



School of Social Sciences

Supply Chain Management

Postgraduate Dissertation

Green Supply Chain Management and ESG Practices in the Global
Oil and Gas Industry

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Piraeus, Greece, June 2023

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Green Supply Chain Management and ESG Practices in the Global Oil and Gas Industry

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To my beloved wife.

Abstract

The adoption and use of green supply chain management (GSCM) and environmental, social and governance (ESG) principles in the global oil and gas industry are both examined in this thesis. The sector has historically been linked to damaging social and environmental implications, and demand from stakeholders to enhance sustainability performance is rising. This study covers the industry's numerous efforts to lessen the environmental impact, advance social responsibility, and improve corporate governance. It also gives an outline of GSCM and ESG practices, their advantages and problems.

The thesis utilizes a review of relevant literature and the inclusion of case studies of GSCM and ESG practices in the global oil and gas industry. The aim of the thesis is to identify the extent to which the industry has progressed in adopting GSCM and ESG practices, and to highlight the barriers that still need to be overcome to achieve sustainable development.

The findings indicate that the industry has made progress in adopting GSCM and ESG practices, but more needs to be done to overcome the barriers and achieve sustainable development. Companies face several challenges, such as the lack of regulatory frameworks, the high costs of implementing sustainability initiatives, and the need for cultural change within organizations. The thesis highlights the importance of stakeholder engagement and collaboration in promoting sustainable development in the industry.

The thesis concludes with recommendations for companies in the industry to enhance their sustainability performance and contribute to the global sustainable development agenda. These recommendations include the need for companies to prioritize sustainability in their operations and decision-making processes, to invest in technology and innovation, and to collaborate with stakeholders to create more sustainable supply chains. The inclusion of case studies of GSCM and ESG practices in the global oil and gas industry provides valuable insights into the challenges and opportunities for the industry to transition towards a more sustainable future.

Keywords

GSCM, ESG, oil, gas, sustainability, decarbonization, greenwashing

Περίληψη

Αυτή η διατριβή εξετάζει την υιοθέτηση και εφαρμογή πρακτικών πράσινης διαχείρισης της εφοδιαστικής αλυσίδας (GSCM) και πρακτικών περιβαλλοντικής, κοινωνικής και διακυβέρνησης (ESG) στην παγκόσμια βιομηχανία πετρελαίου και αερίου. Η βιομηχανία έχει συνδεθεί παραδοσιακά με αρνητικές περιβαλλοντικές και κοινωνικές επιπτώσεις και υπάρχει αυξανόμενη πίεση από τους εμπλεκόμενους φορείς για τη βελτίωση της απόδοσης της σε θέματα βιωσιμότητας. Η παρούσα έρευνα παρέχει μια επισκόπηση των πρακτικών GSCM και ESG, των οφελών τους και των προκλήσεων για τη βιομηχανία πετρελαίου και αερίου και εξετάζει τις διάφορες πρωτοβουλίες που έχει λάβει η βιομηχανία για τη μείωση του περιβαλλοντικού της αποτυπώματος, την προώθηση της κοινωνικής ευθύνης και την ενίσχυση της εταιρικής διακυβέρνησης.

Η διατριβή χρησιμοποιεί μια ανασκόπηση της σχετικής βιβλιογραφίας και περιλαμβάνει μελέτες περιπτώσεων πρακτικών GSCM και ESG στην παγκόσμια βιομηχανία πετρελαίου και αερίου. Ο στόχος της διατριβής είναι να αναγνωρίσει το βαθμό προόδου που έχει σημειώσει η βιομηχανία στην υιοθέτηση πρακτικών GSCM και ESG και να επισημάνει τα εμπόδια που εξακολουθούν να υπάρχουν για την επίτευξη βιώσιμης ανάπτυξης.

Τα ευρήματα υποδεικνύουν ότι η βιομηχανία έχει σημειώσει πρόοδο στην υιοθέτηση πρακτικών GSCM και ESG, αλλά απαιτείται ακόμα περισσότερη προσπάθεια για την άρση των εμποδίων και την επίτευξη βιώσιμης ανάπτυξης. Οι εταιρείες αντιμετωπίζουν πολλές προκλήσεις, όπως η έλλειψη νομοθετικών πλαισίων, τα υψηλά κόστη εφαρμογής βιώσιμων πρακτικών καθώς και η ανάγκη για αλλαγή κουλτούρας εντός των εταιρειών. Η διατριβή υπογραμμίζει τη σημασία της συμμετοχής και της συνεργασίας των εμπλεκόμενων φορέων στην πρόωθηση της βιώσιμης ανάπτυξης στη βιομηχανία πετρελαίου και αερίου.

Η διατριβή καταλήγει σε προτάσεις για τις εταιρείες της βιομηχανίας για την ενίσχυση της απόδοσης τους σε θέματα βιωσιμότητας και τη συμβολή τους στο παγκόσμιο πρόγραμμα βιώσιμης ανάπτυξης. Αυτές οι προτάσεις περιλαμβάνουν την ανάγκη για προτεραιοποίηση των βιώσιμων πρακτικών στις διαδικασίες λειτουργίας και λήψης αποφάσεων των εταιρειών, στην επένδυση σε νέες, καινοτόμες τεχνολογίες και στη συνεργασία με τους εμπλεκόμενους φορείς για τη δημιουργία πιο βιώσιμων εφοδιαστικών αλυσίδων. Η συμπερίληψη μελετών περιπτώσεων πρακτικών GSCM και ESG στην παγκόσμια βιομηχανία πετρελαίου και αερίου παρέχει πολύτιμες πληροφορίες για τις

προκλήσεις και τις ευκαιρίες που αντιμετωπίζει η βιομηχανία για να μεταβεί σε ένα πιο βιώσιμο μέλλον.

Λέξεις – Κλειδιά

GSCM, ESG, πετρέλαιο, αέριο, βιωσιμότητα, απανθρακοποίηση, greenwashing

Table of Contents

Abstract.....	v
Περίληψη	vii
Table of Contents	ix
List of Figures	x
List of Tables.....	Error! Bookmark not defined.
List of Abbreviations & Acronyms	xiii
Introduction.....	Error! Bookmark not defined.
1. Promoting GSCM and ESG practices in the Global Oil and Gas Industry: A Legislative perspective	3
1.1 Overview of the global oil and gas industry	3
1.2 The EU Green Deal	7
1.3 The UN's SDGs	8
1.4 National Legislation	9
2. The oil and gas supply chain and actions to make it “greener” practices.....	12
2.1 Onshore Supply Chain	12
2.2 Offshore Supply Chain.....	13
2.3 Parts of the oil and gas supply chain that can be “greener”	14
3. Implementing GSCM and ESG practices: The case of Shell.....	21
4. Evaluating the GSCM and ESG practices in place and industry's actions.....	30
5. The industry's future outlook in terms of GSCM and ESG practices	35
6. Conclusion.....	43
References.....	46

List of Figures

Image 1: Nes Fircroft (n.d.). The Oil and Gas Industry. Retrieved June 30, 2023, from <https://www.nesfircroft.com/resources/blog/5-tips-to-start-your-oil-and-gas-career/>.

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List of Abbreviations & Acronyms

GSCM: Green Supply Chain Management

ESG: Environmental, Social and Governance

OPEC: Organization of the Petroleum Exporting Countries

IOCs: International Oil Companies

NOCs: National Oil Companies

GDP: Gross Domestic Product

EU: European Union

UN: United Nations

SDGs: Sustainable Development Goals

GHG: Greenhouse Gas

CCS: Carbon Capture Systems

CCUS: Carbon, Capture and Utilization System

Introduction

Due to the oil and gas industry's major impact on the environment, society, and economy, it has come under increasing pressure from stakeholders to adopt sustainable practices and reduce the adverse impact that their operations have on the environment and society. It is crucial for the sector to enhance its sustainability performance and contribute to the global sustainable development agenda as the world moves toward a low-carbon economy.

Environmental, social, and governance (ESG) principles and green supply chain management (GSCM) practices have become essential frameworks for advancing sustainability in oil and gas supply chains and boosting corporate social responsibility.

This thesis examines the adoption and implementation of GSCM and ESG practices in the global oil and gas industry. The thesis aims to identify the progress made by the industry in adopting these practices, the challenges faced, and the opportunities for improvement. The thesis includes case studies of GSCM and ESG practices in the industry to provide valuable insights into the challenges and opportunities for transitioning towards a more sustainable future.

The thesis follows a review of relevant literature, a case study of a large, international oil and gas company implementing GSCM and ESG practices, and analysis of the findings. The thesis aims to provide a comprehensive overview of GSCM and ESG practices, their benefits, and challenges for the industry, and to identify the barriers that need to be overcome to achieve sustainable development.

The findings of the thesis indicate that the industry has made progress in adopting GSCM and ESG practices, but more needs to be done to overcome the barriers and achieve sustainable development. The thesis highlights the importance of stakeholder engagement and collaboration in promoting sustainable development in the industry.

The primary drawback of this thesis is the lack of data and information on the adoption of GSCM and ESG practices in the oil and gas sector, particularly in developing countries.

The structure of the thesis is as follows:

- ✓ Chapter 1 provides an overview of the global oil and gas industry as well as the legislation pushing for GSCM and ESG implementation.
- ✓ Chapter 2 provides an overview of the onshore and offshore supply chains of the global oil and gas industry and presents a literature review of the implementation of GSCM and ESG practices in the global oil and gas industry. It also presents an

overview of the Greek oil and gas industry and potential areas that GSCM and ESG practices can be implemented upon its development.

- ✓ Chapter 3 includes a case study of GSCM and ESG practices in the industry.
- ✓ Chapter 4 analyses the findings and discusses the implications for the industry.
- ✓ Chapter 5 provides the future outlook for the oil and gas industry in terms of GSCM and ESG.
- ✓ Conclusion completes this thesis with recommendations for companies in the industry to enhance their sustainability performance and contribute to the global sustainable development agenda.

1. Promoting GSMC and ESG practices in the Global Oil and Gas Industry: A Legislative perspective

1.1 Overview of the global oil and gas industry

This chapter provides an overview of the global oil and gas industry, as well as the current legislation forcing the players in it to adopt GSCM and ESG practices.

The oil and gas industry is a global industry that involves the exploration, refining, and transportation of petroleum products. The industry plays a vital role in the global economy, providing a major source of energy to fuel the world's transportation, industry, and commerce (1).

The oil and gas industry is a complex network with an extensive supply chain, diverse range of stakeholders, and global reach. This industry encompasses a wide range of activities, including exploration, production, transportation, refining, and distribution of petroleum products. Each of these activities involves multiple stakeholders, including suppliers, contractors, governments, regulatory bodies, and consumers. The oil and gas supply chain is a complex network that involves the coordination of numerous activities and stakeholders. It starts with the exploration and extraction of oil and gas reserves, followed by transportation, refining, and distribution.



Image 1: The Oil and Gas Industry (NES Fircroft 2022)

Each of these stages involves multiple players, including upstream exploration and production companies, midstream transportation and storage companies, and downstream refining and marketing companies. At the exploration and production stage, oil and gas companies must navigate complex regulatory environments, manage environmental risks, and ensure the safety of workers. They must also coordinate with suppliers and contractors to ensure the timely and efficient delivery of equipment and services. In the midstream sector, transportation and storage companies must navigate complex regulatory regimes and manage logistical challenges, such as pipeline construction, shipping routes, and port infrastructure (9). They must also ensure the safe and reliable transportation of oil and gas across long distances and through varied terrain. Finally, in the downstream sector, refining and marketing companies must navigate volatile market conditions, manage supply chain risks, and ensure the safe and efficient distribution of petroleum products. They must also comply with strict environmental and safety regulations while meeting the demands of customers in a highly competitive market (9). All these activities and stakeholders are interconnected, creating a highly complex and dynamic network that is influenced by a wide range of factors, including global economic conditions, political instability, technological innovation, and environmental concerns (9).

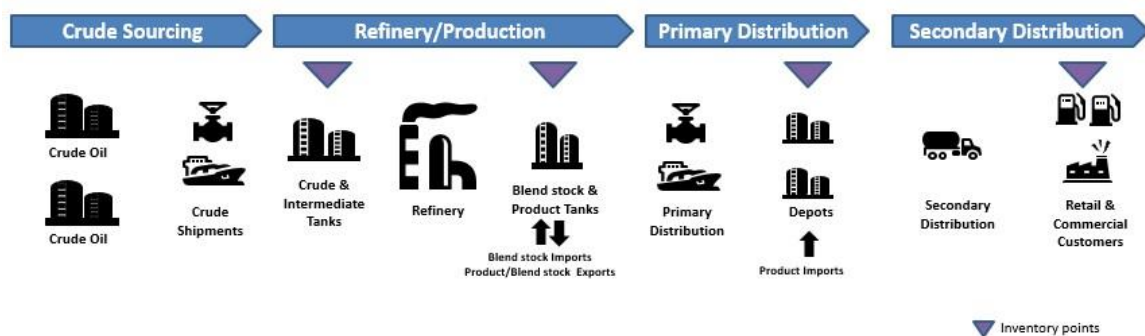


Image2 : The Oil and Gas Value Chain (IT Supply Chain)

Historically, the modern oil and gas industry began in the mid-19th century with the discovery of oil in Pennsylvania, USA. This led to the development of the industry in the United States and eventually to other countries around the world. The industry has gone through many changes over the years, including the rise and fall of major companies and shifts in global politics and economics.



Image 3: First oil well in Pennsylvania



Image 4: OPEC, OPEC+ (Reuters, 2023)

Today, the oil and gas industry is controlled by a few key players, including the Organization of the Petroleum Exporting Countries (OPEC), OPEC+, national oil companies (NOCs), and major private companies (IOCs). OPEC is a cartel of 13 oil-producing countries that control around 40% of global oil production (3). OPEC+

is a group of 23 oil-producing countries that includes OPEC members and other major producers like Russia. NOCs are state-owned companies that control the majority of oil and gas reserves around the world,

including Saudi Aramco, Gazprom, and China National Petroleum Corporation (2). Major private companies (or International Oil Companies, IOCs) include

ExxonMobil, Chevron, BP (5), Royal

Dutch Shell (4), and Total. In terms of key

data, the oil and gas industry is responsible for around 5% of global GDP and employs millions of people around the world. The industry also produces around 90 million barrels of oil per day and 330 billion cubic meters of natural gas per year (6), (8).

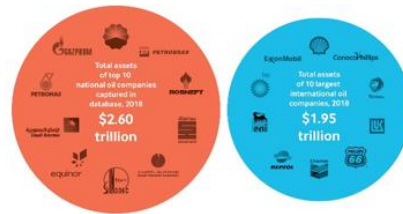
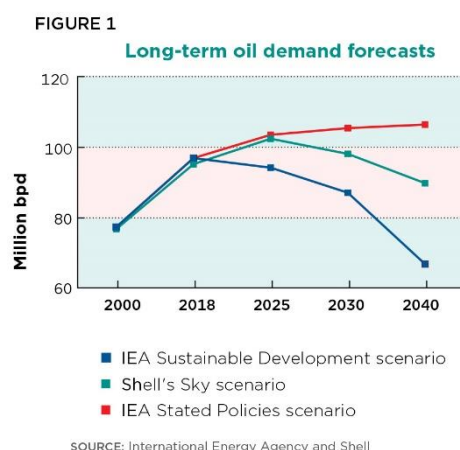


Image 5: Data on the oil and gas industry (NRGI, 2019)

Global economies are significantly impacted by the price of oil and gas, and price changes



may have a significant impact on consumer pricing and governmental budgets. It is impossible to overestimate the value of the oil and gas sector to the global economy. It is a significant factor in economic growth and development and a vital supply of energy for industry, commerce, and transportation. As a result, the oil and gas sector is highly vulnerable to disruptions, natural disasters, and geopolitical events (12). This wide range of

risks and challenges, including price volatility, supply chain disruptions, geopolitical instability, and environmental and social concerns. Firstly, oil and gas remain the primary sources of energy for most of the world's economies. They are essential for powering

transportation, generating electricity, and providing heat for industrial and residential uses (11). The industry's products are integral to modern society, and without them, our daily lives would be significantly impacted. Secondly, the oil and gas industry is a crucial contributor to the global economy (11). The industry generates significant revenue for companies, governments, and countries, creating jobs and driving economic growth. In many cases, the industry is the backbone of national economies, with oil and gas exports accounting for significant portion of government revenue in some countries. However, the oil and gas industry also faces several risks and challenges (10). One of the most significant risks is the volatility of oil prices (7). The price of oil can fluctuate significantly in response to changes in supply and demand, geopolitical tensions, and global economic conditions. This volatility can make it difficult for companies to plan and invest in long-term projects (12). The industry also faces growing pressure to address environmental and social concerns (7). The extraction and use of oil and gas have significant environmental impacts, including greenhouse gas emissions, air pollution, and water contamination (10). There is growing public and regulatory scrutiny of the industry's environmental record, and companies are under increasing pressure to reduce their environmental footprint. In addition to environmental concerns, the industry also faces social and governance challenges (13). The industry has traditionally been associated with negative social impacts, including displacement of communities, human rights abuses, and corruption. Companies are now expected to uphold high standards of social responsibility and governance, which can be challenging in countries with weak regulatory frameworks (13). Overall, the oil and gas sector, which contributes significantly to the world's energy consumption, is an important sector. It is also a very complex and interconnected network. It is crucial for industry players to have an in-depth understanding of the network and its dynamics due to the multiple risks and problems it confronts (11). The sector is continually developing and adapting to new technology and regulations to suit the shifting requirements of the world in order to reduce its rising risks. The global oil and gas sector is under increasing pressure from stakeholders to enhance sustainability performance in addition to the adverse operating environment it now faces (14), (15), (16). The sector has historically been linked to detrimental environmental and social repercussions, including greenhouse gas emissions, contamination of water and air, and human right abuses. The oil and gas sector is under scrutiny to lessen its environmental impact, promote social

responsibility, and improve corporate governance due to the rising concern about climate change and the need to transition to a low-carbon economy (16), (17). The public's increasing awareness of the impact that the sector has on the environment and society, as well as national and international regulations, are major contributors to this pressure (18).

1.2 The EU Green Deal

The European Union (EU) Green Deal, which aspires to make Europe climate-neutral by 2050, is among the most important pieces of legislation. The ambitious EU Green Deal aims to achieve carbon neutrality for the EU by 2050. In addition to protecting biodiversity, the program aims to decarbonize the economy and lower greenhouse gas emissions. The Green Deal, which establishes legally enforceable goals and time frames for lowering greenhouse

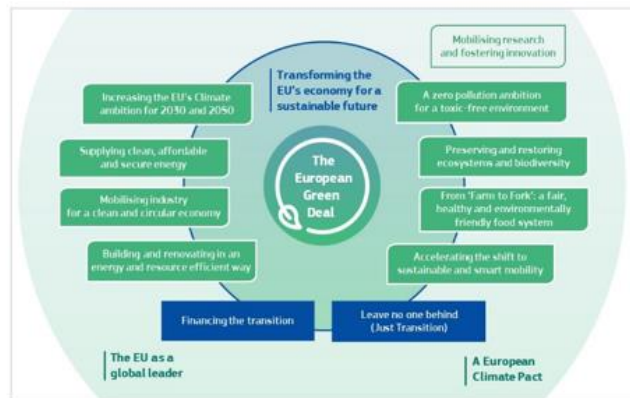


Image 6: The EU Green Deal (EU Commission, 2019)

gas emissions across all economic sectors, is a major force behind the oil and gas industry adopting greener methods (19). The reduction of greenhouse gas emissions in the EU by at least 55% by 2030 compared to 1990 levels is one of the primary goals of the Green Deal. This objective will need substantial contributions from all sectors, including the oil and gas sector, and is more ambitious than the prior target of a 40% reduction. The establishment of a carbon border tax, which would force importers of products into the EU to pay a tax based on the carbon emissions connected with those items' production, is one of many methods the Green Deal suggests to accomplish this objective (20). The Green Deal also calls for a reorganization of the EU Emissions Trading System (ETS) to raise the price of emissions permits and the implementation of a carbon pricing mechanism that would establish a price on carbon emissions (23). This would provide a financial incentive for companies in the oil and gas industry to reduce their emissions and invest in cleaner technologies (24). In addition, the Green Deal sets out to promote the circular economy, which is based on the principles of reducing waste, reusing, and recycling materials, and creating a closed-loop system (25), (27). The oil and gas industry has a significant role to play in the circular

economy, as it is a major consumer of materials, such as plastics and chemicals, which can be recycled and reused (21), (22). To support the transition to a greener economy, the Green Deal proposes a range of funding mechanisms, including the European Green Deal Investment Plan and the Just Transition Fund (26). These funds provide financial support for projects that contribute to the Green Deal objectives, including the transition to clean energy and the decarbonization of the economy. Overall, the EU Green Deal is a comprehensive policy package that sets out to transform the EU economy into a more sustainable and climate-neutral model (28). It provides a clear regulatory framework and financial support for the oil and gas industry to transition towards greener practices and is a key driver for the industry to adopt GSCM and ESG practices.

1.3 The UN's SDGs

The United Nations (UN) Sustainable Development Goals (SDGs) also provide a framework for the oil and gas industry to align with the global sustainability objectives.



Image 7: The UN's 17 SDGs (United Nations, 2019)

The United Nations Sustainable Development Goals are a set of 17 goals aimed at achieving sustainable development globally (29). The SDGs cover a range of social, economic, and environmental issues, including climate change, poverty, and inequality. The global oil and gas industry is a key contributor to several of these issues and is therefore under pressure

to align with the SDGs and contribute to achieving them. One of the primary goals of the SDGs is to combat climate change and reduce greenhouse gas emissions. This is particularly relevant to the oil and gas industry, as it is one of the largest emitters of greenhouse gases. To achieve this goal, the UN has called for a reduction in the use of fossil fuels and an increase in the use of renewable energy sources. This shift towards cleaner energy sources is likely to have a significant impact in the oil and gas industry, particularly as the world moves towards a low-carbon economy (31), (32). In addition to reducing greenhouse gas emissions, the SDGs also call for a reduction in waste and pollution, the protection of biodiversity, and the promotion of sustainable consumption and production (30). These goals are also relevant to the oil and gas industry, which has

traditionally been associated with negative environmental impacts, such as oil spills and habitat destruction. To align with the SDGs, the global oil and gas industry has started to adopt sustainable practices and invest in renewable energy sources (33), (34). Many companies have set targets to reduce their greenhouse gas emissions, increase their use of renewable energy and improve their overall sustainability performance (35). However, there is still a long way to go to achieve the SDGs, and the industry faces numerous challenges, including technological and finance barriers, as well as the need for greater collaboration and cooperation across the value chain (36). Overall, the UN SDGs are a significant driver for the global oil and gas industry to adopt greener practices and contribute to sustainable development. While there are challenges to overcome, the industry's alignment with the SDGs is essential to achieving a more sustainable future (36), (37).

1.4 National Legislation

National legislation plays a crucial role as well in driving the global oil and gas industry towards more sustainable practices. In recent years, many countries have implemented environmental regulations that require oil and gas companies to reduce their carbon footprint and adopt sustainable practices, with the examples being numerous. Firstly, in the United States, the U.S. Environmental Protection Agency (EPA) has implemented a series of regulations aimed at reducing greenhouse gas emissions from the oil and gas industry (38). The most significant of these regulations is the Methane and Waste Prevention Rule, which requires oil and gas companies to reduce methane emissions from their operations (39). Additionally, several states, including California and Colorado, have implemented their own regulations aimed at reducing emissions from the oil and gas industry (40), (41). Moreover, in Canada, the federal government has implemented several regulations aimed at reducing greenhouse gas emissions, from the oil and gas industry, including the Clean Fuel Standard and the Methane Regulations (42), (43). Several provinces, including Alberta and British Columbia, have also implemented their own regulations aimed at reducing the emissions from the industry (44), (45). Norway is another example; the country has implemented some of the most ambitious environmental regulations in the world, including a carbon tax and a ban on new oil and gas explorations in some areas (46). Norway has also implemented regulations aimed at reducing emissions

from existing oil and gas operations (47). Further to this, another example is Greece; in Greece, the government has implemented several environmental regulations aimed at reducing the environmental impact of the oil and gas industry. For instance, Law 4667/2020 on the “Protection of the Marine Environment from the Exploration and Exploitation of Hydrocarbons in the Marine Areas of the Greek Territory” sets out strict environmental requirements for offshore oil and gas exploration and exploitation (48). Finally, in Australia, the federal government has implemented regulations aimed at reducing greenhouse gas emissions from the oil and gas industry, including the Emissions Reduction Fund and the Safeguard Mechanism. Several states, including Victoria and Queensland, have also implemented their own regulations aimed at reducing emissions from the industry (49), (50). These are just a few examples of the national legislation driving the global oil and gas industry towards more sustainable practices. As the global push towards decarbonization continues, it is likely that more countries will implement regulations aimed at reducing greenhouse gas emissions from the oil and gas industry.

In conclusion, the legislation forcing the global oil and gas industry to adopt GSCM and ESG practices is complex and varied, reflecting the range and of environmental and social challenges facing the industry. However, the increasing focus on sustainability from both governments and stakeholders means that the industry must continue to adapt and implement measures to reduce its environmental footprint and promote social responsibility.

As discussed above, various legislative initiatives have been implemented at the international (UN), regional (EU) and national levels in order to lead the global oil and gas industry to sustainability and green practices. The UN SDGs in a global level, the EU Green Deal in a regional one, and each country’s national legislation, all try to force the oil and gas industry to “go greener” and adopt GSCM and ESG practices. The UN SDGs, which provide a global framework for sustainable development, and emphasize the need to address climate change through promoting sustainable production and consumption, and social inclusivity have impacted the global oil and gas industry since countries under the UN framework have implemented policies aligned under these goals, compelling oil, and gas companies to integrate GSCM and ESG practices into their operations. More particular, SDG 7 (Affordable and Clean Energy). SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) have forced the industry to adopt “greener”

practices and integrate GSCM and ESG practices into their operations. The EU Green Deal, introduced by the EU, sets out ambitious targets, including achieving carbon neutrality by 2050 and transitioning to a circular economy. The legislation has significantly influenced the oil and gas industry's approach to GSCM and ESG practices. One of the key drivers is the introduction of stricter emissions' regulations and renewable energy targets, which have forced companies to reduce their carbon footprint and invest in cleaner energy sources. The EU Emissions Trading System (EU ETS) a cap-and-trade system that has incentivized oil and gas companies to adopt GSCM practices, is a crucial component of the EU Green Deal, as it imposes a cap on greenhouse gas emissions and requires companies to acquire emissions allowances. The legislation has also led to increased transparency and reporting requirements, prompting companies to enhance their ESG performance and disclose environmental and social impacts. In addition to these international initiatives, the national legislation also drives the adoption of GSCM and ESG practices in the oil and gas industry. Some countries have implemented stringent regulations on flaring and venting, forcing oil and gas companies to reduce their methane emissions while other have introduced financial incentives and tax breaks to promote the use of renewable energy technologies and reduce environmental impacts.

Overall, both the international and national legislation has played a pivotal role in compelling the global oil and gas industry to adopt GSCM and ESG practices. The EU Green Deal's stringent emissions regulations and renewable energy targets, the UN SDGs' global framework as well as the national legislations, all have driven companies to prioritize sustainability, invest in cleaner energy sources and commit to climate action and responsible production. The legislative landscape has created a paradigm shift in the oil and gas industry, prompting companies to adopt sustainability as integral component of their operations. As a result, the industry is gradually transforming, embracing renewable energy, optimizing resource efficiency, reducing emissions, and enhancing social responsibility. While challenges remain in achieving full sustainability, legislative initiatives continue to be a powerful driver for change in the global oil and gas sector.

2. The oil and gas supply chain and actions to make it “greener” practices

2.1 Onshore supply chain

This chapter provides an overview of the international supply chain of global oil and gas industry, both onshore and offshore as well as an overview on the parts that can implement GSCM and ESG practices based on literature review and research.

The international supply chain for onshore oil and gas operations involves a complex network of entities and processes. The supply chain begins with exploration and production

companies that identify oil and gas reserves and establish drilling operations (51). These companies typically work with service companies that provide specialized services such as drilling, well completion, and production optimization (52). Once the oil or gas has been extracted from the ground, it is



Image 9: Onshore operations (Danfoss, 2021)

transported to refineries via pipelines, trucks, or rail. Refineries then process the crude oil into various products such as gasoline, diesel, and jet fuel. These refined products are then transported to distribution terminals in the same way (i.e., using pipelines, trucks, or rail). From the distribution terminals, the products are transported to retail outlets such as gas stations, where they are sold to end consumers (53). Throughout the supply chain, there are various intermediaries such as wholesalers and brokers who facilitate the buying and selling of oil and gas products (54). The international supply chain for onshore oil and gas operations is heavily influenced by geopolitical factors, as oil and gas reserves are often concentrated in specific regions of the world (59). OPEC+ plays a significant role in setting global oil prices and influencing supply and demand dynamics. Major NOCs also play a key role in the international supply chain, particularly in countries where the state owns or controls the oil and gas reserves (57), (58). IOCs (i.e., ExxonMobil, Chevron, Shell) also have a significant presence in the global oil and gas industry and participate in various segments of the supply chain (56). As already mentioned, the importance of the industry to today's world is very crucial and it should not be ignored. Oil and gas provide the world's

primary energy source, serve as feedstocks for various industrial process and are used to manufacture numerous products such as plastics and fertilizers (55). As such the international supply chain for onshore oil and gas operations is critical to the functioning of the global economy (60).

2.2 Offshore supply chain

Regarding the offshore operations, there is also a similar complex network of suppliers, companies and service providers consisting of the other half of the international supply



Image 10: Offshore operations (EURACTIV, 2018)

chain of the global oil and gas industry. At the exploration stage, offshore drilling contractors and seismic companies are responsible for conducting geological surveys and determining the location of potential oil and gas deposits (61). Once a location has been identified, drilling rigs and support vessels are deployed to

begin drilling exploration wells (61). These drilling rigs and support vessels are typically owned and operated by drilling contractors, who provide specialized drilling services to oil and gas companies. If an oil or gas discovery is made, the production phase begins (61). Production platforms, pipelines, and subsea equipment are installed to extract the oil and gas and transport it to processing facilities on shore (61). These facilities may be owned and operated by the oil and gas companies themselves or by third-party service providers (61). Throughout the production phase, offshore services companies provide a range of support services, including maintenance, repair, and inspection services for production platforms and subsea equipment (61). Shipping companies and pipeline operators are responsible for transporting the oil and gas to onshore facilities. The final stage of the supply chain is the refining and marketing of the oil and gas (61). Oil and gas companies typically sell their products to refiners, who process the crude oil into gasoline, diesel fuel, and other petroleum products (62). These refined products are then sold to distributors, who supply them to gas stations, industrial customers, and other end-users (63). The international supply chain for offshore oil and gas operations involves a diverse range of companies and services, each with a unique role to play in bringing these valuable resources to market (64), (65).

2.3 Parts of the oil and gas supply chain that can be “greener”

According to the latest literature and based on the overview of several parts of the oil and gas industry’s international supply chain onshore and offshore operations, there are many parts that can become “greener” through the adoption and implementation of GSCM and ESG practices. The areas that can be more sustainable are:

1. Exploration and Production: The oil and gas industry generates significant amounts of waste, including hazardous waste from drilling and production processes. The industry is also a significant consumer of water, both for operations such as hydraulic fracturing and for general use in production facilities. The use of green drilling technologies, such as directional and horizontal drilling, can reduce the environmental impact of oil and gas exploration and production (66). Implementing ESG practices such as hydraulic fracturing and for general use in production facilities. The use of green drilling technologies, such as directional and horizontal drilling, can reduce the environmental impact of oil and gas exploration and production (66). Implementing ESG practices, and biodiversity protection can also help reduce the industry’s impact on the environment (67). The latest literature suggests several ways to achieve this. One approach is to adopt more sustainable drilling and extraction techniques. For example, using water instead of chemicals in hydraulic fracturing (fracking) can reduce the risk of contaminating local water supplies (68). Additionally, the use of renewable energy sources, such as solar or wind power, to generate electricity during the E&P phase can reduce greenhouse gas emissions. Another strategy is to improve the management of waste generated during the E&P phase. This can include using close-loop systems to capture and reuse drilling fluids and implementing recycling programs for materials used during the drilling process (69). Also, the adoption of sustainable water management practices, such as wastewater recycling and water reuse, can reduce the environmental impact of water consumption (91). The implementation of ESG standards and certification can also help to ensure responsible and sustainable practices in the E&P phase. These standards can cover areas such as environmental protection, community engagement, and labour practices. Furthermore, the adoption of digital technologies and data analytics can help to optimize E&P operations, reducing waste (92) and improving efficiency. For example, using sensors to monitor drilling operations can help to identify inefficiencies and reduce the use of resources (70). Overall, the adoption of

GSCM and ESG practices in the E&P phase of the oil and gas industry can help to reduce its environmental impact and promote sustainability. However, the success of these practices will depend on the commitment of the industry and the regulatory environment in which it operates.

2. Transportation: The transportation of oil and gas products through pipelines, tankers, and trucks can have significant environmental impacts, including oil spills and greenhouse gas emissions. The use of alternative fuels, such as natural gas and biofuels, can help reduce greenhouse gas emissions from transportation of oil and gas products (71), (90). Additionally, implementing GSCM practices such as efficient logistics and supply chain management can reduce the environmental impact of the transportation activities (72). One way to make the transportation part of the supply chain greener is by reducing emissions from transport vehicles. This can be achieved by using alternative fuels, such as biodiesel, electric, or hydrogen-powered vehicles. In addition, optimizing transport routes and modes of transport can reduce emissions and improve fuel efficiency (73). Another approach is to reduce the carbon footprint of shipping by implementing emissions control areas (ECAs) and using cleaner fuels, such as liquefied natural gas (LNG) or methanol. The International Maritime Organization's (IMO) regulations on sulphur emissions and carbon reduction targets have also played a significant role in driving greener transportation in the oil and gas industry (74). Furthermore, the use of information technology, such as GPS and blockchain, can improve transparency and traceability in the transportation part of the supply chain. This can enhance the efficiency of transport operations and help identify areas for improvement in the supply chain (75). In conclusion, making the transportation part of oil and gas supply chain greener requires a combination of technological, regulatory, and operational improvements. By implementing GSCM and ESG practices, the industry can reduce its impact on the environment and society, while also improving its sustainability and long-term competitiveness.

3. Refining: The use of advanced technologies, such as carbon capture and storage, can help reduce greenhouse gas emissions from refining activities (76). Implementing GSCM practices such as energy and resource efficiency, waste reduction, and sustainable sourcing can also help reduce the environmental impact of refining operations (77). In terms of energy efficiency, refineries can adopt energy-efficient technologies such as heat recovery systems, cogeneration, and process optimization. This can reduce energy consumption and

greenhouse gas emissions while improving overall efficiency and profitability (78). Refineries can also reduce waste through better management practices, such as waste reduction, reuse, and recycling. Emissions control is another key area where refineries can become greener. This includes measures such as the use of low-sulphur fuels, emissions monitoring and reporting, and the implementation of technologies such as carbon capture and storage. Refineries can also adopt sustainable sourcing practices to ensure that their raw materials are sourced in an environmentally responsible way, such as using certified sustainable palm oil or implementing responsible sourcing policies (79), (80). With the implementation of GSCM and ESG practices can help refineries to become more sustainable and reduce their environmental impact. However, the cost of these measures can be significant, and regulatory frameworks can vary greatly between countries, making it challenging for refineries to implement these practices uniformly across their operations.

4. Marketing and Distribution: Implementing GSCM practices such as sustainable packaging and labelling, efficient inventory management, and green procurement can help reduce the environmental impact of marketing and distribution activities (81). Some of the measures that can be taken include the use of alternative fuels for transportation, improved fleet management, and the adoption of green supply chain practices (84), (86). The following are some of the strategies that have been recommended in the literature to achieve a greener marketing and distribution supply chain (24). Firstly, one of the most significant ways to reduce carbon emissions is to implement an effective fleet management system can reduce fuel consumption and emissions. Moreover, the adoption of green procurement practices can help to reduce environmental impacts along the supply chain (87), (88), (89). This includes the selection of eco-friendly products and suppliers, and the consideration of environmental impacts in the selection process (87), (88), (89). Another way to implement “greener” practices in terms of marketing and distribution is the increased supply chain visibility, which can help to identify areas of inefficiency and reduce waste (82). This can be achieved through the use of advanced tracking and monitoring systems, such as RFID and GPS (87), (88), (89). Furthermore, the adoption of sustainable packaging materials can significantly reduce the carbon footprint of the supply chain. This includes the use of biodegradable, recyclable, or reusable materials. The use of renewable energy sources, such as wind, solar, or hydroelectric power, can also help to reduce greenhouse gas emissions and promote sustainable practices (87), (88), (89). Following this, the adoption of a circular

economy model, where waste is minimized and resources are reused, can help to reduce environmental impacts, and promote sustainable practices (87), (88), (89). Finally, another way for implementing GSCM and ESG practices in the marketing and distribution part of the global oil and gas industry is the collaboration with stakeholders, including customers, suppliers, and regulators, can help to promote sustainable practices and encourage the adoption of green supply chain practices (83), (84), (85).

In addition, to the parts of the oil and gas industry's international supply chain mentioned earlier, there are also the fields of energy efficiency and environmental assessment where GSCM and ESG practices can be implemented to promote sustainability and reduce environmental impact:

1. Energy efficiency: The oil and gas industry is a significant consumer of energy, both in production facilities and in the transportation of products. Implementing energy-efficient practices such as the use of renewable energy sources, optimization of production processes, and the adoption of energy-efficient technologies can help reduce the industry's carbon footprint (92).
2. Environmental impact assessment: The oil and gas industry can have significant environmental impacts, including habitat destruction, water, and air pollution. Conducting comprehensive environmental impact assessments and implementing measures to mitigate potential environmental impacts can help reduce the industry's negative impact on the environment (91).

These are some of the areas where GSCM and ESG practices can be implemented to promote sustainability and reduce the environmental impact of the oil and gas industry. The adoption of these practices is essential for the industry to meet the growing demand for environmentally responsible operations and to contribute to a more sustainable future.

In general, the oil and gas industry has numerous opportunities to adopt GSCM and ESG practices throughout its international supply chain to become more sustainable and reduce its environmental impact. In order to proceed with the implementation of the practices described above, the collaboration of all stakeholders, including customers, suppliers and regulators is needed; it is the only way that the sustainable practices are promoted, and their adoption is encouraged.

As the world transitions towards a more sustainable future, the need for the oil and gas industry to make a step forward and address its environmental and social impacts while meeting the growing demand for energy is imperative. The GSCM and ESG practices that can be adopted on the industry's supply chain can be integral to the efforts of achieving sustainability. These practices can enable the industry to manage its supply chain in a more sustainable manner and have also the potential of reducing the environmental impact and improve the overall operational efficiency. They also encompass a broad range of initiatives that focus on environmental stewardship, social responsibility, and good governance and serve as guiding principles for companies to integrate sustainability into their business strategies.

However, to fully harness the benefits of the adoption of GSCM and ESG practices, companies must ensure transparency and accountability throughout the supply chain, including the adherence of suppliers to sustainable practices. Moreover, the effectiveness of the GSCM and ESG practices relies on robust metrics, comprehensive reporting frameworks, and independent verification to ensure credibility and comparability across the industry.

Overall, the oil and gas industry faces the dual challenge of meeting the increasing demand for energy while contributing to a sustainable future. By embracing GSCM and ESG practices, the industry can take steps towards responsible operations. However, further efforts are needed, including accelerating the transition to low-carbon energy sources, implementing efficient resource management, and strengthening community engagement. These actions combined with transparent reporting and accountability, will enable the industry to meet the growing demand for responsible operations and play a significant role in creating a more sustainable future.

The Greek oil and gas industry is a relatively small sector, with Greece being a net importer of oil and gas (96). The country's oil and gas production is limited, with only a few active oil fields and natural gas deposits (93), (94), (95). The main player in the Greek oil and gas industry are Hellenic Petroleum, which dominates the refining and marketing sectors (98), and Energean, which is the country's only upstream oil and gas producer (93). Despite its small size, the Greek government is actively working to attract foreign investment in the industry, including through licensing rounds for exploration and production (97).

Additionally, there is a growing emphasis on transitioning towards renewable energy sources, with Greece aiming to become carbon-neutral by 2050 (94).

There are several ways that the Greek oil and gas industry can be improved and be greener than the global oil and gas industry, once fully developed to similar levels. Firstly, the implementation of renewable energy sources can be prioritized in the country's energy mix (99). This would not only reduce greenhouse gas emissions but also increase the country's energy security and diversification. Furthermore, there is significant potential for offshore wind energy in Greece, and investment in this sector could provide a significant potential boost to the country's economy and employment. Secondly, the Greek oil and gas industry can adopt more sustainable practices for environmental impact assessments, reducing flaring and venting, and minimizing water usage. The adoption of these practices can reduce environmental impacts and improve operational efficiency (100). Thirdly, the implementation of GSCM practices can help the industry reduce its carbon footprint and improve sustainability. This includes optimizing logistics and transportation, reducing waste, and promoting sustainable procurement practices (101). Finally, the industry can prioritize corporate social responsibility and community engagement to ensure that the local communities benefit from the industry's presence and operations. This includes partnering with local communities and stakeholders, providing support for local development, and investing in social and environmental initiatives (102).

The Greek oil and gas sector has been undergoing significant developments in recent years and is expected to expand in the years to come. In this context, an emphasis must be given on the sustainability and environmental responsibility especially for the exploration and production since the implementation of GSCM practices in the Greek oil and gas sector can play a vital role in fostering sustainability. Although the sector is relatively small compared to other global players, there are steps that are already taken and show good potential of adopting GSCM and ESG practices. First, Greece has introduced legislation and initiatives to promote environmental sustainability, providing a conducive environment for the oil and gas sector to embrace GSCM practices. Secondly, Greece boasts significant renewable energy resources, including solar, wind, and geothermal. The country has made considerable progress in increasing its renewable energy capacity, which can serve as an opportunity for the oil and gas sector to diversify its energy portfolio and transition towards cleaner energy

sources, Apart from these, and the points already discussed, the collaboration among stakeholders, including oil and gas companies, academia, and government bodies, can also drive the adoption of GSCM practices in the Greek oil and gas sector. Partnerships can facilitate knowledge sharing, research and development, and the implementation of sustainable technologies and practices within the sector.

In general, the future outlook of the Greek oil and gas sector in terms of GSCM and ESG practices is promising. The country's regulatory environment, renewable energy potential, and the potential for collaboration and innovation provide a strong foundation for establishing a green and sustainable industry. By prioritizing GSCM practices and integrating ESG considerations into their operations, Greek oil and gas companies can contribute to environmental sustainability, social responsibility, and good governance. However, the successful implementation of these practices requires a commitment from industry stakeholders, strong governmental support, and continuous efforts to address the sector's challenges and seize the opportunities presented by the transition to a more sustainable energy future.

3. Implementing GSCM and ESG practices: The case of Shell

This chapter provides a case study of implementation of GSCM and ESG practices in the global oil and gas industry by a large IOC player.

Being under scrutiny for “going greener” and the growing concerns on climate change and transitioning to low-carbon practices (14), (15), (16), (17), the important players in the oil and gas industry have decided to implement more GSCM and ESG practices in their operations.

One example of a large corporation in the international oil and gas industry that has implemented GSCM and ESG practices is Shell.



Image 11: Shell Sustainability Report 2022 – Shell Logo (Shell, 2022)

Shell’s GSCM and ESG practices demonstrate the company’s commitment to sustainability and responsibility in its operations (103). The company has implemented a range of measures to reduce its carbon footprint, including investing in renewable energy and carbon capture technologies. Shell has also established a supplier code of conduct to ensure that its suppliers meet high ethical and environmental standards and has implemented sustainable procurement practices to promote responsible sourcing. Additionally, Shell has made significant investments in social investment programs and biodiversity conservation efforts (104).

Shell’s commitment to sustainability is reflected in its long-term business strategy, which includes a goal to become a net-zero emissions energy business by 2050 or sooner. The company has set a number of interim targets to achieve this goal, including the carbon intensity of its products by 6-0% by 2023 and by 20% by 2030 (105). Shell’s approach to sustainability is aligned with the United Nations’ SDGs, and the company ha stated that it is committed to contributing to the achievement of these goals.

Additionally, Shell has implemented a Supplier Code of Conduct, which sets out expectations for suppliers in terms of human rights, labour standards, and environmental performance.



Image 12: Shell Sustainability Report 2022 (Shell, 2022)

Shell's efforts to implement GSCM and ESG practices have been recognized by various organizations. For example, the company was named to the Dow Jones Sustainability Index (DJSI) for the 23rd consecutive year in 2020 (212) and was recognized as one of the world's most sustainable companies by Corporate Knights (213).

Shell implemented the below GSCM and ESG practices:

1. Reducing Carbon Footprint: Shell's target is to lower its supply chain's carbon impact by utilizing greener energy sources such as renewable power and biofuels (105). Shell revealed plans in September 2020 to attain net-zero emission levels by 2050, which involves decreasing the carbon intensity of their goods by 65% by 2050. Shell declared aspirations to become a zero-emissions energy company by 2050 in September

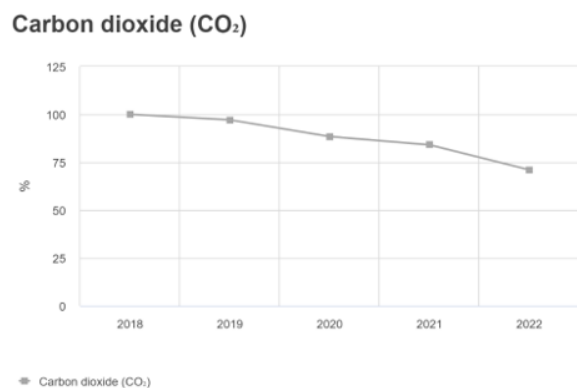


Image 13: Shell Sustainability Report 2022 – Carbon Emissions (Shell, 2022)

2020 (106). The corporation outlined a comprehensive strategy for reaching this objective, which includes lowering the carbon intensity of its goods, expanding the usage of energy from renewable sources, and investing in new innovations. Researchers examined the climatic impact of several oil and gas organizations, including Shell, in a 2020 study released by the journal Nature Climate Change. The study found that while Shell has made

progress in decreasing the carbon intensity of its energy products, further action was

Greenhouse gas (GHG) emissions

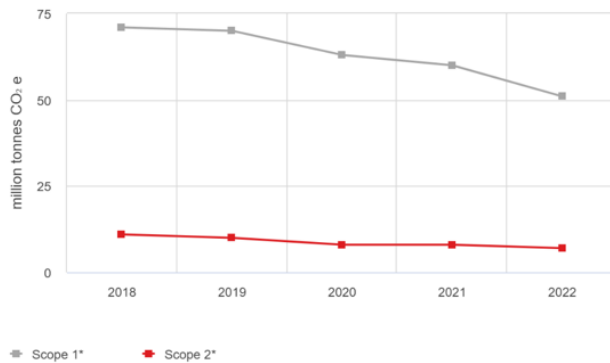


Image 14: Shell Sustainability Report 2022 – GHG Emissions (Shell, 2022)

required to reach the Paris Agreement targets (107). Shell announced intentions to invest \$100 million per year in natural ecosystems as part of their carbon reduction strategy in February 2021. The company aims to use these investments to offset the emissions from its operations (108). In a 2021 report published by CDP, a non-profit that tracks corporate environmental performance, Shell was named as one of the leading companies in the oil and gas sector in terms of climate performance. The report noted that Shell had set ambitious emissions reduction targets and had taken steps to integrate to climate considerations into its business strategy (109).

2. Supplier Code of Conduct: Shell has taken concrete steps to promote sustainable practices in its supply chain by implementing a Supplier Code of Conduct (110). This code outlines clear expectations for suppliers with regards to human rights, labour standards, and environmental performance, requiring adherence to the principles of the Universal Declaration of Human Rights and the implementation of environmental management systems. To strengthen the code's efficacy, Shell updated in 2019 to include more detailed requirements on these issues, as well as anti-bribery and corruption measures (111). In a 2020 study published in the journal Sustainability, researchers found that supply chain sustainability requirements, such as those set out in Shell's Supplier Code of Conduct could significantly enhance supplier performance (112). Shell also collaborated with other major oil and gas companies in 2019 to launch the Supplier Sustainability Assessment Program (SSAP), a joint effort to improve sustainability practices in the sector. The program features a common assessment tool that

Integrity

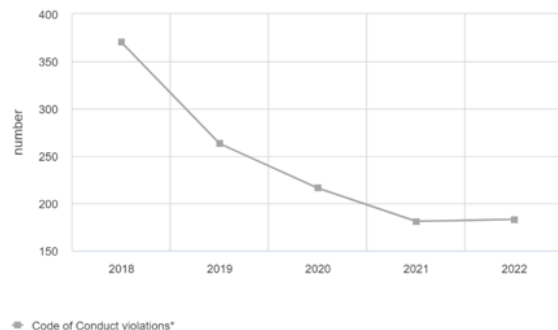


Image 15: Shell Sustainability Report 2022 – Supplier Integrity (Shell, 2022)

suppliers can utilize to gauge their sustainability performance (113). Shell's engagement

Procedures to prevent forced labour*

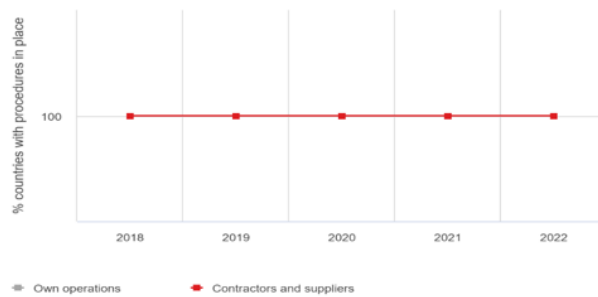


Image 18: Shell Sustainability Report 2022 – Forced labour (Shell, 2022)

with suppliers on sustainability issues, including measures through its Supplier Code of Conduct, has been acknowledged by CDP, a non-profit organization tracking corporate environmental performance. In 2020, Shell was identified as a leader in supplier engagement due to its efforts

to foster sustainable practices among suppliers. Overall, Shell's Supplier Code of Conduct and participation in SSAP demonstrate the company's commitment to promoting sustainability across its supply chain (114).

3. Sustainable Procurement: Shell is committed to sustainable procurement practices that ensure suppliers meet environmental, social, and ethical standards (114). The company's program includes a rigorous supplier screening process that assesses suppliers' sustainability performance and encourages them to improve their performance on time. To further advance its commitment, Shell developed a new sustainable procurement framework in 2020

Contracting and procurement

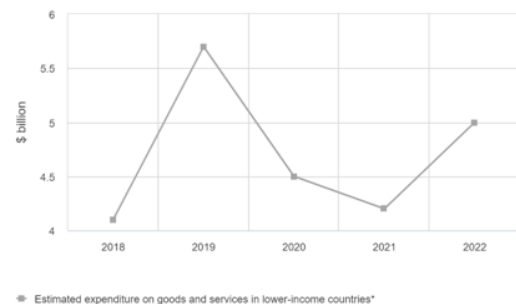


Image 16: Shell Sustainability Report 2022 – Procurement (Shell, 2022)

Procedures to prevent child labour*

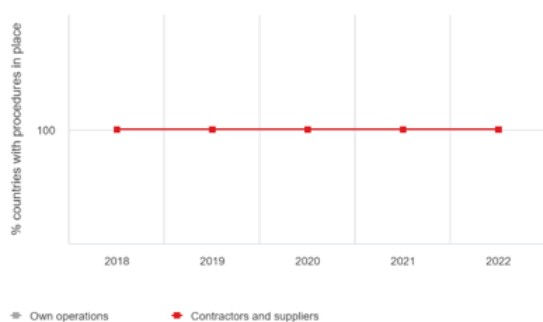


Image 17: Shell Sustainability Report 2022 – Child Labour (Shell, 2022)

framework comprises criteria related to human rights, labour standards, environmental performance, and business ethics (115). A study published in the Journal of Cleaner Production in 2018, evaluated the effectiveness of sustainability requirements in procurement contracts in the oil and gas

industry. The study highlighted Shell's sustainable procurement practices as a case study,

which had helped improve the sustainability performance of its suppliers (116). In 2019, CDP recognized Shell as a leader in sustainable procurement, citing the company's efforts to engage with suppliers on sustainability issues and integrate sustainability criteria into procurement decisions (117). To strengthen its sustainability performance, providing guidance on sustainability requirements and ways to demonstrate their performance. With these initiatives, Shell is working towards a sustainable supply chain and fulfilling its sustainability commitments (118).

4. Social Investment: Shell places great emphasis on investing in social programs and community development initiatives in the areas where it operates (119). In Nigeria, for example, the company has implemented a social investment program that supports education, health, and economic development initiatives (119). In 2020, Shell announced its plans to increase its annual spending on social investment to \$300 million by 2025 (120). The social investment program includes initiatives such as education, entrepreneurship, and access to



Image 19: Shell Sustainability Report 2022 – Social Investment (Shell, 2022)

energy for communities where Shell operates (120). Researchers evaluated the effectiveness of social investment programs in the oil and gas industry in a 2019 study published in the journal *Resources Policy*. The study included a case study of Shell, and it found that the company's social investment programs had helped to establish positive relationships with local communities and contributed to the social and economic development of those communities (121). Shell has invested \$300 million in its Access to Energy program to provide electricity to communities that lack access to reliable energy sources. The program includes initiatives related to renewable energy, energy efficiency, and energy access to rural areas (122). In 2021, Shell announced its plans to establish a social investment fund to support entrepreneurs in communities where the company operates. The fund will provide funding and business support to entrepreneurs in areas such as renewable energy, sustainable agriculture, and waste management (123). These initiatives reflect Shell's commitment to sustainable and responsible business practices, which prioritize the well-being of local communities and contribute to their long-term development (119).

5. Biodiversity Conservation: Shell recognizes the importance of protecting biodiversity and has implemented measures to minimize the impact of its operations on the environment (124), (129). For example, the company has initiated a program in the Niger Delta region of Nigeria to safeguard and rehabilitate mangrove forests (124). Additionally, in 2020, Shell announced its aspiration to become a net-zero emissions energy business by 20250 or earlier, as well as a commitment to conserving and restoring biodiversity in areas where it operates (125). In a 2020 study published in *Ecological Economics*, researchers assessed the impact of Shell's efforts to preserve biodiversity in the Niger Delta. The study found that the company's conservation initiatives had led to the recovery of damaged forest areas and a boost in biodiversity in the region (126). In 2019, Shell collaborated with the International Union for Conservation of Nature (IUCN) on a partnership to promote biodiversity conservation and rehabilitation in three countries where it operates, including Brazil, China, and South Africa. The partnership covers a range of endeavours, including habitat rehabilitation, wildlife preservation, and community involvement (127). In 2021, Shell unveiled a new biodiversity strategy that outlines targets to preserve and restore habitats in areas where it operates. The strategy also includes commitments to involve stakeholders and support biodiversity research (128). Overall, Shell's dedication to biodiversity preservation demonstrates its commitment to environmentally conscious business practices (124), (129).

While Shell's sustainability efforts have been generally well-received, the company has faced criticism from some stakeholders (130). One of the main criticisms Shell faces is that its continued investment in oil and gas exploration and production is incompatible with its sustainability goals (133). Some critics argue that the company should de-invest from fossil fuels entirely and focus on renewable energy and other low-carbon technologies. In response, Shell has stated that it sees oil and gas as continuing to play a significant role in meeting a global energy demand for many years to come, and that it is committed to reducing the carbon intensity of its operations and products (134).

Another area of criticism for Shell has been around its involvement in controversial projects, such as the construction of the Keystone XL pipeline in North America, which has faced opposition from indigenous communities and environmental groups. The company has also faced criticism over its operations in Nigeria, where it has been accused of causing environmental damage and human right abuses (135).

A study published in the journal of Nature Climate Change in 2018 argued that while Shell and other oil and gas companies had made commitments to reduce their carbon footprints, these commitments were insufficient to meet the goals of the Paris Agreement on climate change. The study argued that in order to meet the Paris Agreement's goals, oil and gas companies would need to reduce their production of fossil fuels by around 35% by 2040 (131).

Another study published in the Journal of Cleaner Production in 2020 evaluated the effectiveness of Shell's Supplier Code of Conduct in promoting sustainability among its suppliers. The study found that while the code of conduct had helped to raise awareness of sustainability issues among suppliers, there were limitations to its effectiveness in driving real change, and that more collaborative and systemic approaches were needed to promote sustainable procurement (132).

Shell has also been accused of "greenwashing" by critics who argue that the company is overstating its commitments to sustainability in order to improve its reputation, while continuing to invest in fossil fuels and other activities that contribute to climate change (135). In a 2021 report titled "The Big Con: How the Fossil Fuel Industry's Greenwashing is Undermining Climate Action", Greenpeace accused Shell and other major oil and gas companies of engaging in greenwashing by promoting their commitments to sustainability while continuing to expand their production of fossil fuels (136). Academic research has also highlighted the potential for greenwashing in the oil and gas industry. For example, a study published in the journal "Energy Policy" in 2019 argued that oil and gas companies were using sustainability reporting and other corporate social responsibility initiatives to deflect criticism and maintain their social license to operate, while continuing to prioritize profits over sustainability (137). Another study published in the Journal of Cleaner Production in 2020 evaluated the effectiveness of Shell's Supplier Code of Conduct in promoting sustainability among its suppliers. While the study found that the code of conduct had helped to raise awareness of sustainability issues among suppliers, it also noted that there was a risk of greenwashing if the code was not accompanied by more sustainable efforts to promote sustainable procurement (138).

Despite these criticisms, Shell's commitment to sustainability and its efforts to implement GSCM and ESG practices demonstrate its willingness to take responsibility for the

environmental and social impacts of its operations, and its recognition of the need to transition to a more sustainable energy system.

As already examined, Shell, as one of the major players in the oil and gas industry, has been actively engaged in sustainability initiatives and has demonstrated a commitment to sustainability through various initiatives. Through its set long-term goals to reduce its carbon footprint, and targets to lower its net carbon intensity and aligning its emissions efforts with the goals of the Paris Agreement, its investment in renewable energy projects, and its engagement in social responsibility initiatives, Shell has showcased its shift towards “greener” practices for its supply chain as well as its commitment to sustainability and responsible operations. While there is room for improvement, Shell’s initiatives reflect a commitment to address climate change and contribute positively to society. Other major players in the industry have also made progress, indicating a collective recognition of the need for sustainability. BP has set similar emission reduction targets to those of Shell, invested significantly in renewable energy sources, and demonstrated a commitment to transparency and reporting; Total Energies has made substantial investments in low-carbon energy sources, including renewables and energy storage, and has set ambitious emission reduction targets aligned with the Paris Agreement; Equinor has been proactive in developing offshore wind projects and has set targets to reduce the carbon intensity of its operations and develop carbon capture and storage solutions.

As the industry continues its transition towards a low-carbon future, it is crucial for companies like Shell to remain innovative, set higher benchmarks, and collaborate with peers to drive positive change.

However, while Shell has made some progress in sustainability initiatives, the shift of its investments towards expanding its more profitable departments and focusing again on those handling natural gas and oil instead of the renewables sector, raises concerns, since the industry is a major contributor to greenhouse gas emissions and climate change (139). Therefore, for a company to truly demonstrate a commitment to sustainability, it needs to not only set goals and targets but also allocate substantial investments towards renewable energy sources and technologies. The decision to prioritize investments in natural gas and oil may be driven by short-term profitability considerations and the existing infrastructure and expertise in these sectors, however, as the global energy landscape evolves, there is a growing need to accelerate the transition to low-carbon and renewable energy sources. The

company should allocate greater resources and investments towards renewable energy projects. This would not only contribute to reducing its own carbon emissions but also stimulate the growth of the renewable energy sector and drive positive change in the industry as a whole. Furthermore, while other major players in the industry, such as BP, Total Energies, and Equinor, have also made progress in their sustainability efforts, it is important to recognize that the transition to a low-carbon future requires collective action and collaboration. It is not enough for individual companies to make incremental improvements; a systemic transformation is needed to address the scale and urgency of the climate crisis.

In conclusion, while Shell has showcased some commitment to sustainability through its initiatives, the questions about the company's long-term strategy and its ability to contribute to a sustainable future remain. To truly demonstrate leadership in the industry, Shell should allocate greater investments towards renewable energy, set more ambitious targets aligned with the goals of the Paris Agreement, and actively collaborate with peers and stakeholders to drive the necessary systemic change.

4. Evaluating the GSCM and ESG practices in place and industry's actions

The implementation of GSCM and ESG practices in the oil and gas industry has yielded significant results in terms of improving sustainability and reducing environmental footprints. Studies have shown that these practices have led to a reduction in greenhouse gas emissions, water usage, and waste generation through initiatives such as cleaner production, responsible waste management systems and energy efficiency measures (146). This demonstrates that implementing sustainable practices can contribute to lowering the sector's environmental impact (140). Furthermore, the industry has made progress in integrating renewable energy sources, such as wind and solar power, thereby diversifying energy portfolios and decreasing carbon emissions (141). Another important point is that by implementing GSCM and ESG practices, oil and gas companies can identify opportunities for cost savings and operational efficiency improvements (146). For example, optimizing energy usage and reducing waste can lead to significant cost reductions. Furthermore, implementing sustainable procurement practices can enhance resource efficiency and reduce supply chain costs (149).

In addition to environmental benefits, the adoption of ESG practices has enhanced corporate governance and reporting within the industry (143). Companies are now more transparent in disclosing their sustainability performance and setting targets to reduce emissions, promoting greater accountability (142). These efforts have improved stakeholder engagement, as companies address environmental and social concerns, leading to better relationships with communities, investors, and regulators, as well as enhanced reputation (147). By demonstrating a commitment to sustainable practices, oil and gas companies can build trust with stakeholders, including investors, customers, local communities, and regulatory agencies (147). Moreover, by embracing GSCM and ESG practices assists oil and gas organizations in complying with environmental standards and mitigating operational hazards. Companies can avoid penalties, reputational damage, and legal obligations associated with noncompliance by taking steps to address issues related to the environment and society (145), (148).

In the case of the large IOCs, which have implemented GSCM and ESG practices the results yielded are many. By taking steps to reduce their carbon emissions and address climate

change concerns, they have invested in renewable energy projects, implemented energy efficiency measures, and explored carbon capture and storage technologies. These efforts contribute to the overall reduction of greenhouse gas emissions. Examples of IOCs reducing their carbon emissions are BP (150) and Shell (which has been analysed in the previous chapter).

Furthermore, IOCs have diversified their energy portfolios by expanding their investments and operations in renewable energy sources such as wind, solar, and biofuels. They have independently developed and operated renewable energy installations, as well as forged partnerships to generate clean energy. Research and development (R&D) efforts also play a crucial role towards this direction, as IOCs allocate resources to advance renewable energy technologies. Through innovation and technological breakthroughs, they aim to enhance the efficiency, affordability, and scalability of renewable energy solutions (153). IOCs have also formed strategic partnerships with renewable energy companies and acquired renewable energy assets. These collaborations and acquisitions enable them to leverage expertise and enter new markets in the renewable energy sector (154). This shift reflects a strategic response to the growing demand for cleaner and sustainable energy solutions. As mentioned in the previous chapter, Shell has invested in renewable energies in order to reduce its environmental footprint and emissions (151).

IOCs have also implemented comprehensive environmental management systems to minimize the environmental impact of their operations. This includes rigorous monitoring and reporting of environmental performance, adopting best practices in water management, and implementing robust systems to prevent and respond to oil spills and other accidents. ExxonMobil has taken actions towards this direction in order to avoid accidents and major oil spills, similar to the Exxon Valdez oil spill, that happened back in 1989, and has established rigorous environmental standards and practices that guide the company's operations worldwide. They address key areas such as air emissions, water and waste management, and biodiversity protection. ExxonMobil invests also in research and development to develop and deploy technologies that improve environmental performance. This includes developing advanced fuels, exploring carbon capture technologies, and investing in biofuels and other low-carbon technologies. They also engage in environmental stewardship partnerships with academic institutions, NGOs, and government agencies to address environmental challenges and support biodiversity conservation (152).

The evaluation of the implementation of GSCM and ESG practices by major players in the global oil and gas industry involves assessing several key aspects.

The shift towards greener practices has gathered positive evaluations from various stakeholders, including environmental organizations, investors, and the public. By adopting these practices, the industry has demonstrated a commitment to sustainable development and addressing the environmental challenges associated with their operations (153). The improved environmental performance is one of the key factors leading to this positive outlook. Through their incorporated GSCM and ESG practices companies have managed to minimize their greenhouse gas emissions and ecological footprint. By implementing cleaner technologies and optimizing resource consumption, they have taken substantial steps towards mitigating climate change and preserving natural resources. Moreover, the adoption of GSCM and ESG practices has resulted in improved environmental transparency and accountability within the industry (154). Companies have recognized the importance of measuring and reporting their environmental performance, thereby increasing the availability of reliable data for stakeholders to assess their sustainability efforts. This transparency has enhanced trust between the industry and its stakeholders, as well as facilitated benchmarking and knowledge-sharing among companies, driving further improvements across the sector (155). By incorporating ESG practices, oil and gas companies have shown a commitment to social responsibility and community development. They have actively engaged with local communities, addressing their concerns, and implementing initiatives that aim to improve the quality of life in the areas where they operate (156). Furthermore, the positive evaluations recognize the industry's efforts in research and development to drive innovation and technological advancements (159). Oil and gas companies have allocated substantial resources to develop cleaner technologies, such as carbon capture and storage, methane detection, and advanced wastewater treatment (158). These innovations have the potential to significantly reduce environmental impacts and enhance the overall sustainability of the industry. This includes investments in education, healthcare, and infrastructure, fostering economic growth and social progress in these regions (157). Also, the industry's investments in renewable resources have not only reduced its own carbon emissions but have also contributed to the growth of renewable energy infrastructure and accelerated the energy transition as a whole (158).

On the other hand, the incorporated GSCM and ESG practices aiming to mitigate the industry's negative effects and promote sustainability, have faced criticism and negative evaluation, highlighting concerns related to greenwashing, and insufficient regulatory frameworks (144). First, there is greenwashing. Critics argue that some oil and gas companies employ GSCM and ESG practices as mere public relations tools, engaging in greenwashing (160), (161). Greenwashing refers to the act of conveying a misleading impression of environmental responsibility to deceive the public (160), (161). By incorporating these practices superficially, companies create an illusion of sustainable operations while continuing with environmentally damaging ones (161). This perception management can undermine the true environmental impact of the industry and hinder any progress towards a genuinely sustainable future (162), (163). Furthermore, the negative evaluation of the incorporated GSCM and ESG practices in the oil and gas industry is also rooted in the limited scope and efficacy of the regulatory frameworks (163), (164). Existing regulations often fail to adequately address the industry's complex environmental and social challenges, leaving room for companies to exploit loopholes or engage in practices that fall short of genuine sustainability (163). This lack of robust oversight and enforcement hampers the transformative potential of GSCM and ESG initiatives, perpetuating the industry's negative impacts (164). Another point enhancing the negative evaluation of the practices already incorporated, pertains to the limited scope and ambition of GSCM and ESG practices in the oil and gas industry (160), (165). Critics argue that while these initiatives may focus on reducing operational emissions and improving efficiency, they often neglect broader issues such as the industry's contribution to climate change, biodiversity loss, and human rights abuses (160), (164), (166), (167). Merely addressing environmental impact within the supply chain, without considering the sector's overall carbon footprint and systemic issues, falls short of achieving true sustainability (160), (165), (166), (167). Additionally, critics also point out that the oil and gas industry's adoption of GSCM and ESG practices may inadvertently hinder the necessary transition to renewable energy sources (168), (169), (170), (171). By investing in resources and efforts for greening their supply chains and enhancing their public image, companies can divert attention and delay the urgent need for phasing out fossil fuels (168), (169), (170), (171). This delay may perpetuate dependence on carbon-intensive energy sources, exacerbating the environmental and social challenges associated with the industry (170), (171).

In conclusion, the evaluations of GSCM and ESG practices in the oil and gas industry provide valuable insights into the sector's commitment to improving its environmental performance (178), (179), (180). These evaluations recognize the industry's efforts in adopting cleaner technologies (176), (177), investing in renewable energy (172), (173), enhancing transparency (174), (183), engaging stakeholders (181), (182), and dedicating resources to research and development (175), (180). Such initiatives demonstrate the industry's dedication to sustainable development and signal progress towards a more environmentally conscious oil and gas sector. However, amidst the positive evaluations, there are also negative assessments that shed light on critical concerns within the industry (160), (167). These include the potential for greenwashing, where companies make misleading claims about their environmental practices (160), (167), inadequate regulatory frameworks (160), (165), insufficient transparency (166), (167), limited scope and ambition in sustainability initiatives (160), (165), (167), and potential delays in transitioning to renewable energy sources (168), (169). These negative evaluations highlight the need for substantial improvements in several areas (168), (169), (170), (171). To address these concerns, it is crucial to implement robust regulations that hold the companies accountable for their environmental and social impacts (184), (187). Standardized reporting frameworks can help ensure transparency and accurate representation of sustainability efforts across the industry (185), (189). Furthermore, a more comprehensive and ambitious approach to sustainability is necessary, focusing not only on incremental improvements but also on transformative changes that drive meaningful impact (186), (188). By actively addressing these issues, the oil and gas industry can foster genuine transformation in its practices and contribute significantly to a sustainable future. It requires concerted efforts from all stakeholders involved, including industry leaders, policymakers, and society as a whole (189). Only through genuine commitment and collaborative action can the industry make substantial progress towards achieving its sustainability goals and contribute to a more environmentally sustainable future.

5. The industry's future outlook in terms of GSCM and ESG practices

This chapter explores the future outlook for GSCM and ESG practices in the global oil and gas industry and analyses key trends and drivers for change.

Due to the growing concerns from industry and non-industry stakeholders, as stated in the previous chapters, there is a growing realization among the global oil and gas industry that sustainable practices are essential for long-term viability. The industry's commitment to adopting GSCM and ESG practices will be critical in addressing environmental concerns, meeting evolving stakeholder expectations, and contributing to a low-carbon economy. The future outlook for GSCM and ESG practices in the oil and gas industry is expected to undergo significant transformation. As the world increasingly recognizes the need to address climate change and transition towards a more sustainable future, key trends and developments are anticipated and emerge.

One of these key trends is the decarbonization efforts taken by the oil and gas sector. The global oil and gas industry has been engaging in decarbonization efforts to respond to the critical need to reduce greenhouse gas emissions and tackle climate change. Recognizing its significant carbon footprint, the industry has increasingly focused on initiatives aimed at reducing emissions and transitioning to

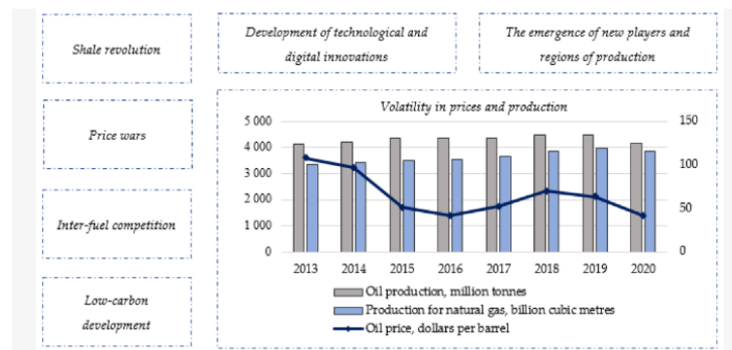


Image 20: Oil and Gas industry – GHG Emissions (Cherepovitsyn, 2021)

cleaner energy sources. These efforts encompass a range of strategies and technologies, including investments in renewable energy, implementation of energy efficiency measures, and the adoption of carbon capture and storage (CCS) systems.

Investment in renewable energy sources is an essential part of the oil and gas industry's carbon neutrality efforts. Businesses are diversifying their portfolios and increasing their presence in renewable energy areas such as wind and solar energy. This strategy change entails both the development of renewable energy projects and the acquisition of existing renewable energy enterprises. Oil and gas businesses hope to reduce their dependency on

fossil fuels and contribute to the worldwide transition to a low-carbon energy mix by incorporating renewables into their operations (192). Energy efficiency initiatives, in addition to renewable energy investment, have emerged as critical components of the industry's decarbonization goal. To minimize energy consumption and related emissions, the oil and gas industry has concentrated on improving energy efficiency in its operations.. This has involved the implementation of various measures such as upgrading equipment and infrastructure, optimizing processes, and employing advanced monitoring and control systems. By enhancing energy efficiency, the industry aims to minimize its carbon footprint and maximize resource utilization (190). The deployment of carbon capture and storage (CCS) technologies is another important decarbonization strategy promoted by the oil and gas sector. CCS is a system that absorbs carbon dioxide emissions produced by industrial activities and keeps them from entering the atmosphere. Carbon dioxide collected is then transported and stored in subsurface geological formations or repurposed for industrial use. CCS allows for large reductions in greenhouse gas emissions while continuing to use fossil fuels for energy generation. It bridges the gap to a low-carbon future by allowing current infrastructure to be used while actively addressing climate change issues (191).

The successful achievement of decarbonization goals in the oil and gas industry necessitates innovation and collaboration. Innovation plays a vital role in developing and implementing advanced technologies that can drive emission reductions and promote sustainable practices. Research and development efforts are crucial for the industry to explore breakthrough solutions, such as more efficient carbon capture processes, advanced CCUS (carbon, capture, utilization, and storage) technologies, and improved integration of renewable energy sources into existing infrastructure. It can be concluded that the global oil and gas industry has been actively engaged in decarbonization efforts to reduce its carbon footprint and address climate change concerns. The industry's initiatives encompass investment in renewable energy, implementation of energy efficiency measures, and adoption of CCS. These actions aim to diversify energy portfolios, reduce emissions, and promote sustainable practices. Innovation and collaboration are critical in achieving the industry's decarbonization goals, enabling the development of advanced technologies and fostering partnerships to accelerate the transition to a low-carbon future.

As previously stated and discussed in previous chapters, the notion of a "circular economy in the global oil and gas industry refers to an approach that aims to maximize

resource efficiency, reduce waste production, and promote the reuse, reuse, and recycling and redistributing of materials throughout the industry's value chain (193). It entails transitioning away from the old standard paradigm of "take-make-dispose" and toward a more sustainable and regenerative one in which resources are kept in circulation for as long as possible. The adoption process typically involves several key aspects, with the most important being to conduct a thorough analysis of the operations to identify areas where circular economy principles can be applied. This analysis helps identify opportunities for waste reduction, material reuse, and the development of circular business models. As sustainability concerns continue to grow, there is increasing pressure on companies to adopt circular practices and reduce their environmental impact. The circular economy offers opportunities for the industry to improve resource efficiency, reduce waste, and enhance the sustainability of its operations (193). To promote the circular economy, the industry has initiated various initiatives. For example, some companies have implemented closed-loop systems, where materials are continuously recycled or repurposed within their operations. Others have established partnerships with recycling companies or invested in technologies that enable the conversion of waste materials into valuable products or energy sources. Innovation and collaboration are also crucial to achieving the goals of a circular economy in the oil and gas industry. Firstly, innovation is needed to develop new technologies and processes that enable efficient resource recovery, recycling, and repurposing. This can include advancements in recycling technologies, waste-to-energy conversion systems, and the development of circular business models (194). Secondly, in order to adopt these measures, the collaboration of all stakeholders is needed. The adoption of a circular economy in the global oil and gas industry involves maximizing resource efficiency, reducing waste, and promoting the reuse and recycling materials. Companies analyze their operations, implement initiatives to reduce waste and improve resource efficiency, and collaborate with stakeholders to develop circular value chains. The adoption of circular economy practices is expected to become more prevalent in the industry's supply chains as sustainability concerns grow. Through the innovation and collaboration, the development of new technologies, processes, and partnerships can be enabled and drive sustainable practices and resource optimization.

Another key trend, and a field that the global oil and gas industry undergoes severe criticism, is the supply chain transparency. The global oil and gas industry has been making efforts to

enhance supply chain transparency in recent years. Recognizing the importance of transparency in addressing ESG concerns, several initiatives have been undertaken by the industry to promote greater visibility and accountability across the supply chain. One notable initiative is the Extractive Industries Transparency Initiative (EITI) (195). EITI is a global standard that promotes transparency and accountability in the extractive sector, including oil and gas. It requires participating countries to disclose information about their extractive industries, including payments made by companies and revenues received by governments. By disclosing financial flows, EITI aims to prevent corruption and foster informed public debate (195). Another important initiative is the Oil and Gas Industry Guidance on Voluntary Sustainability Reporting, which was established by the International Petroleum Industry Environmental Conservation Association (196), the American Petroleum Institute (API), and the International Association of Oil and Gas Producers (IOGP). It provides guidelines for organizations to report on how they perform in terms of sustainability, including factors linked to supply chain transparency. It encourages corporations to publish information about their supply chain activities, such as initiatives to detect and resolve human rights violations, environmental implications, and community participation. Additionally, the industry has seen the rise of independent third-party certifications and standards that promote supply chain transparency. For instance, the Responsible Jewellery Council (RJC) has developed a certification program for responsible sourcing of precious metals, including gold, which is used in various oil and gas operations. This certification ensures that the gold supply chain is free from conflict, human rights abuses, and environmental harm (197). Blockchain technology, for example, has been explored as a means to track and trace the movement of oil and gas products from extraction to end-users and improve the sector's transparency. By recording transactions and data in a decentralized and immutable ledger, blockchain can provide a transparent and tamper-proof record of the entire supply chain, improving traceability and accountability. In terms of the industry's commitment to ESG practices, there is growing recognition of the need to integrate sustainability into business strategies. Many oil and gas companies have made public commitments to reduce their carbon emissions and mitigate environmental impacts. For instance, major companies like Shell (198), BP (199), and Total Energies have announced plans to achieve net-zero carbon emissions by 2050 or earlier (200). These commitments highlight the industry's acknowledgement of the urgency to address climate change and align with global sustainability goals. Furthermore, innovation plays a vital role

in enhancing supply chain transparency. Technological advancements, such as Internet of Things (IoT) devices, data analytics, and Artificial Intelligence (AI), offer opportunities to capture and analyse supply chain data in real-time. These innovations can enable companies to identify and address potential risks, monitor compliance, and make informed decisions regarding their supply chain operations. In conclusion, the global oil and gas industry has made efforts to improve supply chain transparency through various initiatives. The EITI, the Oil and Gas Industry Guidance on Voluntary Sustainability Reporting, and the use of technologies like the blockchain are some examples of these initiatives (195), (197). Additionally, the industry has recognized the importance of ESG practices and has committed to reducing carbon emissions and mitigating environmental impacts. Achieving greater transparency and implementing ESG practices require collaboration and innovation, as complex supply chains and diverse stakeholders necessitate collective action and technological advancements. By embracing collaboration and fostering innovation, the industry can make significant strides towards more transparent supply chains.

Last but not least, the adoption of sustainable sourcing and working with suppliers with high ESG standards is one key trend towards ensuring the future of GSCM and ESG practices in the oil and gas industry. The global oil and gas industry has been making efforts to adopt sustainable sourcing practices in recent years. These initiatives are aimed at mitigating the environmental impact of the industry and ensuring long-term viability. Several sustainable sourcing initiatives have been implemented, demonstrating the industry's commitment to this goal. Additionally, collaboration with suppliers possessing strong sustainability and ESG credentials is prioritized. Following the decarbonization trend, and the need for continuous innovation and collaboration to achieve its sustainable sourcing objectives, the same is demanded by the industry's suppliers. The adoption of renewable energy technologies, such as solar and wind power, are being increasingly utilized in the industry's operations and the shift towards renewable energy and this must be aligned with the suppliers' sourcing practices, which should contribute to the industry's sustainability goals (209). Moreover, this also showcases the industry's commitment to emission reduction and the shift towards a strong sustainable sourcing focus (202). Furthermore, the industry is actively engaged in initiatives aimed at protecting biodiversity and ecosystem conservation. Companies are increasingly implementing measures to minimize their impact on natural habitats and ecosystems. For example, they conduct environmental impact assessments

before commencing operations and adopt sustainable land management practices to protect biodiversity. These initiatives demonstrate the industry's recognition of the importance of preserving ecosystems while sourcing oil and gas (205). In addition to these efforts, the global oil and gas industry recognizes the significance of collaborating with suppliers who have strong sustainability and ESG credentials. There is a growing trend of prioritizing suppliers who share the industry's commitment to sustainable sourcing practices. Companies evaluate their suppliers' ESG performance and consider these factors when selecting partners for collaboration. This focus on supplier sustainability credentials ensures a more holistic approach to sustainable sourcing (203). While the industry has made significant strides in adopting sustainable sourcing practices, it acknowledges the need for continuous innovation and collaboration to further advance these efforts. Innovation plays a crucial role in developing and deploying cleaner technologies, improving energy efficiency, and finding alternative solutions to minimize the industry's environmental impact. Overall, it can be concluded that the global oil and gas industry has undertaken sustainable sourcing efforts to mitigate its environmental impact. Initiatives such as the adoption of renewable energy sources, emissions reduction strategies, and biodiversity conservation demonstrate the industry's commitment to sustainability. The industry also prioritizes collaboration with suppliers possessing strong sustainability and ESG credentials. However, the industry recognizes the need for continuous innovation and collaboration to achieve its sustainable sourcing objectives. Through innovation and collaboration, the industry can further enhance its sustainable sourcing practices and contribute to a more sustainable future.

One of the major challenges to achieve the above, remains the collaboration between the industry's stakeholders. To begin with collaboration among various stakeholders, including governments, industry players, and research institutions, is essential for accelerating the pace of decarbonization. Collaborative efforts enable the sharing of knowledge, resources, and best practices, facilitating the development and deployment of effective decarbonization strategies. Governments can play a crucial role by establishing supportive policy frameworks, incentivizing innovation, and fostering collaboration among industry participants. Industry collaborations and partnerships can drive collective action, promote knowledge exchange, and facilitate the scaling up for successful decarbonization initiatives (190).

Furthermore, collaboration among industry stakeholders, governments, and research institutions is essential for implementing a circular economy. Collaborative efforts can drive the exchange of knowledge and expertise, facilitate the development of standards and regulations, and promote the scaling up of circular economy initiatives. By working together, stakeholders can overcome challenges, share resources, and collectively contribute to the adoption of circular economy practices in the oil and gas industry (193). Collaboration is also needed and is indeed crucial, in order to achieve greater supply chain transparency and effectively implement ESG practices. The oil and gas industry operates within complex and interconnected supply chains, involving numerous stakeholders, from suppliers and contractors to local communities and regulators. Addressing transparency challenges requires collaboration among these stakeholders, from suppliers and contractors to local communities and regulators. Addressing transparency challenges requires collaboration among these stakeholders, as well as technological advancements and innovative solutions. Collaboration can take various forms, such as partnerships between industry players, governments, and civil society organizations. By working together, these actors can share best practices, develop common standards, and establish monitoring mechanisms to ensure transparency throughout the supply chain. Lastly, in terms of sustainable sourcing, collaboration within the industry is vital for sharing best practices, knowledge, and resources to accelerate the adoption of sustainable sourcing initiatives. Through collaboration, companies can collectively address sustainability challenges and drive positive change (204).

The oil and gas industry's efforts in GSCM and ESG practices adopting can be considered crucial for its overall future outlook in terms of becoming "greener". These initiatives are interconnected and have the potential to drive positive change and shape a sustainable future for the industry. By embracing these initiatives, the industry can mitigate its environmental impact, enhance resource efficiency, build resilient supply chains, and foster positive social and economic outcomes. However, it is important to recognize that continuous improvement and innovation are needed to address the challenges of sustainability effectively. The oil and gas industry must remain committed to ongoing efforts in GSCM and ESG practices, setting higher benchmarks and pushing for greater advancements. Embracing emerging technologies, investing in research and development, and collaborating with industry peers, governments, and civil society organizations are essential for driving transformative change.

Only through ongoing commitment and collaboration can the achieve its sustainability goals and contribute to a more sustainable and responsible energy sector; sustainability is an ongoing journey that requires continuous improvement, innovation, and collaboration.

6. Conclusion

GSCM and ESG practices are gaining increased attention and significance in the global oil and gas industry. As the world transitions towards a more sustainable and low-carbon future, companies in the industry are recognizing the importance of integrating environmental and social considerations into their supply chain operations. This includes adopting practices that reduce environmental impact, promote social responsibility, and ensure good governance throughout the value chain. The industry's commitment to GSCM and ESG practices is driven by various factors, including regulatory pressures, stakeholder expectations, and the need for long-term business resilience. One of the key areas where the oil and gas industry is focusing its GSCM and ESG efforts is in reducing carbon emissions. Companies are implementing strategies to monitor, measure, and mitigate greenhouse gas emissions across their supply chains. This involves conducting life cycle assessments of products and services, identifying emission hotspots, and implementing measures to minimize carbon footprints. For example, companies are investing in energy-efficient technologies, optimizing logistics operations to reduce transportation emissions, and exploring carbon offsetting options. By adopting such measures, the industry aims to align its supply chain operations with global climate goals and reduce its overall environmental impact (209). In addition to emissions reduction, the industry is also working towards minimizing waste generation and promoting circular economy principles. This includes adopting practices such as waste reduction, recycling, and resource recovery throughout the supply chain. For instance, companies are implementing programs to reduce packaging waste, reusing materials where possible, and collaborating with suppliers to promote sustainable procurement practices. By incorporating circular economy principles, the industry aims to minimize waste generation, conserve resources, and create value from waste materials (206). Furthermore, social responsibility is a key aspect of GSCM and ESG practices in the oil and gas industry. Companies are increasingly focusing on human rights, labour conditions, and community engagement in their supply chains. This involves implementing responsible sourcing practices, ensuring fair labour standards, and respecting the rights of indigenous communities and local stakeholders. For example, companies are adopting supplier codes of conduct (i.e., Shell as shown on Chapter #3) that require

adherence to human rights principles and social responsibility standards. They are also engaging in community development initiatives and supporting local employment opportunities. These efforts reflect the industry's commitment to promoting social welfare and sustainable development (207). Governance plays a critical role in ensuring the effective implementation of GSCM and ESG practices in the oil and gas industry. Companies are enhancing their governance structures and processes to promote transparency, accountability, and ethical conduct. This includes adopting robust governance frameworks, conducting regular audits and assessments, and integrating sustainability criteria into supplier selection and evaluation processes. The industry recognizes that strong governance practices are essential for managing risks, ensuring compliance with regulations, and maintaining the trust of stakeholders (210). The global oil and gas industry's commitment to GSCM and ESG practices is further demonstrated through various industry initiatives and collaborations. Companies are actively participating in industry associations and partnerships that promote sustainability and responsible business practices. These initiatives provide platforms for sharing best practices, knowledge exchange, and collective action. For instance, industry associations like the International Petroleum Industry Environmental Conservation Association (208) facilitate collaboration and provide guidance on environmental and social performance improvement. The industry's engagement in such initiatives underscores its commitment to continuous improvement and driving positive change at an industry-wide level (208). Moreover, the industry recognizes the need for innovation and collaboration to achieve its GSCM and ESG objectives. Innovation is crucial for developing and deploying new technologies, processes, and business models that enhance sustainability performance throughout the supply chain. Companies are investing in research and development to explore cleaner energy technologies, digital solutions for supply chain optimization, and novel approaches to waste reduction and resource recovery. Collaboration within the industry and with external stakeholders is also vital for sharing knowledge, leveraging expertise, and addressing complex sustainability challenges collectively. By fostering a culture of innovation and collaboration, the industry can accelerate the adoption of GSCM and ESG practices (211).

In conclusion, the global oil and gas industry is increasingly embracing GSCM and ESG practices as part of its commitment to sustainability and responsible business conduct. Efforts are being made to reduce carbon emissions, minimize waste generation, promote

social responsibility, and enhance governance throughout the supply chain. The industry is actively engaged in industry initiatives and collaborations to share best practices, drive collective actions, and continuously improve sustainability performance. Innovation and collaboration are recognized as key enablers for achieving GSCM and ESG objectives. By integrating GSCM and ESG practices, the industry aims to mitigate environmental impacts, ensure social welfare, and promote long-term business resilience in the transition towards a more sustainable future.

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