



TITLE OF DISSERTATION:

Plateauing Energy Demand and the Rise of Renewables:
Energy Transition and Corporate Strategy of Oil & Gas Companies

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Abstract

International oil companies (IOCs) face an uncertain future for their incumbent business, with plateauing energy demand and an increasing share of renewables. Research shows that the total fossil fuel demand could decrease by 64 percent in 2050. This study aims to assess the reaction of IOCs to the looming crisis and to determine possible future actions. It asks: What are the major changes in the business environment caused by the energy transition and how can IOCs adapt to this shift? The study is based on literature review of forces pertaining to energy transition and theories of strategy, industry expert interviews and a bag of word (BoW) method analysis of IOCs annual reports. The results indicate high levels of uncertainty about energy transition for IOCs. There is a heterogeneous reaction to this uncertainty between companies. IOCs have to implement an agile mentality, overcome their inertia, set a clear direction, and acquire suitable capabilities.

Title: Plateauing Energy Demand and the Rise of Renewables: Energy Transition and Corporate Strategy of Oil & Gas Companies

Author: Max Kirchmayer

Keywords: Energy Transition, Oil & Gas, Renewables, Decarbonization, Paris Agreement, Uncertainty, Scenarios, Business model innovation, Strategy, Sustainability

Resumo

As petrolíferas internacionais (IOCs) enfrentam um futuro incerto no seu negócio incumbente, com a estagnação da procura energética e um aumento da quota das renováveis. Pesquisas mostram que a procura total de combustíveis fósseis pode descer 64 por cento até 2050. Este estudo pretende avaliar a reação das IOCs à crise iminente e determinar possíveis futuros cursos de ação. O estudo pergunta: Quais são as maiores mudanças no enquadramento empresarial causadas pela transição energética e como é que as IOCs se podem adaptar a elas? Este estudo baseia-se em literatura referente à transição energética e teorias de estratégia, entrevistas com especialistas da indústria e um método de análise bag of word (BoW) aos relatórios anuais de IOCs. Os resultados indicam elevados níveis de incerteza relativamente à transição energética para as IOCs. Existe uma reação heterogénea à incerteza entre empresas. As IOCS devem implementar uma mentalidade *agile*, superar a inércia, definir um rumo claro, e adquirir as capacidades necessárias.

Título: Estagnação da Procura Energética e a Ascensão das Renováveis: Transição Energética e Estratégia Corporativa de empresas de petróleo e gás.

Author: Max Kirchmayer

Palavras-chave: Transição de Energia, Petróleo e Gás, Renováveis, Descarbonização, Paris Agreement, Incerteza, Cenários, Inovação do Modelo de Negócio, Estratégia, Sustentabilidade

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1 Introduction

1.1 Background

Oil, gas, and energy demand, in general, have experienced steady growth. The main drivers were a steady increase in the world population and the rise of emerging markets. These characteristics of the business environment have translated into specific corporate strategies within international oil companies (IOCs). Strategies include leveraging technologies, improving recovery from existing fields, reducing environmental impact, and seeking new hydrocarbon energy sources. Renewable energy sources have also been embraced, but the overall consensus has been that these will represent only a small part of the overall energy mix in the foreseeable future up to 2030 (Steve Edward et al., 2010).

However, recent studies by various independent organizations predict that energy demand is shifting and the future will tilt predominantly towards renewable energy sources (Cherif et al., 2017; IEA, 2019; IRENA, 2019; Joeri Rogelj et al., 2019; McKinsey Solutions Sprl, 2019). A price drop due to reduced demand makes exploration projects less viable for upstream oil producers, which most recently has become evident due to the COVID19 pandemic. Downstream operators face the risk of structural underutilization of fixed capacity leading to further capacity rationalization. Retail and distribution networks are also facing significant changes due to the increase in electric vehicles and renewable resources (McKinsey Solutions Sprl, 2019).

The most critical threats of a major shift as the energy transition to a company will be external and threaten an entire group of companies. Management is often preoccupied with competitive thinking such that those threats are only detected when they reached significant scale (Rumelt, 1980).

Defining major drivers of this energy transition is crucial for appropriate strategy adoption. I begin by following Valentina Kretzschmar's (2019) four pull and push forces. Once those drivers are identified, there is the question of how to incorporate them into strategy. The basis for good strategies is commitments undertaken today, which are tailored towards the future. This evokes a strategy paradox, a corollary of the necessity to decide on a strategy, despite the high level of uncertainty about which strategy to adopt (Raynor, 2017).

Companies that face uncertainty often experience decision paralysis leaving them only focused upon improving operational effectiveness which Courtney et al. (1997) and Porter (1996) don't recognize as strategy. The next step is to determine how decision makers can overcome this decision paralysis. Following Courtney et al. (1997), scenario analysis examines the level of uncertainty and can be an effective tool for making decisions on strategic postures and lending relative weights to action.

The analysis further provides a view on the nature of the current energy transition, which is dramatic compared to past transitions and has as its goal the desire to diminish the global warming. This fact raises the question of how to incorporate ESG topics into the value proposition of IOCs, with a major focus on environmental impact. Companies have to incorporate these dimensions into strategy, and only then they will be able to establish a competitive advantage (Young et al., 2019). The TLBMC by Joyce and Paquin (2016), which is an extension of Osterwalder and Pigneur (2010), is a useful tool for incorporating those aspects into IOCs value proposition.

1.2 Problem Statement

This thesis tries to understand evolving energy trends concerning energy transition that affects the business environment for O&G incumbents. It further discusses corporate strategy for sustainable competitive advantages.

1.3 Purpose

The current academic landscape on this topic is not yet well developed. Most current literature deals with energy transition and its impact on the environment. So far, secondary research has not revealed a body of work dealing with the strategic impact of energy transition on IOCs. This thesis will contribute to strategic analysis from the perspective of IOCs.

Managerial relevance pertains to rethinking current corporate strategy of IOCs. In the past we have seen companies in various industries neglecting macro changes in their business environments with disastrous consequences. The so-called "innovators dilemma" describes how incumbents are disrupted by startups (Christensen, 1997). This thesis may be used as a guideline for corporate strategy and management decision-making of IOCs adapting to

changing circumstances. These adaptive decisions include, among other things, reconfiguring current production portfolios as well as diversification and picking the right resources, skills, and capabilities to adapt to change.

2 Methodology

2.1 Research Questions

RQ1: What are the major changes in the business environment due to energy transition and the decarbonization phenomenon?

RQ2: What are the past and current fundamental elements of the corporate strategies of IOCs?

RQ3: What elements have to be adopted to adapt to the future energy transition? How can this be done?

RQ4: What strategic insights can be derived, that should be followed by IOCs in the future?

2.2 Research Design

To answer the research questions, this thesis relies on a triangulation research approach with a combination of secondary and primary data. This based on the premise that the weaknesses of each approach are outweighed by the countervailing strengths of the others (Jick, 1979).

The literature review provides a thorough knowledge base of existing secondary data. It examines future scenarios of the energy industry with the arising shift to renewable energy and the pressure for decarbonization. It further reviews forces that influence incumbent firms to adapt to this shift. This is complemented with theoretical knowledge to provide a sound basis for further examination.

Primary data was gathered in a qualitative and quantitative manner. Qualitative data can support explicitly the meaning of quantitative research (Jayaratne, 1993). Following this approach, a semi-structured interview with a blend of quantitative and qualitative questions was conducted. A qualitative case study design proves to be a practical approach examining the transition trends shaping the oil and gas industry, the underlying market interdependencies, and incumbent firms' strategic responses.

Furthermore, integrating a quantitative approach ensures a deeper and a more holistic view of the observed phenomenon (Baxter and Jack, 2008). Hence, a (BoW) bag of words method analyzes is used to scan annual reports for relevant fields that are identified in the literature review.

2.3 Data Collection

2.3.1 Qualitative Data

A semi-structured interview format is used, as it is sufficiently structured to address specific dimensions of the research questions while also leaving space to offer new meanings to the topic of study (Galletta, 2013). Expert interviews prove to be effective when other sources are only of marginal information (Malhorta, 2010).

The interview partners represent a cohort of experts. The sample reflects internal as well as external views on IOCs. Targets include external industry experts as well as top-level employees of IOCs. These were selected based on their related expertise and involvement within the disruptive phenomenon of energy transition. Those interviews offered a sound basis for gaining in-depth insights about strategic implications for incumbents and reveal how experts assess the shift in the energy mix.

2.3.2 Quantitative Data

The annual report analysis is based on a (BoW) bag of words method. This is a commonly used feature extraction method for documents. The model examines the histogram of words of a document, with each word count regarded as a feature (Goldberg, 2017). A bag of words is a collection of words that indicates the appearance of words within a file. It includes 1) a set of familiar terms and 2) a measure of the appearance of them. The sequence or structure of the words in the text is ignored. The algorithm is only looking if there are known words in the file. The reasoning behind this is that from the content alone we can understand the purpose of the document.

A geographical diverse sample of IOCs was selected. The sample consists of nine companies, three of each geographic region (Europe, North America, Russia). A further selection criterion was a significant market capitalization and the interest of reputable analyst houses as Goldman Sachs. A summary of the companies and digital availability of annual reports is shown in Appendix 3.

The basis of this analysis is annual reports, as they serve as major means of communication with shareholders and other stakeholders about the current and future company's business components, financial measures, and strategy. To analyze how these elements have changed over time, reports up to 10 years old were analyzed for each company, depending on their digital availability.

The company's business segments, energy transition topics, Paris Agreement measures, and the toolset to deal with these changes are the focus area of this analysis. The purpose is to gain a first impression of how strategy has adapted in the light of energy transition in the past. This approach helps to quantify qualitative data with the goal to make it more comprehensive. The logic behind this approach is that a higher number of appearances of a relevant term implies a greater strategic focus.

The result of the BoW analysis, is grouped into various categories, summarized in Appendix 2.

2.4 Credibility and Limitations of the Methodology

This BoW approach has the following restrictions, 1) companies publish complementary reports on certain other topics as well for energy transition. But since all companies are doing this and annual reports are still the major report providing an overview of the business, it should not have an impact on the analysis; 2) A technical restriction involves the pdf format, that is used for the digital version of publications, in some cases deviation from the actual number of appearances can occur. To correct for this, manual cross-checks were conducted to reduce the risk of major deviation.

3 Literature review

3.1 Paris Agreement

3.1.1 Content and Goals

One of the most important provisions of the Paris Agreement is the global goal of keeping rising temperatures to “well below 2 C”, to “pursue efforts to limit temperature increase to 1.5 C” (Art. 2), and the goal of achieving a global emissions ceiling “as soon as possible” (Art. 4.1). “All Parties are to undertake and communicate ambitious efforts” (Art. 3) and “Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve” (Art. 4.2), which is reviewed in a five-year time frame. Developed countries “should continue to take the lead” setting absolute reduction targets, while developing countries are subject to a weaker commitment and “should continue enhancing their mitigation efforts, and are encouraged to move over time toward emissions reductions or limitation targets in light of different national circumstances” (Art. 4.4). “Developed country parties shall provide financial resources to assist developing countries” while “other parties are encouraged” to offer such assistance on a voluntary basis (Art. 9) (United Nations, 2015).

3.1.2 Costs of neglecting the goals

With an increase beyond 2°C, global economic output will be reduced substantially. There are forecasts that GDP per capita could be lowered by 15-25 percent by 2100 for an increase of 2.5-3°C, that is implied by current national commitments and by more than 30 percent for a 4°C warming. Achieving the 1.5°C target is projected to mitigate overall damage. Limiting warming to 1.5°C by the middle of the century instead of 2°C would result in an increase in global GDP of 1.5-2.0 percent and avoid losses of 7.7-11.1 trillion USD. Achieving these goals by the end of the century would result in an average increase in global GDP per capita of 3.4 percent and avoid a loss of 36.4 trillion USD (Burke et al., 2018).

Such calculations are discouraging, but far from tell the whole story. First, global GDP has increasingly become what start-ups refers to as the “vanity metric.” The global economy is now growing annually at 3.3 percent, but it is rapidly consuming resources that are valued, according to Global Footprint Network, at 1.75 planets worth of resources per annum. Secondly, we are still poorly positioned to quantify all the effects of climate change such as rising sea levels, fires, heatwaves, droughts, and water shortages (Jens Burchardt et al., 2019).

The Boston Consulting Group analyzed 7 countries (China, USA, India, Russia, Brazil, Germany, and South Africa) concerning their capacities to reach the 2°C Paris target and the related costs. Proven and generally accepted technologies can close the gap between the current policies and the 2°C Paris target by between 65-90 percent until 2050. The closing of the remaining gap implies a nonlinear increase in costs as measures become more far-reaching. This would need 60 percent increase of investments to 45 trillion USD through 2050. Globally, this implies a burden of 75 trillion USD or 2-6 percent of the annual GDP of the countries (Jens Burchardt et al., 2018).

3.1.3 Standard emission KPIs for IOCs

There is a common standard of three scopes of greenhouse gas emissions. Scope 1 contains direct emission from the companies' operation. Scope 2 describes indirect emissions from the companies' business activities, containing methane emissions, and flaring. Scope 3 is all other indirect emissions, heavily influenced by the end-use of products and services offered by the company. Scope 3 makes up the major share of total IOCs emissions, which are about 5 to 10 times the amount of Scope 1 and 2 emissions. All of these three scopes are measured in the standard of CO₂ equivalent (CO₂e) (Energy Intelligence Group, 2019).

Eighty-nine percent of the total GHG emissions of Europe's integrated IOCs pertain to the Scope 3 category. Furthermore, over one-third of the total Scope 1 and 2 emissions are attributable to the energy sector. Energy, utilities, and materials together amount for 85 percent of the total Scope 1 and 2 emissions (Christyan F Malek et al., 2019).

Heede (2014) claims that 63 percent of the aggregate global industrial CO₂ and methane emission between 1751 and 2010 are attributable to 90 companies. The top 10 companies by cumulative emissions are large IOCs. A third of the existing oil and half of the gas portfolio needs to be retained in the ground to mitigate global warming to 2°C (McGlade and Ekins, 2015).

3.2 Energy Transition

3.2.1 Drivers of Energy Transition

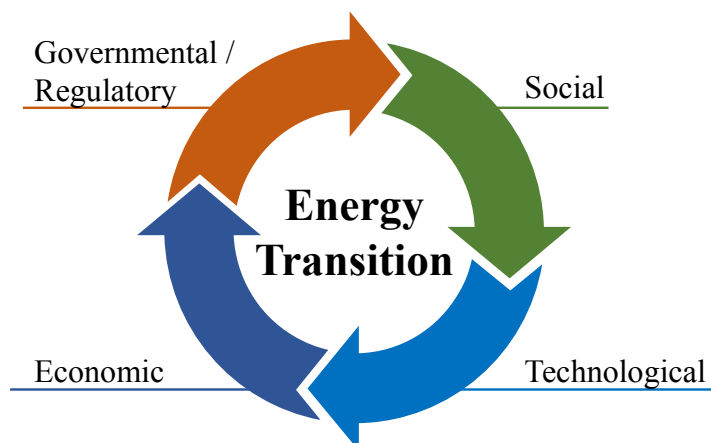


Figure 1: Energy Transition Drivers¹

Figure 1 shows the four major drivers of energy transition. Those can be categorized as pull and push forces. For companies to be able to consider the trend towards energy transition, it has to be technologically possible and economically reasonable. These two forces pull companies towards energy transition. For the technological aspect, this can be digitalization as a technology enabler or technology innovation and evolution. Falling costs of clean technology, expanded use of carbon cost mechanisms and divestments from fossil fuels are important economic drivers. Governmental, regulatory forces and social pressure push companies in the direction of energy transition. For the first, governmental carbon and clean energy policies, concerns about the security of energy supply and smart city initiatives are drivers. Social forces that push companies into energy transition entail investor pressure, legal actions, consumer preferences, and environmental movements.

Investors

Even though there is a spectrum of investor views on climate change, the pressure for IOCs to engage in climate action is increasing. Diverse investor points of view about climate responsibility of IOCs create uncertainty and make it difficult for decision-makers to choose the appropriate degree of energy transition adoption. The movement started with large institutional investors who, at the outset, were demanding stricter disclosures. Currently there is increased pressure and more direct participation forcing IOCs to act. This engagement gradually spills over to the broader range of private investors including the rise of climate

¹ (Valentina Kretzschmar, 2019)

weighted indices, which further increases the pressure on companies. Connected with investors are analysts who incorporate climate-related topics into valuations, such as emission targets, O&G portfolio risk exposure, but as well as investments in renewable energy solutions. Up to this point there is no consensus on a valuation standard for the O&G industry as it relates to climate-related topics. There is a very real risk of divestment by investors if companies fail to take climate dimensions seriously (Energy Intelligence Group, 2019).

Arabella Advisors (2018) states that 985 institutions committed to divest from fossil fuels in 2018, with an asset volume of 6.24 trillion USD. This is a doubling in divestment volume of around 3 trillion USD committed by about 400 institutions in 2015. Part of this movement is faith-based organizations (29%), philanthropic foundations (17%), educational institutions (15%), government Institutions (15%), pension funds (15%), and others (9%).

Analysts

JP Morgan has established a new valuation framework that looks at portfolio quality, fiscal deliverables, and energy transition. Those three pillars are further divided into six metrics, where metrics four and five present a formal new climate framework (Christyan F Malek et al., 2019).

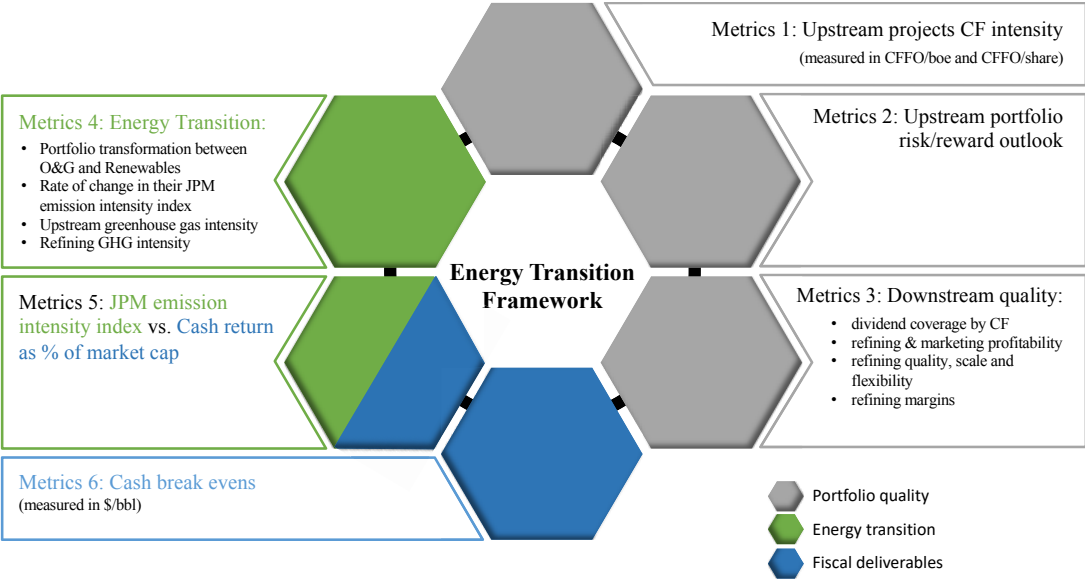


Figure 2: Energy Transition valuation framework

The framework for now only incorporates Scope 1 and 2 emissions, since Scope 3 emissions were barely discussed (Christyan F Malek et al., 2019).

Barclays' new approach starts with a base case scenario and designs upside and downside potential around it, depending on different criteria. The upside case contains the value of investments in businesses that reduce emission. The value is described by the carbon emission price which is defined by \$/t of co₂e. The downside scenario posits a lower oil price and that companies are held responsible for Scope 3 emissions of their portfolio. Barclays thinks it is not sufficient to highlight companies that score well against sustainability benchmarks. A robust ESG valuation requires total alignment with operational and financial performance (Lydia Rainforth et al., 2020).

Economic Environment

Photovoltaics and wind are becoming more competitive and profitable than some conventional oil and gas projects due to falling costs and growing market prospects. Wood Mackenzie has concluded that IRRs for renewable energy projects, on average, are between 5-9 percent. However, in scenarios with low CAPEX and high electricity prices, they could reach up to 17 percent. These returns are attractive relative to investments in downstream oil and gas operations and the low end of the expected returns offered by upstream M&A and exploration projects while representing a much lower investment risk profile. The IRR for downstream O&G is 7 percent and 8-15 percent for exploration and M&A (Tom Ellacott et al., 2018).

Mäkitie et al. (2019) observed the strategic decision making of the Norwegian O&G and offshore wind industry. They used a framework of 2 dimensions. The task environment, including commodity prices and market conditions, and the institutional environment, which includes public legitimacy and policies. They found that Norwegian IOCs tend to increase their diversification in renewables in periods of oil price downturns, as in the global financial crisis of 2008 and the market downturn of 2015, while they immediately reduce this engagement as soon as oil price recover (Figure 3).

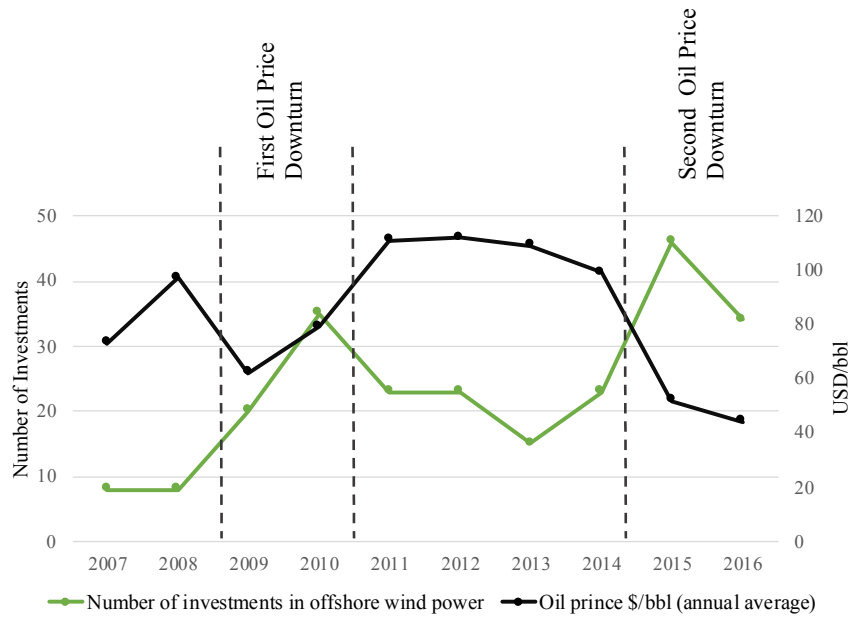


Figure 3: Engagement in Renewable Energy in Market Downturns²

Institutions and Government

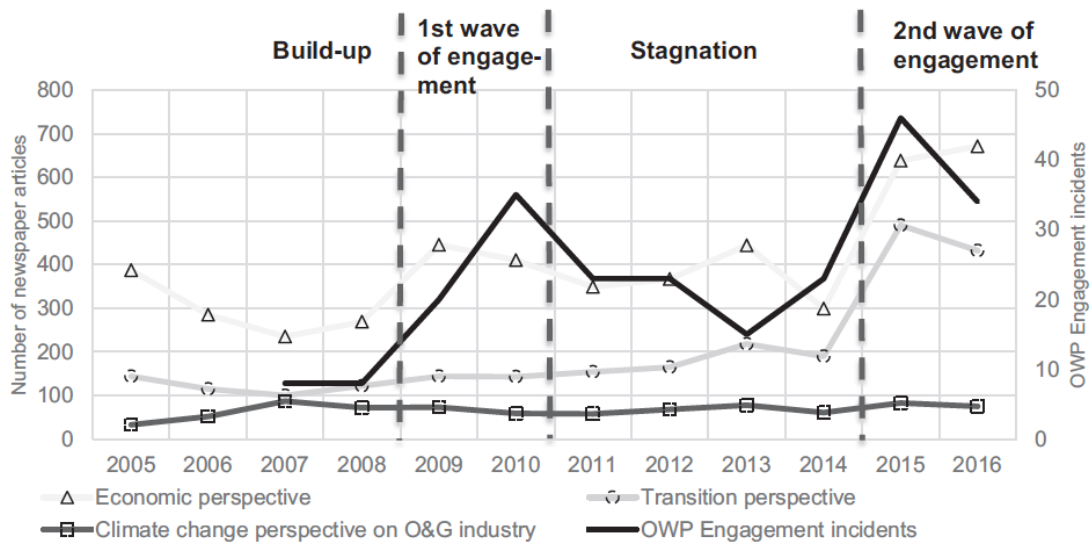


Figure 4: Newspaper attention to different perspectives of IOCs³

The reason for this immediate reduction can be explained by institutional dimensions. First, the reporting behavior of Norwegian newspapers on the O&G industry shown in (Figure 4). The economic context received most attention after the two declines in 2009 and 2015, concentrating on fear of job termination. While the transition and climate perspective got by far less attention in the media. 2015 shows an increased attention on the transition

² (Mäkitie et al., 2019)

³ (Mäkitie et al., 2019)

perspective, while the climate change perspective remained on a low level. Second, politicians did not manage to establish changes in the regulatory environment that would have supported continuing engagement in the renewable sector, after the recovery (Mäkitie et al., 2019).

Government policy is a driver for future energy transition goals (Chapman and Itaoka, 2018). Policies promote exploration, development of infrastructure, and provision of sites for experimental innovation (Farla et al., 2012; Fischer and Newig, 2016; Foxon et al., 2010; Hiteva and Sovacool, 2017). The government also incentivizes renewable energy, making it more attractive (Vidadili et al., 2017) and encouraging private sector investment by providing greater risk-sharing and reducing uncertainties of the risk/return ratio (Corsatea et al., 2014; Zhang et al., 2016).

3.2.2 Scenario comparison

All six scenarios in (Appendix 1) follow a common goal, limiting global warming to at most 2°C. Despite the same goal, they show highly different forecasted numbers, here it is necessary to mention that there are varying time horizons between 2040 and 2050. Looking at the same horizon deviating numbers are observable, which can raise uncertainty for decision-makers.

Figure 5 compares three scenarios of non-industry related agencies (NIRA) and three scenarios of IOCs. For the future energy mix, those two different types of organizations share a similar view of direction. On total energy consumption, they share a different view. For NIRA, two see a flattening, and one sees a decline, while for IOCs two see an increase and one sees a decline.

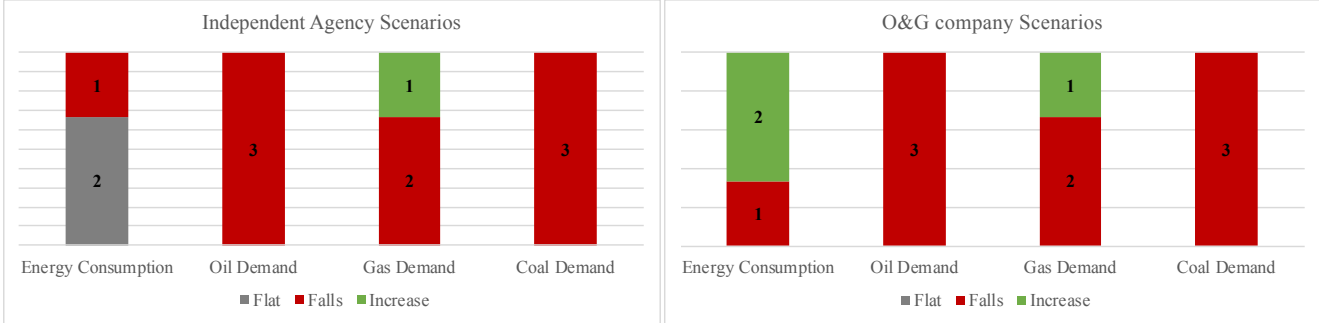


Figure 5: Forecast tendencies by different organization types

Even though the forecasted direction for the energy mix is the same for NIRA and IOCs, the total numbers describe two completely different positions (Table 1). NIRA are forecasting significant lower oil, gas and coal demand both in 2040 and 2050 while suggesting a much higher share of renewables in the total energy mix compared to IOCs scenarios.

	2040		2050	
	Independent Agencies	O&G companies	Independent Agencies	O&G companies
Energy Consumption (bn toe)	14	17	11	12
Oil Demand (Mbpd)	56	84	42	52
Gas Demand (bcm)	3792	4509	2378	3182
Coal Demand (Mtce)	2141	3631	813	918
Renewables share	53%	24%	61%	27%

Table 1: Comparison of scenarios total numbers⁴

3.2.3 Speed of Transition

There are two different views on the pace of the transition to renewables. On one hand there are Fouquet (2016, 2010); Smil (2016, 2017a, 2017b); Sovacool (2016); Sovacool and Geels (2016) that argue for a slow transition process, which is also considered as the mainstream view. Others argue for a fast transition. Their arguments are summarized in Table 2.

Slow Transition	Fast Transition
Historical data and research suggest that the energy transitions in the past were slow	Past energy transitions give a distorted view as the forces underlying the present transition are profoundly different
The extent and complexity of energy transition is so great that it leads to lock-in and path dependency	Transitions are a complex and cross-actor phenomenon. Changes that appear slow within an isolated layer can magnify in a more holistic perspective
Energy transition is strongly affected by the availability of infrastructure, which often takes time and is very costly to establish	The historical transitions rather dealt with the variation of the energy mix, in contrast to the recent transition which also deals with the adaptation to the selection environment
New energy sources are progressively enhancing their efficiency and competitiveness as a result of learning curves and economies of scale	The recent transition is supported by synergistic advances in several areas, such as blockchain, computing, nanotechnology, materials science, and biological and genetic engineering

⁴ (average numbers, if there were multiple scenarios for the same timeline)

The diffusion of innovations is a slow process. It takes time to move from a niche to a mainstream market	The recent transition is managed and coordinated, while earlier transitions have occurred more naturally as a consequence of shifts in technology, prices, demand or consumer preferences
Incumbents have current assets that impose enormous sunk costs, creating inertia and providing an economic incentive to exploit them until they are written off	Since human wisdom is a cumulative process, we can leverage what we have acquired from past transitions to accelerate present transitions
As the transition leads to disruptions, the incumbents will resist, delaying the transition process.	Previous transitions were opportunity-driven, while low-carbon transitions are problem-driven, which involves a collective public good, that engages policies as an important role, that can rapidly change markets and selection environments
Rapid transitions are rare, and when they do appear, they are exceptions related to single countries or specific contexts that have little scope for replication in other countries	Historical records do not uniformly support slow transitions. There are also historical examples of fast transitions at the national level.

Table 2: Pace of Renewable Energy Transition

Eight forces can be identified which would accelerate the speed of energy transition. 1) Faster adoption of electric vehicles; 2) More efficient and increased use of low-emission fuels in aerial and maritime transport; 3) Greater electrification of home heating; 4) Faster electrification of cooking appliances in non-OECD countries; 5) Accelerated demand for reduction in plastics and increased recycling methods; 6) More efficient and lower-emission feedstocks in steel and iron production; 7) Greater electrification of industrial low- and medium-temperature heating systems; 8) Greater cost-effectiveness of renewable energies and energy storage (McKinsey Solutions Sprl, 2018).

3.3 Strategy

3.3.1 Corporate Strategy

Environmental discontinuities, as major changes in companies' technological, political, economic, or social environment, raise a major challenge for incumbent companies (Keck and Tushman, 1993; Meyer et al., 1990). Such discontinuities can cause existing capabilities to become obsolete, forcing a cumbersome and risky process of strategic change to open up new markets or build new capabilities (Christensen and Rosenbloom, 1995; Henderson et al., 2003). Failure to address strategic changes on time can negatively impact the financial

performance of companies (Keck and Tushman, 1993). There is a high likelihood for change programs to fail, Kotter (2012) found that only 30 percent are successful.

Psychology is important for successful change management. In order for employees to embrace change, four basic conditions must be established, 1) a compelling story; 2) role modeling; 3) reinforcing mechanisms; 4) capability building. A compelling story must comprise different fields of motivation, the impact on 1) society; 2) customers; 3) the company, its shareholders, and the working team; 5) on the person itself (Aiken and Keller, 2009).

Companies have to differentiate between operational effectiveness and strategic positioning. Performing operational effectiveness makes companies carry out similar operations better than their competitors. It refers to any number of practices that enable a company to make better use of its inputs. In contrast, strategic positioning means performing different activities or similar activities differently. Strategic positioning seeks to create a sustainable competitive advantage by capturing what makes a company stand out (Porter, 1996). “Improving operational effectiveness is a necessary part of management, but it is not strategy” (Porter, 1996). A strategy is the establishment of fit between the activities of a corporate. The success of a strategy relies on doing several activities well and incorporating them. If the activities do not align, then there is no distinct strategy and little sustainability (Porter, 1996).

Strategy consists of two major parts, first strategy formulation and planning, and second strategy implementation and execution. Strategic management tended to focus on strategy formulation while neglecting the importance of strategy implementation (Grundy, 1998). Historically, it is widely thought that a well-formulated strategy is easy for anyone to implement and execute. As a result, implementation and execution have received much less attention than strategy formulation or strategic planning (Alexander, 1991; Bigler, 2001). Senior management endorse strategic plans that are no more than wishful thinking (Rumelt, 2011). This is what Rumelt (2011) defines as bad strategy, which embody: the failure to meet the challenge, confusion of goals with strategy, poor strategic goals and fluff. Bad strategic goals usually involve a list of things to do and often overlook the frustrating reality that no one really knows how to accomplish them.

Organizations have difficulty in strategy implementation and execution for a variety of reasons. First, there is uncertainty about processes. This uncertainty relates to poor leadership

in implementation, a lack of know-how and communication to steer action, ignorance or lack of clarity of strategy, lack of coordination, lack of skills, rivalling activities within teams, unfriendly market timing, unpredictable environmental factors, ill-directed operations and insufficient control and assessment of processes (Larry D. Alexander, 1985; Okumus, 2003). A good diagnosis elucidates complexities, guiding policy with an integrated approach and coherent actions that are aligned to execute good strategy (Rumelt, 2011).

Strategy evaluation is crucial -- a strategy is never right or wrong in an absolute sense. A situation-based logic, which is not limited to the one best path, can be adapted for each problem being faced. Consistency, consonance, advantage and feasibility of a strategy have to be evaluated in the course of daily activities. If top management does not clearly state where the company stands on these issues, it is likely that conflicts will continue. A significant challenge in assessing consonance is that most critical threats to a company will be external and threaten an entire group of companies. However, management is often so preoccupied with competitive thinking that such threats are only detected once the threat has reached significant scale (Rumelt, 1980).

The strategy paradox means that successful strategies often have a similar likelihood of failure (Raynor, 2017). But the cost of not making a strategic commitment is a missed opportunity; the reward is potentially an enhanced prospect of survival. The concept of requisite uncertainty tries to solve the paradox by splitting the management of these two strategy components. One is given the responsibility for fulfilling the commitments that the organization has already made, and the other is assigned the task of mitigating risks and identifying promising opportunities. Since senior management is in charge of long-term horizons, it should consequently devote its resources to managing strategic uncertainties by considering strategic options and building the capacity to pursue alternative strategies that can be valuable as key uncertainties resolve (Raynor, 2017).

3.3.2 Strategy under Uncertainty

If uncertainty makes detailed planning impossible, then the strategy is primarily about establishing general parameters for the development of the company in terms of domain selection and domain navigation (Bourgeois, 1980). Rapid transition demands strategies that are flexible and creative. These are seldom related to formalized planning. Yet, the vast

majority of companies use a calendar-driven rhythm for strategic planning, which implies that the future will be somewhat similar to the present (Hamel, 1996).

Uncertainty leads companies into imitation and hedging. Since companies cannot risk being wrong or falling by the wayside, some companies adopt all features, provide all new products, and explore all technologies. Industry growth can make certain periods profitable for many companies, but profits are short-lived when emulation and strategic convergence eventually destroy profitability in the industry. Companies will only be successful in the long run, if they start as early as possible to define and embody a unique competitive position in their activities (Porter, 1996).

Classical strategic tools are often oriented towards choosing the most probable or optimal outcomes. These are only suitable for stable environments and lead executives to look at the world in a binary way. Such views lead to risk aversion or favor gut instinct and eventually cause decision paralysis. They avoid critical strategic decisions about products, markets, and technologies. Rather, they rely on reengineering, quality improvement, or internal cost reduction programs (Courtney et al., 1997). Although such programs are valuable, they are no substitute for strategy (Courtney et al., 1997; Porter, 1996).

The authors suggest a framework to deal with uncertainty divided into three layers (Figure 6).

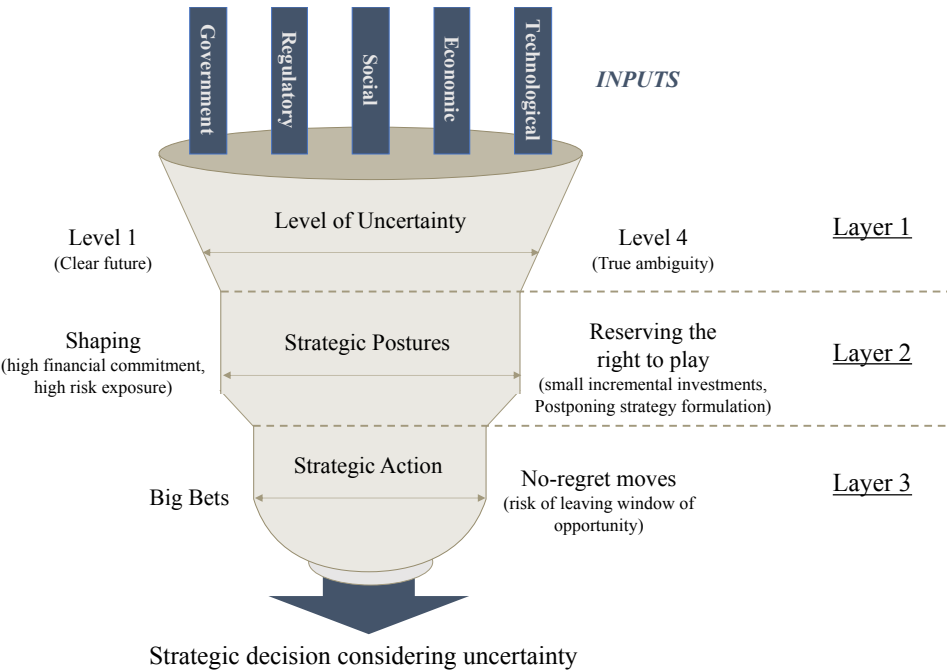


Figure 6: Strategic decision-making funnel under uncertainty

Initially the level of uncertainty has to be clarified. It ranges from a clear enough future, to make strategic decisions, to true ambiguity, where no decision can be made. The major tool for decision-makers in level two and three is the scenario analyses.

When planning multiple scenarios, no attempt is made to predict the future, but instead there are alternative views of the future in the form of different configurations of key environmental variables (Paul J. H. Schoemaker, 1995, 1993). A diverse set of scenarios obviate tunnel vision and create a deeper understanding of the myriad factors and variables that shape the future (Paul J. H. Schoemaker, 1995).

Five scenarios are the maximum to avoid decision paralysis. The difference between the two levels is described in the difficulty of defining scenarios. In level two it is possible to define a reasonable set of discrete scenarios attached with possibilities. Under level three it is only possible to describe extreme points and establish scenarios around them, since scenarios between those points require rare information. Uncertainty in level two arises from regulatory or legislative change (Courtney et al., 1997).

The second layer of this framework is about strategic postures, which outline the strategic intentions of the company. The framework provides three forms: shaping, adapting, and reserving the right to play. Those three forms vary in terms of financial commitment to a certain strategy. Especially at a higher level of uncertainty, focus on adapting rapidly provides the capacity to identify and respond quickly to market developments. Reserving the right to play puts a company in an advantageous position, either through superior information, cost structures, or customer and supplier relationships. This enables the company to postpone the formulation of a strategy until uncertainty decreases to a reasonable level (Courtney et al., 1997).

The third layer completes the strategy with the necessary action. Here the decision of how big the move in a certain strategic intent is set, there are 3 possibilities; big bets, options, no-regret moves, while each of those is suitable for certain strategic posture. (Courtney et al., 1997).

A big bet on changes in energy infrastructure is an exception for IOCs. Most IOCs budget for renewables, energy efficiency, and mobility projects is less than five percent of their total CAPEX. There are various explanations for this. Firstly, IOCs justifiably invest heavily in upstream operations to defend their core business. Secondly, there are some structural hurdles. The current surge in technology-driven energy transitions often demands more flexible, direct interaction with customers, while IOCs are typically centered in large, capital-intensive projects. Thirdly, renewables do not fit into their traditional organizational structures and thus cannot gain necessary traction. Despite these hurdles, IOCs have valuable capabilities that can turn in their favor, including 1) large R&D budgets 2) well-known brands and existing retail networks 3) experienced risk management to deal with high uncertainty 4) experience in M&A and JV to establish co-operations with smaller and more agile companies (Marie-Hélène Ben Samoun et al., 2018).

JP Morgan adds 1) large-scale upstream project management skills, which can be leveraged for offshore wind and solar 2) trading skills in oil and gas, to deal with the high volatility in the energy markets to existing capabilities. Those skills can help leverage returns of renewable energy projects above 10 percent ROACE, which are at the moment not sufficient at about 5-7 percent (Lydia Rainforth et al., 2020).

Four energy transition strategy approaches for IOCs can be identified, which differ in their degrees of commitment: 1) Commitment to a full transition to renewable energy solutions. 2) A shift to an energy provider that first keeps O&G as the core business but tries to rearrange the portfolio to a lower cost base and increases diversification into renewable energies. 3) Reconfiguration to a low-cost portfolio, but with diversification within known competencies, shifting into petrochemicals 4) National oil companies, where a major share is owned by the government, which leads the transformation agenda (Sybille Van den Hove et al., 2002).

3.3.3 Sustainability Strategy

The study of the response of multinationals to the pressures of sustainable development shows that there are two predominant but opposing perspectives. On the one hand, Rugman and Verbeke (1998a, 1998b) argue that responding to the pressure of sustainable development does not result in enhanced profitability, so MNCs should refrain from strategies that address this directly. In rare examples where there exists an international commitment (e.g. the Kyoto

Protocol) to cope with sustainable development pressures, there is no administrative enforcement to guarantee global compliance. This position is based on the belief that the response of multinationals to sustainable development pressures is not voluntary, but rather coercive forces are necessary to achieve compliance (DiMaggio and Powell, 1983).

On the other hand, there are those such as Freeman (2010), Payne and Raiborn (2001), Petersen and Vredenburg (2009) and Sharma and Vredenburg (1998) who advocate for a proactive response by MNCs to yield to the pressure of sustainable development. The premise is that the pressure of sustainable development has led to changes in the organizational environment of MNC, which demands strategic adaptation otherwise the business objectives of the company could be jeopardized.

Moreover, the ability to respond to sustainable development pressures could also provide a novel source of competitive advantage by mitigating pollution, improving efficiency and enabling new markets (Hall and Vredenburg, 2003; Hart and Milstein, 2003). This is based on the view that multinationals should respond to the push for sustainable development, not because of coercive forces, but because there are convincing arguments.

The O&G industry faces an ethical dilemma, which can be described as a trade-off between finding a profitable business and the issue of CO2 emissions causing climate change that is inherently potentially harmful to society.

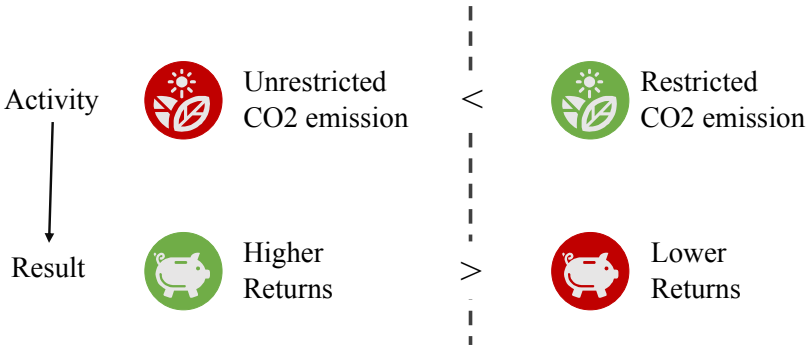


Figure 7: Climate change ethical dilemmas

Approaches to an ethical dilemma vary significantly based on the intention of a company to modify behavior. Companies that do not change their practices will strive to defend themselves by 1) softening the reasons for considering current practices harmful to society

s (Sybille Van den Hove et al., 2002)

and 2) highlighting losses incurred by the alternative practice. Those who aim to pursue alternative practices will aim to turn the dilemma around by 1) strengthening the reasons for pursuing the alternative practice and 2) emphasizing potential additional returns as a result of the alternative practice, possibly by redefining the scope and time frame of their strategy (Le Menestrel et al., 2001).

A continuum such as the RDAP-scale describes corporate responses to climate change. Reactions range from a reactive posture denying accountability, to a proactive one in which managers preempt change. Between these two poles, defensive and accommodating positions can be identified, respectively defined by reluctance to admit and acknowledge responsibility (Clarkson, 1995). Given the challenges of differentiating the last two types, a three-tier continuum (defensive, opportunistic/delayed and offensive) is used to categorize the evolution of corporate strategies on climate change (Kolk, 2000).

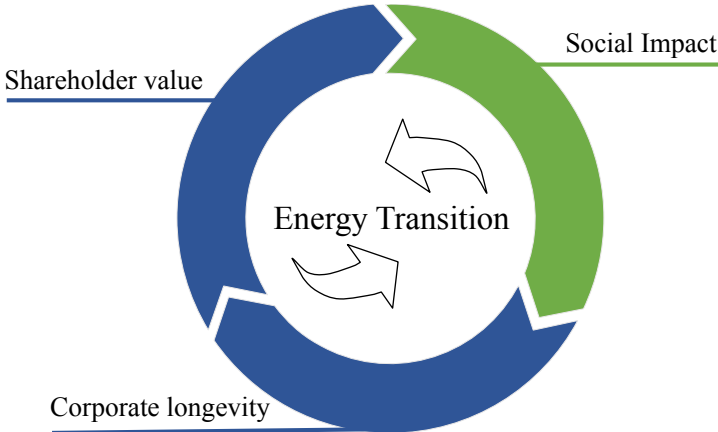


Figure 8: Strategy leading to sustainability and sustainable competitive advantage

Long-term shareholder value creation includes the financial health of the company, its investment and cost discipline, and active portfolio management (Valentina Kretschmar, 2019). The dimension of social impact includes environmental, social, and governance topics (ESG) (Young et al., 2019).

With the Paris Agreement, net-zero carbon goals, and the logically connected topic of energy transition, IOCs have to include ESG dimensions into their strategies. New goals for IOCs concerning the social impact and carbon issues promote new business areas and technologies such as solar and wind energy and energy storage (Valentina Kretschmar, 2019).

Furthermore, the three dimensions in Figure 8 cannot be seen as separate pillars of a company’s strategy, nor can one of them be a priority without harming another. Companies have to incorporate all three dimensions into strategy, only then they will be able to establish a competitive advantage. A strategy is judged according to how it delivers both shareholder value and social impact. With this change in corporate strategy, changes in the business models are also necessary (Young et al., 2019).

Oil and gas companies will need to convince investors and other stakeholders about their low-cost and low-carbon nature of their portfolios. They also need to convince investors of the scalability and profitability of renewable energy solutions. Finally, they have to show progress on emission targets. Also, there is an increased pressure about reductions in emissions from the end-use of their products (Scope 3) (Energy Intelligence Group, 2019).

3.3.4 Sustainable business model innovation (SBMI)

Business model innovations are deemed more profitable than product or process innovations (Chesbrough, 2007; Lindgardt et al., 2009), as well as them bringing about greater resilience (Choi and Wang, 2009) and creation of additional opportunities for diversification and value creation (Nidumolu et al., 2013; Porter and Kramer, 2011; Tukker and Tischner, 2006)

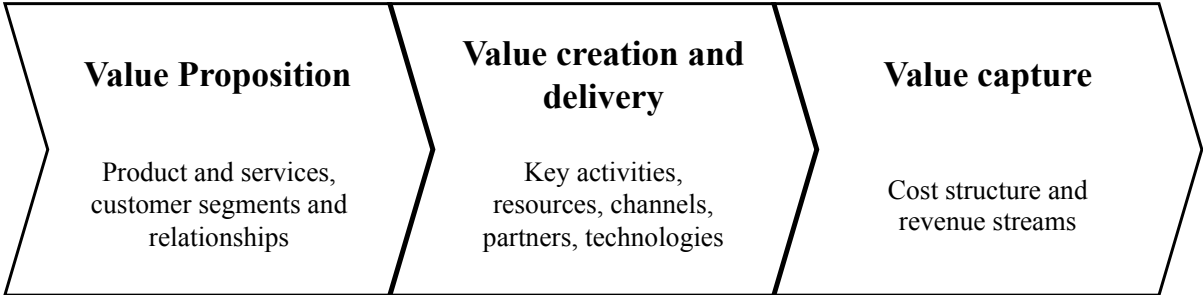


Figure 9: Conceptual business model framework⁶

Value creation is at the core of any business model. Companies create value by exploiting new business opportunities, markets, and revenue streams (Beltramello et al., 2013; Teece, 2010).

⁶ (Osterwalder et al., 2005; Richardson, 2008)

While the value proposition generally refers to the range of products and services offered to achieve an economic return, in a sustainable business approach it combines a verifiable environmental and/or social value with an economic value (Boons and Lüdeke-Freund, 2013). Moreover, value is not anymore created by companies operating independently, but through informal agreements or formal alliances together with external parties (Beattie and Smith, 2013).

Lüdeke-Freund (2010) describes a sustainable business model as “a business model that creates a competitive advantage through superior customer value and contributes to the sustainable development of the company and society”.

A key challenge is to formulate a business model that allows a company to generate economic value by generating societal and environmental benefits (Schaltegger et al., 2012). The TLBMC, as shown in Figure 10, complements and extends the original economically-oriented business model canvas by Osterwalder and Pigneur (2010) with an environmental and social layer. This framework supports the creative exploration of sustainable business models and sustainability-oriented innovation in the broader sense. These additional layers represent an integrated triple bottom line perspective of organizational impact, as already suggested by Glaser (2006); Hubbard (2009); Sherman (2012).

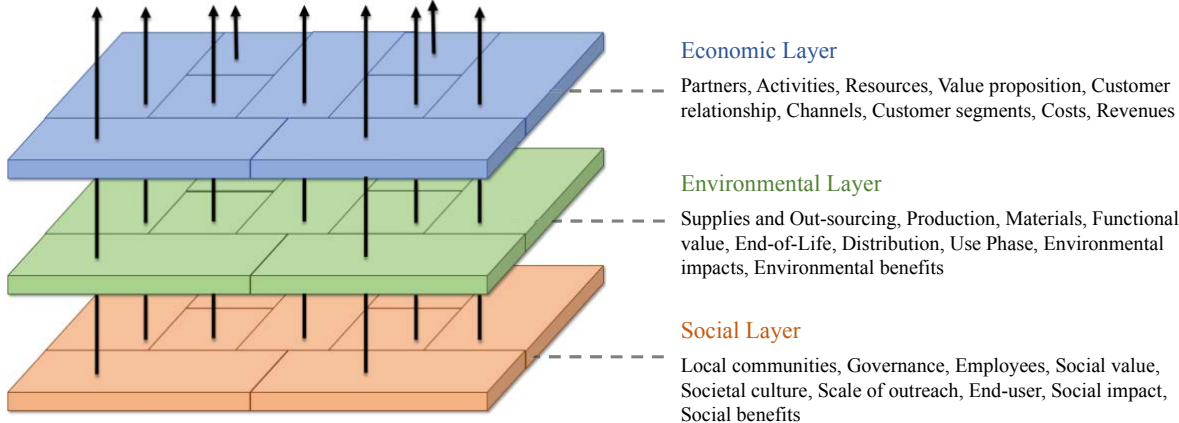


Figure 10: The Triple Layer Business Model Canvas (TLBMC)⁷

⁷ (Joyce and Paquin, 2016)

Young et al. (2019) see sustainable business models in a much more holistic perspective. It encompasses 1) a more diverse spectrum of stakeholders; 2) the dynamism of the socio-environmental context; 3) longer time horizons for achieving an adaptive advantage; 4) the limits of business models (in terms of scale, viability, and durability); 5) the production and consumption cycle from start to end; 6) the drivers for profitable and sustainable transformation.

The difficulty of effecting disruptive technology stems from inertia that prevents changing an incumbent's business model. This inertia is driven by the profits associated with existing technology which leads to misallocation of resources away from disruption (Christensen, 1997; Christensen and Raynor, 2003).

Schaltegger et al (2012) suggest a classification of defensive, accommodating and proactive business model innovations. Defensive strategies involve risk and cost reduction to preserve current business models. Accommodative strategies involve transformations of processes and include some degree of environmental or social goals, while proactive strategies involve reshaping the core business philosophy for sustainable development.

Bocken et al. (2014) and Ritala et al. (2018) formulate nine strategies for sustainable business models. Strategies include: 1) optimizing resource and energy efficiency; 2) circular economy; 3) substitution by renewables and natural sources; 4) providing functionality over ownership; 5) embracing a stewardship role; 6) promoting sufficiency; 7) transforming for society and environment; 8) integrative value creation; 9) designing sustainable scale-up approaches.

In the sustainable business model, there are four modes of innovation: 1) sustainable start-ups; 2) sustainable business model transformation; 3) sustainable business model diversification; 4) sustainable business model acquisition (Geissdoerfer et al., 2018).

3.3.5 Corporate Entrepreneurship

Corporate entrepreneurship can be defined as a process by which an incumbent company engages in innovation (Sharma and Chrisman, 1999). Corporate entrepreneurship can thus create opportunities for incumbent companies to embrace radical innovation in parallel with more incremental developments in their core businesses (Tushman and O'Reilly, 1996).

There are various reasons for firms to engage in corporate entrepreneurship: 1) to improve their performance in the face of shifting environmental conditions (Zahra and Covin, 1995); 2) to seek strategic renewal (Guth and Ginsberg, 1990); 3) to create future revenue streams by utilizing their existing corporate assets (Mcgrath et al., 1994). This may involve management dilemmas, such as whether to focus corporate resources on short-term profits and current consumers, or to pursue future business prospects by addressing tomorrow's consumer needs (Andriopoulos and Lewis, 2009).

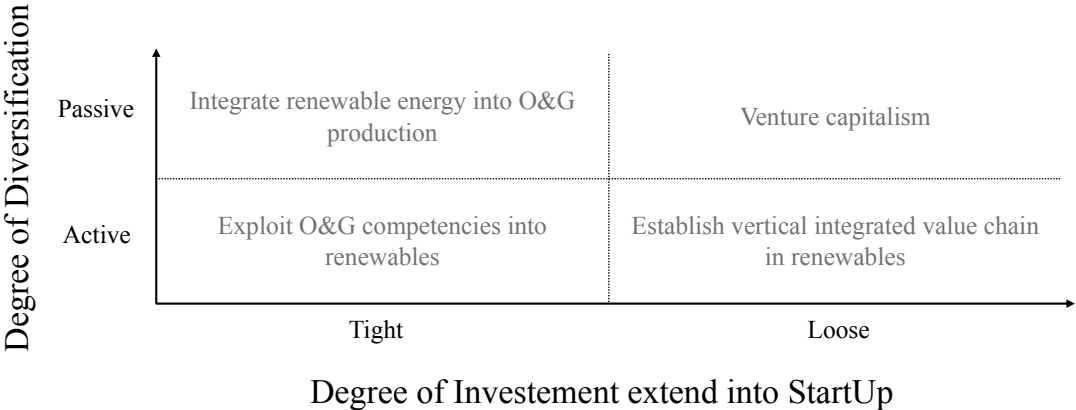


Figure 11: Investment framework into Renewable Energy^s

Acquisitions represent a fast-track to explore new business lines, this offers incumbent companies more flexibility compared to the internal development model (Bjørgum, 2016). Acquired companies often have complementary know-how with their acquirers. For example, smaller firms have an edge in developing disruptive technologies, while incumbents have resources that are useful for market expansion (Andersson and Xiao, 2016; Maula et al., 2005).

^s (Zhong and Bazilian, 2018)

4 Empirical part

4.1 Annual Report Analyses

Four focus areas are analyzed in this chapter 1) business segments, with the focus of New Energy topics; 2) the appearance of climate related issues; 3) reported uncertainty and risk; 4) tools, which are suggested by literature, that help decision makers to adapt to an uncertain environment caused by the energy transition.

Heat maps will be a major visualization tool to present the evolution of specific fields of annual reports over the observed time frame. For this the actual counts per category are normalized to a scale from 0 to 100, where 100 represents the maximum.

4.1.1 Review of Business segments

Upstream and Downstream are the major business segments of integrated IOCs. Additionally, fully integrated IOCs often engage in Petrochemicals. The evolving energy transition and decarbonization pressure adds topics that can be summarized in New Energy to their portfolio.

Within this, two major fields can be identified 1) decarbonization of power and fuel (Renewables, bioenergy, and hydrogen); 2) carbon-capture and carbon-sequestration activities as Carbon Capturing Usage and Storage (CCUS), technology-based carbon-dioxide removal, and reforestation (Kimberly Henderson et al., 2020).

The analysis in this chapter presents the evolution of these four major business segments in companies' annual reports. The buzzword counts of each business segment are set in the relation to the total count of all segments, representing the importance of each segment in the annual reports.

Europe

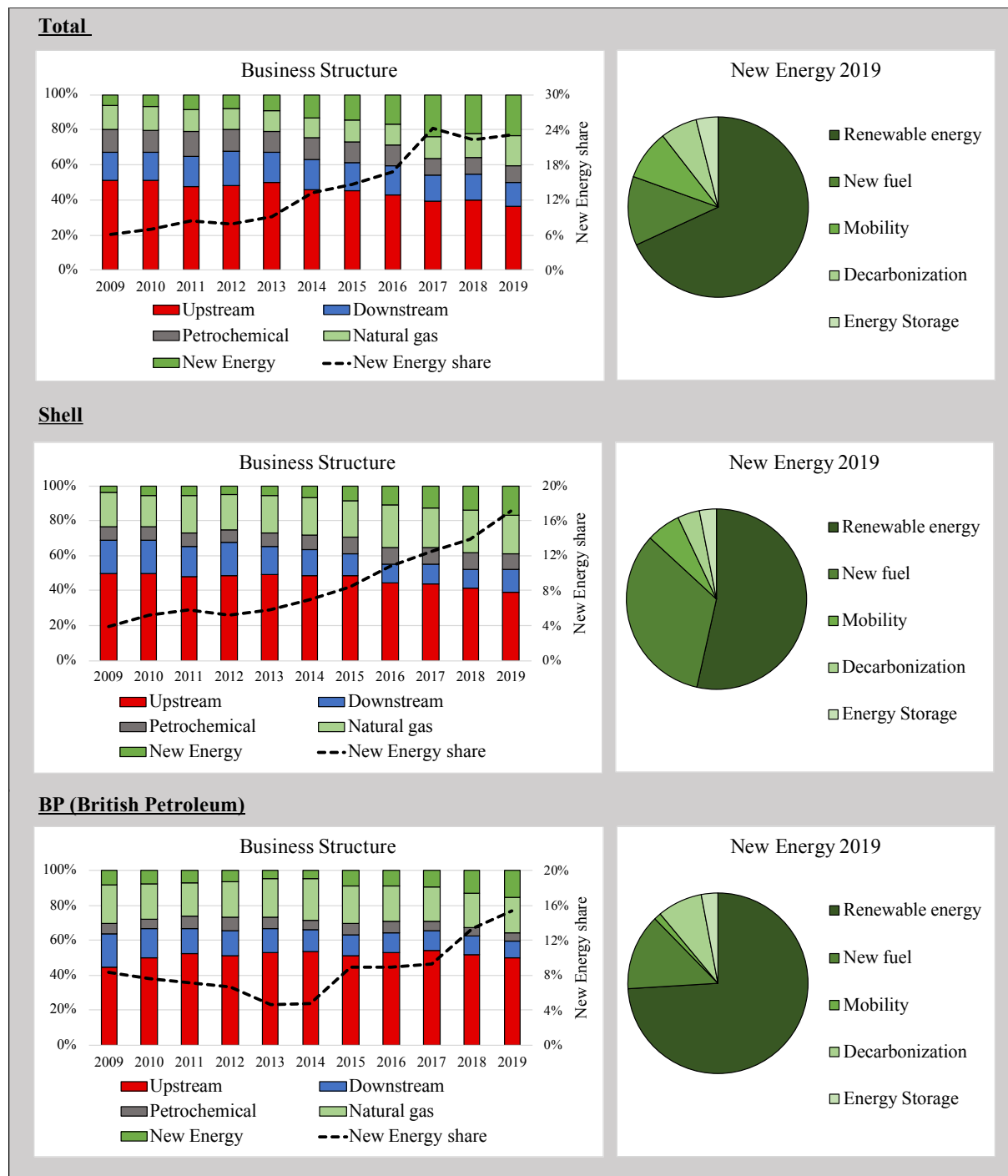


Figure 12: European IOCs, Business structure focus

2016 is a pivotal year for the New Energy field, which correlates with the sealing of the Paris Agreement in December 2015. The New energy business segment gathered further traction after this point, peaking in 2019 for Shell and BP. Totals' peak is in 2017, while afterwards it stays on a slightly lower but steady level of about 23 percent, with an increased focus on natural gas in 2019.

BP shows a very steady reporting between 2015 and 2017, increasing its interest in New Energy again from 2018 onwards.

The core business of Upstream and Downstream diminish in importance in the total reporting, keeping the Natural gas segments at a steady or increasing level. The Petrochemical segment, which gives IOCs another option of diversification from conventional fuel business, stays stable over the observed time period.

Renewables followed by New fuels are by far the most important fields of the New Energy segment in 2019.

North America

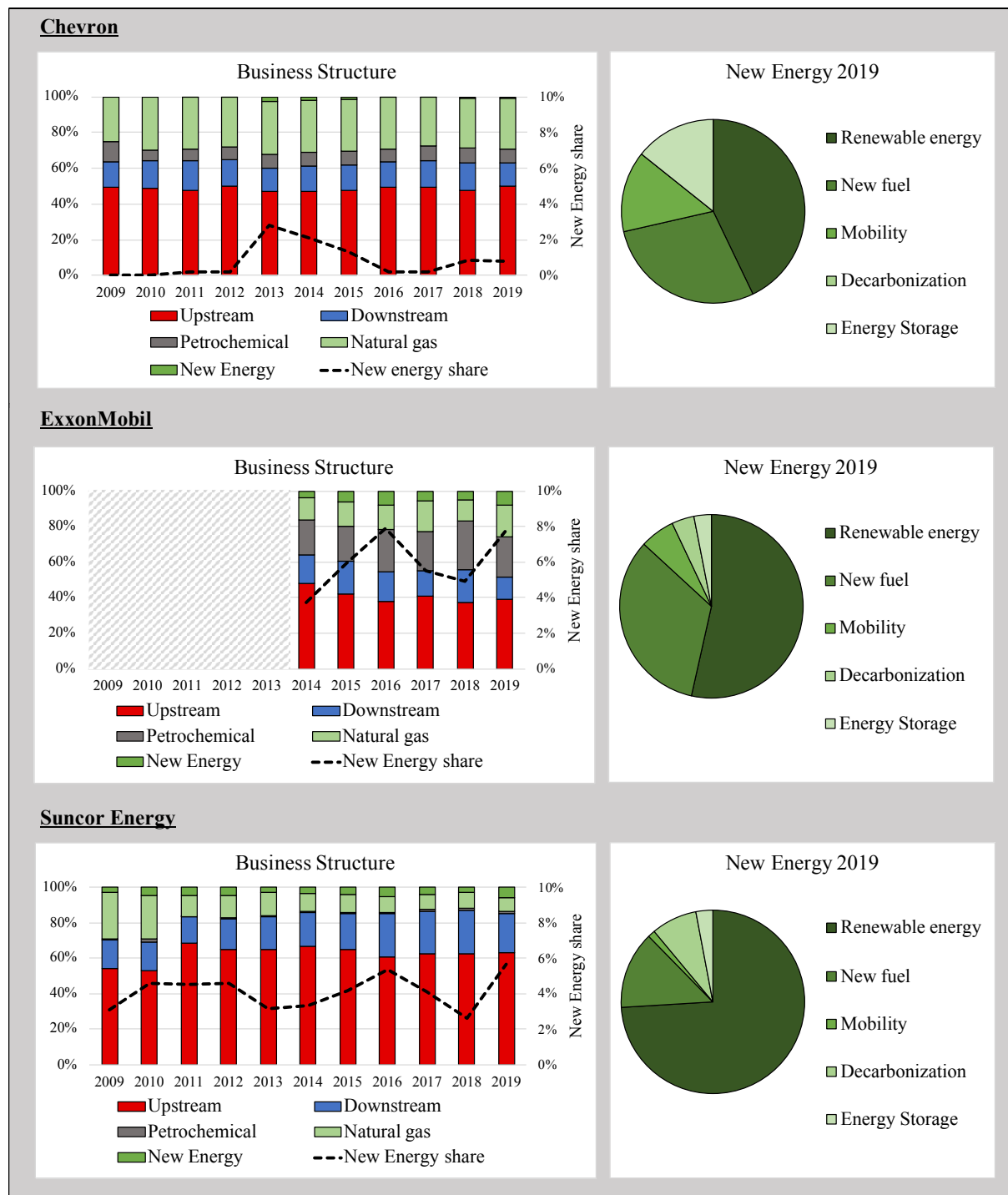


Figure 13: North American IOCs, Business structure focus

Chevron, ExxonMobil, and SuncorEnergy show no clear trend and a general much lower engagement for the New Energy field, compared to European competitors.

Chevrons' reporting stayed on a very steady level over the observed time with a maximum peak of around 3 percent of New Energy in 2013. ExxonMobil and Suncor Energy show a decreasing trend in new energy after 2016, returning to this level in 2019 with around 8

percent and 6 percent respectively. The three companies focus on different areas. Petrochemicals constitute a major part of ExxonMobil’s reports, while Chevron’s show a high commitment to Natural gas. SuncorEnergy diminished its reporting on Natural gas, while the Downstream business got more attention. Again, the by far most important field of the New Energy segment in 2019 is renewables followed by New fuels.

Russia

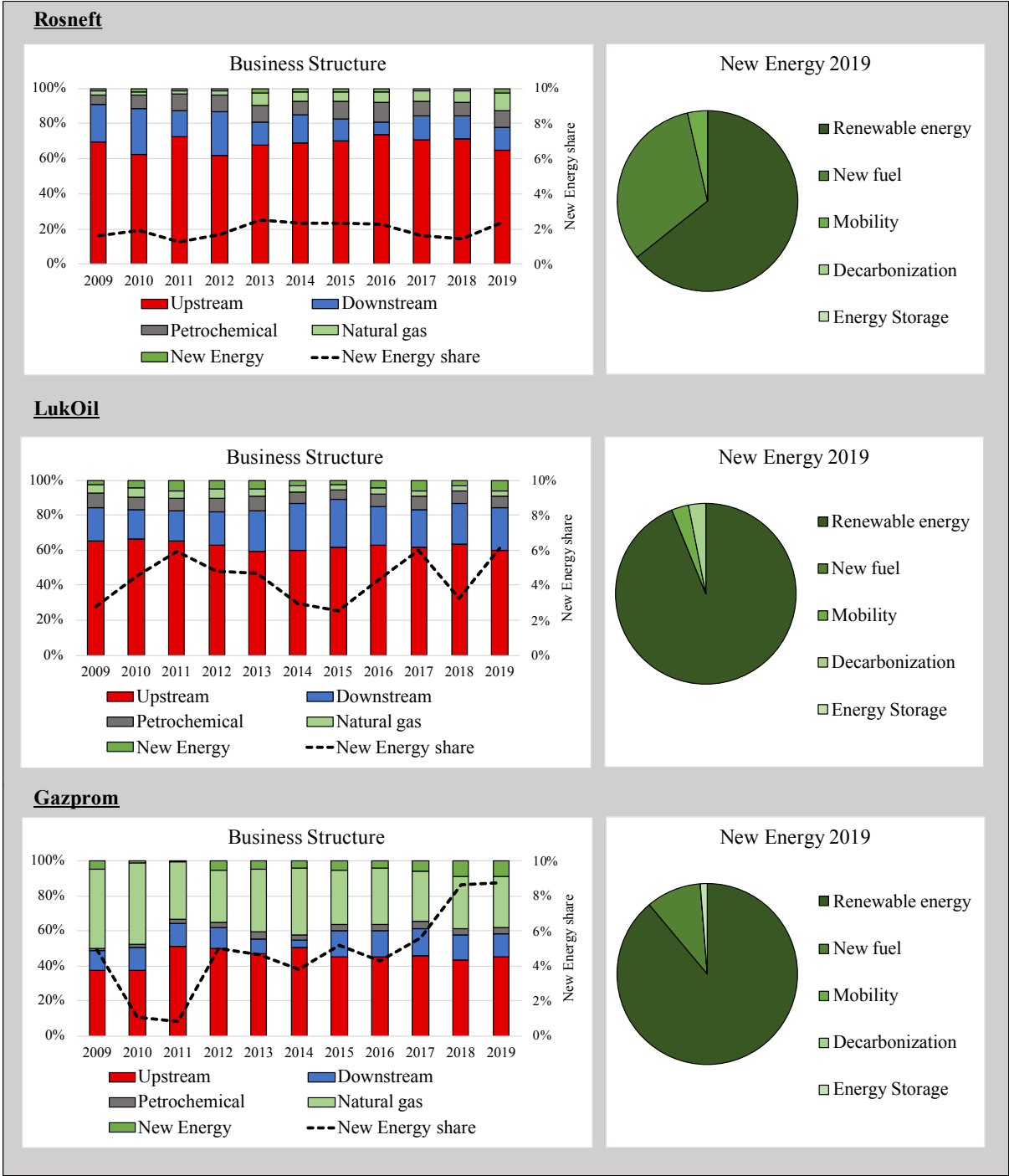


Figure 14: Russian IOCs, Business structure focus

For the observed Russian companies, Upstream is the predominant focus area in their annual reports. Only Gazprom shows an increasing engagement in New Energy topics after 2016, with a constant high reporting on natural gas.

Energy Transition in 2019

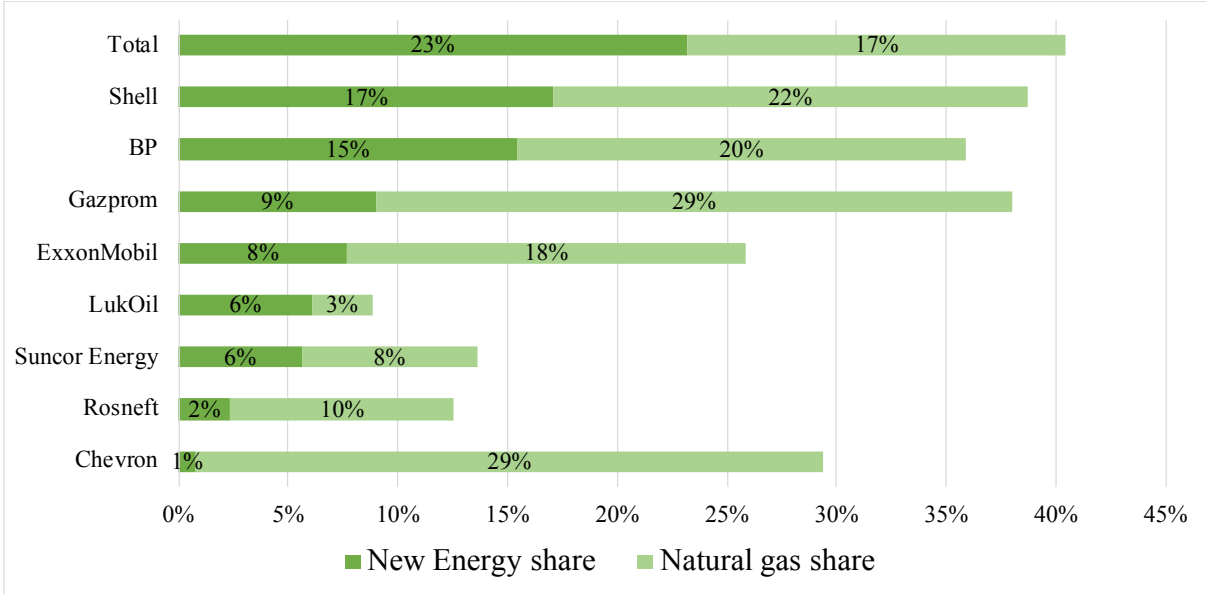


Figure 15: Annual Report 2019, New Energy importance

The three European companies lead the topic of New Energy in 2019. Total is in the forefront with 23 percent. Taking into account Natural gas, which is commonly seen as a transition fuel, European companies focus more than 35 percent of their reporting on energy transition conform business segments. Gazprom is the leading Non-European company in the New Energy sector, with a high involvement in Natural gas, competing with European companies in the combined share of New Energy and Natural gas.

4.1.2 Climate

Climate change is one of the biggest challenges of this century. With the Paris Agreement, a common goal and direction is set and the pressure for companies to act in a climate responsible way increases. The company-level analysis shows a homogeneous evolution of climate topics in annual reports, with a sharp increase from 2018 to 2019 (Figure 16).

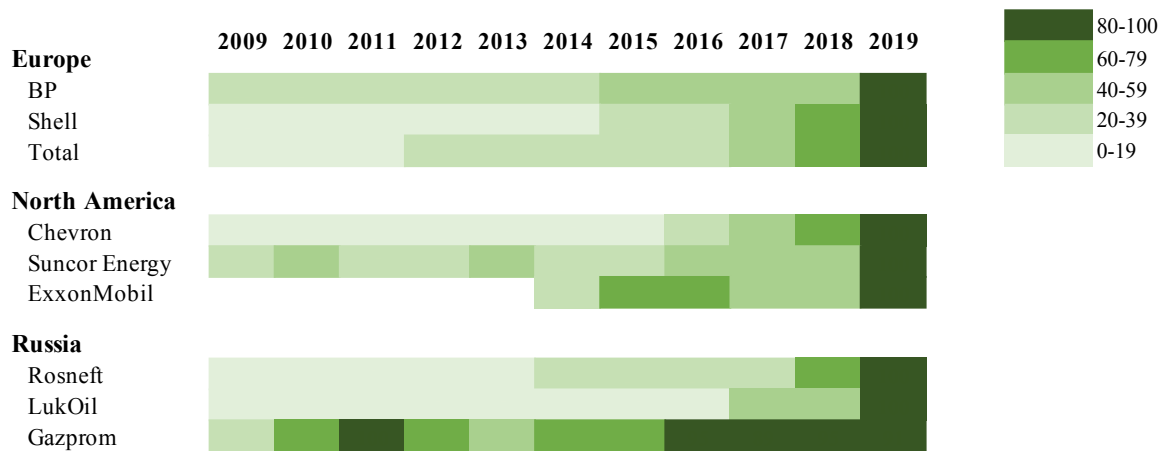


Figure 16: Climate engagement, company comparison

Increasing climate-related engagement in annual reports shows in the overall company sample. Again, 2016 is a turnaround year, where the counts of climate related topics in annual reports gathered momentum and more than doubled within the next years, peaking in 2019 (Figure 17).

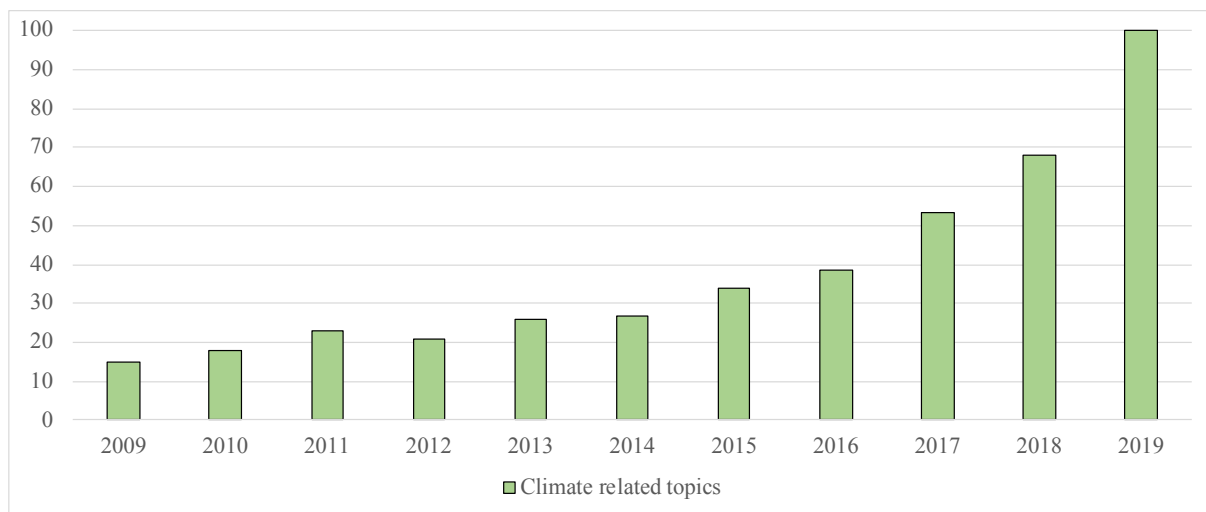


Figure 17: Climate engagement, overall company sample

4.1.3 Risk and Uncertainty

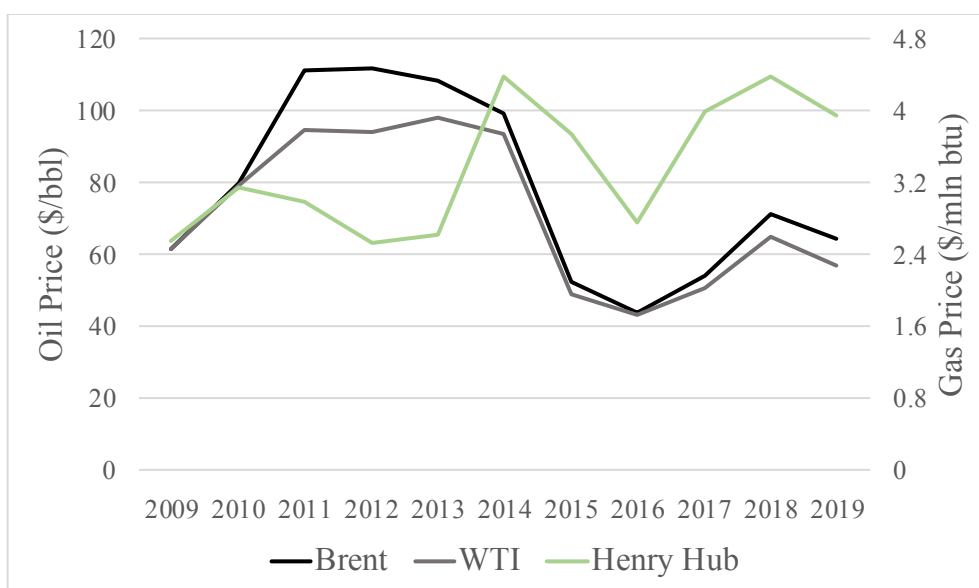


Figure 18: Macro environment, average yearly commodity prices⁹

By its very nature, the oil business has a high degree of uncertainty and risks caused by commodity prices. Volatility is high as shown in Figure 18. Because of this very reason, uncertainty and risk in this area should be a constant part of reporting, since these are the core elements of their incumbent business.

Uncertainty

The emergence of energy transition and decarbonization have the inherent potential to disrupt IOCs incumbent business model. This brings up possible new fields of risk and uncertainty. With 2016 increasing uncertainty for a majority of the companies is observable (Figure 19). Comparing this with the evolution of commodity prices in Figure 18, it is possible that a part of the reported uncertainty is arising from the commodity price drop in 2014. Still there is observable high and even peaking uncertainty in the following years up to 2019, where commodity prices increased and stabilized in a certain range. Therefore, it is possible that this uncertainty is caused from different fields as the increase in New Energy, and climate reporting measures.

⁹ Macrotrends, 2020; Statista, 2020a, 2020b)

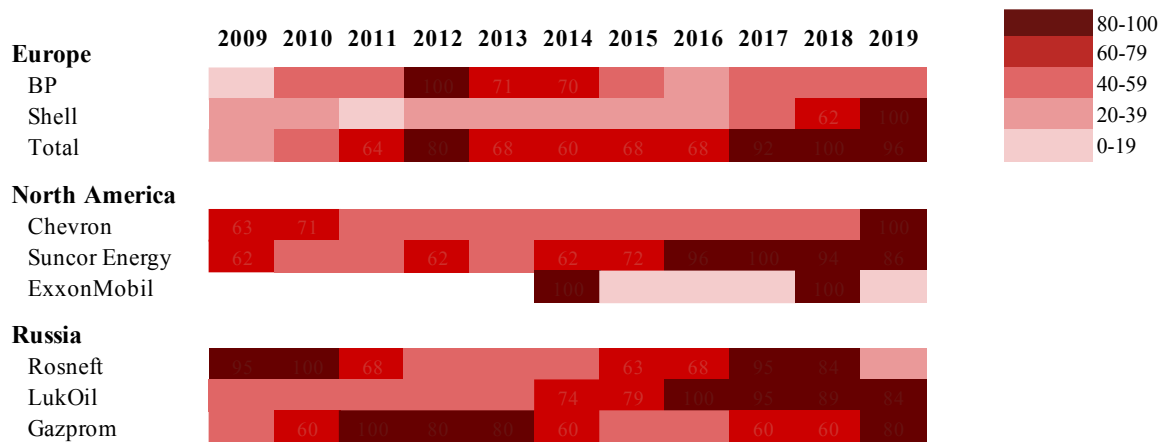


Figure 19: Uncertainty, company comparison

An even more significant trend of risk reporting is shown Figure 20 for the overall sample. All observed companies report risks at a very high level after 2016, with the exception of ExxonMobil. This trend correlates again with the enactment of the Paris agreement in December 2015, and the subsequent increase of climate topics (Figure 17).

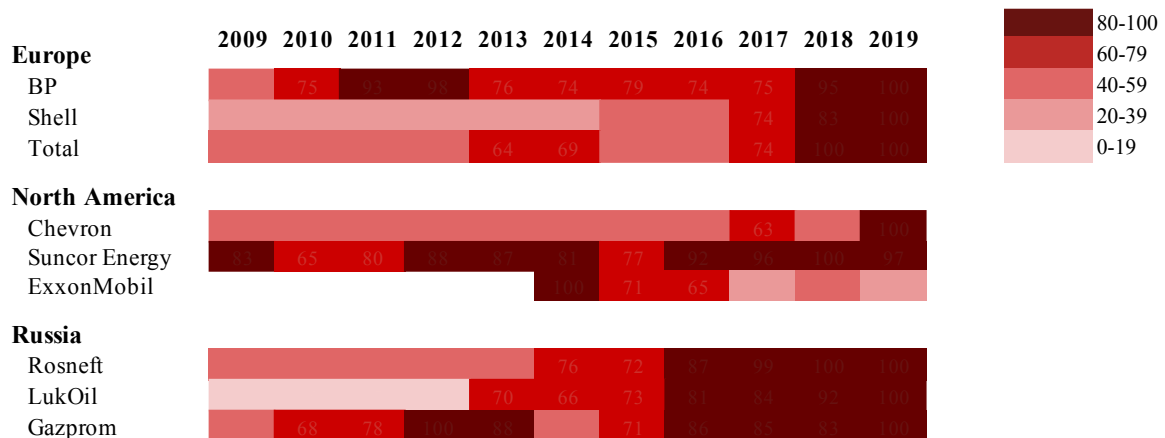


Figure 20: Risk, company comparison

4.1.4 Tools

Scenarios

Following Courtney et al. (1997) suggestion of scenarios for strategy in an uncertain environment, the analysis shows an increasing appearance of scenarios from 2016 onwards, with the exception of Suncor Energy and Gazprom, that show an unchanged low or decreasing level over this period.

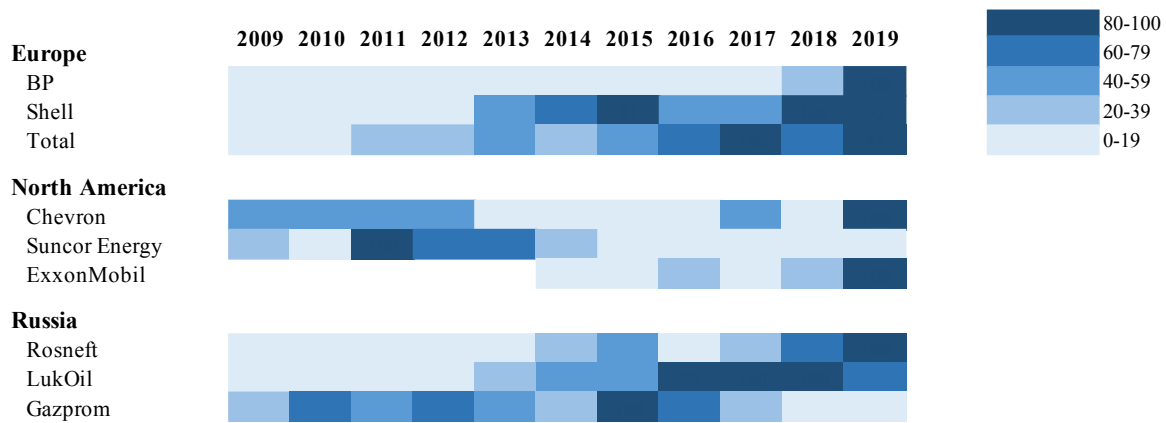


Figure 21: Scenarios, company comparison

Business model

The analysis suggests that IOCs report more intensively on their business model in recent years, with the exception of North American IOCs. This evolution especially makes sense for European companies, looking at their reporting on business segments in Figure 12, were a shift to New Energy topics is observable.

North American companies show no increased reporting of their business model, which can indicate a resistance to change their incumbent business, which is in line with their business segment reporting in Figure 13.

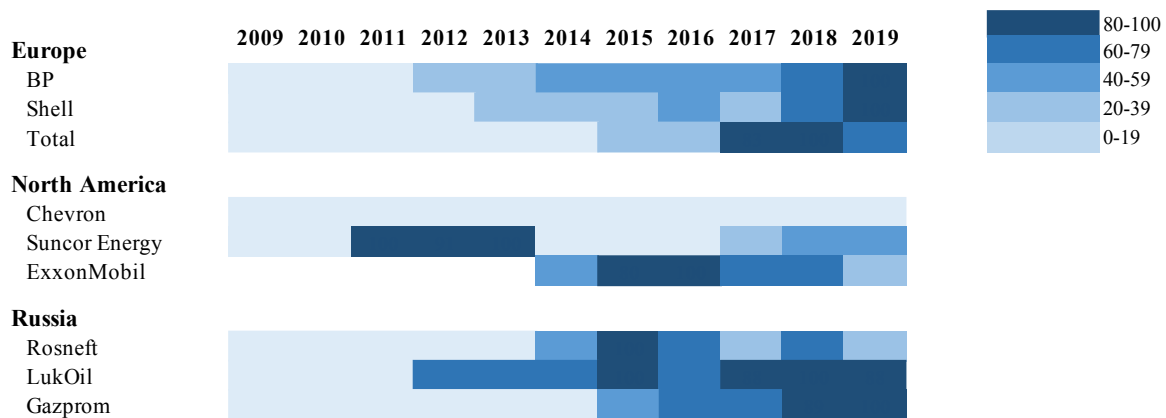


Figure 22: Business model, company comparison

Corporate finance

European companies exhibit an increased corporate finance activity in the most recent years including M&A, Joint venture, and divestments. This is in line with the change in business segments (Figure 12) and the increased reporting about business model (Figure 22).

North American IOCs reporting peaks in 2019, which could indicate a delayed reaction to new energy topics, which is indicated for ExxonMobil and Suncor Energy in Figure 13. Russian IOC show a rather decreasing reporting on corporate finance activities since 2016, increasing again in 2019 for LukOil and Gazprom.

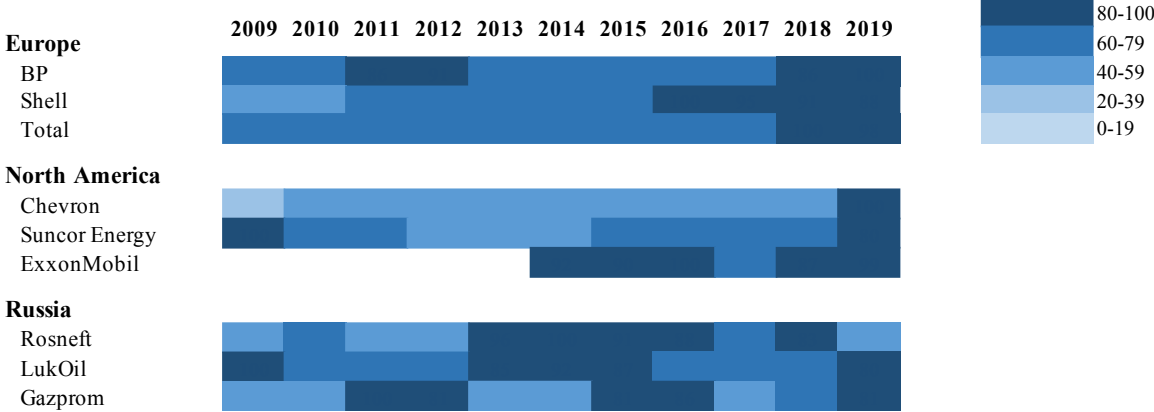


Figure 23: Corporate finance, company comparison

4.2 Expert interviews

4.2.1 COVID19 influence on Energy transition

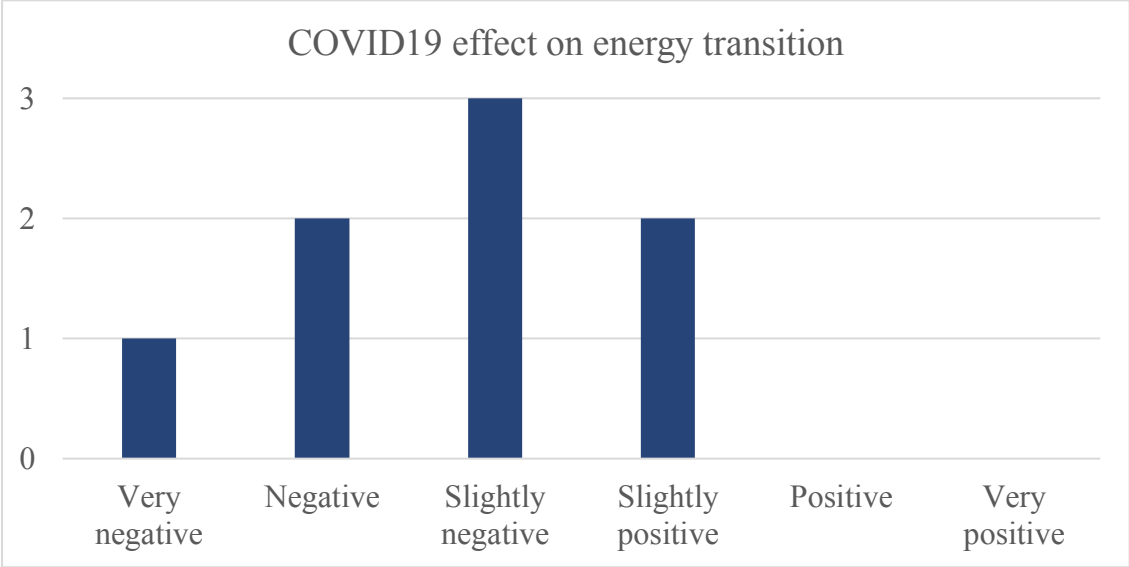


Figure 24: COVID19 impact on energy transition

In the short-term, climate related topics will become a second order priority for the whole economy and so for IOCs (I1, I2, I3, I8). The focus in crisis times will be on commercial issues and actions to save the company, companies switch to a “driving on sight” approach shifting away from long term strategies (I2, I3). Companies are carefully monitoring their

CAPEX (I3, I5). The current oversupply in the oil market leads to underinvestment (I3). In a recession there is the need for cheap energy. Conventional energy is cheap, which makes renewables even less attractive (I2, I3, I5). Upstream and exploration project are the exception here, the current situation brought their IRR to a low, which might increase the attractiveness for renewables in a post COVID world (I5). In such a world, interest in renewables could be higher, since they proof to be more resilient in crisis times (I5). In the long run, the crisis has also a big impact on energy transition, but it could go either way. It depends on the future consumer behavior (I8). Post COVID there can be 2 scenarios 1) environmental measures could be included in bailout packages, increasing the political pressure for climate friendly operations; 2) there can be postponed or eased restrictions on CO2 emissions for hurt industries, to help them recover (I2). European decision makers are planning a green COVID19 recovery. The European green deal from 2019, which until now had funding issues, could accelerate due to the substantial money distribution into the economy following to this crisis (I8). The pandemic has reinforced individual companies' prior assumptions. European companies become even more focused on diversification, while Americans double down on their core business (I7).

4.2.2 Uncertainty about Energy Transition

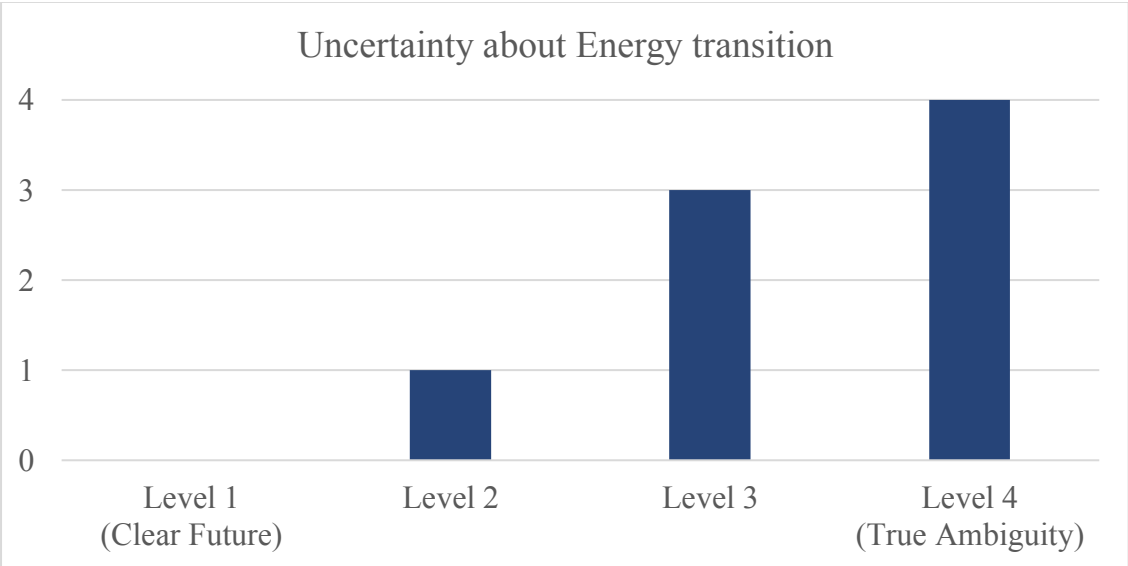


Figure 25: Uncertainty around energy transition

Following the framework of Courtney et al. (1997), it shows that the topic of energy transition has high inherent uncertainty to a true ambiguity for IOCs.

The energy transition consists of a series of transitions within different industries, each of them are separate but also related, making the topic very complex (I7). A stated goal exists

but it is quite uncertain how to get there, if there is no global accepted path to follow (I1, I2, I8). This leads to highly different approaches between countries and governments (I1, I5, I6, I8). A lot of company statements are quite bullish about their carbon-neutral goals, in reality nobody really knows how to get there (I1).

Some solutions do exist, but most of them are still in a R&D stage (I1, I2, I7). Affordable long duration energy storage, distributed energy sources on electric grids at a macro scale are important fields to be developed (I7). Another issue is the restricted technology environment, for example the focus on electric mobility and the neglect of other alternative fuels (I2, I3). There is a lot of lobby influence on this topic, the energy lobby works against solutions in the new fuel field, as hydrogen and biofuels (I3, I7, I8). The question will be how strong certain lobbies are, and which will be able to capture political will and block certain developments (I8).

Customer behavior about new solutions is a factor. Customers demand the same or an even increasing quality of life at the same price. At the same time those solutions have to be profitable for the company (I1, I8). Investors create a further dilemma between IRR and climate measures. Investors demand the same IRR with increasing pressure on environmental responsible methods (I1). Renewables at the current stage are very dependent on subsidies to be profitable with a high dependency on the government. This fact might be contradictory for stock listed companies that at the same time pay dividends to their shareholders (I3). IOCs make most investment decisions on a 20-year time horizon. Demand has always been a given, but the risk of stranded assets has become much greater in recent times (I4).

The O&G business model is very different from renewables (I6).

- 1) IRRs are not comparable because of different risk profiles.
- 2) O&G business is global while renewables are facing a hyper local market
- 3) Renewables are rather a fixed cost model (fixed peer to peer contracts, fixed grow in demand for power, fixed CAPEX) while the O&G business is operating with variable cost of supply, variables revenue, and CAPEX.
- 4) O&G business has very high entry barriers, while renewables have low.

Even though the difference between those two business models creates uncertainty, moving to renewables would take out uncertainty of IOCs business (I6).

Actions to manage this Uncertainty

Scenarios are an essential tool to operate in an uncertain environment (I1, I2, I3, I5, I7, I8).

IOCs have to develop scenarios starting with a business as usual case. On this reference case you can implement the impact of renewables, followed by a decision of how much you want to invest in transition topics to hedge risks (I5).

A flexible mentality to quickly adapt as market requires is essential (I1, I2). The nature of the O&G business developed a zero-failure mentality which leads to risk averseness. It shifts the focus of decision makers on process excellence instead of innovation (I2). A controlled space where new technologies and not yet profitable lighthouse projects can be developed is important (I2).

A clear decision by the senior management is very important to reduce ambiguity within the organization and establishing a culture that talks about change and threats to the current business (I2, I8).

Competitor and market analyses at higher frequency are crucial, it is important to know what others do (I2, I3).

In a changing environment portfolio management and stress tests are of high importance (I1, I4, I8). A close look will be on projects, operating on very high cost levels or need long time to be profitable (I8). There is a clear divide between European and US majors on the appetite to invest in low carbon business as part of this portfolio restructuring (I4).

4.2.3 ESG in Strategy

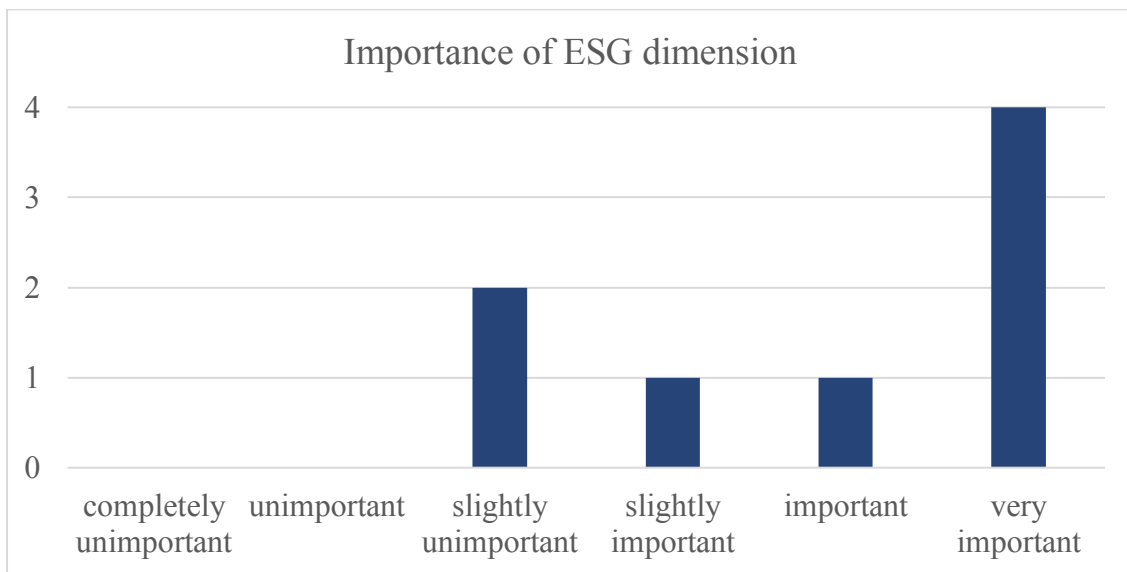


Figure 26: Importance of ESG topics for future strategy

ESG in strategy is highly different between companies (I1, I5, I7). Some just follow the approach of paying dividends and neglecting other measures of value (I7). ESG topics were important and become even more important with a lot of stakeholder that value a high ESG score (I2). Financial institutes increasingly shy away from companies with bad ESG score (I1, I2, I4, I5). The ESG funding pool of PE and banks is increasing, a high ESG score means lower cost of capital (I5).

Staying top quartile on ESG metrics is important for IOCs. However, these metrics are still very heavily focused on negative screening and only starting to get more sophisticated around GHG intensity. The implication is that continued measures to improve scope 1 & 2 emissions intensity are necessary, but that will become table stakes in the path to net zero. It leaves the question of just how much investors will reward near term scope 3 emissions intensity targets and moves. Over time, this will matter more as investors adopt positive screening criteria, but we're not there yet (I4).

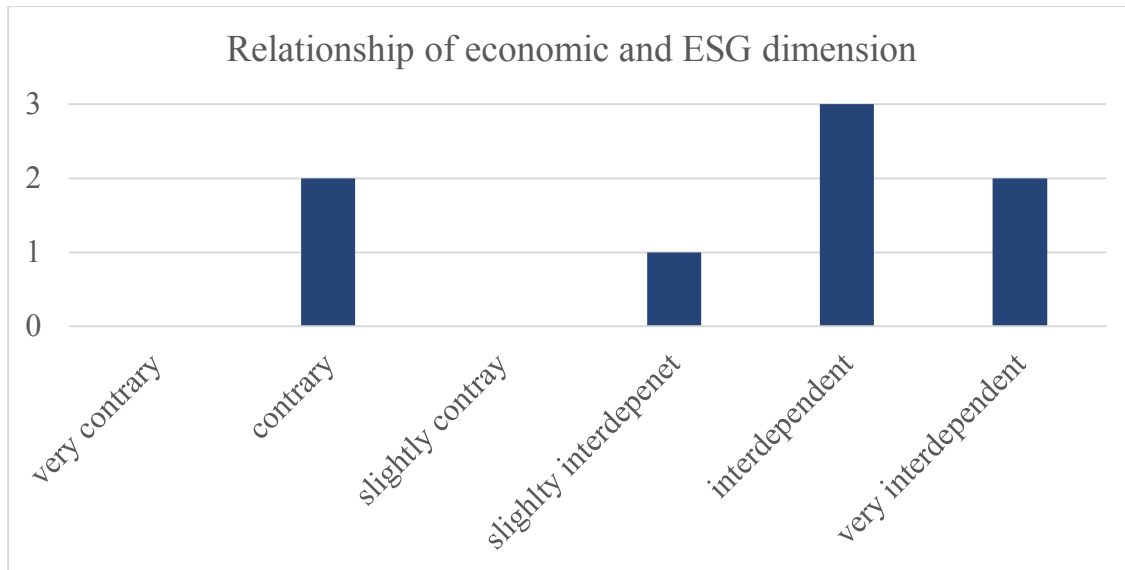


Figure 27: Relationship between economic and ESG dimension in strategy

As a business that is based on long term perspective, it is not possible to lead a company successfully with being against ESG topics. On the short term it can be the case that shareholder value can take over (I2). The social construct is decisive here, if there are fines for breaking rules then it is interdependent (I8). It depends on the shareholders, in Europe it is more interdependent, investors are fine with lower IRR for better ESG ratings (I5).

4.2.4 Energy Transition a Threat or an Opportunity for IOCs

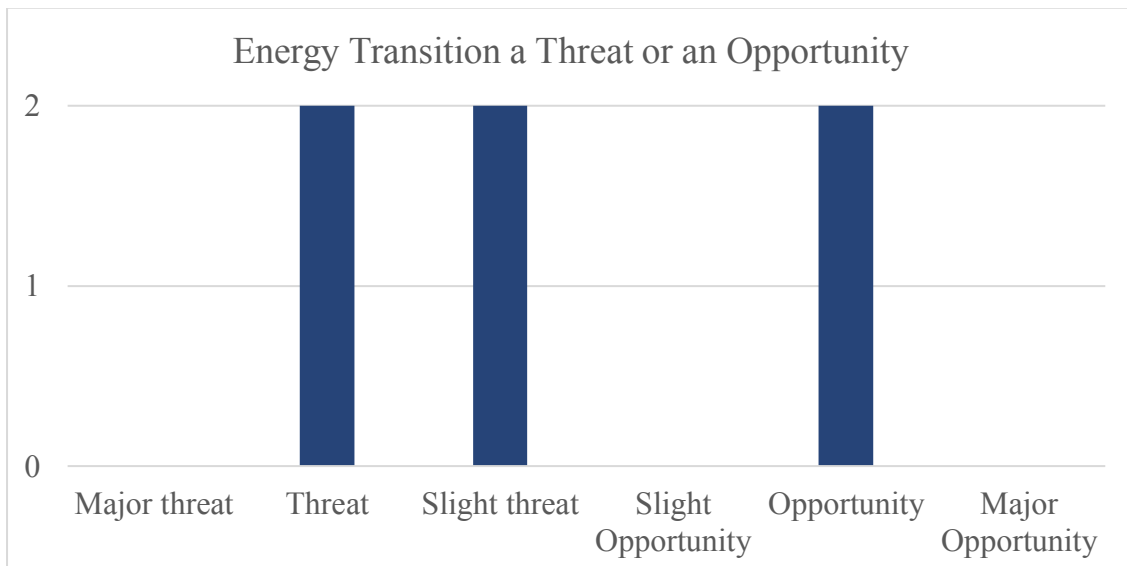


Figure 28: Energy Transition a Threat or an Opportunity for IOCs

It needs to be taken as an opportunity, in the long term it will disrupt the incumbent business of the O&G industry (I1, I2, I5, I8). Energy transition is a big threat for the O&G incumbent

business, most of IOCs try to frame it as an opportunity (I8). The consequences of the energy transition are very different between companies (I6, I7). For US companies it is pretty much a threat. Europeans can leverage on an already broader diversified portfolio, giving them opportunities (I6). There is still time to act and shift portfolios accordingly (I1, I2). The entity that does this fastest can possibly gain good margins out of innovative solutions; this requires an agile environment where innovation can happen (I2).

4.2.5 Capabilities for Energy transition

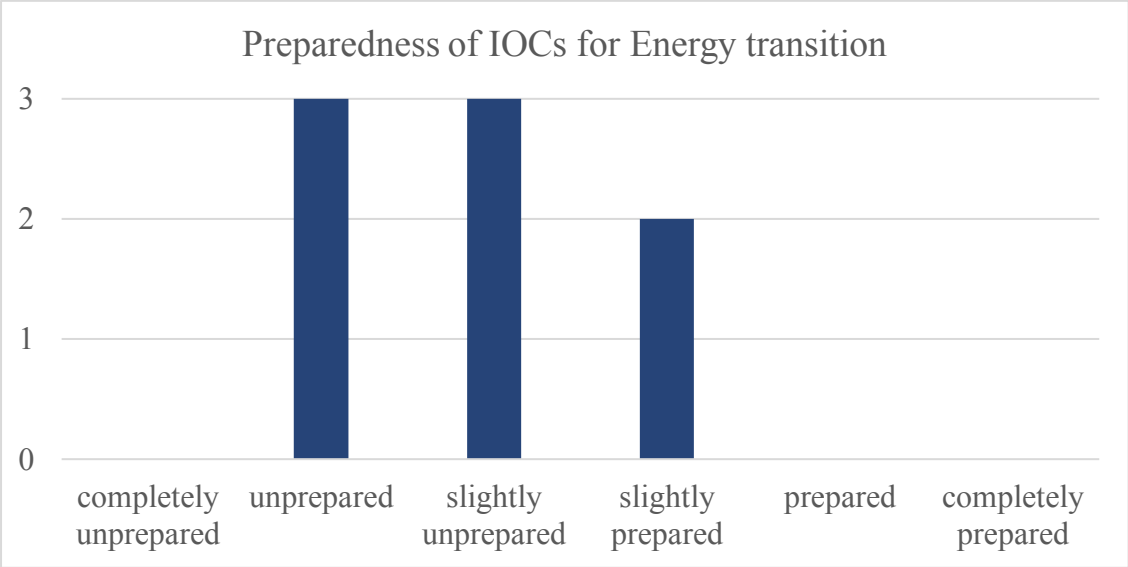


Figure 29: IOCs preparedness for the energy transition

The required resources and capabilities are highly different. It depends on the elected strategic direction (I2, I3, I5, I7). Based on history, companies should spend 20-30% of CAPEX to prepare for disruption, when that is on the horizon, no IOC is coming close to that at the moment (I4).

The mentality of senior management is crucial. Boards need to become more agile, fast and willing to take risks. Currently senior management is reluctant to change and lacks in diversity (I1, I5, I6, I8). Setting up a green team that is screening potential technologies and investment opportunities and an environment that allows innovation to test new technologies and business models are necessary steps (I5, I2).

Human capital is crucial. O&G employees have strong competencies in Upstream topics, there is the need to retrain or acquire people with knowledge in electricity (I1, I6).

VC and investments that are in line with the strategic direction, are helpful means to acquire missing knowledge (I1, I2, I4). So called platform M&A activities are a good way to acquire knowledge, with the goal to provide capital to grow and develop innovative products (I6). Renewables (Wind, Solar) themselves are not a big opportunity for oil majors. The capital structure of oil and gas majors is tailored towards high risk oil and gas investments, not what is effectively infrastructure development with relatively lower risk profile. There might be opportunities for power trading, an area where some IOC's have strengths, but it will not be a material area of value. The O&G industry is more likely to be successful in sectors where electrification is not the given abatement path e.g. synthetic fuels, blue or green hydrogen, CCUS in steel, aviation, heavy transport, and chemicals (I4). IOCs possess competences that can be leveraged for decarbonization topics, as Co2 as feedstock in a circular economy (I3). There are some similarities in renewables as offshore wind to Upstream projects (I5). The existing gas station network is also an advantageous infrastructure that can be leveraged by adding gas or EV chargers, and still make profit from snack stores (I8). IOCs can have opportunities to capture market share in their gas business from a reduction of coal in the energy mix (I7).

5 Discussion

Courtney et al. (1997) suggested scenarios to deal with decision paralysis in an uncertain environment. Both the annual report analysis, and the expert interviews point out that there is high uncertainty for IOCs in the current environment. The majority of experts classified the uncertainty for IOCs about the energy transition at level 3 to level 4 on Courtney et al., (1997) scale (Figure 25). Uncertainty and risks increased in the recent years for most of the companies in the sample (Figure 19, Figure 20). The driving forces of the energy transition by Valentina Kretzschmar (2019) in Figure 1, are all named by experts as factors that create uncertainty. There is uncertainty about 1) technologies, that are still in R&D stage, and limited technology openness caused by lobby interests; 2) insufficient IRRs of new technologies; 3) future consumer behavior; 4) shareholders dilemma that is described by (Sybille Van den Hove et al., 2002) in Figure 7; 5) a declining interest of financial institution in funding O&G projects for companies with a bad ESG score, as found by (Arabella Advisors, 2018); 6) the difference between O&G and renewable business models 7) the reliability on governmental support for renewables; 8) COVID19.

Six experts mentioned scenario planning as an effective tool to deal with uncertainty and to identify myriad factors and variables that shape the future, as suggested by Paul J. H. Schoemaker (1995). IOCs annual reports expose also a higher usage of scenarios in the latest years (Figure 21). The scenario comparison in 3.2.2 underlines the uncertainty of the future energy mix. Very diverging futures are predicted, even with the same goal of restricting global warming to at most 2°C. Experts further suggest a change in the inherent mentality, a clear decision by the senior management, a high frequency of market and competitor analyzes, a controlled environment for innovation, and portfolio stress tests as useful methods to deal with an uncertain environment.

Joyce and Paquin (2016) suggested an extension of the original business model canvas by Osterwalder and Pigneur (2010) with a social and environmental layer, creating a tool for sustainable business model innovation. The majority of the experts classified ESG topics as very important for IOCs future strategy (Figure 26), but it is different between regions and depends on the social construct. A lot of stakeholder value a high ESG score. Most experts mention financial institutes and investors are increasingly shying away from companies with a bad ESG score. Companies with a low engagement in ESG topics are taking the risk of

higher cost of capital. Staying top quartile on ESG metrics is important for IOC's. With the energy transition especially the environmental part recently represents an increasing importance in annual reports (Figure 16, Figure 17). These metrics are still very heavily focused on negative screening and only starting to get more sophisticated around GHG intensity. The implication is that continued measures to improve scope 1 & 2 emissions intensity are necessary, but that will become table stakes in the path to net zero. It leaves the question of just how much investors will reward near term scope 3 emissions intensity targets and moves. Over time this will matter more as investors adopt positive screening criteria. Also most experts see the shareholder value and ESG dimension as interdependent in strategy (Figure 27) as suggested by Young et al. (2019).

European and Russian IOCs show a frequently higher reporting of their business model in the last years (Figure 22). For European IOCs this goes in line with a growing focus on New energy topics. Renewables (solar and wind) and new fuels (hydrogen and biofuels) are the major interest. Besides these, mobility, decarbonization, and energy storage are topics that they involve in (Figure 12). The observed company's energy transition strategy approaches differ in their degree of commitment, as suggested by Sybille Van den Hove et al. (2002). Especially a heterogeneous engagement between regions exist, with Europeans leading in this field (Figure 15). COVID19 potentially reinforced individual companies' prior assumptions. European companies become even more focused on diversification, while Americans double down on their core business. Experts say that in the long term the energy transition poses a threat to the incumbent O&G business, but it needs to be taken as an opportunity. Companies that adapt faster can possibly gain good margins out of innovative solutions, this requires an agile environment where innovation can happen, as suggested by (Porter, 1996).

The necessary capabilities to adapt to this shift depend on the strategic direction chosen by the senior management. IOCs strengths are suited to large Upstream projects and are less fitting for innovative renewable energy solutions and the electricity world. As suggested by Andersson and Xiao (2016) and Bjørgum (2016); Maula et al. (2005) experts consider M&A and VC activities as crucial to acquire missing knowledge in the form of human capital. Platform M&A is a good way to provide capital to grow and develop innovative products. For the European IOCs leading in the topic of New energy, increasing corporate finance activities are observable (Figure 23). As Christensen (1997) described with the innovators dilemma, also the experts believe that the major problem lies in the senior management reluctance to

change. The inherent risk averseness of the O&G business, and the lack in diversity of board members shifts the focus of decision makers on process excellence instead of innovation, which Porter (1996) doesn't define as strategy.

6 Conclusion

Climate change is one of the biggest challenges of this century. With the Paris Agreement a common goal and direction is set and the pressure for companies to act in a climate responsible way increases. Forced energy transition, with a focus on renewables and decarbonization, has been brought about to face the threat of global warming. This has the potential to disrupt IOCs incumbent business model. Energy transition requires companies to make commitments that entail a significant amount of uncertainty. IOCs have to engage in unfamiliar capabilities and technologies, that are partly still in the R&D stage and provide insufficient IRRs. Limited technology openness caused by lobby interests, represent a further difficulty to adapt to the transition. It is also unclear when and how consumer behavior will change. Shareholders are caught in a dilemma between adequate returns and environmental obligations. ESG demands that companies conform their operations to address various stakeholder interests. At the same time, financial institutions demonstrate a decreasing interest to finance Upstream projects, and analysts incorporate CO₂ emission into their financial analyses. The paradox between commitments and uncertainty can be solved by splitting the management of those strategic tasks. Senior management should focus efforts on managing strategic uncertainties by considering strategic options and creating the ability to pursue alternative strategies that may become valuable as the key uncertainties are resolved. Lower management should put its efforts into fulfilling already made commitments. Scenario analysis is a useful tool to create alternative futures, which can help decision makers to overcome decision paralysis (Figure 6).

Upstream, downstream and petrochemicals were the predominant elements of IOCs corporate strategy. These elements started to shift in the most recent years. The nine observed companies differ in the degree of commitment to the energy transition, including renewables, alternative fuels and carbon capturing approaches. European IOCs as Shell, BP, and Total are leading in what can be summarized in New Energy. ESG and essentially environmental reporting amplified as fundamental elements of IOCs strategies over the observed 10 years. IOCs have to find a way to integrate ESG topics into their value proposition. The TLBMC (Figure 10) can be a useful tool to extend the current economic focused business model with a social and environmental layer.

IOCs don't possess the required capabilities for the renewables business. IOCs strengths are suited to large Upstream projects and are not fitting with innovative renewable energy solutions and the electricity world. IOCs will have to commit to M&A activities to acquire missing knowledge in the form of human capital. Platform M&A is a good way to provide capital for innovative companies to grow and develop helpful solution. But the initial and most important shift, before a portfolio adaption can happen, is changing the mindset and culture of senior management and the whole company. Boards need to become more agile, fast, and willing to talk about threats and take risks. Currently senior management is reluctant to change and lacks diversity. An environment that allows innovation to test new technologies and business models is an essential part of this change. In a changing environment stress tests of the current portfolio are important.

Even though the business environment of the O&G industry is changing, requiring new skillsets, IOCs possess capabilities and resources to leverage. These are offshore Upstream knowhow for offshore wind, the existing gas station network to which they can add gas or EV chargers, energy trading, and the ability to replacement coal with natural gas.

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8 Appendix

	IEA	IRENA	IPCC	BP	Shell	Equinor
Short description	Basis are the UN sustainable development goals, approach works backwards to identify what would be needed to reach those goals	future scenario that delivers energy-related emissions consistent with a 2°C scenario (Paris agreement target)	90 different pathways with goal increase below 1.5°C in 2100, some pathways include a possible overshoot of 0.1-0.4 °C (all values below are the median of scenarios)	overall combined scenario of certain BP scenarios (lower-carbon scenario in industry, transport and the power sector)	future scenario that delivers energy-related emissions consistent with a 2°C scenario (Paris agreement target)	future scenario that delivers energy-related emissions consistent with a 2°C scenario (Paris agreement target)
Scenario horizon	2040	2050	2050	2040	2070 (numbers below are up to 2040)	2050
GHG emission trajectory	GHG emission from energy and industrial processes fall by 46% to 21 Gt CO ₂ e	GHG emission fall by 75% in 2050 to 9.8 Gt CO ₂ e	CO ₂ emission falls by 45% until 2030 (base 2010), and net zero emission around 2050	CO ₂ emission from energy use falls by 46% to 18 Gt CO ₂ e	CO ₂ emission falls by 3% to 33 Gt CO ₂ e by 2040, net zero emission by 2070	CO ₂ emission from energy use falls by 67% to 11 Gt CO ₂ e
Temperature impact	1.7-1.8°C above pre industrial levels	below 2°C increase	Median global warming below 1.5°C in 2100	no information disclosed	1.7°C above pre industrial levels	below 2°C increase
Energy consumption	Flat at 13.7 bn toe	Flat at 8.38 bn toe	Flat at 13.86 bn toe	Increases by 20% to 16.4 bn toe	Increases by 31% to 17.9 bn toe	Falls by 11% to 12.3 bn toe
Energy efficiency	Energy intensity of GDP falls from 110 to 50 toe/\$k	Energy intensity of GDP falls by 3.3% per year from 2016 to 2040	no information disclosed	Energy intensity of GDP falls from 119 to 70 toe/\$k	Energy intensity of GDP falls from 131 to 78 toe/\$k	Energy intensity of GDP falls from 177 to 67 toe/\$k
Oil	Demand falls by 26% to 70 Mbpd	Demand falls by 57% to 41 Mbpd in 2040	Demand falls by 54% to 42 Mbpd in 2050	Demand falls by 15% to 77 Mbpd	Demand falls by 1.5% to 90 Mbpd	Demand falls by 45% to 52 Mbpd
Gas	Demand increases by 12% to 4,184 bcm	Demand falls by 9% to 3,400 bcm in 2040	Demand falls by 37% to 2,378 bcm in 2050	Demand increases by 38% to 5,051 bcm	Demand increases by 11% to 3,967 bcm	Demand falls by 12% to 3,182 bcm
Coal	Demand falls by 57% to 2,282 Mtce	Demand falls by 63% to 2,000 Mtce in 2040	Demand falls by 85% 813 Mtce in 2050	Demand falls by 71% to 1,619 Mtce	Demand falls by 2% to 5,642 Mtce	Demand falls by 84% to 918 Mtce
Renewables	Share of energy mix rises from 14% to 31%	Share of energy mix rises from 25% to 75%	Share of energy mix rises from 15% to 61% in 2050	Share of energy mix rises from 4% to 29%	Share of energy mix rises from 4% to 19%	Share of energy mix rises from 4% to 27%
Carbon Capture and Storage (CCS)	2.4 GT of CO ₂ captured	no information disclosed	Material use of carbon dioxide removal (CDR)	4.5 GT of CO ₂ captured	2.2 GT of CO ₂ captured	1.5 GT of CO ₂ captured

Appendix 1: Paris agreement conform energy mix scenarios

Business Segments	Downstream	Downstream, Refining&Marketing, Refining and Marketing, Refining, Marketing, R&M	
	Petrochemicals	Petrochemical, Chemical	
	Upstream	Upstream, Exploration&Production, Exploration and Production, Exploration, Production, E&P	
	Natural gas	LNG, Liquefied natural gas, natural gas	
	New Energy	New fuel	New fuel, Biofuel, Hydrogen, Biomass
		Renewable Energy	Electricity, Renewables, Renewable energy, Solar, Solar power, Solar Energy, Photovoltaic, Wind, Wind Energy, Wind Power
		Energy Storage	Energy storage, Power storage, Battery, Batteries
Mobility		Mobility, Electric Vehicles, Electric mobility, Charging solution, Charging Point, Charge Point	
Decarbonization	CCS*, CCUS, CCU, Carbon capture, Carbon capture and storage, Carbon capture and utilization, Carbon capture usage and storage, Power to fuel, Power to gas, Circular economy		
Climate change	Climate change, Emission, Greenhouse gas, GHG, CO ₂ , Carbon dioxide, Paris agreement, Paris goal, Sustainable development goals, Energy transition, Global warming, Sustainability, Net Zero emission, Net carbon footprint, Carbon neutral, Energy mix, New Energy, Cleaner energy, Clean energy, Lower carbon energy, Low carbon energy, Energy efficiency, Energy efficient, Carbon emission price		
Tools	Risk management	Risk management	
	Scenarios	Scenario	
	Business Model	Sustainable business model innovation, Business model innovation, Business model	
	Corporate Finance	Investment, Joint Venture, Merger, Acquisition, Divestment	
Uncertainty	Risk	Risk	
	Uncertainty	Uncertainty, Uncertain	

* CCS was controlled for the financial statement CCS meaning (CCS EBIT, CCS EBITDA, CCS earnings, CCS basis, CCS oparting, CCS ROACE, CCS EPS, CCS net income)

Appendix 2: Categorization of BoW analyses

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Europe											
BP											
Shell											
Total											
North America											
Chevron											
ExxonMobil*											
Suncor											
Russia											
Rosneft											
Lukoil											
Gazprom											

*only annual report summaries digital available

Appendix 3: Company sample and digital report availability

Interview 1*	Stefania Barbuceanu, Senior Financial Corporate Strategy Advisor, O&G company
Interview 2*	Timo Vehrs, Head of Downstream Strategy, O&G company
Interview 3	Anonym, Senior Corporate Strategy Advisor, O&G company
Interview 4	Anonym, Managing Director and Partner with focus Climate & Energy transition topics, Tier1 strategy consulting company
Interview 5*	Zi Sheng Neoh, Principal with focus in Energy Transition Consulting, O&G consulting company
Interview 6*	Prashant Khorana, Principal - Energy Transition focus on Power & Renewables, O&G consulting company
Interview 7	Anonym, Research analyst Energy Transition, O&G consulting company
Interview 8	Anonym, Engagement Manager (Energy Insights), Tier1 strategy consulting company

*all revealed information of the namely mentioned participant strictly represent their personal view and not their companys'

Appendix 4: Interview participants

Appendix 5: Expert interview 1

Stefania Barbuceanu (Senior Financial Corporate Strategy Advisor, O&G company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

3, climate change topics may become a second order priority due to the economic downturn, on short term, issue delayed

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

5

2.1. Please elaborate on your classification, why do you think like this.

It needs to be taken as an opportunity, in the long term it will disrupt the industry, still time to act and shift the portfolio accordingly

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

4

3.1. What do you consider as the major factors creating this uncertainty?

- even though there are quite a lot of bullish statements by companies, they all claim that they don't know how to get there
- there are some solutions that have the potential to develop on an industrial scale but at this point in time they are in research, (storage of electricity not enough developed, transportation)
- Customer behavior (want the same or increasing quality of life at the same price), at the same time it has also to be profitable for the company
- Investors demand a certain IRR, renewables have lower IRR investors need to accept this / on the other hand they are demanding the company to reduce their climate impact, start to include a certain carbon price in their valuation
- different view in different countries, government has the issue to make sure to keep their economy competitive

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

Uncertainty is the center of O&G business; you can do scenarios; flexible mentality (adapt as market requires), portfolio management

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

6

5.1. Please elaborate on your classification, why do you think like this.

Different between region. Especially investors (banks) have the order to not invest in bad ESG companies (high ESG score from rating companies is important)

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

6

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

4

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- People in the O&G companies are Upstream people they are not electricity people, so you need to think out of the box. Either you need to retrain them, or you need to acquire companies that have the knowledge (depending in what direction the strategy is developed)

- important is the openness of the senior management, commitment to steer in a clear direction with the willingness to change the business model

- mentality is the most crucial

Appendix 6: Expert interview 2

Timo Vehrs (Head of Downstream Strategy, O&G company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

2, conventional energy as cheap as never; recession time, companies will focus on commercial issues (focus on cheap energy); governments could include environmental "rules" in bailout packages; on the other hand there could also be postponements for Co2 emission restrictions (penalty payments) from government side for crises hurt companies; in long-term 2050 it will have no influence

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

Not quantifiable

2.1. Please elaborate on your classification, why do you think like this.

- yes, it is a risk for the current business model
- there is also an opportunity, there is a stated common goal on which you can adapt, the one that do it faster can possible gain good margins out of innovative solutions (chance for agile companies where business model innovation can happen)
- O&G business in non-regulated, energy is regulated (less free business space)
- renewable energy arose in the last years with governmental support which provided a rentability, which wouldn't have been possible without
- renewable energy most of the time less IRR, this makes this business field difficult
- Difficulty as renewables for diversification is to have a USP or have your strength in it, this is difficult compared to incumbent energy companies

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

3

3.1. What do you consider as the major factors creating this uncertainty?

- There is stated goal but only a very vague plan, if there is a plan (it is not technology open e.g. highly focus on electric mobility)
- a lot of the technology is still in development or are not profitable

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

- market and competitor analyze, in an environment of uncertainty I want to know what market and competitors are doing, frequency is higher
- a controlled space where new technologies, green resources can be developed and implemented (light house projects which are not profitable yet), VC and R&D centers
- the zero-failure mentality of the O&G business working with highly hazardous good for live and nature has developed risk averseness (leads to process excellence not innovation), the senior management has to develop company culture that talks about change, threats for current business model
- Scenarios have been always a tool to deal with the inherent uncertainty of the O&G business

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

5

5.1. Please elaborate on your classification, why do you think like this.

it was always important, and it will get even more important (for this business it is important to work with a lot of stakeholders, which value ESG topics)

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

5, as a business that is based on long term perspective, it is not possible to lead a company successfully with being against ESG topics, short term it can be the case that shareholder value can take over"

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

5

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- it is company specific, depends on company's' strategic direction (very heterogenic approaches)
- environment that allows innovation to test new technologies and business models, there has to be a management order into this direction
- agility
- market screening
- venture capital and investments in different topics (again depends on the approaches)

Appendix 7: Expert interview 3

Anonym (Senior Corporate Strategy Advisor, O&G company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

1, more quarters of oversupply lead to reductions of capex (underinvestment); highly negative influence on whole economy; Prioritizing other issues than climate topics; likely that there will be consolidation in the market; buying power and investments will be lower; driving on sight, saving the company, not investing in projects that might be profitable in 10-15 years

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

2

2.1. Please elaborate on your classification, why do you think like this.

energy lobby is working against "new fuels", have interest to electrify mobility; Energy is closer to governments, since they are largely state-owned

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

4

3.1. What do you consider as the major factors creating this uncertainty?

- Renewable energy need subsidies over long time, which is not compatible with stock listed companies. Subsidies and paying dividends is contrary.

- Highly depended on the government for subsidies, and on policies that take at some point longer than it should

- Profitability, oil and gas prices at the moment so low, therefore renewables even more unattractive

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

- shifting from models to scenarios

- driving on sight

- competitor and market monitoring

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

6

5.1. Please elaborate on your classification, why do you think like this.

-

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

2

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

3

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- Decarbonization is an interesting field for O&G companies, where capabilities lie CCU (Co2 as feedstock in circular economy, more acceptance and profitability). In the renewable energy world not too much.

- Different between regions and companies

Appendix 8: Expert interview 4

Anonym (Managing Director and Partner with focus Climate & Energy transition topics, Tier1 strategy consulting company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

4

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

3

2.1. Please elaborate on your classification, why do you think like this.

I don't think renewables (Wind, Solar) themselves are a big opportunity for Oil majors. Even if we move more from a subsidy to a merchant/PPA market structure for renewable development, the capital structure of oil and gas majors is tailored towards high risk oil and gas investments, not what is effectively infrastructure development with relatively lower risk profile. There might be opportunities for power trading, an area where some IOC's have strengths, but it will not be a material area of value. The O&G industry is more likely to be successful in hard to abate sectors where electrification is not the given abatement path (e.g. synthetic fuels, blue or green hydrogen, CCUS in steel, aviation, heavy transport, chemicals, etc.)

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

4

3.1. What do you consider as the major factors creating this uncertainty?

O&G make most investment decisions on a 20-year time horizon (e.g. deepwater projects, LNG liquefaction train, petrochemical plant upgrades). Demand has always been a given when they go to FID, but the risk of stranded assets has become much greater in recent times, making these investments much more risky (we are already seeing cost of capital and hurdle rates go up; not as high as new coal plants which are 30-40%, but it is going up)

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

Very hard to answer that question in Covid19 situation, but many IOC's are doing a lot of portfolio stress tests. There is a clear divide between European and US majors on the appetite to invest in low carbon business as part of this portfolio restructuring. But expect players like Shell and BP to start making more structural shifts in capital allocation in light of their net zero announcements

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

6

5.1. Please elaborate on your classification, why do you think like this.

Staying top quartile on ESG metrics is important for IOC's. However, these metrics are still very heavily focused on negative screening and only starting to get more sophisticated around GHG intensity. The implication is that continued measures to improve scope 1 & 2 emissions intensity are necessary, but that will become table stakes in the path to net zero. It leaves the question of just how much investors will reward near term scope 3 emissions intensity targets and moves. Over time this will matter more as investors adopt positive screening criteria, but we're not there yet.

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

6

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

2

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

It differs from company to company – but as a general rule of thumb (based on history) companies should spend 20-30% of Capex to prepare for disruption (when that is on the horizon but timing not clear). No IOC is getting close to that.

Appendix 9: Expert interview 5

Zi Sheng Neoh (Principal with focus in Energy Transition Consulting, O&G consulting company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

3, O&G companies are quite careful with their CAPEX; On the one hand there can be the view that renewables are more resilient to such crises, on the other hand low O&G prices make renewables less attractive

- post COVID Upstream and Exploration IRR are pretty low which makes renewables more attractive

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

3

2.1. Please elaborate on your classification, why do you think like this.

definitely a threat to traditional business (fuel replacement), especially European big oil take it as an opportunity to get from oil to energy company

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

3

3.1. What do you consider as the major factors creating this uncertainty?

- looking at this topic in a more gradual manor, there will be different approaches (European policies will be more demanding, US will continue on what they have and improve this, they are monitoring it but are not going to public)

- NOC will adapt a more home-based strategy

- not sure if mobility (car, marine, air) can be fully electrified

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

- Scenario planning concept, starting with business as usual and building in the impact of renewables on cashflow, assets, demand, power demand
- From there on you can build on how much you want to invest in transition topics to derisk

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

6

5.1. Please elaborate on your classification, why do you think like this.

- Pressure comes from investors, which have concerns about Paris Agreement in Europe, in America shareholders are not as concerned.
- This will change, since banks and PE funds are looking at ESG ratings for investments.
- ESG funding pool is currently small compared to the traditional pool, in the future ESG will become a key metrics for investments (lower cost of capital can be achieved with higher ESG ratings).

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

2, depends on shareholders (Europe more interdependent, investors are fine with lower IRR for better ESG)

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

4

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- Most of the companies set up green teams, looking at possible technologies / some of them are more developed, they are actively monitoring.
- Capabilities depend a lot on the chosen direction
- There are similarities of offshore wind projects to O&G Upstream projects
- Trading and operating in electricity market they have to build or acquire externally

- No longer a huge asset that needs all attention, its more disposed you are looking at more assets that can fetch the same amount of IRR (more people needed, more competitive)
- Connective devices (smart metering), digitalization may help with the easy of management

Appendix 10: Expert interview 6

Prashant Khorana (Principal - Energy Transition focus on Power & Renewables, O&G consulting company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

3

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

5

2.1. Please elaborate on your classification, why do you think like this.

US companies is pretty much a threat, European companies which are already more diversified which gives them an opportunity

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

4 (European IOCs more clear future)

3.1. What do you consider as the major factors creating this uncertainty?

- different in region (clearer future in Europe players, US and Asian players ambiguous)
- we see a reduction in fossil fuel demand (power sector is already almost gone, it is shrinking, oil and gas demand is peaking)
- most OICs destroyed value in the last decade by paying and maintaining dividends with debt
- The used to plug a hockey stick curve of the oil price into their models and ignoring impacts of downsides
- Highly different business models:

- can't compare the IRR of upstream projects with renewables, due to the highly different risk profile
- O&G business operating with variable cost of supply (variables revenue, CAPEX, cost of supply curves) / renewables is highly fix costs model (fixed Peer to Peer contracts. power contracts, fixed grow in demand for power, fixed CAPEX) --> even though the move to renewables would take out the uncertainty of the business
- renewables are a hyper local market (until the technology for transport of electricity doesn't evolve) O&G is a global market
- O&G business had very high barriers to entry, whole renewables have very low barriers to entry

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

-

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

6

5.1. Please elaborate on your classification, why do you think like this.

Research and statistics prove that ESG companies outperform companies with low ESG engagement

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

6

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

2 (European are better prepared at 4)

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- a big issue is described by the innovator's dilemma; firms are reluctant to change; the business case is pretty clear for the most part
- a lot of old school boards with lack of diversity
- firms need to get faster, more agile and willing to take risk
- need to acquire human capital by acquire companies (platform M&A activities, with the goal to provide growth capital to develop innovative products)
- data science-oriented viewpoint

Appendix 11: Expert interview 7

Anonym (Research analyst Energy Transition, O&G consulting company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

2, slowdown of infrastructure and the associated job losses, supply chain disruptions; pandemic has reinforced individual companies' prior assumptions, a lot of the Europeans becoming more focused on diversification, Americans double down on their core business

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

Not quantifiable

2.1. Please elaborate on your classification, why do you think like this.

- varies between companies, and your thesis if you want to be an energy company (strategic outlook)
- O&G companies might benefit from decreasing coal substituting with gas
- EV in the next 2-3 years not a significant impact on oil demand

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

3

3.1. What do you consider as the major factors creating this uncertainty?

- there is a series of transitions happening, there are transitions within different industries, each of them on the one hand have to be viewed separate but on the other hand related

- COVID multiplies the uncertainty about transition

- the future of EVs, is there a point where a lot of these renewables don't need to be backed up by hydrocarbons anymore

- affordable long duration energy storage

- distributed energy sources on electric grids at a macro scale

- opportunity around hydrogen or fossil fuel replacement

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

You have to do scenarios in an uncertain environment

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

3

5.1. Please elaborate on your classification, why do you think like this.

it is different between companies; some just follow the approach of paying dividends

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

5

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

3

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

It is very different between companies and their followed strategic direction.

Appendix 12: Expert interview 8

Anonym (Engagement Manager (Energy Insights), Tier1 strategy consulting company)

1. How do you think, do the oil market downturn and COVID19 influence the engagement in topics of energy transition? On a scale from 1 to 6 (1 = very negative, 6 = very positive)

4, in the short run it has a huge impact on the demand and the prioritization;

- long run also a big impact, but it could go either way, depends on the future behavior of people;

- European decision maker, green COVID recovery, European green deal (was unclear where money comes from, now huge amount of money distributed to the economy, people are getting ok if money is spend on this topics)

2. Do you consider the transition to renewable energy as a threat or an opportunity for the O&G industry? On a scale from 1 to 6 (1 = major threat, 6 = major opportunity)

2

2.1. Please elaborate on your classification, why do you think like this.

it is a big threat for the incumbent business, companies try to frame it as opportunity

3. How would you rate the uncertainty about the transition to renewable energy for O&G companies? On a scale from 1 to 4 (1 = clear future, 4 = true ambiguity)

2

3.1. What do you consider as the major factors creating this uncertainty?

- It is quite clear that we have a fossil fuel free future, there is uncertainty about when net zero is reached and differences between regions

- policy will

- customer behavior and needs, when and how want that?

- Vested interest, how strong are certain lobbies, how able will they be to capture political will and block certain developments

- hydrocarbon prices

4. Has this uncertainty changed the way O&G companies have to do strategy? If yes, how can they deal with this uncertainty in terms of strategic planning?

- portfolio stress testing, getting rid of projects that are on very high cost levels or need long time to be profitable (where it is uncertain if in the long term they will be still needed)

- make a clear decision is very important to reduce ambiguity within the organization

- sensitivity and scenario planning

5. How important do you think is the ESG dimension for O&G companies' strategy in the future? On a scale from 1 to 6 (1 = completely unimportant, 6 = very important)

3

5.1. Please elaborate on your classification, why do you think like this.

-

6. How do you consider the relationship between 1. Long term shareholder value and 2. ESG dimension in strategy? On a scale from 1 to 6 (1 = very contrary, 6 = very interdependent)

4, depends on the social construct, if there are fines for breaking rules then it is interdependent

7. How prepared are O&G companies for this transition? On a scale from 1 to 6 (1 = not at all, 6 = totally prepared)

2

7.1. Please elaborate on your classification, why do you think like this. What resources and capabilities do they possess or need to acquire to adapt to this shift?

- different between companies, depends on strategy, they need to acquire the field they want to pivot to

- IOCs can build on their gas station network by adding gas or EV chargers, and still make profit from snack stores

- A clear decision for a certain direction is most important and convincing shareholders