



Centre for Energy, Petroleum
and Mineral Law and Policy
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Responding to Climate Change and Energy Security in Africa: the case of Liquefied Natural Gas

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Date: October 2021

Supported by:



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Abstract

Abstract : Africa is the most vulnerable continent to climate change even though its emissions are relatively low compare to others. Furthermore, energy security in the continent is a real concern with its growing population. Thus, governments have been examining clean and affordable energy sources such as Liquefied Natural Gas (LNG) for their use and/or production and export. This paper examines the role of LNG within four countries legal frameworks: Morocco, Egypt, Ghana and Senegal. Each of these countries has its own objectives and LNG history, and each allocates different roles to LNG depending on, *inter alia*, resource availability, energy access rate and energy transition policy. The research concludes that LNG is a viable supply choice for African countries tackling poverty, in need of more downstream energy, and affected by climate change.

Keywords : Liquefied Natural Gas (LNG), climate change, energy security.

1. Introduction

Anthropogenic climate change is a common threat that has driven the international community to adopt measures and policies with the aim to mitigate its effects and limit its deterioration. The phenomenon refers to any important change in the climate over a period of time caused by human activities. In 2015, the international community under the Paris Agreement recognised the threatening character of climate change and the need to put in place mechanisms to effectively address this threat and reduce human effects on the climate. One of the most important mitigating measures highlighted by the parties to the Paris Agreement was to phase out of fossil fuels¹. A recent report of the International Energy Agency entitled “Net Zero by 2050” makes a powerful statement over the need for governments to adopt drastic measures and policies to reduce and annihilate fossil fuel in their energy mix while financing institutions are advised to put an end to fossil fuel investments.² Indeed, burning fossil fuels represents the most threatening of human activities with respect to the livability of our global climate.³

Under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC), governments pledged to limit world temperature increases well below 2°C above pre-industrial levels with particular attention to energy transition.⁴ Furthermore, the United Nations developed in 2015 a framework listing 17 “sustainable development goals” to promote social and economic development. Goal 7 of this framework points out the necessity to provide affordable and clean energy to people.⁵ Thus, a transition to cleaner sources of energy addresses both climate change and energy security. In that sense, Komendantova and Ardestani made a strong case for governments to adopt energy policies that address different issues and merge different goals.⁶ Africa’s level of CO₂ emissions is far lower than those for Europe, Asia, and North America. However, the continent is heavily affected by climate change.⁷

Arguments and policies over energy transition focus more on renewable energies for power generation to replace fossil fuels. Townsend emphasises the importance of gas in the energy mix to back-up renewable

¹ Brown, B., & Spiegel, S. J. (2019). Coal, climate justice, and the cultural politics of energy transition. *Global environmental politics*, 19(2), 149-168

² The International Energy Association (IEA) report “Net Zero by 2050, A Roadmap for the Global Energy Sector”, strongly urges climate action, and highlights the urgency of our situation. It is available at: <https://www.iea.org/reports/net-zero-by-2050>, last accessed 17 June 2021

³ Jorgenson, S. N., Stephens, J. C., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. *The Journal of Environmental Education*, 50(3), 160-171

⁴ The international commitment to fight against climate change started with the adoption of the UNFCCC in 1992. The Convention was an alarm bell for the international community and especially governments. Available online at: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>, last accessed 12 August 2021

⁵ Kim, J. E. (2019). Sustainable energy transition in developing countries: the role of energy aid donors. *Climate Policy*, 19(1), 1-16

⁶ Yazdanpanah, M., Komendantova, N., & Ardestani, R. S. (2015). Governance of energy transition in Iran: Investigating public acceptance and willingness to use renewable energy sources through socio-psychological model. *Renewable and Sustainable Energy Reviews*, 45, 565-573

⁷ Collier, P., & Venables, A. J. (2012). Greening Africa? Technologies, endowments and the latecomer effect. *Energy Economics*, 34, S75-S84

energy and ensure the availability of supply when renewable energy is not sufficient.⁸ According to Townsend, natural gas will be a useful part of power supply for years until more efficient storage technologies are made available for renewables and smart grids. Natural gas can ensure a decrease of total CO₂ emissions by up to 40%. Two types of suppliers have the monopoly in global gas markets: piped gas and LNG exporters.⁹ Collier and Venables claim that two examples of a more sustainable use of hydrocarbons are as follows: a reduction of upstream petroleum installations natural gas flaring; and a conversion of natural gas into its LNG form.¹⁰ Indeed, LNG is the purer form of gas as liquefaction removes carbon dioxide, oxygen and sulfur; and under that liquefied form, natural gas transportation, storage and distribution (i.e. midstream petroleum) logistics are all eased.¹¹

Overtime, LNG costs have decreased, arousing increased levels of governmental interest.¹² Corbeau demonstrates that the choice of LNG in emerging economies to substitute oil and gas is driven by financial consideration because imported LNG is cheaper than imported oil on a British Thermal Unit basis.¹³ Other rationales include the necessity to diversify energy supply and ensure energy security. Shell LNG Outlook 2021 report that global demand for gas had increased to 360 million tonnes (MT) and predicted demand to reach 700 MT by 2040.¹⁴ LNG will thus play a critical role in meeting gas demand increase in emerging importing countries especially in the Middle East and North African (MENA) region and Sub-Saharan Africa (SSA),¹⁵ the latter comprising the area of Africa south of the Sahara.¹⁶ The report acknowledges that LNG could play a key role in decarbonising the energy sector and providing electricity to “hard-to-electrify” regions. Whilst the increasing demand for LNG could be as a result of multiple different factors, Ayaburi et al identify two main causations:¹⁷

- the recent use of gas as alternative fuel to phase-out of coal and oil,
- the improved economics of small-scale floating storage and regasification units (FSRUs) that facilitate access to smaller markets.

From an investor perspective, to avoid stranded assets in long-term investments, investors are concerned about deriving from fossil fuel activities and developing LNG represents a sustainable system.¹⁸

This paper’s objective is therefore to assess the responsiveness of LNG legal framework to climate change and energy security issues. A comparative legal analysis using the functional method demonstrates the different roles allocated to LNG depending on the availability of resources and the intended country’s objective. Four countries have been identified, Morocco and Egypt in Northern Africa; and both Ghana and Senegal in SSA.¹⁹

⁸ Townsend, A. F. (2019). Natural Gas and the Clean Energy Transition

⁹ Ritz, R. A. (2019). A strategic perspective on competition between pipeline gas and LNG. *The Energy Journal*, 40(5)

¹⁰ Collier, P., & Venables, A. J. (2012). *Supra* 7

¹¹ *Ibid.*

¹² Corbeau, A. S. (2016). LNG for Africa. King Abdullah Petroleum Studies and Research Center (KAPSARC)

¹³ *Ibid.*

¹⁴ See “Shell LNG Outlook 2021”, available at: https://www.shell.com/promos/energy-and-innovation/download-the-shell-lng-outlook-2021/jcr_content.stream/1614823770264/2b5b3fdaa9feba85dad9b3408c200f26eadf85f/lng-outlook-2021-final-pack-updated.pdf, last accessed 16 July 2021

¹⁵ Griffiths, S. (2017). A review and assessment of energy policy in the Middle East and North Africa region. *Energy Policy*, 102, 249-269

¹⁶ Mtebe, J. S., & Kissaka, M. M. (2015). Deployment and adoption strategy of cloud computing for blended learning in higher education institutions in sub-Saharan Africa. In *Handbook of Research on Educational Technology Integration and Active Learning* (pp. 395-408). IGI Global

¹⁷ Ayaburi, J., Sharma, S., & Bazilian, M. (2021). Comparative analysis of selected African natural gas markets and related policies. *Energy for Sustainable Development*, 63, 67-77.

¹⁸ Fasihi, M., Bogdanov, D., & Breyer, C. (2015, September). Economics of global LNG trading based on hybrid PV-wind power plants. In Proceedings of the 31st European Photovoltaic Solar Energy Conference, Hamburg, Germany (pp. 14-18)

¹⁹ Griffiths, S. (2017). A review and assessment of energy policy in the Middle East and North Africa region. *Energy Policy*, 102, 249-269.

2. African LNG

LNG in Africa is a result of various elements. Indeed, according to Corbeau, the oversupply of LNG and the decrease of Asia demand led sellers to look into new markets, Africa then became an important target market for LNG exporters.²⁰ Flexibility of LNG facilities and decreasing prices have helped African countries to import the fuel, enhancing their levels of energy security and helping them to diversify their downstream energy supply away from coal and oil dependency.²¹

LNG activities in Africa became a driver for gas-to-power projects especially for countries that are not resource-rich and have limited access to gas pipeline grid for import purposes.²² Indeed, particular African countries are important players in the continent LNG market, notably Nigeria, Equatorial Guinea, Algeria, Angola and, more recently, Cameroon, Senegal and Mauritania. The review of the regional background of LNG developments in Africa thus requires a specific attention.

2.1 LNG in North Africa

The MENA region plays a key role in the global energy system. Indeed, Europe's energy security is highly dependent on North Africa gas supply, a region accounting for 4.4% of the world's proven gas reserves.²³

The Mediterranean coast of north Africa consists of five countries: Egypt, Libya, Algeria, Morocco, and Tunisia. Of these, Algeria, Egypt and Libya are the main natural gas suppliers in that region.²⁴ One of these, Algeria, was the first producer of LNG in the world.²⁵ Its production started in 1964 sourcing mainly European Economic Community (as named then, now the European Union) and USA markets. The country is today the fourth largest LNG exporter globally, accounting for c.13% of LNG exports.²⁶ Egypt's exports started many years later, in 2006; as at the second quarter of 2021, Egypt exported 1.4 MT of LNG.²⁷ While Algeria and Egypt hold strategic place in the gas market with the amount of gas exported, LNG exports from Libya have been relatively negligible and less intensive. Libya plays a more crucial role as a crude oil exporter.²⁸

Egypt and Algeria are the largest gas consumers in Africa with respectively 48 billion cubic metres (bcm) and 39 bcm²⁹. With Egypt's energy mix dominated by gas, the country has been highly affected by its depleted gas resources driving the country to turn into LNG imports in 2015 to meet its growing energy demand.³⁰ A stringent gas research and development policy helped the country to bounce-back and achieve gas self-sufficiency in 2018³¹. Morocco imports its gas from Algeria to supply the power sector³². But due to the expiration of the contract between both countries in 2021, the Morocco is gradually introducing LNG to its energy supply mix to cover its power needs and back-up renewables.³³ LNG stage in SSA has been for a long time monopolised by

²⁰ Corbeau, A. S. (2016). *Supra* 12

²¹ *Ibid.*

²² See "Norton Fulbright Global LNG Outlook 2020", available at <https://www.nortonrosefulbright.com/en-af/knowledge/publications/06d62e6b/global-lng-outlook-2020>, last accessed 17 July 2021

²³ Lacher, W., & Kumetat, D. (2011). The security of energy infrastructure and supply in North Africa: Hydrocarbons and renewable energies in comparative perspective. *Energy policy*, 39(8), 4466-4478

²⁴ *Ibid.*

²⁵ Layachi, A. (2013). The changing geopolitics of natural gas: the case of Algeria

²⁶ Griffiths, S. (2017). *Supra* 15

²⁷ See "(OAPC): Arab countries' exports of liquefied gas increased to 28.3 million tons during the second quarter of 2021", available at: <https://www.moo.gov.kw/single-news.aspx?par1=828>, last accessed 19 October 2021

²⁸ Delalandre, C. (2006). Le GNL: Instrument de flexibilisation du marché du gaz

²⁹ Cornot-Gandolphe, S. (2018). *New and Emerging LNG Markets: The Demand Shock*. OCP Policy Center.

³⁰ *Ibid.*

³¹ Ouki, M. (2018). Egypt—a return to a balanced gas market?

³² El Ghazi F., Sedra M.B. & Akdi M. (2019). Natural Gas Pre-feasibility Study for Future LNG Importing Terminal Project in Morocco. p.4

³³ Griffiths, S. (2017). *Supra* 15

Nigeria, the second largest LNG exporter in Africa after Algeria. More recently, many East, South and West African countries joined the list especially with the facilitation of LNG imports to small markets through Floating Storage Regasification Units (FSRUs).

2.2 LNG in Sub-Saharan Africa

Many studies compare North Africa with SSA without emphasizing on specificity that differentiate both regions. SSA comprises South, East, West, and Central African countries. LNG import in SSA is a recent activity thanks to governments and power companies' motivation to consider natural gas in their sustainable energy schedule. As explained by Cornot-Gandolphe, LNG-to-power projects are expected to empower the SSA energy sector and effectively drive energy security³⁴. Most LNG actors in SSA have been suppliers or exporters due to their resource wealth.³⁵ The first announced LNG importer in the region has been Ghana. Through the Tema port, Ghana is set to receive the first cargo by the end of 2023³⁶. South Africa is predicted to be SSA's next major LNG importer, and with this to occur by 2024.³⁷

Nigeria holds the most dynamic LNG history in the region. The country has the fifth largest gas reserves in the World with proven gas reserves of 197 trillion cubic feet³⁸. In 1963, Nigeria LNG was established with the aim to promote LNG operations and diversify the economy. Activities started in 1993 and recently more LNG export projects are being developed³⁹. The country is nowadays listed among the biggest LNG exporters. Not far behind Nigeria in that respect is Equatorial Guinea, Angola and Cameroon.⁴⁰ Indeed, LNG exports in these four countries have been relatively resilient despite the coronavirus pandemic.⁴¹ Senegal and Mauritania have launched a LNG project regarding the Grande Tortue Ahmeyim (GTA) gas field with a capacity of about 2.5 MT per year.⁴² The production expected to start in 2023 will not only serve for export but will also supply both countries' domestic markets⁴³.

In East Africa, Mozambique and Tanzania resource prospectivity in petroleum basins to both the north (Tanzania) and south (Mozambique) of the outflow of the Rovuma river has been known for decades, but it is only comparatively recently, and due to technological advancements, market demand and political situation, that commercial upstream petroleum development has occurred.⁴⁴ Mozambican LNG upstream development has recently been delayed due to physical insecurity concerns linked to ongoing armed insurgency in its highly prospective zones for natural gas extraction.

³⁴ Cornot-Gandolphe, S. (2018). Supra 28

³⁵ Ibid.

³⁶ Read Fulwood M. and Bros T. (2018). Future prospect for LNG demand in Ghana. *Oxford Institute for Energy Studies*

³⁷ Read the Bloomberg article "Ghana set for the first Sub-Saharan Africa LNG to power project." Available at:

<https://www.bloomberg.com/news/articles/2021-01-07/ghana-to-open-sub-saharan-africa-s-first-lng-to-power-project>, last accessed 19 July 2021

³⁸ Andeobu, L., Hettihewa, S., & Wright, C. S. (2015). Australian and Nigerian LNG Projects: Insights For Resolving Challenges Facing New LNG Project. In *Proceedings of 4th Global Business and Finance Research Conference, Marriott Hotel, Melbourne, Australia*

³⁹ Ibid.

⁴⁰ Read the Norton Rose Fulbright Global LNG Outlook 2020. Supra 21

⁴¹ Ibid.

⁴² Ouki, M. (2020). *Mauritania-Senegal: An emerging New African Gas Province-is it still possible?*. Oxford Institute for Energy Studies

⁴³ Oyewunmi, T. (2020). Gas commercialisation projects in West Africa: Pipelines, LNG and gas-to-power. In *Routledge Handbook of Energy Law* (pp. 471-488). Routledge

⁴⁴ Ledesma, D. (2013). *East Africa gas—the potential for export*. Oxford Institute for Energy Studies

3. Literature Review

3.1 LNG, an eco-friendly fuel?

A transition to a carbon neutral economy necessitates time, planification and technological advancements; unfortunately, the transition cannot feasibly happen in a short time. Thus, to satisfy growing demand for energy in the short-term, natural gas in its liquefied form represents a valuable transitional fuel.⁴⁵ Lute J stressed out the importance of LNG in the energy transition agenda in the USA.⁴⁶ The researcher explains that electricity generated from natural gas emits less greenhouse gases than coal and oil because natural gas only emits 40% of the CO₂ emitted by coal. Lute demonstrates how difficult an aggressive renewable energy transition policy might be to pursue if demand gaps/ supply shortages are to be reliably avoided. Research done by Lindstad and Riialand comparing LNG and other fuel based cruise ships acknowledge that LNG, due its lower percentage of GHG emissions, is in conformity with the International Maritime Organisation air emission regulations and therefore represents an important transitional fuel.⁴⁷ Sakmar S. gives additional support to that conclusion, in a study questioning the role of LNG in the 21st century energy industry.⁴⁸ The scholar concludes the study arguing that LNG as a “clean burning fossil fuel” could be a relevant choice to supply energy needs in carbon-aware industry.⁴⁹

Many studies however argue against LNG as a *bona fide* green energy transition fuel. A paper prepared by Anderson and Broderick reveals that the production of natural gas implies methane and carbon dioxide emissions, two important components of GHG⁵⁰. Methane, with greater warming effect than carbon dioxide in a short time period can result in temperature rise if persistent. Moreover, Anderson and Broderick highlight the increasing climate change impact resulting from LNG value-chain that annihilates its clean-burning potential. This conclusion is further supported by Hedlund and Cowi who present the environmental and safety issues related to LNG facilities in a study questioning the sustainable feature of the resource in a climate conscious World.⁵¹

Aquatic pollution and disruption, water waste and spills are serious issues that may be associated with LNG activities.⁵² These arguments have been refuted by Lute J. who recognised the risks of operating LNG facilities but maintained that those risks are “manageable” if good safety practices are implemented.⁵³ Technological advancements also have the potential to reduce the climate threat from LNG supply chains. Faishi, Bogdanov and Breyer and Van den Akker demonstrate in that sense that if fossil LNG substituted by renewable energy LNG or carbon capture applied to LNG ships, emissions and stranded assets in long-term investments would be avoidable.⁵⁴

⁴⁵ Lute, J. (2007). LNG Terminals: Future or Folly. *Willamette L. Rev.*, 43, 621

⁴⁶ Ibid.

⁴⁷ Lindstad, E., & Riialand, A. (2020). LNG and cruise ships, an easy way to Fulfil regulations—versus the need for reducing GHG emissions. *Sustainability*, 12(5), 2080

⁴⁸ Sakmar, S. (2010). The globalization and environmental sustainability of LNG: Is LNG a fuel for the 21st century?

⁴⁹ Ibid. p.18

⁵⁰ Anderson, K., & Broderick, J. (2017). Natural gas and climate change

⁵¹ Hedlund, F. H., & COWI, K. L. (2014). LNG safety—an emerging and ignored issue in the climate change debate *European Safety and Reliability Association Newsletter*, (September)

⁵² Ibid.

⁵³ Lute, J. (2007). LNG Terminals. *Supra* 42 p.651

⁵⁴ See Fasihi, M., Bogdanov, D., & Breyer, C. (2015, September). Economics of global LNG trading based on hybrid PV-wind power plants. In *Proceedings of the 31st European Photovoltaic Solar Energy Conference, Hamburg, Germany* (pp. 14-18) and van den Akker, J. (2017). Carbon capture onboard LNG-fueled vessels: A feasibility study

3.2 LNG for energy security in Africa

Energy security in Africa is a vital concern. The population grows in poverty and the need for affordable energy occurs as a consequence because demand grows but supply fails to keep pace with that growth.⁵⁵ The urgency to limit GHG gives priority to renewable energy technology to supply growing energy needs. Nevertheless, shortages of capital, unavailability of workforce and governance incapacity limit the development of renewable technology in Africa to meet growing demand.⁵⁶ According to the International Energy Agency (IEA), approximately 600 millions of people lack access to electricity, a number accentuated by Covid-19 effects. Collier and Venables demonstrated that choice of energy supply in Africa is motivated by costs of alternatives.⁵⁷ According to the researchers, renewable energy is still highly expensive for African governments and the availability of gas, transportable through FSRUs across the continent is more cost-effective and can easily reach small. A paper from McKinsey revealed that LNG supplies sold at the spot markets in 2020 were more than 50% less costly than oil.⁵⁸ Townsend champions the argument by pointing out that LNG provides a back-up to renewable energy, reduces reliance on oil and coal-burned fuel and secures supply of natural gas to diversify energy supplies.⁵⁹

There is an increasing effort to switch coal and oil fired plants with gas plants especially for small markets with limited financial capacities.⁶⁰ According to Ayaburi, Sharma and Brazilian, FSRUs offer the opportunity to new and emerging African gas markets to secure gas supply for power generation⁶¹. Most African countries, except Egypt, still rely on crude oil and coal for their energy supply.⁶² The continent accounts for the minimum %age of emissions in the World but bears the worst climate change⁶³. Given the analysis above, African countries, although less polluting, need to align with global commitments and transit from coal and oil to cleaner sources of energy, gas represents the “fuel for the future” and a solution to energy poverty⁶⁴. Cornot-Gandolphe S. even forecasted that LNG demand could quadruple in emerging importing countries in the MENA and Sub-Saharan African regions by 2030.⁶⁵

Development of LNG facilities across Africa is emerging following different objectives. Morocco and Ghana are the new potential LNG importers while Senegal and Egypt are cited as exporters (New and emerging LNG markets: the demand shock).

⁵⁵ Luft, G., & Korin, A. (2009). *Energy security challenges for the 21st century: a reference handbook*. ABC-CLIO.

⁵⁶ Afful-Dadzie, A., Mallett, A., & Afful-Dadzie, E. (2020). The challenge of energy transition in the Global South: The case of electricity generation planning in Ghana. *Renewable and Sustainable Energy Reviews*, 126, 109830.

⁵⁷ ⁵⁷ Collier, P., & Venables, A. J. (2012). *Supra* 7.

⁵⁸ Read McKinsey article “The future of Liquefied natural gas: opportunities for growth » <https://www.mckinsey.com/industries/oil-and-gas/our-insights/the-future-of-liquefied-natural-gas-opportunities-for-growth> Last accessed 20 July 2021

⁵⁹ Townsend, A. F. (2019). *Supra* 8.

⁶⁰ Ayaburi, J., Sharma, S., & Bazilian, M. (2021). *Supra* 16.

⁶¹ *Ibid.*

⁶² Choukri, K., Naddami, A., & Hayani, S. (2017). Renewable energy in emergent countries: lessons from energy transition in Morocco. *Energy, Sustainability and Society*, 7(1), 1-11.

⁶³ Collier, P., & Venables, A. J. (2012). *Supra* 7.

⁶⁴ *Ibid.*

⁶⁵ Cornot-Gandolphe, S. (2018). *Supra* 28.

4. Methodology

The research follows a comparative law matrix to assess the responsiveness of LNG legal framework in each country's systems to energy transition trends. Comparative law is often used for legal studies but widely criticised on the grounds of alleged vagueness.⁶⁶ Hoecke V.M illustrates how using comparative legal methods depends on the objectives and the research questions grounding the research.⁶⁷

In light of these considerations, in analysing LNG in Egypt, Morocco, Ghana and Senegal, this paper applies a functional approach. According to Coninck and Leuven, the functional method is the best method for comparative legal studies because it does not uniquely entail the analysis of regulations and legal systems but approaches them as a response to a concern.⁶⁸ Energy transition as previously stated is a matter of emergency. The effect of burning fossil fuels, especially oil, is immensely harmful for the environment and exacerbates climate change threat. Further, millions of households in Africa do not have access to reliable and affordable energy. Energy transition in that sense resolves dual problems of harmful carbon dioxide emissions and energy poverty.

This paper reviewed scholarly arguments on the place of LNG in the energy transition. To follow this review, an analysis of LNG regulations in the four targeted countries opens the debate on the role that governments in different African context allocate to LNG in their whole energy policy in response to climate change mitigation and energy security.

4.1 Case Studies

African countries' interest for LNG is motivated by different factors. As previously developed, LNG exporters and importers countries in North and SSA have distinctive history and policies orientation. In this paper, four countries have been considered regarding the development of LNG in line with the energy transition and energy security.

4.1.1 Morocco: the emergent LNG importer

Morocco is located in the Arabian/ north-east Africa's Mashriq zone, an important part of MENA, a region that plays a key role in the global gas market. However, unlike nearby Maghreb (a region that plays a key role in the global gas market)⁶⁹ countries Algeria and Libya, Morocco is not a gas-resource rich country and most of its supply is imported from Algeria.⁷⁰

According to the IEA, Morocco imported 94% of its gas supply from Algeria.⁷¹ Despite the natural gas consumption growth by 215% from 2007 to 2017, the Kingdom of Morocco's gas share in its energy mix remains low by international standards and oil remains the dominant fuel. The first gas imports dated back to 2005 with the Tahaddart plant.⁷²

⁶⁶ Eberle, E. J. (2009). The method and role of comparative law. *Wash. U. Global Stud. L. Rev.*, 8, 451.

⁶⁷ Van Hoecke, M. (Ed.). (2004). *Epistemology and methodology of comparative law*. Bloomsbury Publishing.

⁶⁸ De Coninck, J. (2010). The Functional Method of Comparative Law: "Quo Vadis"? *Rabels Zeitschrift für ausländisches und internationales Privatrecht/The Rabel Journal of Comparative and International Private Law*, (H. 2), 318-350.

⁶⁹ Griffiths, S. (2017). *Supra* 15

⁷⁰ Corbeau, A. S. (2016). *Supra* 12

⁷¹ See ""Energy Policies beyond IEA Countries: Morocco 2019, Country report — May 2019", <https://www.iea.org/reports/energy-policies-beyond-iea-countries-morocco-2019>, Last accessed 20 July 2021

⁷² *Ibid.*

The country has developed multiple energy policies pursuing different objectives to ease its energy dependence on imports. The development of LNG facilities thus came as alternatives to diversify gas supply and step out of oil. To source the power sector and industrial hubs as part of the Ministry of energy, mines and sustainability implemented in 2014 a gas development plan including LNG as main source of gas supply to be set in two phases : “Gas to power” and “Gas to industry”⁷³. The first LNG import facility should be operational 2028⁷⁴.

4.1.2 LNG in Senegal

Senegal has for years been a relatively small-scale gas producer⁷⁵. Natural gas discovery and development date back to the 1980s with the DiamNiadio gas field. Gas production from DiamNiadio stopped in 2000 and two years later, Fortesa International started gas production from Gadiaga field, reaching a peak production for that field in 2013.⁷⁶ Between 2008 and 2017, the Senegalese government launched programs and campaigns to boost hydrocarbons activities. These actions led to major oil and gas discoveries between 2014 and 2017. Gas exploration and production contracts were thus signed for the Sangomar offshore field, the Teranga and Yakaar gas fields, and the GTA gas field discovered in 2015 shared between Senegal and Mauritania.⁷⁷ The GTA discovery marked the introduction of LNG into the Senegal gas sector. Indeed, the development of the GTA gas field is under phase 1 consisting in an LNG export project with an expected capacity of 2.45 MT p.a.⁷⁸ Despite phase 1 under development, project partners, BP, Kosmos Energy, the Mauritanian and Senegalese hydrocarbons corporations⁷⁹ have signed: in 2019 a 20-year gas Lease and Operate agreement with Golar LNG; and in 2020 a 20-year Sale and Purchase Agreement with BP Gas Marketing Limited.⁸⁰

4.1.3 LNG in Egypt

Egypt is well known for its gas capacities and the importance of its reserves to supply the MENA region. Egypt has been among the main LNG producers in Africa with Algeria and Nigeria. In 2005, the country launched two LNG projects.⁸¹ However, due to depleted fields, the country stopped gas exports forcing neighbouring countries like Israel and Morocco to look for alternatives, as reported in 2014.⁸²

Egypt is the only country in Africa where natural gas dominates downstream energy (electricity) production.⁸³ Corbeau A.S described Egypt as the largest gas consumer in Africa.

⁷³ See the Oxford Business Group’s “The Report: Morocco 2018”, available at: <https://oxfordbusinessgroup.com/morocco-2018>, last accessed 20 July 2021

⁷⁴ Ibid.

⁷⁵ Ayaburi, J., Sharma, S., & Bazilian, M. (2021). Supra 16

⁷⁶ Ouki, M. (2020). *Mauritania-Senegal: An emerging New African Gas Province-is it still possible?*. Oxford Institute for Energy Studies

⁷⁷ Ibid.

⁷⁸ Davis, W., & Mihalyi, D. (2021). Opportunities and Challenges for Senegal in Oil and Gas Production: Lessons Learned from Other New Producers

⁷⁹ In the latter case, the corporation in question is the Société Mauritanienne des Hydrocarbures et Patrimoine Minier and Société des Pétroles du Sénégal

⁸⁰ Ouki, M. (2020). Supra 75

⁸¹ Cornot-Gandolphe, S. (2018). Supra 28

⁸² Siddig, K., & Grethe, H. (2014). No more gas from Egypt? Modeling offshore discoveries and import uncertainty of natural gas in Israel. *Applied energy*, 136, 312-324

⁸³ Corbeau, A. S. (2016). Supra 12

Given the large and growing natural gas demand from the power and the industrial sectors, the country turned to LNG imports in 2015,⁸⁴ imports that reached levels highly significant globally.⁸⁵ Hence, LNG imports resulted as an immediate and short-term pragmatic measure to meet the supply gap caused by a decline in domestic production.⁸⁶ Even so, Egyptian public policy sought to limit imports as far as practicable, providing impetus to the country's upstream petroleum exploration drive, a drive that proved successful in the form of the discovery and fast track development of the country's Zohr offshore gas field. This turnaround evidenced a remarkable determination whereby the country first achieved self-sufficiency in natural gas supply⁸⁷ and, subsequently, enough natural gas production to allow for LNG exports.⁸⁸

4.1.4 Ghana: the first Sub-Saharan Africa LNG importer

Energy supply in Ghana is highly dependent on thermal and hydro sources. Thermal and hydro facilities are mainly fueled by crude oil, effectively crowding out natural gas in downstream energy markets. Following the government's ambition to diversify energy supply, ensure universal access and effective electrification to battle irregular power supply and unreliability of the existing West African Gas Pipeline (WAGP), ensuring greatly enhanced levels of natural gas became an issue of the highest importance.⁸⁹ Natural gas consumption in Ghana grew by more than 100% in the decade starting 2010.⁹⁰ Seeking to spur higher levels of electricity generation, measures to add LNG into downstream energy supply were set in place, and an LNG facility has been constructed in Tema from 2016 to import gas and increase gas-fired power plants.⁹¹ The Ghana Petroleum Company (GPNC) and a subsidiary of the Russian Rosneft Oil Company, Rosneft Trading S.A signed a Gas Supply Agreement (GSA) to supply 1.7million metric tonnes per annum of gas to Tema LNG Terminal.⁹² The LNG terminal is expected to receive its first gas in July 2021, supplementing both WAGP imports and the country's own domestic production from the Jubilee (from 2014), Tweneboa, Enyenra, Ntomme/ TEN (from 2017), and Sankofa (from 2018) offshore fields.

4.2 Energy policy and LNG

Increasing demand for electricity in Africa opened opportunities for LNG within countries' energy policies. Across Africa, the necessity to multiply the share of renewable energy in the energy mix and diversify supply to adopt affordable and cleaner fuel sources motivated LNG expansion. In Morocco, energy needs are totally dependent on foreign energy market due to its resource poverty.⁹³ Thus, the government launched in 2009 the National Energy Strategy to reduce its energy dependence and align with the commitments to fight against climate change. The country hosted the 2015 United Nations Climate Change Conference in Marrakech and announced during the event its new goal to reach 50% renewable energy capacity by 2030.⁹⁴ The demand for

⁸⁴ Ouki, M. (2020). Supra 75

⁸⁵ Read the Oxford Business Group Morocco's Energy Report 2018 Supra 71 and Merkulov et al (2020). Analysis of world LNG production capacity IOP Conf. Ser.: Earth Environ. Sci. 539 012057

⁸⁶ Ibid

⁸⁷ Ouki, M. (2020). Supra 75

⁸⁸ Hussein A., Gamal H. & Tasheem M. (2021). Decrypting the Egyptian Gas Legal Framework, available at: https://issuu.com/egyptoil-gas/docs/decrypting_the_egyptian_gas_legal_framework, last accessed 6 August 2021

⁸⁹ Read the African Development Bank's Environmental and Social Impact Assessment for the "Access LNG FSRUs project" in Ghana, available here: <https://www.afdb.org/en/documents/document/ghana-access-lng-floating-storage-and-regasification-projects-fsu-fru-esia-summary-108933>, last accessed 9 August 2021

⁹⁰ Abudu, H., & Sai, R. (2020). Examining prospects and challenges of Ghana's petroleum industry: A systematic review. *Energy Reports*, 6, 841-858

⁹¹ Ayaburi, J., Sharma, S., & Bazilian, M. (2021). Supra 16

⁹² African Development Bank ESIA for the "Access LNG FSRUs project" in Ghana. Supra 87 p.4

⁹³ Choukri, K., Naddami, A., & Hayani, S. (2017). Renewable energy in emergent countries: lessons from energy transition in Morocco. *Energy, Sustainability and Society*, 7(1), 1-11

⁹⁴ Ibid.

electricity drastically increased by 270% from 1990 due to population growth and economic advancements.⁹⁵ The key points of the 2009 energy strategy are: the diversification of energy sources, the increase of renewable energy capacity, the liberalisation of energy investments to foster investments and the promotion of regional electricity integration.⁹⁶ The country clearly prioritises renewable energies investments but gas also holds a place of central importance in the energy strategy. Considering the increasing electricity demand, the growing renewable energy developments are nevertheless not sufficient, requiring more gas to meet the need.⁹⁷ Under the National Energy Strategy, LNG has been targeted to back-up renewable energy intermittency and diversify gas supply in the energy policy. The government has developed ambitious gas-to-power and gas-to-industry project to meet the need for additional power generation capacity and increase the use of natural gas in the industrial sector to replace use of coal and harmful fuel.⁹⁸ The IEA in its latest report on Morocco's energy sector points out the country's objective to increase major industries supply of LNG by 2030.⁹⁹

Egypt's energy profile is relatively different from Morocco. The country is one of the biggest energy markets in Africa and the MENA regions thanks to its natural gas wealth. Natural gas has historically been an important resource for electricity generation in Egypt.¹⁰⁰ The natural gas shortage and the recession in the country unsurprisingly affected the management of the energy sector especially for electricity generation driving first LNG imports in 2015.¹⁰¹ Continuing efforts from the government to stop import and achieve self-sufficiency forced the decrease in LNG imports and in 2018 the country declared gas self-sufficiency.¹⁰² However, Atlam and Rapiea observe that there is a problem of energy sector strategy uniformisation in Egypt.¹⁰³ Many energy policies from different institutions are in conflict, hindering the idea of common energy objectives and the importance of LNG in the global energy strategy.¹⁰⁴ The country's vulnerability to climate change due to its dependence on Nile River water and Mediterranean Sea for gas exploration requires a relevant national energy strategy.¹⁰⁵ In 2021, there has been a surge in LNG exports.¹⁰⁶ Natural gas plays an important role in the Egyptian energy sector especially for electricity generation and energy security but the role of LNG in the renewed gas-sufficient country regarding climate change and its domestic benefit are hardly detectable.

Ghana's gas demand is driven by the power sector.¹⁰⁷ Energy sector in Ghana faces many challenges. The non-diversification of energy supply and the disturbance in power supply.¹⁰⁸ The electricity sector is dominated

⁹⁵ Look at the IEA Morocco's electricity consumption graph, available at: <https://www.iea.org/countries/morocco>, last accessed 9 August 2021

⁹⁶ Schinko, T., Bohm, S., Komendantova, N., Jamea, E. M., & Blohm, M. (2019). Morocco's sustainable energy transition and the role of financing costs: a participatory electricity system modeling approach. *Energy, Sustainability and Society*, 9(1), 1-17

⁹⁷ Read King and Spalding article "LNG in Morocco" (2016), available at: <https://www.kslaw.com/blog-posts/lng-in-morocco>, last accessed 9 August 2021

⁹⁸ Read the White and Case paper "Morocco-Gas to power project and natural gas pre-feasibility study for future LNG import Terminal Project in Morocco", available at: <https://www.whitecase.com/sites/default/files/2021-02/morocco-gas-to-power-project-eng-2021.pdf>, last accessed 9 August 2021

⁹⁹ the IEA Morocco's energy report 2019. Supra 83

¹⁰⁰ See the article from Mohamed A (2020) "Oil & Gas Regulations in Egypt: Fundamentals legal aspects for the Liquefied Natural Gas (LNG)", available at: <https://www.irglobal.com/article/oil-gas-regulations-in-egypt-fundamentals-legal-aspects-for-the-liquefied-natural-gas-lng/>, last accessed 9 August 2021

¹⁰¹ Cauich-López, D. A., Payan, L. B., Abdelhalim, A. M. N., Izrantsev, V. V., Knorring, V. G., Kondrashkova, G. A., & Sinitsyn, A. A. (2019, November). Egypt and nuclear energy: aspects, reasons and future. In *IOP Conference Series: Earth and Environmental Science* (Vol. 337, No. 1, p. 012081). IOP Publishing

¹⁰² Ouki, M. (2018). Supra 75

¹⁰³ Atlam, B. M., & Rapiea, A. M. (2016). Assessing the future of energy security in Egypt. *International Journal of Energy Economics and Policy*, 6(4)

¹⁰⁴ Ibid.

¹⁰⁵ Ibrahiem, D. M. (2020). Do technological innovations and financial development improve environmental quality in Egypt?. *Environmental Science and Pollution Research*, 27(10), 10869-10881

¹⁰⁶ See White and Case paper "Morocco-Gas to power project and natural gas pre-feasibility study for future LNG import Terminal Project in Morocco » Supra 97

¹⁰⁷ Fulwood M. and Bros T. (2018). Supra 36

¹⁰⁸ African Development Bank ESIA for the "Access LNG FSRUs project" in Ghana. Supra 81

by hydropower which in 2018 accounted for 39.6% of the country's energy mix, with oil and gas-fired power plants accounting for a further 58.1%.

Power generation capacity from hydro has declined in recent years due to infrastructural problems.¹⁰⁹ The National Energy Policy highlights key challenges faced by the energy sector are the obsolescence of power supply infrastructures, the inadequate access to electricity, the high cost of fuel for electricity and the approach to climate change.¹¹⁰ The power sector constitutes the largest share demand for gas in the country.¹¹¹ LNG imports in Ghana are therefore motivated by affordability, energy security and its relatively climate-friendly properties compared to oil.

Approximately 90% (excluding biomass) of Senegal's downstream energy supply is imported.¹¹² The main components of the energy mix are biomass and oil.¹¹³ An important energy strategy for the country is to switch oil fueled power-plants to gas fired power, for reasons of affordability¹¹⁴ that also have benefits in terms of lower carbon emissions. Indeed, the choice for LNG as source of supply in Africa is often driven by affordability, in Senegal and elsewhere, and even allowing for the price premium of LNG as compared to piped natural gas. Energy consumption in Senegal remains moderate and just 70% of Senegalese citizens had access to electricity according to the World Bank.¹¹⁵ Wood and coal are still mainly used by households followed by Liquefied Petroleum Gas (LPG). The use of a part of gas extracted from Sangomar and GTA LNG facilities for the domestic market is aimed at increasing the country's access to power.¹¹⁶ According the Emerging Senegal Plan adopted in 2014 and revised in 2019, LNG projects are expected to improve competitiveness and lower electricity prices.¹¹⁷ But natural gas still has a negligible share in the country's energy mix. Despite the high LNG ambition, Ayaburi, Sharma and Brazilian observe that LNG in Senegal is primarily to foster investments.¹¹⁸ The "gas-to-power" plan launched by the Senegalese government following LNG developments from the Sangomar and the GTA fields in aimed at supplying the domestic market but the amount of gas to allocated to domestic use has not yet been negotiated.¹¹⁹

Following the objective of introducing LNG in the energy markets, Morocco, Egypt, Ghana, and Senegal designed legal frameworks to support LNG developments and investments

4.3 Legal frameworks and LNG

The difference in country's context affects its legal approach to LNG development. In Morocco, The long term gas supply agreement between the Office National de l'Electricité et de l'Eau Potable (ONEE) and the Algerian Petroleum Company (SONATRACH) first supplier of gas to Morocco expected to end in 2021 forced the Kingdom to look for alternatives¹²⁰. To respond to increasing gas demand from the electricity sector, reduce energy dependence and include gas in the energy mix by up to 40% as stated in its National Energy Strategy,

¹⁰⁹ Afful-Dadzie, A., Mallett, A., & Afful-Dadzie, E. (2020). The challenge of energy transition in the Global South: The case of electricity generation planning in Ghana. *Renewable and Sustainable Energy Reviews*, 126, 109830.

¹¹⁰ Read the National Energy Policy 2010. P.11

¹¹¹ See "Ghana Gas Master Plan 2016", available at: https://uploads-ssl.webflow.com/5a92987328c28c00011db053/5bbf7dca7a04d6da6a45aa82_GMP-Final-Jun16.pdf, last accessed 10 August 2021

¹¹² Tchanche, B. (2018). Analyse du système énergétique du Sénégal. *Journal of Renewable Energies*, 21(1), 73-88.

¹¹³ Ibid

¹¹⁴ Davis, W., & Mihalyi, D. (2021). Supra 77

¹¹⁵ See the Worldbank data on electricity access rate in Senegal [Energy access rate](#) last accessed 10 August 2021

¹¹⁶ Davis, W., & Mihalyi, D. (2021). Supra 77

¹¹⁷ The "Plan for an Emerging Senegal 2019-2023" comprises the national policy to foster economic growth. Access to energy represents one of the most important objective to achieve. Available at <https://www.economie.gouv.sn/en/dossiers-publications/publications/pse>, last accessed 10 August 2021

¹¹⁸ Ayaburi, J., Sharma, S., & Bazilian, M. (2021). Supra 16

¹¹⁹ Ibid

¹²⁰ Cornot-Gandolphe, S. (2018). Supra 28

Morocco launched in 2014 a National Plan for LNG Development.¹²¹ The plan introduced the LNG “Gas-to-power” and “Gas-to-industry” project located at the Jorf Lasfar field. The main beneficiary of the LNG development plan is the electricity sector and especially renewables energies. To support and guide the implementation and incentives for the project, the government designed in 2017 a draft gas law for downstream gas activities. Energy security, supply diversification and renewable energies back-up have been clearly presented as the reasons grounding the draft gas law.¹²² To improve competitiveness, the draft set out an environment for the liberalisation of exploitation, import and distribution of gas. In sum, Morocco LNG specific legal framework was designed primarily for the benefit of the domestic electricity sector even though the adoption of the draft gas law is still awaited.

The commercial orientation of the LNG legal framework in Egypt translates its objective to become a regional gas hub.¹²³ After a decrease of gas production obliging the country to import LNG in 2015 as mentioned above, the vast campaign to maximise oil and gas recovery and discover new fields and the expansion of the international LNG market relaunch the LNG industry in Egypt. In 2017, a Gas Market Activity Law was adopted followed in 2018 by its regulatory decree to regulate gas commercial activities: shipping, transmission, distribution, storage, supply, marketing, and trading. The Gas Market Activity Law expressly mentioned LNG and promote free competition to avoid monopolistic practices and discriminatory treatment.¹²⁴ Creating an investment-friendly environment for gas market became a matter of priority for the Egyptian government.¹²⁵ LNG Sales and Purchase Agreements (SPAs) dealing with the commercialisation of LNG are at the center of the LNG legal framework in Egypt.¹²⁶ Thus, LNG responds to a more commercial objective rather than a need to source the domestic energy sector in a sustainable way. This chosen setting is understandable considering the universal access to energy rate in the country since 2016 right after the first import of LNG in 2015 and its gas self-sufficiency.

In Ghana, there is no dedicated law to LNG activities. LNG operations are under the Energy Commission Act 1997 (Act 541), the National Petroleum Authority Act 2005 (Act 691) and the Natural Gas Pipeline Safety 2012 framing natural gas activities and regulatory bodies.¹²⁷ From a policy perspective, LNG has been following the country’s National Energy Policy and the Ghana Gas Master Plan respectively adopted in 2010 and 2016. The previous section illustrated the role of LNG within the energy sector in Ghana. Considering the unreliability of the WAGP, the country turned to LNG to supply primarily the domestic power sector and promote economic growth accordingly.¹²⁸ Natural gas constitutes 18.2% of total primary energy supplied in 2019 less than biomass and oil.¹²⁹ Hence, given the large increase of gas production between 2014 and 2019 and the expected first LNG supply in 2021, its share in the energy mix is likely to grow.

In the case of Senegal, the country has recently discovered its important oil and gas potential arousing great expectations for economic growth and social welfare. Biomass is still the principal energy source in Senegal.¹³⁰ A National Development Plan was adopted in 2014 and revised in 2019 with special attention to energy access. Indeed, the national policy expects to reach universal energy access by 2025 and reduce energy

¹²¹ Morocco adopted in 2014 a “National Plan for LNG Development” to guide the policy framing its development and benefits. See footnote 94 above.

¹²² The objectives of adopting a gas law in Morocco has been cited and clearly identifies in the draft law preamble. The draft law and the LNG development plan demonstrate the country’s ambition towards LNG, see “Draft Law 94-17 Relating to the Downstream Part of the Natural Gas Sector”, available at: <https://www.mem.gov.ma/en/Pages/secteur.aspx?e=6&prj=9>, last accessed 10 August 2021

¹²³ Elshazly, M., & Khodeir, S. (2018). Legislative reforms in the Egyptian energy sector to liberalize the natural gas market. *The Journal of World Energy Law & Business*, 11(4), 354-359

¹²⁴ See articles 21 and 36 of the Gas Market Activities Law

¹²⁵ Elshazly, M., & Khodeir, S. (2018). *Supra* 119

¹²⁶ See Mohamed A (2020) article “Legal essentials for LNG”, available at: <https://egyptoil-gas.com/features/legal-essentials-for-lng-spas/>, last accessed 10 August 2021

¹²⁷ Read the African Development Bank ESIA for the “Access LNG FSRUs project” in Ghana. *Supra* 83 p.4

¹²⁸ *Ibid* p.2

¹²⁹ Read the Ghana National Energy Statistics 2000-2019, p.12, available at:

<http://energycom.gov.gh/files/2020%20ENERGY%20STATISTICS-revised.pdf>, last accessed 10 august 2021

¹³⁰ Tchanche, B. (2018). *Supra* 112

dependency.¹³¹ The country is dependent on the international energy market by 90% (out of biomass) justifying its motivation to benefit from the country's gas potential to become self-sufficient. The government forecasted electricity generation capacity by 2022-2023 thanks to the GTA LNG project.¹³² The main objectives of the GTA projects according to the Senegalese government are: the substitution of fuel with gas-to-power and the production of affordable energy from gas allowing sustainable access to energy. The strategy to achieve the cited objectives began with a legal reform of the oil and gas legal framework that welcomed the first downstream gas law in 2020. The natural gas law was adopted in early 2020 after the discovery of the GTA gas potential by BP in 2019 giving a framework for LNG development and closing this legal gap in the gas legal family. In comparison to Morocco, Senegal is a gas resource country, thus the downstream law deals with exports and imports and emphasize on the market liberalization. Indeed, as previously noted, a Gas Lease Agreement has already been negotiated for the Phase 1 of the GTA project. Given Morocco's context, the draft law provides incentives for foreign investment in LNG mainly for imports, transport, and distribution activities.

¹³¹ Ibid.

¹³² Ba, A. S. (2018). *Analyse de la politique d'efficacité énergétique du Sénégal* (Doctoral dissertation, Université Paris Dauphine PSL).

5. Conclusion

This paper's objective was to assess the responsiveness of the LNG framework to climate change and energy security in Africa. LNG benefits when it comes to the climate change issue has been highly controversial. While some scholars, experts and governments estimate that gas under the liquefied form is more climate friendly than oil, others dispute the argument emphasizing on the emissions emitted by the LNG value chain exceeding oil development emissions. Further, in a context like Africa where more than six hundred million people face energy poverty, there is an urgent need to opt for an affordable, reliable, and clean source of energy to align with international climate change mitigation commitments and sustainable development goals. As mentioned by the Senegalese, LNG is affordable and less harmful than fuel¹³³. In response to the research objective, four countries with different profiles have been studied. Egypt, gas self-sufficient, with universal energy access focused its LNG framework on a more commercial pathway with the aim to secure its place as the LNG hub in the MENA region after the country experienced in 2009 a decline in its renowned gas industry. Morocco on its part, is a gas resource poor country, thus given the end of its Gas Supply agreement with Algeria and the growing need for gas to source its energy transition, back-up renewable energies and satisfy demand, turn to LNG imports. The availability of resources in a country clearly makes a difference in its development policy and regulation. Indeed, compared to Morocco, Senegal has recently discovered gas fields and an important LNG project, the GTA LNG project was launched in 2019 driving the country to review its National Development Policy and adopt a downstream gas law. The country expects that the LNG development due to start in 2023 will foster development growth and reduce the problem of energy poverty. The last case, Ghana follows in general the same goal than Morocco and Senegal which is to tackle energy poverty and increase gas share in its energy mix. However, it is important to fill the legal gap in the gas framework, as the country will become the first LNG importer in Sub-Saharan Africa, a proper LNG law would be appropriate to materialise the Gas Plan objectives.

To conclude, LNG has the potential to be a beneficial supply choice for Africa and African nations' citizens, governments, and policymakers strive to tackle energy poverty, and the impacts of climate change; however, the right policies, laws need to be in place, and implemented, to make a success of such a strategy.

¹³³ Ibid. p.2

6. Selected Bibliography

Brown, B., & Spiegel, S. J. (2019). Coal, climate justice, and the cultural politics of energy transition. *Global environmental politics*, 19(2), 149-168.

Jorgenson, S. N., Stephens, J. C., & White, B. (2019). Environmental education in transition: A critical review of recent research on climate change and energy education. *The Journal of Environmental Education*, 50(3), 160-171.

Kim, J. E. (2019). Sustainable energy transition in developing countries: the role of energy aid donors. *Climate Policy*, 19(1), 1-16.

Yazdanpanah, M., Komendantova, N., & Ardestani, R. S. (2015). Governance of energy transition in Iran: Investigating public acceptance and willingness to use renewable energy sources through socio-psychological model. *Renewable and Sustainable Energy Reviews*, 45, 565-573.

Collier, P., & Venables, A. J. (2012). Greening Africa? Technologies, endowments, and the latecomer effect. *Energy Economics*, 34, S75-S84.

Townsend, A. F. (2019). Natural Gas and the Clean Energy Transition.

Ritz, R. A. (2019). A strategic perspective on competition between pipeline gas and LNG. *The Energy Journal*, 40(5).

Corbeau, A. S. (2016). LNG for Africa. *King Abdullah Petroleum Studies and Research Center (KAPSARC)*.

Griffiths, S. (2017). A review and assessment of energy policy in the Middle East and North Africa region. *Energy Policy*, 102, 249-269.

Ayaburi, J., Sharma, S., & Brazilian, M. (2021). Comparative analysis of selected African natural gas markets and related policies. *Energy for Sustainable Development*, 63, 67-77.

Fasihi, M., Bogdanov, D., & Breyer, C. (2015, September). Economics of global LNG trading based on hybrid PV-wind power plants. In *Proceedings of the 31st European Photovoltaic Solar Energy Conference, Hamburg, Germany* (pp. 14-18).

Lacher, W., & Kumetat, D. (2011). The security of energy infrastructure and supply in North Africa: Hydrocarbons and renewable energies in comparative perspective. *Energy policy*, 39(8), 4466-4478.

Layachi, A. (2013). The changing geopolitics of natural gas: the case of Algeria

Delalandre, C. (2006). Le GNL: Instrument de flexibilisation du marché du gaz.

Cornot-Gandolphe, S. (2018). *New and Emerging LNG Markets: The Demand Shock*. OCP Policy Center.

Ouki, M. (2018). Egypt—a return to a balanced gas market?

El Ghazi F., Sedra M.B. & Akdi M. (2019). Natural Gas Pre-feasibility Study for Future LNG Importing Terminal Project in Morocco.

Mtebe, J. S., & Kissaka, M. M. (2015). Deployment and adoption strategy of cloud computing for blended learning in higher education institutions in sub-Saharan Africa. In *Handbook of Research on Educational Technology Integration and Active Learning* (pp. 395-408). IGI Global.

- Fulwood M. and Bros T. (2018). Future prospect for LNG demand in Ghana. *Oxford Institute for Energy Studies*.
- Andeobu, L., Hettihewa, S., & Wright, C. S. (2015). Australian and Nigerian LNG Projects: Insights for Resolving Challenges Facing New LNG Project. In *Proceedings of 4th Global Business and Finance Research Conference, Marriott Hotel, Melbourne, Australia*.
- Ouki, M. (2020). *Mauritania-Senegal: An emerging New African Gas Province-is it still possible?* Oxford Institute for Energy Studies.
- Lindstad, E., & Riialand, A. (2020). LNG and cruise ships, an easy way to Fulfil regulations—versus the need for reducing GHG emissions. *Sustainability*, 12(5), 2080.
- Sakmar, S. (2010). The globalization and environmental sustainability of LNG: Is LNG a fuel for the 21st century?
- Anderson, K., & Broderick, J. (2017). Natural gas and climate change.
- Hedlund, F. H., & COWI, K. L. (2014). LNG safety—an emerging and ignored issue in the climate change debate. *European Safety and Reliability Association Newsletter*, (September).
- Fasihi, M., Bogdanov, D., & Breyer, C. (2015, September). Economics of global LNG trading based on hybrid PV-wind power plants. In *Proceedings of the 31st European Photovoltaic Solar Energy Conference, Hamburg, Germany* (pp. 14-18).
- Van den Akker, J. (2017). Carbon capture onboard LNG-fueled vessels: A feasibility study.
- Luft, G., & Korin, A. (2009). *Energy security challenges for the 21st century: a reference handbook*. ABC-CLIO.
- Afful-Dadzie, A., Mallett, A., & Afful-Dadzie, E. (2020). The challenge of energy transition in the Global South: The case of electricity generation planning in Ghana. *Renewable and Sustainable Energy Reviews*, 126, 109830.
- Choukri, K., Naddami, A., & Hayani, S. (2017). Renewable energy in emergent countries: lessons from energy transition in Morocco. *Energy, Sustainability and Society*, 7(1), 1-11.
- Eberle, E. J. (2009). The method and role of comparative law. *Wash. U. Global Stud. L. Rev.*, 8, 451.
- Van Hoecke, M. (Ed.). (2004). *Epistemology and methodology of comparative law*. Bloomsbury Publishing.
- De Coninck, J. (2010). The Functional Method of Comparative Law: "Quo Vadis"? *Rabels Zeitschrift für ausländisches und internationales Privatrecht/The Rabel Journal of Comparative and International Private Law*, (H. 2), 318-350.
- Ouki, M. (2020). *Mauritania-Senegal: An emerging New African Gas Province - is it still possible?*. Oxford Institute for Energy Studies.
- Davis, W., & Mihalyi, D. (2021). Opportunities and Challenges for Senegal in Oil and Gas Production: Lessons Learned from Other New Producers.
- Siddig, K., & Grethe, H. (2014). No more gas from Egypt? Modeling offshore discoveries and import uncertainty of natural gas in Israel. *Applied energy*, 136, 312-324.
- Merkulov et al (2020). Analysis of world LNG production capacity IOP Conf. Ser.: Earth Environ. Sci. 539 012057.
- Abudu, H., & Sai, R. (2020). Examining prospects and challenges of Ghana's petroleum industry: A systematic review. *Energy Reports*, 6, 841-858.

- Choukri, K., Naddami, A., & Hayani, S. (2017). Renewable energy in emergent countries: lessons from energy transition in Morocco. *Energy, Sustainability and Society*, 7(1), 1-11.
- Schinko, T., Bohm, S., Komendantova, N., Jamea, E. M., & Blohm, M. (2019). Morocco's sustainable energy transition and the role of financing costs: a participatory electricity system modeling approach. *Energy, Sustainability and Society*, 9(1), 1-17
- Cauich-López, D. A., Payan, L. B., Abdelhalim, A. M. N., Izrantsev, V. V., Knorrning, V. G., Kondrashkova, G. A., & Sinitsyn, A. A. (2019, November). Egypt and nuclear energy: aspects, reasons, and future. In *IOP Conference Series: Earth and Environmental Science* (Vol. 337, No. 1, p. 012081). IOP Publishing.
- Atlam, B. M., & Rapiea, A. M. (2016). Assessing the future of energy security in Egypt. *International Journal of Energy Economics and Policy*, 6(4).
- Ibrahiem, D. M. (2020). Do technological innovations and financial development improve environmental quality in Egypt?. *Environmental Science and Pollution Research*, 27(10), 10869-10881.
- Afful-Dadzie, A., Mallett, A., & Afful-Dadzie, E. (2020). The challenge of energy transition in the Global South: The case of electricity generation planning in Ghana. *Renewable and Sustainable Energy Reviews*, 126, 109830.
- Tchanche, B. (2018). Analyse du système énergétique du Sénégal. *Journal of Renewable Energies*, 21(1), 73-88.
- Elshazly, M., & Khodeir, S. (2018). Legislative reforms in the Egyptian energy sector to liberalize the natural gas market. *The Journal of World Energy Law & Business*, 11(4), 354-359.
- Ba, A. S. (2018). *Analyse de la politique d'efficacité énergétique du Sénégal* (Doctoral dissertation, Université Paris Dauphine PSL).
- Ledesma, D. (2013). *East Africa gas—the potential for export*. Oxford Institute for Energy Studies.
- Oyewunmi, T. (2020). Gas commercialisation projects in West Africa: Pipelines, LNG, and gas-to-power. In *Routledge Handbook of Energy Law* (pp. 471-488). Routledge.