Social sustainability of energy infrastructures: The role of the programme governance framework

Abstract

The energy infrastructure literature focuses on the economic and environmental dimensions of sustainability, neglecting the social dimension. Particularly obscure is how the programme governance frameworks of energy projects and programmes shape their social performance. We address this gap in knowledge by leveraging a cross-case analysis of comparable energy infrastructures planned and delivered in contexts with different programme governance frameworks (i.e., Iran, Italy, Nigeria, Norway, Saudi Arabia, and the USA). This article first clarifies how investigating social sustainability at the infrastructure/project level is inadequate, showing that the overarching programme governance framework - set at the country level - is a major driver for social sustainability. Second, this article identifies three perspectives to examine the link between the programme governance framework and social sustainability: 1) Types of contracts, 2) Leadership of the infrastructure programme, and 3) Maturity of the legal and regulatory framework. These perspectives are combined to provide a novel analytical framework, useful to both examine the present status and plan future energy infrastructures. Last, this article discusses the findings from a policy perspective deriving a research agenda.

Keywords: Programme governance, Programme framework, Socially sustainable development, Social Justice

List of abbreviations

AGIP: Azienda Generale Italiana Petroli

CEO: Chief Executive Officer

ENI: Ente Nazionale Idrocarburi

HC: Host Country

IOC: International Oil Company

JV: Joint Venture

L&RF: Legal and Regulatory Framework

NOC: National Oil Company

O&G: Oil&Gas

OPEC: Organization of the Petroleum Exporting Countries

PSA: Product Sharing Agreement

SC: Service Contract

SWF: Sovereign Wealth Fund

USA: United States of America

1 Introduction

The United Nations have been pledged to sustainability for decades, with several efforts such as adopting *Agenda 21* in 1992, *The Future We Want* in 2002, and the *2030 Agenda for Sustainable Development* in 2015 [1]. As highlighted by Hutchins and Sutherland [2] in 2008, the interactions among the three sustainability dimensions are pivotal for sustainable development. They pointed out how decision-makers and scholars focused mostly on the economic pillar of sustainability, followed by the environmental pillar, disregarding the social dimension. Surprisingly, more than a decade after these claims, the literature about energy infrastructures still focuses on the environment and economics [3]–[8]. Despite the evident larger focus on the economic and environmental pillars [9], [10], the literature about the social impact of energy infrastructures, i.e., the ultimate impact on internal and external stakeholders (e.g., creation of jobs, development of equitable and diverse communities, contribution to intergenerational equity), is slowly growing. Yet, a relevant gap in knowledge is about the elements influencing the social sustainability of energy infrastructures [11]–[14]. As detailed in Section 2, studies about social sustainability see energy infrastructures in isolation, neglecting the role of the context. However, energy infrastructure development is specific to each country and is enacted by the programme governance framework comprising public institutions and legal instruments.

The governance framework is a well-established concept for organisations, especially corporations [15], public administration [16], projects and programmes [17], [18]. The term "governance" originates from the Latin "gubernare", which means "to steer" [19]. In this research: "Governance refers to all processes of governing, whether undertaken by a government, market, or network; whether over a family, tribe, corporation, or territory; and whether by laws, norms, power, or language" [20]. In corporations, the governance framework is relatively straightforward to define since the organisational boundary are very well defined [15], [21]. Conversely, infrastructure programmes involve a multitude of public and private organisations and sometimes relate to specific public policies and ad hoc laws & regulations, enacting, for example, bespoke public concessions schemes for the programme.

In this study, we consider the governance framework as the intangible infrastructure enabling the coherent development of the infrastructure programme, proving the necessary line of information and

authority, and decision-making processes. This perspective is coherent with major infrastructure programmes having a pivotal impact on countries' development that require creating bespoke laws and regulatory bodies for nuclear safety [22]–[24]. In line with [25], we considered the following key instruments to assess the governance framework for O&G infrastructure programmes (1) Legal and Regulatory Framework (L&RF), (2) Types of contracts, (3) HC Revenue Regime, (4) National Oil Company (NOC), (5) Government and minister of petroleum, (6) Sovereign Wealth Fund (SWF), (7) Decommissioning regime, and (8) National Strategy.

The programme governance framework brings together stakeholders (e.g., governments, contractors, technology providers) using both formal instruments, such as contracts, concessions, consortiums and ad-hoc organisations [26]–[28], and informal interactions among them. The programme governance framework directly impacts energy infrastructure planning, construction, and operation because it provides incentives and control systems for various stakeholders to work together toward a common objective. Remarkably, there are no studies investigating the role of the programme governance framework in shaping the social sustainability of energy infrastructures. This "gap-spotting", which can be categorised as "neglect spotting" [29], determined the need for this research. Filling this gap can be pivotal because it contributes to understanding what drives the social sustainability of energy infrastructures. Against this background, we derived the following research question: *How and why does the programme governance framework shape the social sustainability of energy infrastructures?*

This article aims to analyse the role of the programme governance framework in shaping the performance of energy infrastructures in terms of social sustainability. The objectives of this article are:

1) to examine how the programme governance framework shapes the social sustainability of energy infrastructures;

2) to investigate why the programme governance framework shapes the social sustainability of energy infrastructures.

This article investigates the social sustainability of similar energy infrastructures planned and delivered in different contexts. The rationale is that similar energy infrastructures delivered in contexts characterised by different programme governance frameworks can present a different social

sustainability performance. Figure 1 shows the conceptual framework depicting the structural relation of the dimensions in this paper.



Figure 1: Conceptual framework

Based on a cross-case analysis of similar upstream Oil&Gas infrastructures, planned and delivered in contexts characterised by different programme governance frameworks (i.e., Iran, Italy, Nigeria, Norway, Saudi Arabia, and the USA), this article provides two main contributions. First, it shows how the programme governance framework – its institutional elements in particular - is a key determinant for the social sustainability of energy infrastructures. Second, it identifies three perspectives to look at the link between programme governance framework and social sustainability of energy infrastructures: 1) Types of contracts, 2) Leadership of the infrastructure programme, and 3) Maturity of the legal and regulatory framework. These three perspectives are thereafter combined to provide a novel analytical framework, useful to both examine the present situation and plan future energy infrastructures and their governance. Additionally, the last section of this paper discusses the findings from a policy perspective and suggests future research opportunities.

2 Theoretical background: From corporate social responsibility to social sustainability

The literature proposes two main expressions about the social dimensions of organisations: "corporate social responsibility" and "social sustainability". These two expressions are often used interchangeably; however, they are different concepts and need to be treated as such, as elaborated in the next sections.

2.1 Corporate social responsibility

Corporate social responsibility is defined as *"a type of international private law and can be defined as a socio-political movement which generates private self-regulatory initiatives, incorporating public and private international law norms seeking to ameliorate and mitigate the social harms of and to promote public good by industrial organisations"* [30, p. 639].

The construction industry has increasingly embraced corporate social responsibility [31]–[33]. However, the concept of corporate social responsibility does not fully embrace the dynamics of the energy sector, where the social impact of a single firm is often negligible compared to the compound of stakeholders involved in the planning, construction and operation of an energy infrastructure. The latter potentially has a relevant social impact [34]. Examples of positive social impacts of energy infrastructures are [35]: immigrant settlement, occupational health and safety [36], disaster prevention and mitigation, and poverty eradication [26], [27]. The traditional focus on a single organisation is reasonable in normal business operations (e.g., a car manufacturer or a food manufacturing company) or in small projects, where decision-makers are relatively easy to define; therefore, the concept of corporate social responsibility is meaningful in these cases. Remarkably, the attribution of corporate social responsibility is more complicated in the planning, construction and operation of energy infrastructures, where it is based on a complex and dynamic governance framework [39]. Contrariwise, the concept of social sustainability is ideal for dealing with energy infrastructures, as detailed in the next section.

2.2 Social sustainability

A common definition of social sustainability in the literature is "*Social sustainability occurs when the formal and informal processes; systems; structures; and relationships actively support the capacity of current and future generations to create healthy and liveable communities. Socially sustainable communities are equitable, diverse, connected and democratic and provide a good quality of life*" [40]. Of note, as elaborated by Vallance et al. [41], the definition of social sustainability is not straightforward. There are at least three elements to consider:

- "What people 'need' (development) versus what is good for the biophysical environment.
- What people 'need' (development) versus what people want.
- What is good for the biophysical environment versus what people want".

Therefore, the concept of social sustainability directly impacts the prioritisation of the objectives of individuals or organisations, promoting sustainable and ethical decisions for the economy, society, and environment.

Whitton et al. [42] stressed how a community-led approach is needed to achieve social sustainability in the context of energy infrastructures. Additionally, the authors presented a conceptual framework based on a process of community group prioritisation and visioning to deal with sustainable pathways. Botelho et al. [43] investigated the welfare costs of several renewable energy projects, showing how local communities often do not receive any compensation for their welfare loss. Such loss is not considered in the project sustainability assessment. Furthermore, Sueyoshi and Yuan [44] stressed that the Chinese Government mostly limited energy-related initiatives in well-developed municipalities and provinces, neglecting the less-developed areas, thereby increasing imbalances.

Hueskes, Verhoest, and Block [45] investigated how Flemish public procurers consider sustainability in developing public-private partnerships. A key result is that sustainability considerations are generally taken into account from an environmental perspective, largely neglecting the social dimensions of sustainability. Kivilä, Martinsuo, and Vuorinen [46] looked at social sustainability in managing the construction and operation of energy infrastructures. They showed how a relevant social sustainability aspect is the "collaborative spirit" between the alliance partners and the local population. It is worth

mentioning that the context of the study is Finland, a country with a very high human development index (12th in the world [47]) and very low corruption (3rd less corrupted country in the world [48]); therefore, issues such as, for example, corruption, exploitation of labour, and sexism, are far more limited than in other countries, consequently hard to capture.

Furthermore, Yuan [49] investigated social sustainability in China, underlining that priorities vary largely between different clusters of stakeholders (i.e., government agencies, environmental protection organisations, and the general public). The general public highly considers social sustainability, whilst the other stakeholders disregard it. Hendiani and Bagherpour [50] proposed an index allowing the measurement of social sustainability in the construction industry; it is based on a fuzzy approach, which considers extensive attributes to obtain the final integrated index. Salite et al. [51] analysed the electricity sector in Mozambique, stressing the relevance of unbundling the sector to improve social sustainability. Additionally, Gill-Wiehl et al. [52] analysed the sustainability aspects of mini-grid projects, highlighting how community participation often appears in the operation and maintenance phases, with a positive impact on the social sustainability of the project.

The literature about social sustainability is scattered and confusing to some extent. It is often not possible to establish links between the different studies. Moreover, energy infrastructures are often seen as isolated, neglecting the role of the context. This article addresses this gap in knowledge by leveraging a cross-case study approach, as described in the next section.

3 Methodology

This article leverages a cross-case study approach, which is appropriate for the *why* and *how* research questions [53]. The unit of analysis is the energy infrastructures programme, focusing on its social sustainability performance. The infrastructure programme is: "*A group of related projects, subprograms, and program activities that are managed in a coordinated way to obtain benefits not available from managing them individually*" [54].

Three reasons justify the focus on the energy infrastructures programme. First, the energy infrastructure is an element of a broader programme (e.g., energy programme, transportation programme) [55]. It is important to consider the broader picture highlighting the overarching objectives and social impacts to appreciate the social sustainability of energy infrastructures. Second, the performance of infrastructures belonging to the same programme can have meaningful patterns, and they often reach a degree of uniformity in social terms. This is observable at the programme level rather than at the project level. Last, the institutional framework (e.g., laws and regulations, concessionary system) is usually tailored to the specific programme.

In particular, this research considered the Oil&Gas (O&G) upstream programmes of 6 countries as case studies, as detailed in Section 3.1.

3.1 Case study selection

Three main steps led to the selection of 6 case studies, i.e., the O&G upstream programmes of six countries: Iran, Italy, Nigeria, Norway, Saudi Arabia, and the USA.

First, the O&G sector is based on programmes and has a vast social impact. Therefore, it is ideal for investigating the social sustainability of energy infrastructures. Second, the focus on the "upstream" infrastructures is due to their higher relevance in social terms than their counterparts. O&G infrastructures are usually divided between "upstream", "midstream", and "downstream". Upstream operations include deposits, drill wells and recovering raw materials from underground [56]. Midstream operations (e.g., transportation, energy storage) link the upstream and downstream operations, while downstream operations include refineries and marketing [57]. The upstream infrastructures, being the

most important in social terms, is the focus of this research. Third, the O&G upstream programmes are usually polarised regarding social performance: they can be either quite a success or a failure [58]. This "polarisation" guided the selection of the 6 case studies. Indeed, the case study selection is consistent with Eisenhardt [59], who suggests a heterogeneous sample of comparable cases to enhance the validity and generalisability of the findings; therefore, the cases (i.e., the programmes) have been selected because they represent "polar types" [59]. The investigation considered the evolving programme governance frameworks and social sustainability performance for all countries.

3.2 Methodology phases

The methodology involves three main phases: data collection, data analysis, and result display.

Data collection: The research is based on secondary data, including institutional reports (e.g., Government reports), laws and legislations, contracts (e.g., petroleum contracts), scientific articles, and press articles. Triangulation, i.e., employing different data sources/methods/theories to enhance the validity of (and confidence in) the findings [42], [49], is enacted by considering alternatives and sometimes conflicting institutions and authors. Several discussions among senior academics facilitated the selection of cases and secondary data. The goal of investigating the link between the programme governance framework and social sustainability guided the discussions.

Data analysis: The data analysis is qualitative and based on an explanatory cross-case study analysis. The case studies are initially assessed individually and then compared cross-sectionally. The initial analysis is longitudinal for each single case study. In particular, the analysis is inspired by the approach introduced by Winn [61], enabling the identification of the programme phases, their objective priorities and their social impacts. Different from Winn, the research is based exclusively on secondary data. The cross-comparison is made qualitatively by considering the main patterns emerging from the sample.

Result display: The cases are briefly presented singularly, and the emergent cross patterns are identified and explained. The cases are mapped and compared, adopting the relevant perspectives that permit discrimination between the emergent patterns.

4 Findings and discussions

This section first provides an overview of the main elements (Section 4.1) of the programme governance framework in the O&G sector and its evolution over the last decades (Section 4.2). These two sections are essential to understand the context surrounding the case studies. Second, this section presents an overview of the O&G infrastructure programmes selected and examined (Section 4.3). Last, this section critically analyses the findings leading to the definition of the analytical framework linking social sustainability and programme governance framework (Section 4.4).

4.1 Elements of the programme governance framework in the O&G sector

In O&G upstream infrastructures, the contracting involves the critical economic relationship between the International Oil Companies (IOCs), i.e., multinational corporations with sufficient technical, managerial and financial capabilities to compete in the international market, and the Host Country (HC) [62]–[64]. This relationship is critical because it determines elements such as technology transfer and revenue retention; therefore, it is particularly relevant to social sustainability [65]. The HC can benefit from the O&G programme through different revenue streams such as signature bonuses, production bonuses, rentals, corporate income taxes, profit shares, state participation and other general taxes [25], [66], [67]. Usually, these revenues can be destined to support local communities and/or gathered into a Sovereign Wealth Fund (SWF) to address general public needs. The positive social impact might be jeopardised in highly corrupt countries. Other benefits for the HCs include technological development, the creation of jobs, energetic independence, improved trade balance, and increased political influence at regional and international levels.

Furthermore, O&G programmes usually involve parallel infrastructures to benefit local communities where resources are extracted, such as transportation infrastructures, hospitals or other social programmes. Negative repercussions of the O&G programmes include corruption, lack of public accountability and worker exploitation, oil theft, and wars. The following section summarises the historical milestones that contributed to the evolution of the programme governance framework in the O&G sector.

4.2 The evolution of the programme governance framework in the O&G sector

In the 19th century, the early development of the USA O&G industry paved the way for the institutional framework concerning petroleum rights. In the USA, the first petroleum law was inspired by the land and mining industry, which prescribes that the land owner owns underlying ore resources. This legal principle was exported to regulate the activities of the seven main IOCs, i.e., the *"seven sisters"* [68], [69]. During those years, the IOCs had significant bargaining power concerning several HCs with vast petroleum reserves [69]. The HCs had not sufficient technical, managerial and financial capabilities to develop the O&G infrastructures. The IOCs paid fixed fees to own petroleum rights for the geographical area indicated in their concessions [70]. Additionally, other instruments, such as royalties, funded the HCs.

In 1957, Enrico Mattei (CEO of AGIP, later ENI[1]) established a long-term relationship with the HCs to gain a competitive advantage. Mattei negotiated an agreement involving the Iranian Government as a shareholder investor on a 50-50% basis. These percentages later changed in favour of Iran. The deal can be seen as one of the first social sustainability initiatives because the IOC treated the HC as an equal partner for the first time. ENI committed to constructing additional parallel infrastructures to improve the social conditions of local Iranian communities and allowed the Government to access the technological know-how. This established a worldwide reference for future deals and improved the economic and social benefits for the HCs. Similar agreements in Algeria, Egypt, and Libya rapidly followed this approach. After the Iranian deal, the relationship between IOCs and HCs evolved, with the latter increasing their bargaining power. A key factor was the transfer of knowledge and capabilities between the IOCs and HC. Due to this knowledge transfer, most HCs could develop National Oil Companies (NOCs), i.e., petroleum utilities controlled by the state, managing oil fields directly in the HC. Another relevant factor for HCs was the control of O&G extraction. Under the traditional concession approach, IOCs had control of the production. This exclusive right led the IOCs to acquire several concessions around the world as *"real options"*. The construction and operation of several O&G

[1] AGIP was the national oil company for Italy, it was publicly owned and during the years he grew to become an IOC. In 1952 GAIP changed name and become “Ente Nazionale Idrocarburi” (ENI)

infrastructures were postponed as an independent choice of the IOC (e.g., waiting for the price increment of O&G). However, this strategy opposed the interests of HC, who wanted to accelerate revenues from the O&G extraction to foster national development. These conflicting interests led the HC to rethink the petroleum contracts and establish specific mechanisms to stimulate and control the construction and operation of O&G infrastructures.

In 1960, a key major milestone was the institution of the Organization of the Petroleum Exporting Countries (OPEC) to control the production of members HCs, including some of the biggest producers. By jointly controlling about two-thirds of oil extraction, these HCs strongly influenced the oil price in the international market. This concentration of power is particularly important for the social impact of O&G infrastructures. Firstly, a sufficiently high oil price triggers the delivery of new O&G infrastructures in locations where the extraction is more expensive (e.g., deep water). Secondly, the royalties and revenues collected by the HCs strongly depend on the actual oil cost; this cash flow significantly impacts the economy, society, and environment in the HCs. Many accidents progressively intensified attention and concerns regarding safety regulations. For instance, in 1989, the Exxon Valdez tanker ran aground off the south coast of Alaska, releasing about a fifth of its crude oil cargo into Prince William Sound's pristine waters. Since the accident sparked a protest against the company, Exxon used it as a transformational moment, spurring improvements and fostering a new safety framework known as the operations integrity management system [71]. This framework constituted a reference point for competitors and shaped the industry over the next decades until the Deepwater Horizon oil spill in the Gulf of Mexico.

In summary, Table 1 shows the fundamental elements constituting the programme governance framework in the O&G sector, focusing on the institutional elements because they are directly observable.

Table 1: Elements composing the programme framework in the O&G sector

LEVEL OF ANALYSIS	Instruments	BRIEF DESCRIPTION
National/ programme	Legal and Regulatory Framework (L&RF)	Whereas the HC has a sufficiently big reservoir(s), it develops specific O&G legislation. The legislation specifies the proprietary rights over the land and underlying reservoir. It assigns the main power and responsibilities of the Government and other regulatory bodies, e.g., licencing process. Other relevant components of the L&RF are anti-corruption, working, and environmental laws.
Programme/ Project	Types of contracts	The petroleum contract regime determines the eligible contracting options for the HC, the NOC and IOC. There are four main types of contracts: Concessions, Product Sharing Agreements (PSA), Joint Ventures (JV) and Service Contract (SC). O&G infrastructures within the programme can have different types of contracts depending on the national strategy and energy policy, the L&RF, and the technical and managerial maturity of the HC.
Programme/ Project	HC Revenue Regime	It includes several revenue streams such as signature bonuses, production bonuses, rentals, royalties, corporate income taxes, profit shares, state participation and other general taxes. Usually, the royalties are the most relevant cash flow.
National/ Programme	National Oil Company (NOC)	It is the national oil utility, controlled by the HC and managing the oil fields.
National/ Programme	Government and minister of petroleum	The Government promotes the national strategy and energy policy, controls the NOC and negotiates the petroleum contract with the IOCs. It provides the necessary licensing to construct and operate with the O&G infrastructures. It establishes the L&RF and determines the revenue regime with the Parliament.
National/ Programme	Sovereign Wealth Fund (SWF)	It is the state-owned investment fund where most O&G revenues (e.g., royalties) are usually collected. The SWF support the national strategy and finances other social initiatives.
National/ Programme	Decommissioning regime	The decommissioning regime introduces the rules for the decommissioning of the O&G infrastructures. These rules are usually contained in the L&RF and petroleum contracts. The company operating with the O&G infrastructures (i.e., NOC, IOC, or the JV) is responsible for the decommissioning.
National/ Programme	National Strategy	The Government formulates the national strategy and related energy policy, normally financed by the SWF and delivered by the NOC. The strategy encloses how to achieve the HC goals (e.g., country development and energy independence). This influences the petroleum contract regime, the Revenue Regime, the training programme for the workers, the local content, etc.

4.3 Case studies: O&G programmes

This article considered the O&G upstream programmes of six countries as case studies, focusing on the evolving governance framework and social sustainability performance. This section presents an overview of the cases, further discussed in Section 4.4.

- **Nigeria (1950-2021) – National context, elements of the programme governance framework, elements of social sustainability**

Nigeria is the most important oil producer in Africa [72]. Shell was the prime concessionaire that explored the availability of oil in Nigeria. Since 1950, significant reservoirs have been found, especially in the delta of Niger, and other IOCs acquired different concessions for the exploration. The IOCs played a central role in developing the O&G programme and are still important in developing offshore infrastructures. Nowadays, the NOC (i.e., the Nigerian National Petroleum Corporation) plays a significant role in the onshore field [73]. The O&G interest and the tribal division originated in several civil wars. The Niger Delta concentrates most of the economic interests and the episodes of violence such as abductions and oil theft. Nigeria has chronic issues, including poverty, sanitation problems, poor access to water in several regions and relatively weak education and training. Corruption and inadequate institutional framework are the main reasons for that [74]. The Nigerian reservoirs are rich in gas traditionally flared because of the absence of well-developed logistics infrastructures (i.e., LNG terminals and pipelines) [65], [66].

- **Saudi Arabia (1910-2021) - National context, elements of the programme governance framework, elements of social sustainability**

Saudi Arabia is among the most important oil producer worldwide [77]. The O&G sector accounts for 95% of the net exporting and 70% of the government budget. The O&G programme has had three phases. Firstly (1920-1940), IOCs - primarily Shell, California Arabian Standard Oil Company, and Texas Oil Company - made the initial exploration and extraction. Secondly, in 1940, the NOC - the Arabian American Oil Company - was formed, leading to the 50-50% PSA; later, the HC increased its

participation [78]. Thirdly (from the late '80s until nowadays), Saudi Arabia is strongly independent and nationalised [25]. The O&G contributed enormously to the Saudi Sovereign Funds (SWF) and boosted the development of the country, primarily regarding infrastructure, health, and education [69], [70], [71]. The major adverse social problems come from poor working conditions [82].

- **Iran (1901-2021) - National context, elements of the programme governance framework, elements of social sustainability**

Iran is one of the founders and main producers of OPEC. The O&G sector is vital for the Iranian economy; its history is complex and summarised elsewhere in the literature [83]. As an extreme simplification, in the early development of the O&G programme (1901-1979), there was one almost monopolistic concessionaire: the Anglo-Persian Oil Company, later Anglo-Iranian Oil Company and British Petroleum. In 1914, the British Government became the majority shareholder of the Anglo-Persian Oil Company and controlled the Iranian Petroleum Industry. In 1950, the NOC "National Iranian Oil Company (NIOC)" was created. Between 1950 and 1980, Iran experienced the first attempts at nationalisation, which was impeded by the British and Americans [84]. After the Islamic revolution (1978-79), the existing O&G activities were nationalised; the expropriation of the Anglo-Iranian Oil Company led to an embargo [85]. The status of nationalisation persisted until today, and an ad hoc contracting framework has been experienced (e.g., buy-back construction contracts) with the primary objective of maintaining national control over the O&G sector. The O&G programme was strongly affected by the recent embargo (2012-2016) justified by the controversial nuclear programme. Iran also has poor working conditions [86].

- **Norway (1950-2021) - National context, elements of the programme governance framework, elements of social sustainability**

Norway has probably one of the most successful O&G programmes in social terms, and it is based on the construction and operation of offshore infrastructures in the North Sea. In 1963, the Norway Government proclaimed sovereignty over the Norwegian underground reservoirs and specified the L&RF. In 1965, the UK, Denmark and Norway agreed on how to split their sovereignty over the North

Sea. In the same year, the first licensing activities started in Norway. The first licenses were awarded to IOC and JVs. In 1972, the NOC Statoil was created, and the programme was partly nationalised from the new licences following the 50-50% PSA [87]. In 1985, a further step toward nationalisation was made with the creation of the State Direct Financial Interest (SDFI) initiative [88]. In 2001, the programme was partly liberalised but remained under governmental control. The Norwegian programme is one of the bests from the social sustainability perspective and the health and safety and environment perspective [89].

- **USA (1900-2021) - National context, elements of the programme governance framework, elements of social sustainability**

The USA is one of the most important producers and consumers of O&G worldwide [77]. The energy policy has been wholly liberalised since its origins and involves thousands of private companies. The most important vertically integrated IOCs include, among others, BR, Chevron, ConocoPhillips, Exxon Mobil, Occidental Petroleum, and Shell Oil. Most IOCs are American and operate in several developing countries [68], [69]. The Federal Government coordinates and leads the energy programme, which focuses primarily on the trade side (i.e., importation and exportation) and leaves a vast degree of investment freedom to the private sector [90]. The US concession regime is very peculiar as it gives full extraction rights to landowners [25]. Furthermore, the US Oil & Gas market is characterised as being fully liberalised. This combination of these two aspects highlights the profit-driven nature of the US approach, leaving limited welfare and requirements for social sustainability. The only form of public benefits comes from taxes, royalties, and any corporate social responsibility initiatives brought forward by private enterprises.

- **Italy (1945-2021) - National context, elements of the programme governance framework, elements of social sustainability**

Italy is one of the major European HC for gas reserves [91]. The O&G programme was nationalised in the '50s with AGIP (later ENI). AGIP developed its capability quite fast, and between 1950 and 1960, it carried out further explorations in Southern Italy and offshore (e.g., Sicily). The O&G sector was

particularly crucial for economic development, and AGIP developed O&G infrastructures primarily to support domestic use [92]. Afterwards, AGIP expanded its activities in foreign countries, promoting the 50-50 PSA for the first time, particularly in Iran. In 2003, the O&G sector was partly liberalised. Nowadays, Italy adopts a concessionary system, and several IOCs are licensed; ENI is still participated by the state and is the most O&G operator in the sector; however, most of its activity and revenues are produced overseas (e.g., Africa). Historically, the HC performed well regarding environmental standards, health and safety and working conditions. Of note, the sector has been crossed by some corruption scandals [93]. Furthermore, the full Italian potential regarding gas extraction was not exploited. This underperformance is mostly derived from the highly regulated and complex legal and institutional framework, along with the strong opposition of local communities to the construction of O&G infrastructures [94]. Historically, the social impact deriving from O&G extraction has been derived indirectly via the leading public-owned National Oil Companies, i.e., ENI. ENI is the largest company in Italy by capitalisation; it provides a relevant revenue stream for the state in the forms of dividends, taxes and royalties. The state then uses this revenue for public services, generating a social impact. The public services in Italy are relatively inefficient, and a limited part of the revenues generated are invested in clear social initiatives.

4.4 Critical analysis

This research sheds light on the critical role of the programme governance framework in shaping the social sustainability of energy infrastructure. Two key points shaping the social sustainability of energy infrastructures are the capabilities and the balance of powers among the actors involved (HC and IOC in the case studies). Energy infrastructures require technical and managerial capabilities to be successfully developed and operated. In the case studies analysed, capabilities are retained by the IOC and the major contractors on the field; while the HCs have sovereign rights over the HC territory, including the underground reserves. This dichotomy is central in attributing powers between the IOC and HC. Hence, the power exercised by the HC is a crucial determinant of social sustainability performance in the territories where the infrastructures are implemented. This balance of powers is

observable by looking at the programme governance framework, particularly the institutional framework regulating the relationship between the HC and IOC.

This research identifies three perspectives to look at the link between programme governance framework and the social sustainability of energy infrastructures. The first involves the types of contracts, the second the leadership of the infrastructure programme, and the third the maturity of L&RF in the field of environment, public accountability, corruption and work rights.

- *Types of contracts*

In the case of upstream O&G infrastructures, the first perspective is based on petroleum contracts. Petroleum contracts can be classified based on the level of involvement and control that the HC makes. The four main types of petroleum contracts are Concession, Product Sharing Agreement (PSA), Joint Venture (JV) and Service Contract (SC). Some of these contracts assign more power and responsibilities to the HC, which can be considered a "strong owner" in those cases [95].

Concessions assign the construction risks and extraction rights to the IOC; the traditional scheme is used in countries where the HC has no sufficient managerial and technical capabilities. This approach is used in liberalised countries such as the USA [96].

The **PSA** involves a joint control (IOA and HC) of the O&G infrastructures [97]. Under the PSA, the HC controls the infrastructure either directly (i.e., minister of petroleum) or indirectly (i.e., through the NOC) [98]. This approach enabled countries such as Saudi Arabia, Iran, and Nigeria to acquire operational knowledge and capabilities incrementally. Usually, compared to the concession, this approach gives the HC three main advantages. First, it provides a higher income to the HC during the extraction phase. Second, the HC can control (or influence) the extraction of O&G. Last, the HC promotes the country's development by employing people and acquiring knowledge from the IOC. Conversely, this approach involves financial risks and requires a certain degree of technical, managerial and financial capabilities for the HC.

The **JV** involves more oil companies, usually several IOCs and the NOC [99]. JVs allow the sharing of the initial costs and risks for the exploration. The JV usually agglomerate the interests of various IOCs; this can lead to lower bargaining power from the HC [100]. This approach permits sharing the

exploration risk when it is significant (e.g., there is limited information about the presence of petroleum reserves or expensive exploration and drilling in deep seawater). However, the JVs can have a variety of configurations; therefore, it is difficult to generalise. Thus, the presence of JV does not constitute sufficient information to understand the balance of power between the HC and the IOC.

In **SC,** the HC has control of the Oil Wells that the NOC typically operates. With SC, the HC needs highly developed technical and managerial capabilities. The IOC is involved as a contractor/service provider and is paid for the sole product/service provided.

HCs aims to increase the control over O&G operations and increase technical and managerial local content. The typical pattern is to start a programme with PSA with limited HC involvement. The second step is to increase the level of direct participation in the PSA until establishing a sufficient capacity and experienced NOC. At this point, the HC is in a position to employ the SC. The HC can involve the IOC with JV or concessions if the exploration requires special technology or taking a particular risk.

- *Maturity of the L&RF*

The second perspective to look at the link between programme governance framework and social sustainability of energy infrastructures involves the maturity of L&RF in the field of environment, public accountability, corruption and work rights. This research considers all these factors together and divides the HCs according to two sets depending on their performance. To do so, the Human Development Index [47] has been considered. This indicator distinguishes between Very High Human Capital, High Human Development, and Low Human Development. The social benefits deriving from the exploitation of O&G resources depend largely on the level of development of the country. On the one hand, environmental regulations are set up or become stringent only as a reaction to significant incidents; on the other hand, the management of revenues is not transparent, less structured and may end up in the unfair division of inflows among the population. Nigeria is a typical example, where constant changes in government rules characterise it, along with an unclear subdivision of powers among national and regional parliaments, loose environmental regulations, oil theft and unsystematic management of liaison with multinational oil companies. These weaknesses have drastically impaired

the benefits for the population and caused severe environmental damages such as oil spills, contamination, oil theft or damages to the pipelines [101], [102].

In other HCs, such as Italy, the environmental regulation is well established, but the ineffective management of O&G revenues still hinders the social benefits. Also, the environmental constraints may be so stringent that the region's full potential is not maximised. For instance, after the Deepwater Horizon oil spill, Italy developed strict rules regarding environmental legislation, prohibiting companies from exploiting offshore O&G resources within 12 miles of the coast (increasing from 5) and allowing greater power to local communities to block the development of energy infrastructures.

The "good" HCs are characterised by environmental regulations set up according to best practices and continuously updated, as well as effective and transparent management of revenues, which is organised and lead to improved well-being for the population. Norway is a champion in social terms. This is highlighted by the social indexes and the presence of the most stringent regulations in the world. Furthermore, the Norway SWF is the biggest mutual fund in the world and is set as a reference for the management of oil revenues. In the USA, the economic benefits are well exploited due to the structured management of revenues and royalties. The signals of corruption are low, and public accountability is good, as described by the Corruption Perception Index. The environmental legislation had to be strengthened after major incidents such as the Exxon Valdez case and the Macondo oil spill. After these major accidents, the construction of several O&G infrastructures has been delayed, contested or blocked due to environmental concerns, e.g., the Keystone Pipeline [103].

- *The leadership of the infrastructure programme*

The third perspective involves the leadership of the infrastructure programme. This research divides the programmes into two main sets. The first comprises programmes led by the HC, i.e., involving the SC or the PSA - with primary control of the HC. In this case, the HCs can benefit from better social benefits (e.g., technology transfer and economic development). Iran, Norway, and Saudi Arabia belong to this first set, especially during their later development. The second set comprises programmes led by the IOC, i.e., involving concessions, PSA (with the primary role left to the IOC) and JV led by the IOCs. The USA, Italy and Nigeria belong to this set.

- *Summary and analytic framework*

The identified and examined three perspectives (i.e., types of contracts, maturity of the L&RF, and leadership of the infrastructure programme) are combined in Figure 1. This novel analytical framework allows positioning different cases according to their social performance and the elements influencing social performance. Indeed, by leveraging the information detailed in this article, Figure 1 presents the programmes/case studies analysed according to their social performance and the elements influencing their performance. In this article, we examined the Oil&Gas sector; however, the analytical framework can be relevant also to analysing the link between social sustainability and programme governance framework of other energy infrastructures such as nuclear.

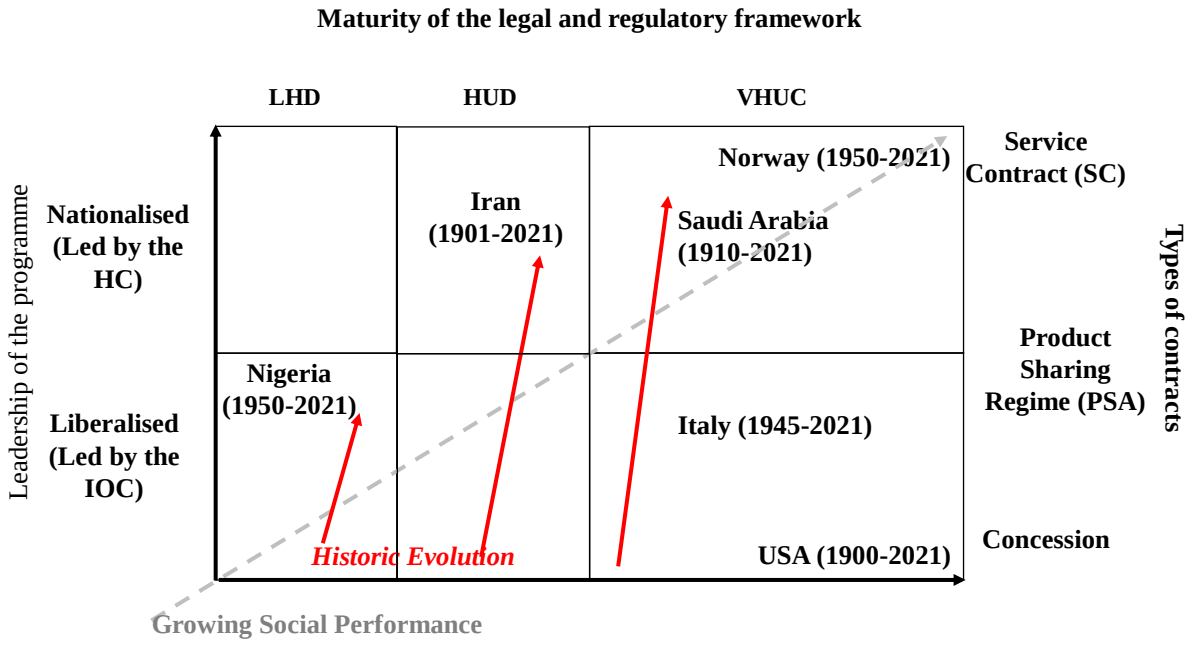


Figure 2: Analytical framework linking programme governance framework and social sustainability performance.

Legend: Very High Human Capital (VHUC), High Human Development (HUD), Low Human Development (LHD)

5 Conclusions, limitations, and future research opportunities

5.1 Conclusions

The literature about energy infrastructures focuses on the economic or environmental impact. The body of knowledge about their social performance is slowly growing; however, it is still limited and lacks empirical evidence. This article addresses this gap in knowledge by investigating how and why the programme governance framework shapes the social sustainability of energy infrastructures. Based on a cross-case analysis of similar upstream O&G infrastructures, planned and delivered in contexts characterised by different programme governance frameworks (i.e., Iran, Italy, Nigeria, Norway, Saudi Arabia, and the USA), this article provides two main contributions. First, the findings show how the programme governance framework – its institutional elements in particular - is a key driver for the social sustainability of energy infrastructures. Therefore, energy infrastructure development should be assessed in combination with the programme governance framework. Second, it identifies three perspectives to examine the link between programme governance framework and social sustainability of energy infrastructures: 1) Types of contracts, 2) Leadership of the infrastructure programme, and 3) Maturity of the legal and regulatory framework in the field of environment, public accountability, corruption, and work rights. These three perspectives are combined to provide a novel analytic framework to deal with the social sustainability of energy infrastructures.

From a policy perspective, the social sustainability of energy infrastructures is an essential component of an energy policy "success" or "failure". A critical aspect that emerged from this research is that the planning, construction and operation of energy infrastructures cannot be seen in isolation. Consistently with Miller & Lessard [28], this article shows how energy infrastructures influence and are influenced by the context, where the energy policy plays a key role. Starting from their work, this research takes a step forward, showing how the social sustainability of energy infrastructures depends on the governance of the programme and, ultimately, it depends on the energy policy. The O&G as a sector is an outstanding example to frame this conceptualisation. According to the sample of cases analysed, investigating social sustainability at the infrastructure level is inadequate. Indeed, a sample of energy infrastructures with similar scope and design might achieve radically different social performance. For

instance, technology is not the primary determinant. Conversely, the overarching governance/programme strongly depends on the institutional framework and, more widely, the energy policy. This changes the perspective of investigating social sustainability. For instance, the social impact of building a power plant will mostly depend on the context, particularly the institutional framework. Supposing the power plant is delivered in an HC with an adequate institutional framework, in that case, there are the preconditions for a socially successful power plant and, ultimately, for a successful energy policy. Supposing the power plant is delivered in an HC with an inadequate institutional framework, in that case, there are the preconditions for a socially unsuccessful power plant and, ultimately, for an unsuccessful energy policy. Therefore, studying and finding these "policy determinants" and developing an adequate institutional framework is the first essential step to be successful from the social sustainability perspective. Most of the social impacts of energy policies are predetermined and foreseeable before the energy infrastructures' inception. The project context, the energy policy and the institutional framework are pivotal determinants.

5.2 Limitations and future research opportunities

A relevant limitation of this article is the lack of primary data collection. In fact, what happens "in reality" could partially differ from what is "on paper". Therefore, a logical step forward could be collecting primary data to investigate further the link between the social sustainability of energy infrastructures and the related programme governance framework. Another limitation lies in the limited number of case studies, which might limit the generalisability of the findings. However, this is an explorative qualitative piece of research which analyses the role of the programme governance framework in shaping the social performance of energy infrastructures. Therefore, a quantitative approach/analysis is out of the scope of this paper. In fact, considering the complexity of the elements constituting the programme governance framework, a qualitative approach is the appropriate first step to categorise and examine such elements and be a trigger for future quantitative and semi-quantitative research and further qualitative research. In particular, the three perspectives identified (i.e., types of contracts, the leadership of the infrastructure programme, and maturity of the legal and regulatory

framework) to examine the social sustainability of energy infrastructures open up research avenues. According to the authors, examples of relevant research questions are:

- Under which circumstance the knowledge of the context can predict the social outcome of energy infrastructures?
- Which is the ideal institutional framework for new, revolutionary technologies (e.g., Nuclear fusion)?
- To what extent the programme governance framework influences the social sustainability of other types of infrastructures (e.g., airports, hospitals)?
- Which elements influence the adoption of different types of contracts (e.g., service contracts, concessions) between the HC and the IOC/NOC?

Additionally, it could be relevant, for instance, to leverage the framework to frame further future quantitative studies, e.g., to benchmark the link between GDP and electricity consumption in countries characterised by different social sustainability performances. It could also be relevant to quantitatively assess different countries or big O&G companies in terms of their social sustainability performance or to establish "social sustainability key performance indicators" and weight each item with a certain percentage leading to a social sustainability score of the country or company.

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