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EUROPEAN OIL & GAS MAJORS FACING THE ENERGY TRANSITION:
How can oil & gas companies redefine their business model during the energy transition?

Angelica Menga [1]
Master in Business Administration

*Corresponding author: Angelica Menga

Email: **angelicamenga@hotmail.it**

ABSTRACT

The major oil & gas companies, with a particular regard in this study for the European ones, are going through a particular historical and societal period. The sector, which has always been a leader in energy supply, is having to face challenges, not only related to the production of the product but also to the impacts this has on the environment. For the first time, the industrial crisis is not linked to factors such as the price or quantity of resources, but also to social and cultural aspects, such as attention to the environment. Faced with a precise regulatory framework and pressure from society, oil companies are therefore called to account in redefining their operations and strategies. To do this, an adaptation of the current business model is also necessary, through the introduction of the transition model canvas (TMC).In fact, this can be adopted in view of the classification of the oil industry in the multi-level perspective (MLP) dedicated to socio-technical transitions. The oil industry, which is part of the sphere of the regime, is having a hard time readjusting its long-standing ways of working and thinking to face this new challenge and is therefore reluctant to accept the emergence of new models, the niches. Indeed, the study serves to listen to how the main European oil industries are reacting to this challenge and how their strategies could diversify and change over time adapting a new strategic business model, such as the TMC.

1. Introduction

The problem of energy supply has always been present in civilization, especially after the introduction of coal and oil (Klare, 2013). Since the discovery of oil, the society has witnessed the formation of an oligopoly of major companies which, worldwide, held the world's reserves (Roncaglia, 1985). These companies have dominated the market for almost a century and a half but now, the sector is facing challenges. In particular, the problem of climate change had already emerged at the end of the last century with the ratification of the Kyoto Protocol in 1997 (Solomon & Krishna, 2011). That can be considered as a starting point for raising awareness of the environmental issue. To date, the turning point turns out to be the Paris Agreement (UN, 2015), which places strict climate targets to achieve before 2050. It is one of the first strong signals that the sector is directly persecuted which, inevitably, is called to answer. Through the adaptation of the Paris Agreement in the European “Fit for 55” package (European Council, 2023), the European oil industries find themselves having to re-plan their strategy and their business model.

Although many companies have already started a path of sustainability for years (BP, 2021; ENI, 2021; Repsol, 2021; Shell, 2021; Equinor, 2022; TotalEnergies, 2022), today the direction seems to be clear. What were previously to be considered as parallel projects, aimed at pursuing the company's own objectives, now turn out to be actual regulatory obligation? The impositions of an obligation without however the planning of strategic objectives could collapse an entire system that has existed for more than a century. Added to this are other factors, such as the financial market, national political decisions, scarcity of reserves, shareholders' expectations, and even environmental associations' pressures. It is in this regard that the researcher wants to investigate this area, thus elaborating the related research question:

RQ: "How can European oil & gas companies redefine themselves to approach energy transition?"

To answer this question, it is first necessary to frame the context. As indicated by Geels (2002), we are witnessing a socio-technical transition impacting the oil industry. From here, we can therefore indicate the multi-level framework as more suitable to describe how the socio-technical change is taking place in this sector (Geels, 2002). Once it is assumed that the oil companies are part of a "regime" that has been established for years, the transition model canvas (TMC) (van Rijnsoever and Leendertse, 2020) is further added as suitable for readjusting the position of the oil industry in the context of the transition, to adapt the existing regime without destroying it. While the previous existing literature has already placed oil companies in the context of socio-technical transitions within the Geels' multi-level perspective framework, little has been explored in adapting the transition model canvas (TMC), especially concerning European oil & gas companies. This study aims to answer the research question through the testimonies of several transition managers for the European oil & gas industry. Indeed, it is indicative to see how in recent years the creation of this figure (Sondeijker et al., 2006) has become necessary, at various levels and for various sustainability projects, to make the path towards decarburization feasible. In fact, the goal of many companies is to avoid the so-called transition risk (Blondeel and Bradshaw, 2022), implying the financial and economic risks relating to the change of business, from a regime economy to a more sustainable one. What led the researcher to investigate this issue is undoubtedly its relevance but also his curiosity in listening to opinions of the sector in the face of these social and political changes. The research is therefore structured as follows: after having explained a brief history of oil companies and their main activities, the focus shifts to the context of the energy transition and regulatory obligations. This is followed by the introduction of frameworks deemed suitable for research. After that, the methodology's section aims to explain the methodological approach adopted by the researcher to carry out her investigation. After having clarified the approach, the research sample is introduced. Finally, the results obtained from the data analysis follow, which will then be discussed in the last part of the research.

2. Theoretical background

This section aims to provide a theoretical context on the world of the oil & gas industry and the related challenges it is going through in the historical moment of the energy transition. The narration is divided into three blocks: a general overview of the oil industry; an overview of the actual energy scenario and,

finally, the presentation of the framework in which the context can be inserted.

2.1. Oil & gas industry overview

2.1.1. Brief historical overview

Since its discovery in the second half of the 19th century, oil and its derivatives have become essential elements in common life and in the development of new technologies (Hassan, 2013). The industry has always been very strong worldwide, especially highlighting the American primacy (Ladd, 2017). Oil was and is used to satisfy every area of human life: mobility, industry, and heating (Hassan, 2013), for example. One of the first breaking points occurred in 1973: the energy crisis led to a shortage of the product and even to a lack of imports from Arab countries (Venn, 2013). From this moment on, the hegemony of the leading companies of the time (the so called 7 sisters) ceased with the consequent emergence of the Arab powers, which still today hold most of the world's crude oil reserves (around 67,1%) (OPEC, 2021). The term coined by Enrico Mattei (Luciani, 2012) to the Iranian cartel formed by the oil companies of the time (Royal Dutch Shell, Standard Oil, Anglo Persian Oil, Mobil, Chevron, Gulf and Texaco) (Sampson, 1975). Today, a further distinction is applied: oil companies are divided into private (IOCs) and state-owned (NOCs).The former is subject to the rules of competition and the market, while the latter depend solely on the interests of the country to which they belong (Al-Fattah, 2013). In this case, European companies are classified in the category of IOCs, even if this terminology is becoming increasingly obsolete given that many of them have redefined themselves as "energy companies" (Lu et al., 2019). In fact, this is one of the industry's first responses to growing climate restrictions. Especially in Europe, these companies must adapt to climate commitments and consequently readapt their portfolio.

2.1.2. Oil & gas core business activities

The typical activity of the oil industry can be divided into three main operations regarding hydrocarbons: upstream, midstream, and downstream (Davcheva, 2019).

- Upstream: upstream activities refer to the oil & gas exploration, field development and production.
- Midstream: midstream activities refer to the transport, processing, and storage.
- Downstream: downstream activities refer to the refining process and the market distribution of the final fossil-based product.

When oil companies manage to cover all these activities they are called “integrated oil & gas companies”, even if today many come together in some of these three phases to minimize costs and risks (Haller et al., 2007). Although some products processed during the midstream phase can be sold, for example, to other industries such as chemical or pharmaceutical, the main products are those coming from the last phase. It is basically fuels, in liquid or gaseous form, intended for the transport of people or goods (cars, heavy vehicles, planes, ships) or to satisfy other needs, such as heating, for example. This regime has continued to function for more than a century but, especially in Europe today,

several factors lead the oil industry to diversify in order to continue to exist in the market: climate measures, such as the Paris Agreement (UN, 2015); criticism from society (Boyer et al., 2020) and environmental movements (de Moor et al., 2020); the monopoly of energy resources in the hands of a few countries (Norouzi and Fani, 2021; OPEC, 2021); the recent war in Ukraine (Kolaczkowski, 2022) and the fear of a new pandemic (OECD & IEA, 2021).All these factors have led the oil companies the necessity to adapt to a new scenario and, consequently, to develop parallel alternative products and services.

2.2. Energy scenario

2.2.1. Energy transition and consequences for the oil & gas industry

The International Renewable Energy Agency (IREA) describes the energy transition as a pathway toward the transformation of the global energy sector from fossil-based to zero-carbon sources by the second half of this century (IREA, 2022). The main aim is to gradually eliminate CO2 emissions into the atmosphere by 2050, to become carbon neutral. The energy sector and consequently the oil sector have always gone through periods of transition. In fact, from a historical point of view, one of the first transitions took place while passing from the coal era to the oil era between the end of the 19th century and the begin of the 20th century (Klare, 2013). Nowadays, we are experiencing the begin of the renewable energies' era. However, one of the substantial differences from the past energy transitions is the fact that the actual process is not driven by the best features of a new product, but by the convergence of governmental, social, and economic factors (Berkhout et al, 2009; 2012).In this case the transition is not opportunity driven by the improvement of the technological, functional, or economic aspects of the product, but is more problem driven because of the effects that this product brings to the environment (Fattouh et al, 2019). This means that it is not a natural market mechanism, but forced by external government actors (Fattouh et al., 2019).Furthermore, the more the population increases, the more the energy demand increases, causing a shock within the system, especially if the supply is not adequate. This energy transition is harder to deal with than the others as it excludes all products that emit carbon from the energy offer, reducing its availability overall (Fattouh et al, 2019). The paradox is that, now, the increase in population also leads to a greater consumption of energy and therefore of emissions but, in the future, the inability to adjust the offer in the face of the increase in population will lead to a shock of the economy (Hannon, 2022).The question is therefore being able to satisfy the energy demand in the face of population growth only using renewable energies which are currently scarce (IEA, 2021; Holecheck et al., 2022). Now, the path drawn up by the European Union to achieve climate neutrality is the "Fit for 55" package (European Council, 2023), which implements the objectives of the 2015 UN Paris Agreement. The main goal is to reduce carbon emissions by 55% by 2030 and achieve climate neutrality in 2050. These measures are aimed above all at the oil industry and particularly at the mobility sector. The production of fuels for

mobility is around 70% (Eurostat, 2018), thus effectively making this use one of the main areas of the oil industry.

2.2.2. Alternative fuels

One of the main measures to reduce emissions is the use of "alternative fuels". This large category mainly includes low carbon fuels, hydrogen and even electricity. Low carbon fuels would in fact be one of the main components on which the oil industry could focus, as they are almost compatible with the infrastructures present now and with all range of transportation currently moving. In addition, they can cover the same uses of the conventional fossil fuels. Low carbon fuels include:

- Biofuels: mixed with other components or pure. The origin of these products can be vegetable, animal and from algae (Khan et al., 2021).
- Biogas: it can be produced “from organic waste, livestock manure, and agricultural residues through biological degradation and is a byproduct of the microbial breakdown of these wastes” (Bhan et al., pp. 325, 2020).
- Recycled carbon fuels: they are obtained from unsorted waste and plastics (Stančin et al, 2020).
- Refuels: synthetic fuels obtained from the combination of renewable energy and carbon capture storage (CCS) (eFuels Alliance, 2023).

The first three categories allow a reduction of final emissions of up to 55, 90 and 40% circa respectively, while the eFuels allow a 100% reduction (European Alternative Fuels Observatory, 2023). Regarding the hydrogen, depending on the way it is obtained, a reduction of up to 100% can be achieved if obtained from renewable sources (European Alternative Fuels Observatory, 2023). However, it is not compatible to the current range of circulating transport, as is the case of electricity. One of the main measures contained in the Fit for 55 packages is to ban the registration of cars with internal combustion engines from 2035. The inclusion of LCFs in the network would allow oil companies to survive in the near-term, to be able to study a strategic plan to adapt to the market. Although the legislation could reconsider some points up to that moment (AGI, 2023), the use of the LCF could also help in the medium to long term. They would support future growing energy demand, diversify the energy sources available (Yuksel, 2021) and make each country independent from the main holders of the world's resources, even from the nations which possess the components necessary for the electricity supply chain (Madureira, 2021).Furthermore, the existence of more alternative energy carriers available on the market leads to a reduction in costs (Yuksel, 2021).

2.2.3. Oil majors’ strategies for decarburization

A business strategy is defined as “the result of choices executives made, on where to play and how to win, to maximize long-term value” (Favaro et al., pp. 1, 2013). Or, again, as “the firm's working plan for achieving its vision, prioritizing objectives, competing successfully, and optimizing financial performance with its business model” (Business Encyclopedia, 2023). Business

strategy involves three levels – corporate, business, and functional (Pahwa, 2021), in which internal and external actors interact (Chamberlain, 2010). In the case of energy transition's strategy for oil & gas companies, the external actors are the main drivers who move the decision within the firm's environment (The geographer online, 2023).

The common points between the strategies adopted by the oil & gas majors, according to their reports (BP, 2021; ENI, 2021; Repsol, 2021; Shell, 2021; Equinor, 2022; TotalEnergies, 2022), are mainly aimed at: developing biofuels and biochemical's; investing in renewable, such as solar and wind; developing electric mobility; carbon capture, energy and hydrogen storage; but also, parallel projects such as reforestation, culture of raw materials for biofuels production, geothermal and circular economy activities. While companies such as TotalEnergies, Repsol and BP choose to diversify their product portfolio while maintaining the focus on oil for now, others are trying to move more and more towards renewable energies. This is the case with companies like Shell, ENI and Equinor. Mostly, these operations are possible through acquisitions or partnerships (Cherepovitsyn and Rutenko, 2022).

2.3. Framework

2.3.1. Socio technical transition

The current energy transition could be insert in the macro category of the "socio-technical transition" (Rip et al., 1998; Geels, 2002). The socio-technical transitions concern the socio-technical systems, which are explained through the societal functions of energy supply, mobility, and food production (van Rijnsoever and Leendertse, 2020). Socio-technical transitions regard not only the technologic process but also policy changes, consumers' demand, innovation systems and need of new infrastructures (Rip et al., 1998; Geels, 2002). The transition could bring to the disruption of the actual socio-technical system and consequently with the replacement or the integration of a new socio-technical system, or to the complete substitution of it, which often emerges from a niche system (Geels, 2005; van Rijnsoever and Leendertse, 2020). Both socio-technical and niche systems are composed by three interrelated elements: actors who form supply chain; set of rules that control the actions of the actors; and infrastructures that make working the entire system (Kemp, 1994; Chappelow, 2019; van Rijnsoever and Leendertse, 2020).

2.3.2. Multi level perspective (MLP)

The most popular framework in which socio-technical transitions are analyzed is the multi-level perspective one, proposed by Geels (2002). Indeed, transitions are read through the correlation of multi-dimensional developments at three different levels: landscape (macro-level); regime (meso-level); and niche (micro-level) (Geels, 2002; Geels, 2014).

• Landscape: the landscape level comprehends the development of external factors to the regime and niches, which however could have an influence on them. These developments are quite slow and could regard political, macro-economic or cultural aspects (Geels, 2002; Loorbach and Rotmans, 2006).

• Regime: socio-technical systems are saw as established regimes which explicit a specific function in the society, in this case regarding the fossil fuel industry. Innovations are hard to be adopted because is already existing a set of organizations, methods, and rules to make the system work (Geels, 2002; Loorbach and Rotmans, 2006).
• Niche: the niche environment creates opportunity for innovation and creativity, where regime-deviant practices are adopted (Geels, 2002). In this case, niche is identified in alternative energy solutions: low carbon fuels, hydrogen, electricity.

Niche, which is the birth and developing environment of radical innovations, creates pressures on the established regime in order to emerge. The consequent destabilization of the regime allows niche to have an opportunity to come out. The alignment between the niche and the regime causes the breakthrough of radical innovation which, however, meets the differences of the multiple dimensions of the regime (economic, cultural, infrastructural, technical, political…) (Geels, 2014). The correct transition could happen only if the developments at the three levels move together in the same direction (Geels, 2002).

2.3.3. Transition model canvas (TMC)

The transition model canvas is one of the practical ways to explain the MLP because "systematically analyze, accelerate, or evaluate transition processes" (van Rijnsoever and Leendertse, pp. 235, 2020). Geels and Schot (2007) suggested several possible transition pathways:
• Reproduction process: with no external landscape pressure, the system will remain stable.
• Transformation path: if there is a moderate landscape pressure when niche innovations are not ready yet, the regime will modify the direction of the development.
• De-alignment and re-alignment path: if landscape is changing drastically, the regime will fall, causing a de-alignment. However, the scarcity of niches, bring the niche level to develop multiple solutions. Eventually, one of them will be successful, forming a new regime.
• Technological substitution: If a massive landscape pressure coincides with the full development of a niche, this will cause the complete replace of the existing regime.
• Reconfiguration pathway: Some niches are adopted to solve problems in the regime.
• Sequence of transition pathways: if in the landscape there is a disruptive change, multiple ways of transitions will be adopted.

Van Rijnsoever and Leendertse (2020) see the last point as the possible scenario for the current energy transition. For this reason, the TMC is designed both for incumbents (regime actors) and niche, because the model supposes to promote collaboration (van Rijnsoever and Leendertse, 2020). Oil & gas firms are suggested to adopt an integrated energy and transition approach if they want to be part of the transition (Hoekstra et al., 2017; Chen et al., 2020). Since a sudden change from one regimen to another is

completely unthinkable (Hoekstra et al., 2017) indeed it is suggested that the transition management approach aims to "develop appraisal and valuation techniques that could inform a choice between different technologies" (Elzen et al., 2004; Hoeksa et al., pp. 6, 2017). The TMC consists of four blocks: identify the transition goal; analyze the incumbent; analyze the niche; analyze the landscape (van Rijnsoever and Leendertse, 2020). With consideration of the van Rijnsoever and Leendertse framework (2020), only one subsequent study has adapted this model for studying a particular change into the oil field (Campos and Viglio, 2021). The scholars have highlighted how the introduction of an alternative fuel "has extended the current system, rather than competing with it" (Campos and Viglio, pp. 36, 2021), meaning that the introduction of a niche into the oil companies'regime in the near term would not destroy the system but support the final transition goal.

3. Methodology

This section presents the methodology chosen for this research. The section initially starts with the identification of the research philosophy and the research approach. Then, it moves on to the research design and the sampling. Finally, data collection and data analysis are following. In addition, to reach the level of completeness, the research design limitations are presented.

3.1. Research philosophy

Research philosophy refers to the relation between the process of developing knowledge and the nature of that knowledge (Saunders et al., pp. 108, 2019), and is the starting point of every research design (Creswell, 2007). Then, the philosophy describes the way the researcher sees the world and underlines what is relevant for him, defending the line of thought he is following over all other philosophies he could has adopted (Johnson & Clark, 2006). Through an ontological assumption, which refers to the nature of reality (Creswell, 2007; Saunders et al., 2019), the chosen approach is constructivism. This philosophy approach is typical of qualitative research (Edmondson & McManus, 2007). Constructivism allows the researcher to observe the various manifestations of the phenomenon under study through the different perspectives of the sampled participants (Myers, 2019).After having identified a research philosophy in line with the researcher's vision of the world, it is necessary to define an approach to follow in continuing the investigation. For a qualitative study with an inductive approach, the grounded theory is identified as the best way to continue the research (Glaser & Strauss, 1967; Charmaz, 2006).The inductive method, also identified as bottom-up process, bases its validity on the collection of specific and different observations of reality which, together, will constitute the general theory. When using grounded theory, in fact, the collected data – although apparently different from each other, will be collected to find and generate a common theory (Thomas, 2006; Creswell, 2007).This implies that there is little previous literature on the subject that the researcher intends to analyze (Creswell, 2007) or, if it exists, it doesn't exactly cover the research question that moves the entire study, resulting then as incomplete. This study then aims to build a new theory about the oil & gas companies' product portfolio in the recent energy scenario.

3.2. Research design

The study would be exploratory (Saunders et al., 2019) to find out what are the new insights

of a phenomena or a problem (Robson, 2002). This objective is pursued by administering one-to-one interviews to the sample analyzed. This allows great flexibility according to each context (Saunders et al., 2019), without however forgetting the direction to follow (Adams &Schvaneveldt, 1991). The interviews are the semi-structured type, to satisfy all the doubts and curiosities emerged along the dialogue (Rubin & Rubin, 2012). Regarding the whole interview process, seven steps are identified (Kvale&Brinkmann, 2015): thematizing (1), designing (2), interviewing (3), transcribing (4), analyzing (5), verifying (6) and reporting (7), which have been scrupulously followed.

1. Labels the entire purpose of the research, according to the research question.
2. Designs the questions and their macro-themes.
3. Conducts the interview following the design chosen in the previous stage.
4. Transcribes the audio or video recording of the interviews into text.
5. Analyzes the collected data through a suitable method.
6. Verifies the findings based on the dependability, credibility, transferability, and conformability.

3.3. Sampling

The researcher selects a sample for the study to reduce the time and the cost to all the data available (Saunders et al., 2019). Starting from a “population” case, which describes the social environment the researcher wants to investigate; sub-groups are then identified as a study portion (Saunders et al., 2019). The non-probability way of sampling is the one chosen, because is based only on the subjective judgment of the researcher (Saunders et al., 2019). The convenient number of people to meet the sample is mentioned by Guest et al. (2006) and should be 12, even though Creswell (2007) encourages reaching 25 to 30 interviewees to obtain more different insights. For this research, due the low number of data collected (12 interviews) the specific sample chosen is the purposive one (Saunders et al., 2019), as it is based on the researcher judgment of meet his purposes and it is often linked to grounded theory (Saunders et al., 2019). Although this sample is not fully representative of the total population (Saunders et al., 2019), it implies that the analyzed portion is strictly connected with the phenomena the researcher wants to explore (Etikan, 2016). It also should be added that initially snowball sampling were preferred but, because of the difficulty to reach the high-level people and the competition in this industry, this operating way has not worked. However, this has prevented probable bias during the research and in no way denied the efforts to find the roles that could best contribute to the research. The researcher has then identified as a population of the study the oil & gas companies, geographically located and operating in Europe. Instead, as regards the roles taken into consideration, the energy transition managers – or those who covered the same responsibilities, although called differently, were interviewed.

3.4. Data collection

Once defined the sample, this section provides an explanation on how the data are obtained. The study considers 12 semi-structured interviews as a primary data, conducted between November 2022 and January 2023. Each interview required different dialogue times– due to the nature itself of the semi-structured interview, between 25 and 40 minutes, depending on the length of some of the interviewees' answers, as well as on additional questions. Empirical data are generated from all the 12 interviews, which

have been transcribed and analyzed. Secondary data are also consulted, such as companies' websites, companies' reports, and documents. Although an interview protocol is defined, the researcher reserves the right to take memos (Glaser & Strauss, 1967) during and immediately after the interviews, to highlight the most important aspects and to integrate them in subsequent interviews. This helps the researcher narrow the field of the research even further and focus on the key aspects of it (McIntosh & Morse, 2015). The interview starts with a general introduction, in which the researcher presents himself, explains the rationale for the research and the related use of the data, asks for the permission to record the conversation. Then, the interviewee generally introduces himself. The protocol is divided as follow: questions regarding the role covered in the company; questions regarding the core (traditional) business of the company; questions regarding the new nascent business in the company; questions regarding the reasons and the strategy that led to the introduction of the new business(es).

3.5. Data analysis

The interviews are manually transcribed and therefore analyzed and coded using the data analysis' program Atlas.ti. Following the Gioia's framework (Gioia et al., 2012) data is categorized into topics and themes to obtain an overall of the results emerged. The starting point is the first order coding, where sentences from each interview are categorized (Strauss and Corbin, 1998). Then, through axial coding, the initial codes are thematically distinguished and grouped. Finally, the themes are combined into aggregate dimensions. The aggregate dimensions allow the researcher to highlight new insights that could contribute to build a new theory (Aberbach&Rockman, 2002). In this case, three aggregate dimensions are identified: (1) Product portfolio diversification. (2) Investments to ensure technological and operational excellence. (3) Consider the socio-technical environment.

3.6. Research design evaluation

3.6.1. Dependability

Consistency of findings (Lincoln & Guba, 1994): the collected data are the result of a continuous revision of the interview protocol, resulting from the additional details that each interviewee added in the previous interviews. This meant that the data collected was increasingly precise and transparent.

3.6.2. Credibility

Explanation and justification of the research interferences (Lincoln & Guba, 1994): the lack of multiple data (data triangulation) (Denzin, 1988) questions the credibility of the research. To avoid this, the researcher transcribes and analyzes the answers received by each person, even with the help of recordings and memos.

3.6.3. Transferability

Degree to which findings can be generalized to other people (Lincoln & Guba, 1994): although many details were collected, the sample is made up of only 12 elements, which refer only to the European oil & gas companies. However, although the interviewees cover a very specific role within the company, each one presents his own opinion based on his own experience, which create a certain level of transferability.

3.6.4. Conformability

Representing facts not being influenced by personal feelings (Lincoln & Guba,

1994): the researcher is not influenced by his ideals or opinions in asking the questions to the interviewees, nor does the compromise the sample or the data analysis to obtain the desired results.

4. Results

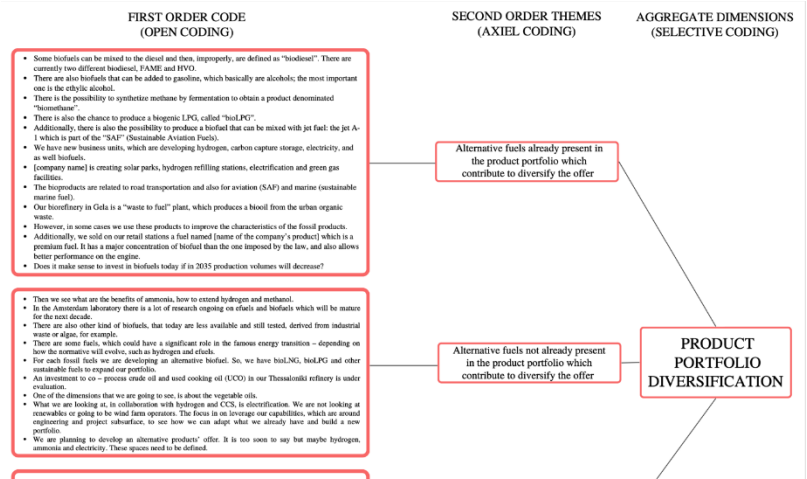
This section shows the results emerged from the data. The results are categorized under three aggregate dimensions: product portfolio diversification; investments to ensure technological and operational excellence; consider the socio-technical environment.

They are organized and presented from the micro to the macro dimension to achieve the goal of transitioning successfully from the near-term to the long-term. Each of the three aggregated dimensions has several paired second order themes, which in turn are combined with some of the significant coded sentences.

In relation to the background that emerged in the previous theoretical section:

- Aggregate dimension 1 is linked to the suggestion for oil companies (regime) to adopt an integrative transition approach for the alternative fuels (niche) in accordance with the transition model canvas (TMC).
- aggregate dimension 2 presents company's key elements as one of the operations that in the near-term can promote a way for achieving better results in approaching energy transition.
- Aggregate dimension 3 proposes the variables to consider for adapting the business model in the macro context of the socio-technical systems.

4.1. Aggregate Dimension 1: Product portfolio diversification



4.1.1. Alternative fuels already present in the product portfolio which contribute to diversify the offer

One of the first moves implemented by the major European oil companies to reduce emissions is undoubtedly the introduction of alternative fuels into the range of products offered (Stančin et al., 2020). Biofuels particularly are those that have emerged as the most developed and usable now. These are defined as one of the best solutions for the short to medium term, as they are already adaptable to most vehicles on the road without any consequences in terms of performance. Furthermore, it is the type of fuel that comes closest to conventional ones, and therefore does not require a change in infrastructure or logistics. For several years now there has been legislation which provides for the blending of biofuels for petrol and diesel, to gradually reduce emissions. However, there are those who had started this procedure regardless of the legislation, as they found benefits in terms of performance and therefore set out to offer a better product to their group of customers (see, for example, Interview n. 1 and 10).

- Interview n.1: "However, in some cases we use these products to improve the characteristics of the fossil products."
- Interview n.10: "Additionally, we sold on our retail stations a fuel named [name of the company's product] which is a premium fuel. It has a major concentration of biofuels than the one

imposed by the law and allows better performance on the engine."

The previous R&D on biofuels allows them to emerge as a possible solution for the future. Now, biofuels are mostly obtained from plant sources. However, there are still ongoing projects to obtain biofuels from other sources, such as algae. Almost all the companies present in the sample (11 out of 12, excluding interview n.5) already have biofuels in their product portfolio, even if not all of them have started marketing the pure product. The product has not yet fully found the space to be sold pure, thus considering it as a niche product. However, only one of the members of the sample (Interview n. 8) argues that it makes little sense to invest money, time, and R&D in short-term solutions (such as biofuels) if in 2035 already they could be excluded as possible alternatives.

- Interview n. 8: "Does it make sense to invest in biofuels today if in 2035 production volumes will decrease?"

However, it should be added that instead biofuels can play a fundamental role for the navy and aviation, since these two categories cannot be completely zero-impact in order not to compromise the efficiency of the vehicle. This is the main reason why biofuels can be seen as a "bridge fuel" for the foreseeable future.

A company (Interview n. 2) has also mentioned the production of green hydrogen, while other two companies (Interview n. 3 and n. 10) have grey hydrogen which, however, is fossil.

Furthermore, three companies (Interview n. 3; n. 10; n. 11), have already integrated one of the emerging niches which is one of the long-term solutions and which deviates from fuels: the columns for electric charging of cars. This already partially indicates their intention of diversifying from the label of Oil Company.

4.1.2. Alternative fuels not already present in the product portfolio which contribute to diversify the offer

In the previous paragraph, biofuels were indicated as a solution partially present and usable for the short-medium term. However, only some categories of biofuels, such as biodiesel (specifically, hydro treated vegetable oil – HVO) or SAFs (sustainable aviation fuels) are widespread. Research on biofuels is still ongoing, as demonstrated in interviews 6 and 10.

- Interview n. 6: "For each fossil fuel we are developing an alternative biofuels."
- Interview n. 10: "There are also other kind of biofuels, that today are less available and still tested, derived from industrial waste or algae, for example."

This second order theme has therefore identified all those alternative fuels, still belonging to the sphere of niches, on which research and development are still ongoing.

The projects in which investments are undoubtedly being made now are hydrogen and synthetic fuels, with a particular regard to eFuels. As for hydrogen, it is cited by almost all respondents as a project that companies are working on (11 out of 12, excluding Interview n. 11). As pointed by

- Interview n. 5: "What we are looking at, in collaboration with hydrogen and CCS, is electrification. We are not looking at renewable or going to be wind farm operators. the focus in on leverage our capabilities, which are

around engineering and project subsurface, to see how we can adapt what we already have and build a new portfolio."

The hydrogen obtained through the CCS (carbon capture storage) – and then defined as "blue hydrogen", can help the companies to reduce their own emissions and produce a low carbon fuel. Additionally, it could be used to provide electricity. Old oil & gas fields are starting to be reconverted for storage of CO2 or hydrogen, which therefore don't lead to abandonment of the land or to costs for its reclamation. The other category of hydrogen in which a lot is being invested is the green one, completely with zero impact, which comes from renewable energies, such as solar and wind power. However, as pointed by Interview n. 8 "Every company is testing this process but there aren't real plants at all.". The same has happened for eFuels, that also currently require large investments, but hold significant potential in the future. Hydrogen and the eFuels, with ammonia and methanol as well, can also contribute to the successfully decarburization of the maritime sector.

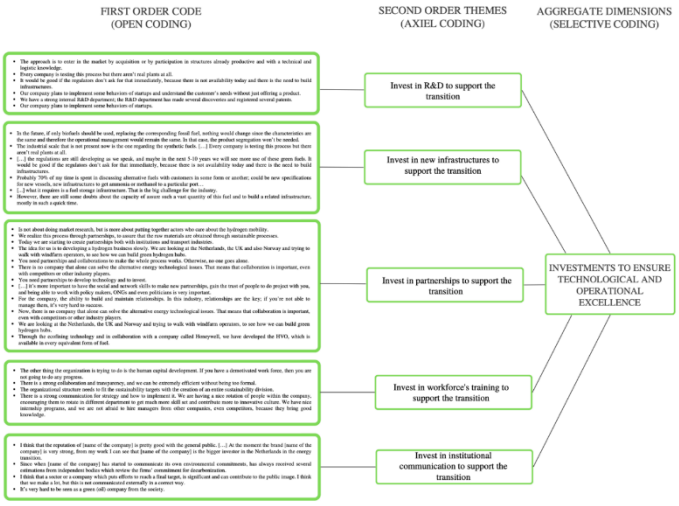
Two companies (Interview n. 3 and n. 10) have also mentioned the launch of a project not completely related to fuels but related to mobility: the mobility hub. It is a reinterpretation of the classic concept of service station, where it will no longer only be possible to fill up (naturally offering all kind of possible fuels) but also to take advantage of other services useful to people, to reduce traffic on the road. On this place that offers multi-services, it is also proposed to offer a car sharing service.

4.1.3. Projects not related to mobility which contribute to diversify the offer

Although the companies won't aim to lose their competitive advantage on fuels, several different projects not related to mobility are present in their portfolio to further diversify their value on the market. Many oil companies already have their own chemicals division but as of today, companies are mostly focusing on producing electricity from renewable, biomasses, or even geothermal energy. Two respondents (Interview n. 3 and n. 12) talk about energy production for district heating, effectively positioning themselves as actual electricity providers for people.

- Interview n. 3: "I also work with on-stream organizations to develop geothermal projects."
- Interview n. 9: "[…] we work with the biomass which is used for produce electricity."
- Interview n. 12: "For instance, could be […] looking into geothermal energy for hot water to use into district heating. We are also into chemicals, and we have our own production."

4.2. Aggregate Dimension 2: Investments to ensure technological and operational excellence



4.2.1. Invest in R&D to support the transition

Starting new projects requires a lot of investment, especially in the discovery and testing phase. The participants have highlighted how a solid research and development department is essential to carry on the study and experimentation of alternative fuels. There are those who have an "in house" research and development department, those who start collaborations with other companies, those who acquire startups or those who buy the patent directly. In each of these cases, the key element is collaboration between actors, whether they are internal or external to the company.

- Interview n. 10: "We have a strong internal R&D department; the R&D department has made several discoveries and registered several patents."
- Interview n. 12: "Our Company plans to implement some behaviors of startups."

4.2.2. Invest in new infrastructures to support the transition

The search for collaborations is not only seen for research and development, but also for subsequent stages, such as production, warehousing or distribution. Now, apart for biofuels – that have similar characteristics to conventional fuels, there are established networks regarding hydrogen and eFuels. For this reason, oil companies ask regulators to set gradual and intermediate goals to be able to build adequate infrastructures for new kinds of fuels.

- Interview n. 1: "In the future, if only biofuels should be used, replacing the corresponding fossil fuel, nothing would change since the characteristics are the same and therefore the operational management would remain the same. In that case, the product segregation won't be needed."
- Interview n. 8: "The industrial scale that is not present now is the one regarding the synthetic fuels. […] Every company is testing this process but there aren't real plants at all."
- Interview n. 9: "[…] the regulations are still developing as we speak, and maybe in the next 5-10 years we will see more use of these green fuels. It would be good if the regulators don't ask for that immediately, because there is not availability today and there is the need to build infrastructures."

4.2.3.3 Invest in partnerships to support the transition

It is also interesting to see how many participants underlined the importance of signing collaboration agreements as "you can't go anywhere alone", thus promoting a new corporate spirit to achieve a

common goal. The transition model canvas (TMC)(van Rijnsoever and Leendertse, 2020) proposes indeed the need of collaboration between the incumbents and the niche.

- Interview n. 3: "[…] it's more important to have the social and network skills to make new partnerships, gain the trust of people to do project with you, and being able to work with policy makers, ONGs and even politicians is very important."
- Interview n. 6: "For the company, the ability to build and maintain relationships. In this industry, relationships are the key; if you're not able to manage them, it's very hard to success."
- Interview n. 7: "You need partnerships and collaborations to make the whole process works. Otherwise, no one goes alone."
- Interview n. 12: "Now, there is no company that alone can solve the alternative energy technological issues. That means that collaboration is important, even with competitors or other industry players."

Partnerships can be signed for each operational level. Some participants have already signed agreements to meet climate commitments, such as:

- Interview n. 5: "We are looking at the Netherlands, the UK and Norway and trying to walk with wind farm operators, to see how we can build green hydrogen hubs."
- Interview n. 10: "Through the *ecofining* technology and in collaboration with a company called Honeywell, we have developed the HVO, which is available in every equivalent form of fuel."

4.2.4.4 Invest in the workforce's training to support the transition

Efficient collaboration within the company undoubtedly leads to a better understanding of each other, to achieving the set objectives, as well as to the personal growth of the employee.

- Interview n. 1: "There is a strong collaboration and transparency, and we can be extremely efficient without being too formal."
- Interview n. 12: "There is a strong communication for strategy and how to implement it. We are having a nice rotation of people within the company, encouraging them to rotate in different department to get much more skill set and contribute more to innovative culture. We have nice internship programs, and we are not afraid to hire managers from other companies, even competitors, because they bring good knowledge."

On the other hand, to testify how transparency and collaboration within the company is necessary, some interviewees have in fact expressed that the lack of these characteristics leads the organization to be slower and more demotivated. For example,

- In Interview n. 5: "The other thing the organization is trying to do is the human capital development. If you have a demotivated work force, then you are not going to do any progress."

4.2.5. Invest in institutional communication to support the transition

It has highlighted how the evolution of the companies over the years has increased their reputation among the public and consequently raised the level of reliability.

- Interview n. 3: “I think that the reputation of [name of the company] is pretty good with the general public. […] At the moment the brand [name of the company] is very strong, from my work I can see that [name of the company] is the bigger investor in the Netherlands in the energy transition.”
- Interview n. 10: “Since when [name of the company] has started to communicate its own environmental commitments, has always received several estimations from independent bodies which review the firms’ commitment for decarburization.”

However, on the other hand, the lack of external communication could be a problem for the company.

- Interview n. 1: “I think that a sector or a company which puts efforts to reach a final target is significant and can contribute to the public image. I think that we make a lot, but this is not communicated externally in a correct way.”

4.3. Aggregate Dimension 3: Consider the socio-technical environment

4.3.1. Consider the Fit for 55 packages

The main reason why the regime must evolve is the presence of a precise regulatory framework. Confirming an ongoing transition, this variable impacts on all three levels of the framework proposed by Geels (2002). The main reason why the oil companies are driven to adopt low environmental impact measures, which consequently cause the emerging of niches, are the European regulations, which go hand in hand with what is currently present in the landscape: rising climatic temperature, economic and political crisis, scarcity of resources.11 out of 12 participants explicitly confirmed that the main cause of their new considerations is European regulations. The remaining one (Interview n. 5), although has not mentioned specifically the normative, anyhow mentioned the “energy transition” as the cause of the change. In particular, the most cited provision that moves the operations of oil companies are Scopes 1, 2 and 3 envisaged by the GHG Protocol (Deloitte, 2023).

It has also emerged that some companies are struggling to adapt as laws are constantly changing and revising. However, setting medium and long-term objectives to combat emissions and adhere to laws is a fundamental aspect to ensure the survival of oil companies.

- Interview n. 1: “The introduction of these products is a not a choice made by the single one, because it is a somewhat forced by legislation.”
- Interview n. 2: “[…] we need to reduce our own emissions of the refinery and petrochemicals because of Scope 1 and 2 but as well to produce products which are low in term of carbon content, so reduce emissions respecting Scope 3.”
- Interview n. 12: “There is a mandatory requirement only for road fuels momentarily and we don’t know how the regulations will look like.”

4.3.2. Adapt the alternative fuels' offer to market and customers

As pointed in the Interview n. 12, the effect of the energy transition will directly impact the market, with the consequent evolution of the competitiveness rules.

- Interview n. 12: "From the market trends we also know that the demand for fossil fuels is going down and there is no other way: you are an innovator or you will die."

This automatically means that the regime environment is assimilating the normative framework which also influence the main actors around: the customers (Axsen and Kurani, 2012). Based on the customers' request, oil companies have to offer as many solutions as they can to satisfy their needs. Customers, from suppliers to end users, perceive the use of fossil fuels as limiting for them too and consequently ask the oil industry to reply.

- Interview n. 3: "We work with customers and they make the choice, someone wants all electric, someone wants all hydrogen and someone else wants both."
- Interview n. 12: "There is already a push from the market side to introduce such new products and this is coming from buyers and customers, which are the final users of the products, because people want green products and being associated with companies which put sustainability in their targets."

Each customer, always entering the framework of regulatory uncertainty, requires the solution that could best adapt to its needs, and this inevitably leads to the development of as many alternatives as possible to survive and compete on the market.

- Interview n. 7: "In order to come up with a solution for a customer, you need to understand what the challenges are and to make the business more efficient."
- Interview n. 10: "We chose in advance the technology to develop but, as a company, we offer to our customer's as much as possible solutions, both talking about energy carriers and fuels. The purpose is to make the client do the best choice for him."

In fact, as highlighted in interview n. 2, when the market will finally stabilize, a new regime will therefore be created, and one or more solution(s) will win.

- Interview n. 2: "The key for us is to follow the demand: when the fossil fuels will decrease, the production will be adapted in Europe overall, and then we will see how the competition between different actors will happen. It is going to be just market and competitors' adaptation, depending on regulative competitiveness."

4.3.3. Consider the company's growth ambitions

Although external agents are the main causes of movements within the regime, several companies also try to set personal growth goals to lead the industry. In fact, to define a correct business model, it is also essential that the industry is not guided solely by factors such as legislation or competitors, but that it sets its own long-term objectives. Although the sector is always the same, each company must become the protagonist of the process by highlighting its strategic skills and ambitions for the future.

- Interview n. 3: “[name of the company] wants to be a big player in the future, because this is also what shareholders expected from us.”
- Interview n. 6: “We need to achieve our goals and so our offer will be completely different compared to what we currently have.”
- Interview n. 9: “For us will be a big opportunity because we have all the competences to support this big change.”

5. Discussion and Conclusion

In presenting the discussion part, the transition model canvas (TMC) (van Rijnsoever and Leendertse, 2020) will be applied for each aggregate dimension. To clarify, after making the distinction between “incumbent” and “niche” – where the former refers to oil companies and the latter to alternative fuels, the authors ask to identify strengths and vulnerabilities of each regime. By doing this, pros and cons will be exposed.

5.1. Discussion on findings

5.1.1. Product portfolio diversification

In interpreting the results, it has emerged how the oil incumbent system can integrate the niche system through the diversification of its product offer. In fact, this action is a fundamental point for immediately approaching the energy transition and starting to promote actions to adopt the Fit for 55 normative (European Council, 2023). Business diversification has always been one of the strategic moves when the core business is in decline, there is an excess in capital or there is external pressure (Mitchell, 2023). For what concern mobility, which is the fundamental aspect that the normative covers, almost all companies have already incorporated some alternative products. Some companies started this process with a special regard for biofuels, which are like the existing main business product’s derivates. Due to the already tested reliability of these products, they could in fact already be ready to be put on the market right away, especially because they are compatible with the current fleet of vehicles with an internal combustion engine (Bioenergy Association, 2023). The pros in adopt these kinds of fuels are mainly the fact that they do not require a change in the infrastructure or in the habits of consumers and, of course, they reduce emissions (Lark, 2023).Oil companies mostly produce or buy biofuels of different kind to be mixed with conventional fuels, because of the RED II directive (EU Science Hub, 2023). Even though the percentage of biofuels will increase over the years, the pure product is hard to be sold if people have the possibility to spend less for conventional fuels (Løkke at al., 2021). The legislation does not yet ban the sale of fossil fuels, and, for this reason, oil companies continue to invest and sell conventional fuels, which are cheaper compared to high quantities of biofuels (Lark, 2023).There is a need to produce fuels cheaply and on a large scale before being replaced by conventional ones, which is not yet possible. Oil companies know that until there is a real ban on the circulation of internal combustion cars, alternative fuels will have a limited space, and this is why research on alternative solutions is still going on. Furthermore, fossil fuels will still be used for other types of transport, such as ships and planes, which cannot be fully decarbonizes now. However, the legislative climate does not play in favor

of the oil companies which in any case have to adapt in studying more different solutions for the near future, especially concerning the European market. It is for this reason that other spaces, such as hydrogen or eFuels, are investigated. However, the study on the storage of hydrogen and the production of eFuels is now very expensive and lacks in infrastructures are present. Fossil fuels' revenues are also used in part to be invested in the research and development of alternative solutions, as well as in the construction of new infrastructures, thus preventing this from being definitively cut. That is why oil companies are also focusing on offering services such as electric charging for cars or becoming electricity providers. Electricity can be produced both from fossils and renewable, and so in this way oil companies can satisfy the demand as well for electric vehicles or district heating. Some implications are then found:

- Product portfolio diversification, through an integrated niche approach, is useful to reduce the transition risk.
- For what concerns internal combustion engine's vehicles, which are the majority in Europe, hypothetically biofuels could be the best solution to achieve decarburization in the near-term.
- Oil & gas companies are very careful in invest in new solutions because of the continuous change in the regulatory framework.
- Oil & gas companies are choosing to be also energy providers as it could be convenient and profitable in the long-term.

5.1.2. Investments to ensure technological and operational excellence

In developing a business strategy to cope with the energy transition's goals, few actions emerged as necessary: invest in R&D; invest in new infrastructures; invest in making partnerships; invest in the workforce's training; invest in institutional communication. The research and development department is fundamental for studying alternative fuels and could be seen as an innovation niche incubator. Niche can emerge in two ways: discoveries can be made "in home", meaning that some oil companies have a R&D department and invest their resources on these activities; or startups could collaborate with them develop the niche to emerge. However, not all companies allocate the same funds for the R&D of alternative fuels, due to either financial reasons or strategic outlook. This means that some spend more time and resources looking for something new, while others study the environment and the market waiting to adapt to the most successful and economic solution. This can be addressed as one of the reasons why the research for alternative solutions is slow and still ongoing, and different between each company. Related to the development of new fuels, there is the question of infrastructures. For some products, such as hydrogen or eFuels, there is not a network of infrastructure within Europe, which is necessary for their chemical characteristics. This then implies that for some alternative fuels will be harder to penetrate the market. The success of the company, and the consequent leadership on the market, is also linked to the ability to know how to entertain and maintain relationships with

partners. Partners are fundamental during transitions in each level, including R&D and the build of infrastructures, but not only. Oil companies should start to collaborate with their competitors, to go together toward a secure future. Collaboration between them and the use of their specific skills is the only way to accelerate the search for valid alternative solutions with low environmental impact and the relative construction of a network. Furthermore, this would halve risks and costs and would allow oil companies to maintain their leadership on the energy supply market. Consequently, the more a company invests, the more it attracts capital. A company with an excellent reputation in society has more chances of attracting investors and customers, especially if it can offer them as many alternatives as possible for their needs. However, not all oil companies have understood the importance of communicating their achievements externally, above all leaving room for consumers not to understand what they could offer. Furthermore, a company works efficiently especially if its workers are motivated, respected and gratified (Martela and Pessi, 2018) and there is a growing willingness to educate them on sustainable targets. Some implications are then found:

- R&D plays a fundamental role in the discovery and testing of alternative solutions, even though not all companies allocate enough resources.
- The lack of adequate infrastructures damages the development and diffusion of some alternative fuels.
- Partnerships in the oil sector are important in promoting niches.
- The more a company differentiates its product portfolio, the more attract investors.

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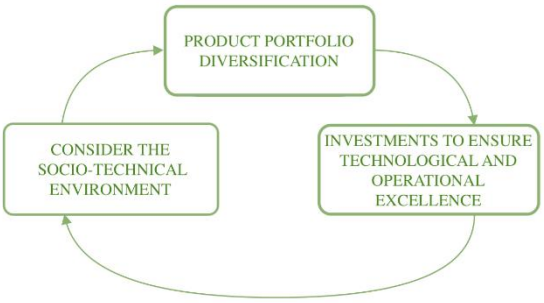

To summarize, what is emerged as winning solution for European oil & gas companies is to focus their business on these three variables, which are interrelated. A first approach to respect and follow the energy transition could be the product portfolio diversification. The introduction of more alternative solutions allows the industry to understand in which direction move, according to the current normative framework and the market and customers' demand. However, since some technologies are more developed than others, continuous investments are requested, especially in the preliminary phase. Although acquisitions and partnerships are the best way to achieve future successes, institutions should provide more incentives for oil companies, if they want results in the short-term. Each oil industry, in fact, takes care of the environment cause, sometimes even setting aside their own goals unrelated to the energy transition, but collaboration with the legislators is needed.

5.2. Theoretical implications

This study contributes to expand the research about the oil & gas industries and their adaptation in the current historical moment of the energy transition, oriented towards decarburization. The available literature is often very discordant or critical, and the vision

is often driven by civil society or the legislator, therefore failing to understand opinions from the corporate point of view. The results of the research led to highlighting the aspects that oil companies should improve to better approach the situation and ensure their long-term survival. Particularly, attention fell on the establishment of company objectives and strategies. It emerged that many companies aim at diversifying their portfolio, which inevitably cannot be centered solely on oil & gas and related activities. However, given the uncertain climate, oil companies still find themselves wandering in the dark, experimenting with multiple solutions but without having yet set any real strategic objectives. This is why the issue is still to be explored, especially with the evolution of times and the legislative framework that concerns the energy sector.

5.3. Practical implications

The results of the research show that many companies are still unable to establish a precise strategic and operational plan for their new businesses. There are those who try to be pioneers in research, those who timidly follow the others. In fact, not everyone is willing to invest large sums of money without any legislative certainty, but many are nevertheless forced to diversify to avoid taxes and fines. The suggestion is to participate in discussion tables with legislators to set clear and coherent objectives for the industry, to avoid dissolution of the regime. Once the collaboration between the sector and the institutions is consolidated, consequently also the corporate structure can be oriented towards a more efficient organization.

5.4. Limitations

As suggested above, further research on the topic is encouraged, as this study has limitations. Already in the section dedicated to the methodology, it is highlighted how the sample is made up of only 12 representatives of the oil industry, therefore resulting very limited. Indeed, it is incorrect to think that only the testimony of twelve people can be considered representative and generalizing for such a large sector. Furthermore, the study refers only to the European area, once again limiting the research, both from a geographical and cultural point of view. In fact, European companies could widely deviate from other visions typical of other geographical areas. Additionally, even the regulatory framework in which they fit places limits on research, given that this is not present in other countries. Again, not all the interviewees clearly complied with the question protocol, often deviating on the subject. In most cases, the interviewees reserve the right to release protective information. Furthermore, the research has failed to reveal a real strategy for the oil industry. It is therefore to be considered as a starting point for future investigations. A quantitative study would have helped more since the data collected would have been more suitable to analyze following a typology of this type.

5.5. Conclusion

This study aimed to investigate how oil companies could redefine their business to meet the obligations of the energy transition. The researcher started introducing the theoretical framework for the oil & gas field, which was found in the Geels' framework for socio-technical transitions (2002). Starting from this, the TMC (van Rijnsoever and Leendertse, 2020) appeared to be the best business model framework for the industry to address this challenge. Indeed, it emerged that, through the study of the levels of the landscape, regime and niche, the oil industries

could succeed in defining strategic approaches. Therefore, an approach of diversification of the product portfolio therefore, an improvement of the business strategy and consequently of the business model emerged. Clear intentions have emerged, such as the extensive use of biofuels or the desire to focus on renewable energies. However, due to the uncertain climate, not all companies still feel the need to invest large amounts of capital in alternative investments and therefore are still unable to set a long-term vision.

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