissions along the industry's entire value-chain – upstream, midstream, and downstream operations. Most emissions are predominantly from offshore and onshore conventional oil and gas production – from flaring, venting and other fugitive sources. A damning question that has surfaced in recent times is whether the Organisation of the Petroleum Exporting Countries (OPEC) is on the path to death, taking cognisance of the practical multi-dimensional implications of the energy transition to a low-carbon economy.[1] Thus, it may seem counter-intuitive to advance scholarship on a sunset industry. However, it is equally important to reckon the economic dynamics between oil and fossil fuels and the human need for energy services, and the slow pace of the energy transition. For example, within the 46-year interval of 1971-2017, coal, oil and natural gas accounted for

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[1] 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.

approximately 81% of world energy consumption.[2] As a fact, petroleum resources have historically constituted the global primary energy sources since the 19th century.[3] In addition, contemporary civilisations largely rely on fossil fuels to power industries and homes.[4] While energy transition gains momentum, there is no certainty about when renewables and other forms of clean energy will totally displace the need for oil and gas.[5] It is indeed a slow transition.[6] Therefore, it is justifiable to continue sustainability research and other efforts within the oil and gas industry, while energy transition evolves into the future.

Gas flaring in petroleum-producing countries is a notorious environmental menace. The emission of carbon dioxide (CO_2), methane (CH_4) and volatile organic compounds (VOCs) from flaring alone account for vast amounts of GHG emissions from upstream oil and gas activities.[7] Research shows that, globally, flaring accounts for approximately 75% of upstream field-level carbon intensity.[8] As of mid-2020, satellite estimates showed a 3% rise in global gas flaring (from 145 billion cubic meters in 2018 to 150 billion cubic metres in 2019, equivalent to the total annual gas consumption of the entire Sub-Saharan Africa.[9] The World Bank reveals that gas flaring results in over 400 million tons of CO_2 equivalent emissions annually.[10] These incidents show the extent of colossal waste arising from gas flaring, in addition to climate change and other environmental implications. They also underscore the need for optimal regulatory measures to address petroleum upstream GHG emissions generally.

Gas flaring and other petroleum industry emissions surface tersely in texts that address decarbonisation of the energy industry and managing the decline of fossil fuels production.[11] Oyewunmi and others[12] have recently studied energy systems decarbonisation, focusing on the role of law and regulation in advancing emerging technologies such as hydrogen and carbon capture and storage (CCS), as well as international investment law and complementary roles by oil majors for reducing GHG emissions in the energy industry.[13] The text discussed the regulation of emissions from natural gas but predominantly within the American context. It also investigated the decarbonisation of gas and electricity systems and the role of technologies like power-to-gas and CCS. However, gas flaring from Africa's dominant petroleum jurisdictions did not receive prominent attention in their analysis. Also, Wood and Baker have

[2] IEA, *World Energy Balances: An Overview* (IEA 2019) at 4.
[3] 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.
[4] Vaclav Smil, *Energy and Civilization: A History* (MIT Press 2017) at 295.
[5] Benjamin K. Sovacool, 'How Long Will It Take? Conceptualizing the Temporal Dynamics of Energy Transitions' (2016) 13 Energy Research & Social Science 202-215.
[6] Vaclav Smil, *Energy Transitions: History, Requirements, Prospects* (Praegar 2010) at 150.
[7] 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.
[8] Mohammad S. Masnadi and others, 'Global Carbon Intensity of Crude Oil Production' (2018) 361:6405 Science 851.
[9] World Bank Global Gas Flaring Reduction Partnership, *Global Gas Flaring Tracker Report* (World Bank Global Gas Flaring Reduction Partnership July 2020).
[10] World Bank, 'Zero Routine Flaring by 2030' (World Bank) <https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030> accessed 2 February 2021.
[11] Rafael Leal-Arcas and others, 'Decarbonising the Energy Sector' (2019) 15 Journal of Animal and Natural Resource Law 173-272; Tade Oyewunmi and others (eds), *Decarbonisation and the Energy Industry: Law, Policy and Regulation in Low-Carbon Energy Markets* (Hart Publishing 2020); Geoffrey Wood and Keith Baker (eds), *The Palgrave Handbook of Managing Fossil Fuels and Energy Transitions* (Palgrave Macmillan 2020).
[12] Tade Oyewunmi and Others (eds) *Decarbonisation and the Energy Industry: Law, Policy and Regulation in Low-Carbon Energy Markets* (Hart Publishing 2020).
[13] Ibid Chapters 6-8.

recently explored regulatory and legal approaches for managing the decline of fossil fuels production globally in light of the energy transition.[14] Their edited text features insightful and scholarly inquiries on the subject matter, but with more focus on selected European and Australasian countries and less consideration of African petroleum-producing jurisdictions.[15] More so, there are good examples of scholarly efforts that inquire into country-level and state-level flaring regulation.[16]

There is a paucity of research on the comparative examination of the applicable regulatory frameworks for addressing gas flaring in Africa's prominent petroleum-producing jurisdictions – Nigeria, Angola, Algeria, Libya, and Egypt. This paper fills this gap. However, due to the language barrier and the difficulty in accessing materials from all these countries, the analysis is limited to Algeria, Egypt and Nigeria. Thus, the central remit of this study is to compare the prevalent regulatory regimes in these three countries, alongside best practices in overseas jurisdictions such as Canada and the United States of America (USA), to proffer logical legal solutions to the problem of gas flaring within an African legal context.

In pursuit of the identified objective, the study adopts a doctrinal approach and conventional comparative legal analysis to examine the state of the law on the subject. Within the law domain, conventional legal analysis is the most prominent research method employed by legal researchers, judges, lawyers and academics.[17] In addition, the comparative legal analysis is useful when examining the legal regimes in multiple countries for appreciating their peculiarities and applicable contexts and gleaning lessons for the improvement of the law.[18] More so, it entails distilling the similarities and differences that exist in legal systems.[19] These approaches are useful for identifying some fundamental issues militating against the emergence of effective regulatory solutions to gas flaring and opportunities for legal reforms in the case study petroleum jurisdictions. Perhaps, a good starting point is to appreciate the prevalent regulatory regimes.

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[14] Geoffrey Wood and Keith Baker (eds), *The Palgrave Handbook of Managing Fossil Fuels and Energy Transitions* (Palgrave Macmillan 2020).

[15] Ibid, Chapters 5-10.

[16] Monika U. Erhman, '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 549-591; 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; Tade Oyewunmi, 'Natural Gas in a Carbon-Constrained World: Examining the Role of Institutions in Curbing Methane and Other Fugitive Emissions' (2021) 9 LSU J. of Energy L. & Resources 88-163; 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 115-163; 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; Stephen Oluwaṣeun Ọkẹ, 'Gas Flaring in Nigeria and the Flexed Muscles of the 2018 Regulations: Key Implications and Investment Considerations' (2019) 17:1 Oil, Gas & Energy Law Intelligence www.ogel.org/article.asp?key=3806.

[17] P. Ishwara Bhat, *Idea and Methods of Legal Research* (OUP 2019) at 144 and 145; Amrit Kharel, 'Doctrinal Legal Research' (Social Science Research Network 26 February 2018) <https://dx.doi.org/10.2139/ssrn.3130525>.

[18] 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) at 209.

[19] 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.

2. Flaring Regulation in Algeria, Egypt, and Nigeria

Algeria, Egypt, and Nigeria comprise three of the major oil and gas producers on the African continent. Arguably, GHG emissions attributed to petroleum operations through venting and flaring would be relatively considerable. Taking an example of methane emissions from petroleum operations, in 2020 alone, Algeria emitted approximately 2592 kiloton (kt) (3.6% of global emissions), Nigeria 1393 kt (1.9%) and Egypt 995 kt (1.4%), all from venting, fugitive emissions and gas flaring.[20] While a large part of the section may seem descriptive, it is important to note that a good understanding of the existing regulatory frameworks is fundamental to appreciating and distilling the core barriers and opportunities for the emergence of robust and context-specific improvements to the law in these jurisdictions.

2.1 Algeria

Algeria introduced a new Hydrocarbons Law[21] in 2019 to govern the oil and gas industry and address gas flaring and other associated GHG emissions. The law vests regulatory powers over the industry, principally in two independent agencies – the National Agency of Valorization of Hydrocarbon Resources (ALNAFT) and the Hydrocarbons Regulation Authority (ARH).[22] The law generally prohibits waste in the form of flaring or venting but empowers both the ALNAFT and ARH to issue flaring permits regarding upstream sector emissions (ALNAFT has powers) and downstream sector emissions (ARH has powers).[23] For permit applications for emissions related to pipeline activities, the operator is required to describe work to be carried out, as well as provisions for preventing or mitigating risks to people, the environment and property. However, there is an exception for flaring occurring as a security measure. Operators can flare without necessarily securing an exception if the flaring ensures the security of lives and critical industry facilities.[24]

The new law imposes a specific tax on gas flaring applicable to hydrocarbon activities – a non-deductible payment of 12,000 Algerian dinars (DZD) (approximately USD 90) per thousand cubic meters of flared gas,[25] and the rate is revised annually. This applies to flaring that is subject to a permit granted by either ALNAFT or ARH. In circumstances where operators flare without obtaining the applicable permit or authorisation, or if the flaring exceeds the quantity allowed, quantities flared without authorisation are subject to the payment of the standard flaring tax, with a 50% mark-up.[26]

Notwithstanding the requirement to obtain flaring permits, the law clearly excludes flaring occurring because of the following operations from the payment of penalties or taxes:

- exploration and/or delineation well testing as well as during the pilot's implementation;
- during the start-up period for the new facilities for periods not exceeding the thresholds set ALNAFT and ARH;

[20] Methane Tracker Database https://www.iea.org/articles/methane-tracker-database.
[21] Law No. 19-13 of 14 Rabie Ethani 1441 Corresponding to the December 11, 2019 Governing Hydrocarbon Operations.
[22] Ibid, arts 42 and 43.
[23] Ibid and art 158.
[24] Ibid, art 159.
[25] Ibid, arts 160, 161 and 2010.
[26] Ibid, art 213.

- for areas where infrastructure is needed, recovery and/or discharge of the gas are non-existent or limited; and
- facilities that are operated under the provisions of art 235 (that is, facilities and equipment built before 19 July 2005).[27]

Further, there is a reporting obligation on operators. The law provides that the national company, under an upstream concession, or the contracting parties must regularly furnish ARH with the information obtained during the conduct of upstream operations and reports required in the forms and periodicities established by the ARH.[28] The ARH has a responsibility to implement the reporting system and estimate GHG emissions from the hydrocarbons sector.[29]

2.2 Egypt

The Mines and Quarries Law of 1956 principally regulate the oil and gas industry in Egypt.[30] Currently, regulatory powers lie with the Ministry of Petroleum through the Egyptian General Petroleum Company (EGPC) and the Egyptian Natural Gas Holding Company (EGAS).[31] There is no specific law for addressing gas flaring in the country. Instead, the relevant applicable instruments are based on the Egyptian Model Concession Agreement,[32] which operates alongside the Mines and Quarries Law, the Environment Law[33] and its subsidiary Regulations.[34]

The Model Concession Agreement requires oil and gas operators to comply with the relevant provisions of the Environmental Law and the Environmental Regulation regarding environmental safety and to avoid waste.[35] Still, it makes no specific provisions for addressing flaring or other GHG emissions. The Environmental Law requires establishments – including oil and gas operators/companies – to observe general environmental safety and take necessary precautions to prevent emissions or leakages of air pollutants above the maximum levels allowed under a licence issued by the appropriate authority.[36] The Environmental Regulation also forbids oil and gas companies from discharging hazardous substances and wastes without a license from the competent authority (the Ministry of Petroleum), in line with the Environmental Law provisions.[37] Also, under the provisions of the Environmental Law, the maximum limit of emissions from petroleum and oil refining operations set by the Environmental Regulation is 100 milligram per cubic meter (mg/m^3).[38] Operators also must

[27] Ibid, arts 215 and 235.
[28] Ibid, art 70.
[29] Ibid, art 43.
[30] Law No. 86 of 1956 Relating to Mines and Quarries.
[31] Mohamed Youssef Kamal, 'Oil and Gas Regulation in Egypt: Overview' (Thompson Reuters Practical Law 1 September 2019) <https://uk.practicallaw.thomsonreuters.com/7-565-7867?transitionType=Default&contextData=(sc.Default)&firstPage=true> accessed 7 February 2021.
[32] Model Concession Agreement, available at <https://apexintl.com/wp-content/uploads/2018/04/7-2016-EGPC-Model-Agreement.pdf>
[33] Law No. 4 of 1994 Promulgating the Environmental Law.
[34] Prime Minister's Decree No. 338 of 1995 Issuing the Executive Regulations of the Environment Law Promulgated by Law No. 4 of 1994
[35] Model Concession Agreement, (n 32), art XVIII (b).
[36] Environmental Law (n 33), arts 35 and 43.
[37] Environmental Regulation (n 34), art 25(4).
[38] Ibid, arts 36, Annex 6, Table 1.

keep a register indicating the emissions or discharges emanating from their operations, as well as the environmental impact of such emissions and discharges.[39]

It is essential to observe the absence of prominent emphasis on gas flaring in both the Egyptian Environmental Law and the Environmental Regulation. The cogent reference to gas flaring is the specification for operators to take necessary precautions to prevent the leakage of uncollectable oil and gas extracted in tests conducted during the drilling and completion of wells, as well as any other oil or gas that must be burned either in open pits or in flares.[40] There is also an obligation to take due care to make the optimum selection as regards the number and size of the nozzles and flares for the burning process, the use of the sprinkling process or additional air, or the possibility of using diesel fuel to complete the burning of heavy crude oil. However, it is logical to construe gas flaring as part of the restricted emissions connected to oil and gas industry operations.

2.3 Nigeria

The Petroleum Industry Act (PIA) 2021[41] is the current legislation governing petroleum prospecting, exploration, and production activities in Nigeria. It replaced the Petroleum Act of 1969.[42] However, the transitional and savings provisions of the PIA give effect to continuing acts resulting from the operation of the Petroleum Act. Specifically, the PIA provides that anything done under the Petroleum Act[43] and having continuing or resulting effect with respect to taxation of profits of a company, shall be, treated as done under the corresponding provisions of the new law (the PIA).[44] A similar effect is given to rules, orders, notices, or other subsidiary legislation made pursuant to the repealed Petroleum Act of 1969.[45]

Amongst other things, the PIA makes salient provisions relating to environmental management, generally, and the abatement of flaring specifically. It requires upstream and midstream operators/licensees to submit an environmental management plan to manage the externalities or negative impacts of their operations on the environment.[46] There is an express prohibition of waste through gas flaring except in the case of an emergency, an exemption, or as a safety mechanism.[47] Any flaring outside these conditions attracts a fine (monetary penalty) to be imposed by the newly-established regulator for the upstream petroleum sector — the Nigerian Upstream Petroleum Regulatory Commission (the Commission).[48]

Two other important provisions of the PIA are flaring measurement and flare elimination plan obligations. First, a licensee is required to install metering equipment conforming to the specifications prescribed for every facility to measure the volume of flared natural gas.[49] This is important for reporting and planning purposes. Second, a licensee is required to, within 12

[39] Ibid, art 17.
[40] Ibid, art 43(2) (e).
[41] Petroleum Industry Act, Federal Republic of Nigeria Official Gazette No. 142 Vol. 108 Lagos — 27th August 2021.
[42] Petroleum Act, CAP P. 10 LFN 2004.
[43] This also applies to other related laws such as the Petroleum Profit Tax Act and the Deep Offshore and Inland Basin Production Sharing Contract Act.
[44] Petroleum Industry Act, (n 41), s.317.
[45] Ibid.
[46] Ibid, s. 102.
[47] Ibid, s. 105.
[48] Ibid, s. 104.
[49] Ibid, s. 106.

months after the commencement of natural gas operation, submit a natural gas flare elimination and monetisation plan to the Commission, which shall be prepared in accordance with regulations made by the Commission under the PIA.[50]

Although the PIA is the current primary legislation governing upstream and midstream oil and gas operations in Nigeria, there remains the need for the new Regulatory Commission to design robust regulations that capture the details of every segment of the industry. For the problem of gas flaring, it may be desirable to step back a little to understand the relationship of the new law with the pre-existing body of laws and regulations on the matter. The PIA did not expressly repeal some pivotal pre-existing legal instruments for flaring management. We assume that such instruments will remain valid under the savings and transitional provisions of the PIA in the absence of an express repeal clause proscribing them. It is on this note that we address our minds to other relevant pieces of legislation and frameworks. Over the years, the laws and policies relevant to the issue under consideration are the Associated Gas Re-injection Act,[51] the National Energy Policy[52] and the National Gas Policy.[53] Pursuant to the now defunct Petroleum Act of 1969, the Petroleum Production Regulations require the licensee to take precautions to prevent pollution in the course of drilling or production activities; and promptly initiate control measures if pollution occurs.[54] 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 utilisation to avoid flaring.[55]

The Associated Gas Re-injection Act is more direct on the issue. It compels every oil and gas company to submit preliminary programmes for gas re-injection and detailed plans to implement gas re-injection.[56] This is similar to the natural gas flare elimination plan contemplated under the PIA mentioned. It also stipulated a flare-out date for gas flaring – 1 January 1984 or continuing flaring with a monetary penalty payment.[57] Irrespective of these statutory provisions, gas flaring continued beyond the 1984 stipulated flare-out date. Therefore, the Associated Gas Re-injection Regulation[58] was promulgated and vested powers on the Minister for Petroleum Resources to issue a certificate to oil multinationals as permission for the continued flaring of gas in a particular field or fields. This permission is, however, subject to certain conditions. They include 74% gas utilisation by the operator; impure contents of produced gas; interruption of on-going utilisation programme by equipment failure; proof of infrequency of such equipment failure; and where the distance of gas field and the possible utilisation point is less than 50,000 standard cubic feet (scf) per kilometre.[59]

The Nigerian Energy Policy also covers gas flaring and gas utilisation. It initially set an ambitious flare-out date of 2008,[60] although it was not achieved. Its successor, the National

[50] Ibid, s. 108.
[51] Associated Gas Re-injection Act Cap A. 25 LFN 2004.
[52] Nigerian National Energy Policy 2003.
[53] Nigerian National Gas Policy 2017.
[54] Petroleum (Drilling and Production) Regulations 1969, s. 25.
[55] Ibid, s. 43.
[56] N 51, s. 1.
[57] Ibid, s.3 (1).
[58] The Associated Gas Re-injection (Continued Flaring of Gas) Regulations 1985.
[59] Ibid, s. 1(a) and (b).
[60] N 52, s. 25.

Gas Policy, stipulated 2020 as the next flare-out date and mandates oil and gas companies to work towards the new date.[61]

Two recent legal instruments also address gas flaring in Nigeria's petroleum sector. The first is the Flare Gas (Prevention of Waste and Pollution) Regulations 2018,[62] 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.[63] These laws complement the existing legal regime and prohibit flaring[64] but retain the flaring permit and penalty regime of former laws. The most significant changes that the 2018 regulations introduced include an increase in flaring penalties and a metering system for flare measurement. Unlike the ten Nigerian Naira (₦10) for every 1000 scf of flared gas in force since 1998 under the Associated Gas Re-injection Act, the new regulations stipulate a penalty of USD2 (approximately ₦724).[65] This outweighs the erstwhile paltry flaring 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.[66] This is also covered by the PIA. 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), an equivalent of USD 27,570, or imprisonment for not more than one year, or both.[67] These provisions suggest a greater emphasis on data collection and monitoring. They also signal a more significant potential for enforcement in comparison with the provisions of the Petroleum Act and the Associated Gas Re-injection Act.

Keeping the foregoing regulatory regimes in Algeria, Egypt, and Nigeria regarding upstream gas emissions in mind, the next cardinal task is to compare and analyse their robustness or suitability for providing the requisite incentive for curbing gas flaring and other industry-specific GHG emissions. This is the remit of the next section.

3. Comparative Analysis

This study identifies three specific themes as a framework for examination to enable a rational comparative analysis of the case study countries' regulatory regimes. These include the regime typology, permit regimes and price mechanisms, and level of regulatory ambitiousness. These do not necessarily represent an exhaustive list of the peculiarities of the case study countries, but they provide a veritable frame of reference for the analysis.

3.1 Regime Typology and its Efficacy

The reference to regime typology here means the various types of regulatory arrangements for mitigating upstream emissions in the case study countries. Sometimes, they show as resource conservation. Sometimes, they are blanket energy/petroleum provisions that superficially address emissions. There are also environmental law provisions for waste, pollution, and emissions. In some other jurisdictions outside the study's scope, climate change legislation is

[61] N 53, at 13 and 63.
[62] Flare Gas (Prevention of Waste and Pollution) Regulations 2018, Federal Republic of Nigeria Official Gazette No. 88 Vol. 105 Page B97-111.
[63] Gas Flaring (Prohibition) Act 2019.
[64] Flare Gas Regulations, (n 62), s. 12; Gas Flaring Act, (n 63), s. 1.
[65] Associated Gas Re-injection Act Cap A. 25 LFN 2004, s. 13.
[66] N 62, s. 6.
[67] Gas Flaring Act (n 63), ss. 10 and 11.

also a form that has emerged in recent times. The phrase 'good oilfield practice' is another form. In a few cases, there are also dedicated regulations that specifically regulate upstream emissions. It is also important to note that sometimes, multiple regulatory forms occur within a jurisdiction. An important aim of this study is to make some inferences on suitable regulatory approaches for addressing upstream gas emissions. Therefore, even if there are multiple regulatory types in a jurisdiction, the analysis will provide insights into suitable emissions reduction approaches for petroleum-producing jurisdictions, especially for countries that lack robust and fit-for-purpose frameworks.

Resource Conservation Legislation

As section 2.3 above shows, resource conservation is inherent in the regulatory framework of the case study countries. This is within the context of regulatory provisions that oblige operators to avoid waste in the form of gas flaring and venting. The cardinal consideration is whether this regime typology incentivises a large-scale curtailment of gas flaring.

The International Union for Conservation of Nature (IUCN) defines conservation as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations."[68] The Dictionary of Environmental Economics adopts this definition.[69] Similarly, the Dictionary of Environment and Conservation defines it as "the planned protection, maintenance, management, sustainable use, and restoration of natural resources and the environment, in order to secure their long-term survival."[70] These definitions embody three core themes – resource maintenance; resource preservation; and sustainable utilisation of resources. From a legal perspective, there can be legislative frameworks for conserving natural resources broadly – for plants, energy, animals, aquatic and wildlife species, birds, natural habitats, and the natural environment.[71] However, the narrow focus at present is the conservation of oil and gas resources, and its suitability as a regulatory tool for reducing upstream petroleum emissions. It is important to state that conservation measures originally emerged to solve the problems associated with the rule of capture – indiscriminate drilling and waste in the United States.[72] The American conservation movement of the early nineteenth century projected the jeopardy of future economic welfare if indiscriminate drilling and waste continued unabated.[73] One commentator states the original purpose of conservation legislation was "to protect the correlative rights of the producers and maintain the health of the industry by prevention of waste and to seek the greatest ultimate recovery of the resource."[74]

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[68] IUCN (ed), *World Conservation Strategy: Living Resources Conservation for Sustainable Development* (IUCN-UNEP-WWF 1980) at 1.
[69] Anil Markandya and others, *Dictionary of Environmental Economics* (Earthscan, London 2001) at 45-46.
[70] Chris Park and Michael Allaby A Dictionary of Environment and Conservation (3rd edn OUP Online 2017 eISBN: 9780191826320) available at <https://www-oxfordreference-com.ezproxy.waikato.ac.nz>.
[71] Christopher P. Rodgers *The Law of Nature Conservation* (OUP 2013) 1-32.
[72] --- 'Oil and Gas Conservation' (1930) 43:7 Harvard Law Review 1137; Terence Daintith, *Finders Keepers? How the Law of Capture Shaped the World Oil Industry* (Routledge 2010) at 7 and 171; Terence Daintith, 'The Rule of Capture: The Least Worst Property Rule for Oil and Gas' in Aileen McHarg and others (eds), *Property and the Law in Energy and Natural Resources* (OUP 2010) 140 at 143
[73] 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.
[74] Thomas A. Mitchell, 'The Future of Oil and Gas Conservation Jurisprudence: Past as Prologue' (2010) 49 Washburn Law Journal 379 at 422.

Aside from the historical context underpinning resource conservation, there is a logic in the possibility of minimising environmental impacts of petroleum production through efficient conservation measures.[75] The identified core themes of conservation – resource maintenance, resource preservation, and sustainable utilisation of resources – may be useful. If there is optimal maintenance, preservation and utilisation of resources, oil producers may reduce the quantum of emissions and other environmental effects associated with oil production. Nevertheless, most times, this is not the purport of most conservation legislation/regulation. Conversely, the use of conservation in most producing jurisdictions is in two broad contexts – a purely economic context and an economic and environmental protection context. The purely economic context presupposes the maximum exploitation of resources for the economic advantage of the resource owner or host state. The economic and environmental protection context presupposes both maximum resource exploitation for economic benefit and a sense of environmental protection. In the countries being considered, resource conservation appears to be in these two contexts — economic and environmental protection considerations — as they all focus on managing the environmental externalities and recouping maximum economic benefits from oil and gas exploitation.

We contend that conservation can become more useful for emissions reduction if there is a readjustment of its purport from historical times to capture contemporary problems. Gas flaring is a problem of high contemporary significance requiring pragmatic legal considerations.[76] Regulators can draft conservation regulations to be more holistic and specific in their coverage. They can be holistic to the extent that they capture different resource conservation implications, not just the economic imperative. They can be specific to the extent that they provide practicable requirements and approaches for curtailing upstream gas emissions and not merely leaving policy actions at the whims and caprices of the regulated entities. 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 oil and gas production.[77] Specifically, the law states 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.[78] This notable redefinition is relevant for addressing flaring, venting, and fugitive emissions under conservation legislation. We argue that it is a good practice that the case study jurisdictions can emulate.

General Petroleum and Environmental Regulation

Petroleum legislation and environmental regulation in oil-producing jurisdictions attempt to strike a balance between economic interests and environmental/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 importance of the energy sector to all of humanity.[79] These regimes express notions of conservation and

[75] David E. Pierce, 'Minimizing the Environmental Impact of Oil and Gas Development by Maximizing Production Conservation' (2009) 85:4 North Dakota Law Review 759.
[76] 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 88.
[77] Assembly Bill No. 1057 Chapter 771, s. 7 amending s. 690 of the California Public Resources Code, at s. 9.
[78] Ibid.
[79] Robert Falkner, 'Global environmental Politics and Energy: Mapping the Research Agenda' (2014) 1 Energy Research and Social Science 188-197.

waste avoidance as provisions in both petroleum and environmental laws. These laws oblige producers to reduce the associated environmental externalities in upstream petroleum 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 principle, environmental responsibility, public participation, and environmental impact assessment. It is an issue of general environmental obligations recurring in the regulatory frameworks of oil-producing countries.

Achieving reasonable emissions reduction in upstream oil and gas operations would, arguably, need more than general industry governance through petroleum laws and customary environmental law provisions and standards, either as provisions in petroleum statutes/regulations or environmental statutes/regulations. This does not undermine conventional environmental law principles, practices, and their usefulness in mitigating emissions. Conversely, they receive recognition in international environmental agreements, especially the United Nations Framework Convention on Climate Change, the Paris Agreement, and the Rio Declaration. Nevertheless, upstream decarbonisation will need well-structured regulatory and policy frameworks that build on general notions and principles of environmental law.[80] In addition to building on these principles, such coordinated frameworks would reflect concrete and tailored measures in the context of upstream emissions. Specific prescriptive regimes may be more suitable for this purpose, and this will show in the examination that comes in section 5 of this study.

As section 2 above suggests, this general environmental regulation regime is prevalent in Algeria, Egypt, and Nigeria's legal frameworks. However, it is important to reiterate that different regulatory types can play out in one jurisdiction. While there are prominent provisions in Algeria and Nigeria's petroleum laws, there is an apparent non-coverage of gas flaring or other petroleum sector-specific GHG emissions in Egypt's legal framework.

A key positive effect of this regulatory approach may be the compromise between economic/industry interests and environmental concerns. In this respect, the conflict between trade and the environment is apparent. On the other hand, complacency (business-as-usual), inaction or insufficient action and the problem of emissions are bound to recur as negative effects. First, companies may be willing to carry on business as usual in the absence of well-structured strict regulations directly requiring emissions reduction measures. Second, corporate actions at self-regulation for emission reduction may be insufficient to address emissions on a very large scale. It is also possible that such corporate actions will exceed the requirements of regulations (if in existence). Thirdly, if corporate complacency and inaction or insufficient action set in, the direct consequence is a recurrence of emissions.

[80] 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 Motu 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).

Targeted Emissions Control Regulation

In some petroleum-producing jurisdictions, regulators transcend conventional conservation legislation, general industry regulation and environmental law provisions; and specifically promulgate industry-specific regulations to target upstream gas emissions. Within the purview of the present study, Nigeria shows a good example of this regulatory approach by the enactment of the Associate Gas Re-injection Act and its successive regulations, as well as the recent gas flaring regulations earlier discussed.

Targeted regulations do not leave the regulation of gas flaring and other industry-specific GHG emissions at the level of general environmental law principles. Instead, they expressly regulate upstream emissions through specific instruments that stipulate structured mechanisms, technical standards, and best industry practices. There is a strong supportive argument that there ought to be a measure of prescription in national legal frameworks that seek to achieve emissions reduction in the petroleum upstream industry.[81] This regulatory approach or paradigm is also prevalent in the legal frameworks of the United States, the United Kingdom, Canada, and Norway. However, this study has not provided a detailed examination of these countries as they fall outside the scope of analysis.

3.2 Permit Regimes and Price Mechanisms

Most countries generally prohibit gas flaring and require operators to formally obtain flaring authorisation or permit from the requisite authority. As section 2 has shown, this is also the case in Algeria, Egypt, and Nigeria. This is a good practice to reduce petroleum industry GHG emissions, but the nature of its use presents a major barrier to the eventual curtailment of flaring. How is it structured in the case study jurisdictions? Does it really incentivise emissions reduction? Sometimes it is a contradistinction to *the Devil's Gift* epigram – the Devil presents you a gift with the right hand and retakes it with the left hand. On the contrary, the law prohibits flaring but allows it in the form of a permit regime.

The structuring of flaring restriction is a technical industry dilemma. One known fact, and a point deducible from section 2 above, is that routine flaring is a conventional industry practice, especially as a safety or emergency mechanism.[82] It also occurs because of difficulties in achieving optimal gas utilisation, predominantly because of the huge cost implication and lack of adequate infrastructure.[83] The current state of technology does not also support zero-emission exploration and production processes. Therefore, the law does not completely restrict flaring without exceptions or exemptions. From a jurisprudential perspective, some established principles and hallmarks of law are that it commands the performance of actions and imposes restrictions and grants exceptions.[84] These rightly apply to regulating activities of the oil and gas industry.

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[81] Chris Malins and others, *Reduction of Upstream Greenhouse gas Emissions from Flaring and Venting* (Report of the International Council on Clean Transportation 2014).

[82] Matthew R. Johnson and Adam R. Coderre, 'An Analysis of Flaring and Venting Activity in the Alberta Upstream Oil and Gas Industry' (2011) 61:2 Journal of the Air and Waste Management Association 190.

[83] Abass Olajire, 'The Petroleum Industry and Environmental Challenges' (2014) 5:4 Journal of Petroleum and Environmental Biotechnology 1.

[84] Hans Kelsen, 'The Pure Theory of Law and Analytical Jurisprudence' (1941) 55 Harvard Law Review 44-70; Andrew Stumpff Morrison, 'Law is the Command of the Sovereign: H.L.A. Hart Reconsidered' (2016) 29:3 Ratio Juris 364-384; John T. Valauri, 'Dialectical Jurisprudence: Aristotle and the Concept of Law' (2011) 3 Drexel Law Review 415 at 439.

However, a lot depends on the structure of permit systems. The practice of permitting emissions on fulfilling stated regulatory conditions would merely sustain a cycle of emissions. This is exactly the experience of almost all oil and gas producing countries where gas flaring has continued for many years. Operators may continue to present cogent justifications and meeting permit requirements. In some cases, apart from technical requirements, the payment of prescribed flaring fines/penalties constitutes an exploitable loophole for continuous flaring.

A good example is Nigeria, where there is a stipulation of monetary penalty. The practice of operators over the years has been to flare and pay the penalty. This has both economic and environmental consequences. Economically, the penalty regime may be a revenue spinner for the government, to the extent that operators are willing to make monetary payments to continue flaring. The reality is that the accrued revenue from penalties falls short of the true economic value of flared gas 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 and generates a comparatively paltry three billion Naira (slightly over 8 million US dollars).[85]

What then should represent a better permit-penalty system? It is important to observe that carbon pricing tools (either in the form of taxes or flaring penalties, or emissions trading systems) are common market-based regulatory instruments for mitigating environmental externalities.[86] The fundamental question is whether the current gas flaring pricing or penalty regimes in the case study countries are robust enough to send strong signals to operators to reduce GHG emissions. The Intergovernmental Panel on Climate Change (IPCC) estimates for a 50-66% probability of keeping peak temperature below 1.5°C range from US$135–6,050/tCO2e in 2030, US$245–14,300/tCO2e in 2050, US$420–19,300/tCO2e in 2070, and US$690–30,100/tCO2e in 2100.[87] The World Bank Carbon Pricing Trends Report also finds that initiatives around the world fall short of the IPCC's estimates.[88] Similarly, the United Nations Environmental Programme (UNEP) Emissions Gap Report 2019 finds that, as of 2019, no country had ambitious, comprehensive CO2 pricing in all sectors of the economy.[89] These reports show that pricing schemes are generally spotty in their coverage and have insufficient price signals.

Narrowing down to Algeria, Egypt and Nigeria, the prevailing penalty/carbon tax or flaring tax regimes are far below the IPCC projections. Thus, a proposition is to set flaring penalties or flaring/emission taxes that outweigh the cost of gas utilisation on a cost-benefit analysis consideration. Oil and gas companies would prefer to flare gas and pay penalties because the cost of re-injection or utilisation is comparatively higher than paltry penalties/taxes. Suppose the system is structured in such a manner that the penalty cost is eventually higher than the financial requirements for utilisation. In that case, companies could be incentivised to invest

[85] 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.

[86] 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>.

[87] IPCC, *Global Warming of 1.5°C*, report available at https://www.ipcc.ch/sr15/ at 152.

[88] World Bank, *State and Trends of Carbon Pricing 2019* (World Bank, June 2019); report available at <http://documents.worldbank.org>.

[89] UNEP, *Emissions Gap Report 2019* (UNEP 2019) at 32.

more in utilisation and energy efficiency. This proposition may seem an extreme measure with possibly two or more challenges. First, it may impose huge financial burdens on operators, and second, it may discourage investments. Nevertheless, the present practice encourages continued flaring by operators and leaves them in a comfort zone.

3.3 Level of Regulatory Ambitiousness

Arguably, an important index for assessing a country's commitment to addressing gas flaring and other industry-related GHG emissions is the level of its regulatory ambitiousness in relation to the problem(s). This can entail both the robustness of general governance frameworks for climate change mitigation and specific regulatory measures targeted at the oil and gas industry. An examination of the general climate governance frameworks of the case study countries falls outside the scope of this paper. The immediate concern is to look at industry-specific measures. For this examination, this paper solely considers the existence of or not of flaring abatement target(s) to support general climate action in the case study countries, especially in low-carbon governance and supportive regulatory strategies.

At an international level, it is common knowledge that the World Bank Global Gas Flaring Reduction Partnership (GGFRP) and the Zero Flaring Partnership (ZFP) aim to end gas flaring globally by 2030.[90] This is indeed a positive ambition, especially in view of a low-carbon energy landscape. All the case study countries are members of these World Bank initiatives.[91] However, despite the global-level ambition of ending gas flaring by 2030, it is paramount for oil and gas producing countries to further work on supportive national level incremental steps, policy milestones and strategies for achieving zero flaring. Such steps could be annual flaring reduction targets leading up to 2030 or any other future date(s) and national level carbon budgeting. To avoid unending flare-out extensions, regulators can also use the expertise of modelling experts to ascertain feasible flare reduction targets based on available technologies, technical expertise, and incentives. These could help to set well-informed attainable goals within the stipulated moratorium. It is possible that zero flaring may not be achieved, but flaring could be significantly reduced.

It is desirable to narrow the analysis to the domestic level of the case study countries, particularly focusing on relevant flaring abatement targets. Table 1 provides a summary for ease of reference, tersely highlighting the flaring reduction targets and supportive strategies prevalent in the case study countries.

[90] World Bank, 'Global Gas Flaring Reduction Partnership <https://www.worldbank.org/en/programs/gasflaringreduction>; World Bank 'Zero Flaring by 2030' <https://www.worldbank.org/en/programs/zero-routine-flaring-by-2030#:~:text=This%20%E2%80%9CZero%20Routine%20Flaring%20by,perspective%2C%20and%20who%20agree%20to>

[91] Ibid.

3.4 Table 1: Flaring Reduction Targets in Algeria, Egypt, and Nigeria

Country	Flaring reduction target	Policy document	Policy support strategies
Algeria	Less than 1% by 2030, now abridged to 2021.	Algeria's Nationally Determined Contribution (NDC) under the Paris Agreement.[92]	Strict implementation of flaring tax regime and continuous investment in gas monetisation[93]
Egypt	Flaring occurs as one of the key areas for GHG mitigation in Egypt's NDC but without specific details about reduction target.	Egypt's NDC under the Paris Agreement.[94]	No known supportive strategies, except the minimal attention given to flaring in the regulatory regime discussed in section 2.2 above.
Nigeria	Ending gas flaring by 2030. Abridge target to achieve 100% gas flaring elimination by 2020. 50% fugitive methane reduction by 2030	Nigeria's NDC under the Paris Agreement.[95] Nigeria's National Action Plan to Reduce Short-Lived Climate Pollutants (SLCPs)[96]	Nigeria's Flare Gas Commercialization Programme (NFGCP), which entails: Gas to Power Initiative; Domestic Supply Obligation (DSO); Industrial Park project; Incentives: Tax holidays; Infrastructure; Gas Flare Penalties; Regulatory Activities; Collaboration with government security agencies to stamp out illegal bunkering and vandalization that could occasion gas flaring.

Source: Authors.

From Table 1, it is apparent that Algeria and Nigeria have ambitious gas flaring curtailment targets. While Nigeria has elaborate strategies to support the achievement of the set target, and

[92] Algeria's Intended Nationally Determined Contribution, submitted to the UNFCCC Secretariat 3 September 2015, available at <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Algeria%20First/Algeria%20-%20INDC%20(English%20unofficial%20translation)%20September%2003,2015.pdf> accessed 14 February 2021.

[93] United Nations, *Reducing Gas Flaring in Arab Countries: A Sustainable Development Necessity* (United Nations 2019), report available at <www.unescwa.org> accessed 14 February 2021.

[94] Egyptian Intended Nationally Determined Contribution, submitted to the UNFCCC Secretariat 29 June 2017, available at <https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Egypt%20First/Egyptian%20INDC.pdf> accessed 14 February 2021.

[95] 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.

[96] National Action Plan to Reduce Short-Lived Climate Pollutants (SLCPs) 2018.

Algeria has modest regulatory strategies, there is a different dynamic in Egypt. The country lacks a well-defined flaring reduction target as well as supportive strategies. Amongst the three case study countries, the foregoing analysis suggests that Egypt has a comparatively weaker regulatory regime for addressing gas flaring and other industry-related GHG emissions. Some of the major regulatory constraints in Egypt include lack of clarity and transparency in emissions metering/measurement provisions, deficiencies in monitoring and evaluation processes, absence of flaring permits (unlike the case in Algeria and Nigeria), inconsistent enforcement of maximum flare volumes, and lack of clear stipulation of penalties for flared gas.[97]

Furthermore, the regulatory circumstances in the case study countries provide an opportunity for useful reforms, especially in Egypt. For example, despite Nigeria's ambitious target to achieve 100% flaring reduction in 2020, there is no indication that there has been a stop to flaring in the country in 2021. Similarly, Algeria has an opportunity to incorporate more supportive strategies towards achieving its set target to reduce gas flaring to less than 1% by the end of 2021. Thus, all case study countries may profit from good complementary regulatory practices in overseas jurisdictions. This is the remit of the next section.

4. Some Lessons from Good Regulatory Practices

This section provides three specific examples of good regulatory practices that the case study countries can learn from overseas jurisdictions to strengthen their regulatory regimes for incentivising large-scale flaring abatement. These encompass incremental sector-specific emissions reduction, gas monetisation and intensity requirements and the implementation of robust leak detection and repair programmes, all drawn from Canadian and American regulatory practices.

4.1 Incremental Sector-Specific Emissions Reduction Targets

The decarbonisation agenda has nudged multiple countries into setting emission reduction goals and the now common 2050 net-zero target. As discussed in the previous section, two of the case study countries – Algeria and Nigeria – have also set flaring curtailment targets. While there is no guaranty that Nigeria may have achieved its flare-out target of 2020 and Algeria achieving its flare-out target of 2021, all the case study countries have an opportunity to recalibrate their target-setting with an incremental approach. As the case of Nigeria shows, adopting a very ambitious target for a short period may prove unrealistic. Rather, it may be feasible to adopt incremental flaring abatement targets across a span of years leading to the year 2030, when the World Bank flaring curtailment initiatives have been set to put a stop to routine gas flaring globally.

The province of Newfoundland and Labrador in Canada provides a good example of an incremental emissions abatement target. It requires oil and gas operators to achieve emissions reduction by 6% (for 2019), 8% for 2020, 10% (for 2021 and 12% for 2022 and subsequent years.[98] Furthermore, the regulations provide lesser emission reduction goals for newer production fields that started after 2015. These include 2.4% (for 2019), 4.8% (for 2020), 8%

[97] Economic Consulting Associates, *APG Flaring in Egypt: Addressing Regulatory Constraints* (Report submitted to The European Bank for Reconstruction and Development (EBRD), November 2017) at 37-38.
[98] Newfoundland and Labrador Management of Greenhouse Gas Regulations 116/18 under the Management of Greenhouse Gas Act (As Amended by 31/19), s.8.

(for 2021), and 12% (for 2022 and subsequent years).[99] The respective regulators in the case study countries may adopt this incremental approach for providing a fair regime that does not put unnecessary pressure on oil and gas operators.

It is important to observe that, in 2018, Nigeria introduced a similar strategy to reduce gas flaring by 2% annually, leading to the complete elimination of flaring by 2020. However, this was not incremental. In addition, there is no indication to show that gas flaring has stopped in the Nigerian oil and gas industry. Thus, all the case study countries have an opportunity to adopt the incremental approach, alongside other regulatory methods on a complementary basis, as there is no silver bullet or unilateral magic wand for addressing gas flaring. For example, there can also be optimal gas monetisation and intensity requirements as discussed in the next paragraph.

4.2 Gas Monetisation and Upstream Intensity Specifications

In addition to the annual incremental reduction approach and the implementation of an efficacious permit and pricing regimes discussed above, Canada provides useful practices regarding gas monetisation and intensity specifications. For example, Canadian federal level regulations require production-related flaring and carbon intensity to stay within a limit of 1,250m^3 per month (that is 15,000m^3 annually) for each producing field from the year 2023.[100] The province of Alberta requires operators to keep emissions emanating from oil sands operations to a maximum of 100 megatonnes per annum.[101] The intensity requirement in the province of British Columbia is higher. The law requires operators to achieve a 95% gas utilisation from every production field instead of flaring.[102] Even in Brazil, the law requires 85% utilisation of associated gas, thereby limiting flaring to only 15% of produced gas per field.[103]

The foregoing examples provide a sense of what petroleum-producing jurisdictions in Africa, particularly the case study countries, may incorporate into their respective regulatory regimes. It is equally important to observe that Nigeria's previous regulatory regime also provided for 74% gas utilisation.[104] It is unclear whether this utilisation requirement is still obtainable, as the new Flare Gas Regulation is silent about it. While there is an opportunity to clarify and incrementally review this re-injection index, the other case study countries can also draw some insights from the preceding regulatory practices for their respective national regulatory improvements.

4.3 Leak Detection and Repair Programmes

The International Energy Agency (IEA) has recently recognised the usefulness of implementing leak detection and repair (LDAR) programmes for addressing fugitive GHG emissions occurring as leaks from compromised assets in the oil and gas industry.[105] For the

[99] Ibid, s. 8(2) and Schedule A.
[100] Federal Regulations Respecting Reduction in the Release of Methane and Certain Volatile Organic Compounds (Upstream Oil and Gas Sector) SOR/2018-66, s. 26.
[101] Oil Sands Emissions Limit Act, Statutes of Alberta, 2016, Chapter O-7.5, s. 2.
[102] Drilling and Production Regulation, B.C. Reg. 282/2010, s. 52.02.
[103] Federal Law No. 11909 (The Gas Act) of March 4, 2009, arts 1(3), 3 and 22.
[104] The Associated Gas Re-injection (Continued Flaring of Gas) Regulations 1985, s.25.
[105] IEA, *Driving Down Methane Leaks from the Oil and Gas Industry: A Regulatory Roadmap and Toolkit* (IEA January 2021) at 45 and 47.

avoidance of doubt, LDAR entails 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.[106]

The prescription of LDAR requirements is predominantly prevalent in Canadian and American oil and gas regulations. At the federal level in Canada, the law requires operators to regularly carry out LDAR programmes to address fugitive emissions regarding federal lands' oil and gas activities.[107] In Alberta, there is no specific mention of LDAR. Still, the law also requires operators to implement emission surveys using either an organic vapour analyser, gas imaging camera or any other equipment capable of detecting fugitive emissions and repair all detected sources of fugitive emissions.[108] There is also a similar regulatory obligation on operators in the province of British Columbia.[109] Moving over to the USA, the Waste Prevention Rule of the Bureau of Land Management requires operators on federal lands to implement LDAR programmes for identifying and fixing sources of fugitive emissions.[110] The United States Environmental Protection Authority also requires operators in both federal and state lands within the USA to implement LDAR programmes and gives individual states the powers to stipulate even stricter and more comprehensive LDAR measures for operations within state lands.[111]

However, it is important to observe that this paper does not dabble into the technicalities of how LDAR programmes help to reduce upstream gas emissions or even provide a supportive quantitative assessment. Nevertheless, it relies on the recognition by the IEA of the potential effectiveness of LDAR programmes to drive the reduction of fugitive emissions in the oil and gas industry, as afore-mentioned.[112] Moreover, in several technical conferences, there is also a wide consensus among petroleum engineers on the necessity of implementing LDAR programmes to ensure asset integrity of oil and gas production facilities to avoid GHG emissions.[113] Thus, regulators in the case study countries can consider incorporating these ideas into their regulatory regimes for effectively addressing gas emissions, but with a cautious approach that suits national peculiarities.

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[106] 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.
[107] Methane Regulations, (n 100), ss. 28-36.
[108] The Alberta Energy Regulator Directive 060: Upstream Petroleum Industry Flaring, Incineration, and Venting, Released 13 December 2018, Effective from 1 January 2020, ss. 8.10.2.2 and 8.10.4.3
[109] BC Oil and Gas Commission Flaring and Venting Reduction Guideline, Version 5.1: May 2018, s. 7.6.
[110] 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, at p. 49190.
[111] 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 35827, 35830, 35858, 35865-35867; USEPA *Leak Detection and Repair: A Best Practices Guide* (USEPA 2016) 1.
[112] IEA (n 105).
[113] Jack Elliott, Richard Fletcher and Mike Wriggleswort, 'Seeking the Hidden Threat: Applications of a New Approach in Pipeline Leak Detection' (2008) 3 Society of Petroleum Engineers - 13th Abu Dhabi International Petroleum Exhibition and Conference, ADIPEC 2008, 3-6 November 2008, Abu Dhabi, United Arab Emirates; Shiv N. Jalan and others, 'Well Integrity: Application of Ultrasonic Logging, Production Logging and Corrosion Logs for Leak Detection in Wells - A Case Study' (2013) Society of Petroleum Engineers - Kuwait Oil and Gas Show and Conference, KOGS 2013, 7-10 October 2013, Mishref, Kuwait; Mark Rahmes and others, 'Continuous Environmentally Efficient Pipeline Leak Detection' (2015) Society of Petroleum Engineers - SPE Canada Heavy Oil Technical Conference 2015, CHOC 2015, 9-11 June 2015, Calgary, Canada.

5. A Reform Agenda

Across the globe, law reform becomes necessary when exiting laws and regulations do not provide suitable solutions to the problems they were set up to address. Such a reform is necessary to improve the legal or regulatory regime for effectiveness or optimal performance.[114] Thus, in applying this notion to this paper's subject matter and taking cognisance of the preceding analysis, the case study countries may profit from undertaking legal reforms to reposition their regulatory regimes for providing effective interventions to the problem of upstream gas emissions. Such reforms may include prescribing the kinds of technical prescriptions or specifications obtainable in Canadian and American jurisdictions, as the previous section discussed. These are incremental sector-specific emissions reduction targets, gas monetisation and carbon intensity requirements, and the implementation of well-monitored LDAR programmes.

However, it is important to state a caveat, to the extent that a complete transplant of regulatory practices from overseas jurisdictions to the case study countries may be counter-productive. Regulators in these countries will need to adopt a cautious approach that helps them consider their national peculiarities while introducing new regulatory practices in such a manner that does not propose the impossible, with the result of a regulatory failure.

Furthermore, it is also important to acknowledge how certain political economy peculiarities hamper the emergence of an effective regulatory regime. As the energy transition topic gains momentum, it is becoming more apparent that the emergence of effective regulatory and policy regimes depend largely on the political will of sovereign states, and is predominantly connected to economic dependence on petroleum revenues, rent-seeking and corruption.[115] Similarly, a global overview of supply-side policies to constrain the production of fossil fuels reveals the existence of stringent regulatory regimes in countries with less reliance on the petroleum economy.[116] Table 2 shows that oil revenue has a significant contribution to Algeria, Egypt, and Nigeria's economies in terms of gross domestic product (GDP) and export revenue.

5.1 Table 2: Economic Impact of Oil to Algeria, Egypt and Nigeria

Country	Oil contribution to GDP (2019)	Oil contribution to export revenue (2019)
Algeria	20%	85%
Egypt	5.3%	23%
Nigeria	10%	85%

Source: Adapted from the OPEC Annual Statistical Bulletin 2020[117] and World Bank data.[118]

[114] Commonwealth Secretariat *Changing the Law: A Practical Guide to Law Reform* (Commonwealth Secretariat 2017) at 12.

[115] 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.

[116] 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.

[117] OPEC, *Annual Statistical Bulletin 2020* (OPEC 2020) available at <https://www.opec.org/opec_web/en/publications/202.htm> accessed 2nd February 2021.

[118] World Bank, 'Oil rents (% of GDP) - Egypt, Arab Rep' (World Bank 2020), available at <https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS?locations=EG> accessed 2nd February 2021.

While dependence on the oil economy is predominant in Algeria and Nigeria, it seems less pronounced in Egypt. Thus, Algeria and Nigeria have a higher imperative to diversify their economies to assert stricter regulatory authority towards addressing upstream emissions. Contrariwise, it is intriguing to observe that Algeria and Nigeria, which have a higher petroleum reliance challenge, have more ambitious and robust regulatory regimes than Egypt, with less economic reliance on the petroleum industry. This probably shows that the political economy dynamics of ensuring a robust regulatory regime may have more to do with actual political will and less of economic dependence. Nevertheless, as the literature reveals, a lot still depends on the political will, economic dependence, rent-seeking and corruption,[119] even though they may not always co-exist contemporaneously (as the case of Egypt shows).

6. Conclusions

Government and industry stakeholders need to recognise action to reduce emissions from the oil and gas industry as a pivotal element of the energy transition by adopting appropriate regulatory and policy tools at the various resource value chain levels. This paper has examined the applicable regulatory regimes and approaches for addressing upstream gas emissions in some of Africa's prominent petroleum jurisdictions – Algeria, Egypt, and Nigeria as case studies. We have also referred to some good practices in jurisdictions such as Canada and the USA as reference points for reform proposals.

The approach we adopted for this study allowed us to proffer context-specific insights for improving the regulatory regimes applicable to gas flaring in our case study countries and in other petroleum jurisdictions with similar characteristics. The study reveals that Algeria and Nigeria have ambitious flare-out targets, but with opportunities to adopt context-specific approaches for achieving their set targets. These include incremental annual emission reduction targets, optimal gas monetisation and upstream emission intensity requirements, and the stipulation of a regulatory obligation for operators to implement LDAR programmes to avoid fugitive emissions, drawing from Canadian and American jurisdictions. Egypt also has an opportunity to incorporate these elements into its regulatory regime. These all constitute the reform agenda canvassed by this paper for the case study countries. However, legal reforms need cautious implementation to suit national peculiarities without revolutionary changes that are not feasible.

Furthermore, the analysis shows a need to ensure a dedicated and well-tailored regulation that addresses gas flaring and comprehensive coverage of other sources of upstream GHG emission. This shows from the regime typology existing in the case study countries within the taxonomy used for our analysis. While Algeria and Egypt predominantly operate general petroleum and environmental governance regimes, Nigeria, like Canadian and American jurisdictions, has gone beyond these generalities to introduce a sector-specific arrangement targeting gas flaring and other GHG emissions. Algeria and Egypt can adopt this regulatory typology while considering the recommended insights for law reforms. However, the ability of these countries to muster the requisite political will and reduce reliance on petroleum revenues will play a huge role in the emergence of the necessary regulatory reforms to drive down gas emissions.

It is important to note that this study limited its insights to only three best practices from Canadian and American jurisdictions – incremental sector-specific emission reduction targets, gas monetisation and upstream intensity specifications, and LDAR programmes. It is possible

[119] Lamb and Minx (n 115); Gaulin and Le Billon (n 116).

to glean additional regulatory approaches from other jurisdictions such as Norway and the United Kingdom. This represents a limitation in the study. Another limitation worth mentioning is that this study has not provided a relevant quantitative assessment of the recommended regulatory practices' emission reduction potential. Thus, future studies may advance the analysis by incorporating broader parameters and providing a quantitative assessment of the emission reduction potential of these and other regulatory practices within the case study countries. Lastly, Angola and Libya are also prominent petroleum-producing countries in Africa, which the present study excluded because of the language barrier and the difficulty in accessing data. Consequently, future studies may provide valuable analyses on these countries. Scholars in these countries may also be in an excellent position to undertake the necessary scholarly analyses. Nevertheless, we believe that the present research provides a veritable reference material for improving the relevant gas emissions regulatory regimes in the case study countries and other jurisdictions with similar peculiarities and characteristics.