

INTERNATIONAL OIL COMPANIES AND THE ENERGY TRANSITION

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BY ELISA ASMELASH AND RICARDO GORINI**

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For further information or to provide feedback: publications@irena.org

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ABBREVIATIONS

ADNOC	Abu Dhabi National Oil Company	IRENA	International Renewable Energy Agency
°C	Degrees Celsius	Mt	Megatonne
CCS	Carbon capture and storage	MW	Megawatt
CCUS	Carbon capture, utilisation and storage	OGCI	Oil and Gas Climate Initiative
CEO	Chief Executive Officer	PV	Photovoltaic
CO₂	Carbon dioxide	R&D	Research and development
EJ	Exajoule	RRR	Reserve replacement ratio
EU	European Union	SDS	Sustainable Development Scenario
EUR	Euro	TPES	Total primary energy supply
EV	Electric vehicle	UK	United Kingdom
Gt	Gigatonne	US	United States
GW	Gigawatt	USD	United States dollar

KEY FINDINGS

Renewable energy technologies have experienced a breakthrough in recent years, and their deployment has continued to rise despite the uncertainties of the COVID-19 crisis. Similarly, the surge in climate-friendly commitments and the pressure to accelerate the energy transition from investors, consumers and governments have intensified since the outbreak of the pandemic. A rising number of countries have been complying with the decarbonisation targets agreed to in the Paris Agreement, as well as setting pledges to reach net-zero emissions by mid-century.

These circumstances, together with the economic downturn associated with the pandemic (*i.e.*, very low and negative oil prices) have presented significant challenges and threats to the activities of international oil companies. As such, these companies are progressively repositioning themselves in the energy industry, with investments, and commitments on further investments, in renewable energy solutions, energy efficiency, and other clean technologies as well as defining new or more ambitious emission reduction targets. However, this raises the question to what degree these climate commitments and investments in clean technologies indicate that international oil companies are transforming into energy companies to reduce greenhouse gas emissions, at the speed required to limit global warming.

This report addresses this question, by analysing and presenting oil companies' clean energy strategies and investments, as well as climate targets. Results show that, despite the recent announcements of emission reduction targets and engagement in renewable energy projects, the companies' actual investments in renewables are still low compared to those in fossil fuels. Oil companies are now competing with a mature renewable industry, which leaves them as small players without a competitive edge over renewable companies. Oil companies are also facing flat-to-declining oil demand, investor scepticism and public pressure on safeguarding the climate and

environment. Moreover, the low oil prices of recent years serve as a reminder of the volatility of markets for oil – and other fossil fuels – and of the geopolitics associated with the current energy system. Many oil companies have woken up to this challenge and are actively developing new lines of business activity. The findings in this paper suggest more could be done, but the proposed adjustments are not in line with the expected energy transition needs.

The Transforming Energy Scenario of the International Renewable Energy Agency (IRENA) shows the path where the world should be headed to create a sustainable future energy system. The global energy system needs to undergo a profound transformation, replacing the present system that is based largely on fossil fuels with one based on renewable energy, not only in electricity generation but also in end-use sectors such as industry and transport. Oil companies could acknowledge this in their business decisions and adjust their lines of activities and investing accordingly. For example, as a capital-intensive industry, they could play a critical role in filling the gap in renewables investments that needs to be covered in the next several years to achieve climate targets. The challenge is two-fold: to be able to adapt to the energy transition, as well as to evolve in ways that do not simply support the decarbonisation of the energy system, but also perhaps even lead it.

Among the key decarbonisation tools now featuring high in countries' priorities, there are a few options in which oil companies would have a competitive advantage:

- **Hydrogen.** This is an attractive fuel source, which can have different applications, such as for transport, heavy industry and power and heating, where established renewables (*i.e.* solar and wind) cannot deliver the necessary heat. Hydrogen is one of the new markets in which oil companies could establish themselves thanks to their existing expertise in transporting and selling gas.

- **Offshore technologies.** The oil and gas industries, which have operated offshore for more than half a century, could leverage synergies by transferring the knowledge acquired to the offshore wind industry (IRENA, 2020a). For example, they could upgrade existing infrastructure from the offshore oil and gas and shipping industries and convert it for offshore renewable energy technologies (*i.e.*, wind).
- **Electrification.** A key component of the energy transition is renewable electricity, which under IRENA's climate-compatible scenario would become the dominant energy carrier. Some European oil companies are already entering the power sector, with aspirations of transitioning to electricity companies and playing a significant international role in the production and supply of renewable electricity. They have been pursuing this primarily by investing heavily along the electricity supply chain, namely in generation (from solar photovoltaics (PV) and onshore and offshore wind), as well as in electric vehicle (EV) charge points. While this is an interesting path, it comes with difficulties, especially as power systems become more complex and demanding to manage.
- **Liquid biofuels.** Many oil companies have already been investing in biofuels for decades, especially through research efforts and venture capital spending. They have placed a bet on the continued demand for combustible fuels (Raval, 2019), particularly for modes of transport that so far cannot make extensive use of electricity (*i.e.*, heavy trucks and airplanes). With many governments planning to phase out internal combustion engine vehicles, investments in liquid biofuels become strategic even in a context of low oil prices.
- **Carbon Capture and Storage (CCS).** This is a technology in which all oil companies are already investing and could help them in keeping their businesses in the short-term in different ways.

This includes reducing emissions in their operations, reducing the carbon footprint, and especially driving new business lines, such as clean hydrogen production. This latter is quite important, as IRENA's analysis foresees hydrogen playing a key role in the decarbonisation of the energy sector, with green hydrogen¹ representing two thirds of the production and blue hydrogen² only one third. In the case of blue hydrogen, natural gas would still have a role to play and therefore CCS would be key for ensuring its clean production.

These alternative business opportunities could position the oil industry to be at the forefront of the quest for sustainable and inclusive growth as energy companies of the future, in line with the governments' shift towards low-carbon energy and net-zero policy strategies.

The main investors and shareholders in oil and gas companies are also seeking changes in companies' investment portfolios, reflecting the growing interest, societal pressure, public policy environment and growing competitiveness of renewable technologies. For many companies (such as Shell and BP), targets to reduce carbon emissions have partly been the result of pressure from asset managers demanding companies to recognise the financial impacts of climate change on their operations, and as a means to accurately estimate a company's long-term value (Mooney, 2020). The expectations of shareholders and investors have shifted in the debate around climate change, with growing calls for carbon emission reductions as well as commitments to investing in renewable energy.

Oil companies should indulge this pressure from shareholders and investors for greener business activities and prove that these activities are becoming more sustainable in the energy transition ahead. Companies have a portfolio of options to choose from, which would enable them to fundamentally reinvent themselves by further strengthening their commitments and creating a more compelling long-term vision for

1 Hydrogen produced from renewable energy

2 Hydrogen produced from fossil fuels combined with carbon capture and storage

clean technologies and renewable energy investments. This would create strong price-to-earnings multiples, and attract investors and please shareholders, all important elements for competitive and successful differentiation (Thomson and Fitz, 2020).

Overall, the trust of shareholders is essential for the industry to remain an attractive and reliable long-term investment, and these decisive shifts towards low-carbon energy are vital to help oil companies find their place as the energy companies of the future.

1. INTRODUCTION

Climate change has become one of the greatest threats of this century to the environment, as well as to global security including health, wealth and political stability. Over the past decade, energy-related carbon dioxide (CO₂) emissions have increased 1% annually on average. If this average growth rate continues, it is expected to result in global warming by the end of the century of more than 3 degrees Celsius (°C) compared to pre-industrial levels. The Paris Agreement aims to limit the increase in global temperature to “well-below” 2°C, and ideally to 1.5°C (compared to pre-industrial levels) this century. Governments’ current and planned policies would result in a flattening of emissions by 2050, to levels similar to those today, but this would still cause a temperature rise of around 2.5°C. As such, to realise the Paris climate target, a profound transformation of the global energy landscape is essential.

The COVID-19 pandemic has had wide-ranging and unprecedented global impacts at an economic, social, as well as energy and environmental level. As countries consider their economic stimulus options, they should not lose sight of the need to meet global climate and sustainability objectives through the decarbonisation of our societies. Renewable energy solutions provide clean, reliable, cost-effective and easy-to-mobilise energy for different services, including essential services such as health care, water and food supply. These characteristics make renewable energy technologies decisive in the immediate response to COVID-19. While also reducing climate-changing emissions, renewable technologies could play a key role in the economic recovery, ensuring sustainability and energy security, creating jobs and strengthening resilience to protect and improve people’s health and welfare (IRENA, 2020b).

Clean energy technologies, including renewables, lie at the heart of the energy transition and are the cornerstone of efforts to mitigate climate change and achieve the goals of the Paris Agreement. While there

are many uncertainties induced by the energy transition, analysis by the International Renewable Energy Agency (IRENA) highlights the need for fundamental changes in the energy system and the central role that renewables would play in achieving such a deep transformation. Increasing both renewable energy and energy efficiency can achieve more than 90% of the energy-related emission reductions required to set the world on a clean path (IRENA, 2020c).

The current energy supply system, based largely on fossil fuels, must instead be based on renewable energy. Many countries have recognised the urgency of action and have committed to a carbon-neutral future. In 2019, countries pledging to achieve net-zero emissions by 2050 included Denmark, France and the United Kingdom (UK), which have all enshrined the target into law. In the wake of the COVID-19 pandemic, other countries including China, Hungary, Japan and the Republic of Korea also joined the commitment.

Renewable capacity additions have seen a breakthrough in recent years and are now dominating many markets for new power generation capacity. Solar photovoltaics (PV) and wind are increasingly the cheapest sources of electricity in many markets, and most renewable power sources will be fully cost competitive within the next decade. Renewable power generation is now growing faster than overall power demand, and many innovative solutions are being developed to make the power system and grids more flexible, allowing for higher and more cost-effective use and penetration of renewables. Distributed energy resources such as rooftop solar PV, behind-the-meter batteries and electric vehicles (EVs) are emerging as promising solutions. All these achievements and cost reductions have been driven by enabling policies, including deployment policies, research and development (R&D) funding, and other measures that have supported development of the industry in leading countries.

Global investment in renewable electricity generation reached USD 254 billion in 2019,³ while investment in fossil-based generation totalled USD 130 billion (IEA, 2019a). Astonishingly, renewables received almost double the investment that fossil fuel generation did. Oil still dominates the transport sector, but renewables are now the largest source of investment in the electric power sector. While global investments in renewable energy have increased thanks to their cost-competitiveness and reliability, pension funds and multilateral agencies also have become reluctant to invest in oil and gas (IRENA, 2020d). In addition to the declining investments in fossil-based electricity generation, oil companies face growing criticism from their shareholders about the lack of climate action, as well as pressure to have a clear long-term strategy to address climate risks and concerns (Walker, 2019).

In this challenging scenario, it becomes of vital importance for both international and national oil companies to assess the future of the energy system, trying to position themselves and find solutions that would keep them in the market and maximise value creation while contributing to global climate change mitigation. Whereas for international oil companies the challenge is how to integrate renewable energy assets into their portfolios in order to cope with a disruption of their business models, national oil companies face a compromise in their revenue base, with the risk of lost export revenues disrupting their socio-economic security. What is clear is that these companies can no longer afford to ignore the energy transition, which is leading to structural changes in energy markets.

1.1 AIMS AND OBJECTIVES

This paper uses both qualitative and quantitative methods to analyse selected international oil companies in the context of the energy transition and to identify how these companies are adapting to the ongoing transformation. The key research question is:

“What are the strategies and current activities of international oil companies related to the energy transition, and how do they compare with what is needed to achieve climate stabilisation?”

1.2 STRUCTURE

The results presented in this paper stem from an in-depth literature review and analysis of strategies and scenarios developed by prominent oil companies and from IRENA’s in-depth global energy modelling framework, known as REmap. The remainder of this paper is organised as follows:

- » **Chapter 2** introduces the selected oil companies and conducts a literature review describing their past and current strategies, as well as emission targets in the context of the energy transition. This serves as context for the discussion and provides an overview of past and recent engagements.
- » **Chapter 3** draws from the analysis in chapter 2 and identifies key financial and qualitative indicators for the evaluation of the oil companies, clustering them according to their engagement in the energy transition.
- » **Chapter 4** compares IRENA’s Transforming Energy Scenario to 2050 – which outlines an accelerated transition that is consistent with 1.5°C and climate goals – with scenario pathways developed by some oil companies. This helps to provide an overview of companies’ visions of the energy future, in the context of IRENA’s roadmap to a sustainable energy transition.
- » **Chapter 5** summarises and presents the main conclusions of the analysis.
- » **Chapter 6** outlines the way forward as well as potential pathways for oil companies to embrace the energy transition in their business activities.

2. OIL COMPANIES AND HISTORICAL ENGAGEMENT IN RENEWABLE ENERGY

Climate change challenges and the rise of renewable energy sources are increasing the social and environmental pressure on oil companies to re-position themselves in the societies in which they operate. They have been doing this in a variety of different ways.

Firstly, some oil companies have continued with business as usual and are strengthening their current strategies of oil extraction to maximise profits. Secondly, other oil companies have switched to low carbon sources, such as natural gas, blue hydrogen and biofuels. Switching from oil to gas would result in fewer greenhouse gas emissions and greater efficiency, while biofuels are already being used to a large extent (blended into petrol and diesel) but raise concerns regarding biodiversity effects and competing land use. Some oil companies are already using carbon capture and storage (CCS) for enhanced oil recovery, and are converting natural gas into hydrogen and capturing the CO₂ released to produce a valuable fuel that could be used in home heating, industry and eventually ships and planes (Mills, 2019). Finally, other oil companies are, with different degrees of intensity and commitment, transitioning to renewable energy and related technologies, such as solar, wind, EVs and green hydrogen.

Before diving into analysis of the main oil companies, which is the primary focus of this paper, it is worth mentioning the national oil companies and briefly summarising their approach towards the energy transition. National oil companies are state-owned leading petroleum producers that are primarily managed directly by governments; they represent more than 85% of global oil production and include companies such as Saudi Aramco, Abu Dhabi National Oil Company (ADNOC), Brazil's Petrobras, China's Sinopec and Malaysia's Petronas.

The attitude of national oil companies towards the energy transition depends on and is subject to diverse factors, such as the size of their markets (*i.e.*, largely domestic or primarily exporters), governance structures, funding from fuel subsidies, as well as the institutional features of their home countries (political stability, regulatory quality, etc.). However, similar to the international oil companies, national oil companies are also embracing the energy transition through the adoption of strategies such as reducing energy consumption and/or emissions in oil production processes and facilities, investing in alternative fuel vehicles, and investing in new technologies such as CCS and hydrogen.

Some national oil companies have started using renewable energy in their facilities or providing it to other sectors. The latter, however, is not their key activity, and in some instances they are leaving the renewable energy production and ownership to their electricity sector counterparts in their home countries (Shojaeddini et al., 2019). For example, ADNOC has not established renewable energy assets on its own but rather co-operates with the Abu Dhabi Future Energy Company (Masdar), which is leading renewables development in the United Arab Emirates (UAE) and through investment abroad (*i.e.*, solar PV and wind).

In their strategies to lower emissions, almost all national oil companies are pursuing *energy efficiency improvements* and *emission reduction strategies*, including gas flaring reductions (Shojaeddini, et al., 2019). Saudi Aramco stands out as a first mover in flaring as a result of Saudi Arabia's Master Gas System in the 1970s, rolling out a company-wide Flaring Minimisation Roadmap, and through the pursuit of circular carbon economy technologies today.

Some national oil companies are also engaged in *renewable energy* activities. China National Offshore Oil Corporation (CNOOC) revived its activities in offshore wind power in 2019, after closing its renewable unit in 2014 (which operated wind, solar and biomass projects). The offshore wind sector aligns with the company's overall business, which can apply its resources in offshore engineering and its experience in offshore operations in the sector (Xin, 2020). Similarly, Saudi Aramco has long been interested renewable energy and recently revealed plans to launch a new USD 500 million fund to promote energy efficiency and renewable technologies (Murray, 2020). Petrobras is actively engaged in biofuel energy generation with several biodiesel plants. However, with regard to renewables in general, Petrobras recently announced its intention to focus only on research and to stop investing in operational assets, as this "requires competencies different from the oil and gas business" (Spatuzza, 2019).

In addition, national oil companies are actively exploring the use of CCS as well as carbon capture utilisation and storage (CCUS), which represents a game changer that would allow them to keep producing oil but with fewer emissions. The first CCUS facility in the Middle East, Reyadhah, was developed by ADNOC together with Masdar and has the capacity to capture 800 000 tonnes of CO₂ annually, with plans to expand this to 5 million tonnes by 2030 (Hydrocarbonprocessing, 2020). Petronas also announced at the end of 2020 its strategy to achieve net-zero carbon emissions by 2050.

This follows the company's more than two-decade-long journey to integrate sustainable practices into its business and decision making (Petronas, 2020).

Thanks to their better access to capital, experience in managing large projects and easy access to skilled professionals, national oil companies could play a key role in boosting the energy transition and driving the expansion of renewables. However, national oil companies may be reluctant to abandon the billion-dollar fossil fuel business for the less appealing profits and tighter margins of renewable energy projects (Heller, 2019). In addition, national oil companies are primarily managed directly by governments, in contexts where societies depend heavily on oil income. As such, they face specific challenges related to their mandated stewardship of national hydrocarbon resources, and thus their decision-making process is highly policy driven.

2.1 INTERNATIONAL OIL COMPANIES

This paper focuses primarily on the seven main international oil companies: BP plc, Chevron Corporation, Eni S.p.A, Equinor ASA, ExxonMobil Corporation, Royal Dutch Shell plc and Total SE. These companies were selected for analysis because, as independent and private sector businesses, they are the largest publicly traded oil companies and together accounted for 13%⁴ of total global oil production in 2018.

Table 1 provides a brief overview of the seven companies' activities in low-carbon technologies.

4 Calculated based on oil production per company in 2018 (from annual statements) and world oil production: Ycharts (from [YCharts.com](https://ycharts.com)).

Table 1: Overview of oil companies' engagement with low-carbon technologies

COMPANIES	EXPANDING BEYOND OIL PRODUCTION TO CLEAN ENERGY TECHNOLOGIES	INTEGRATING LOW-CARBON TECHNOLOGIES IN OIL PRODUCTION	AIMING TO LOWER OPERATIONAL EMISSIONS	RENEWABLE ENERGY TECHNOLOGY MAIN INVESTMENTS	INVESTMENTS IN DOWNSTREAM ELECTRICITY	RENEWABLE ENERGY TARGETS	OTHER ENGAGEMENTS IN LOW-CARBON INITIATIVES (I.E. JOINT VENTURES OR FUNDS)
BP plc	✓	✓		Onshore wind, solar, biofuels, EVs infrastructure, batteries		50 gigawatts (GW) by 2030	Joint ventures with renewable companies
Chevron Corporation		✓	✓	N/A		N/A	Future Energy Fund to invest in breakthrough low-carbon emission technologies
Eni S.p.A	✓	✓		Solar, wind, hydrogen, EVs batteries and chargers, biofuels	✓	15 GW by 2030 and 55 GW by 2050	Venture capital fund for R&D in renewables with universities and research centres
Equinor ASA	✓	✓		Solar, offshore wind, hydrogen, EVs	✓	4-6 GW by 2026 and 12-16 GW by 2035	Joint ventures with renewable companies
ExxonMobil Corporation		✓	✓	N/A		N/A	N/A
Royal Dutch Shell plc	✓	✓		Offshore wind, hydrogen, biofuels, EVs	✓	Invest USD 3 billion in renewable energy (including hydrogen) per year by 2030	Investments in renewable start-ups and innovation hubs
Total SE	✓	✓		Solar, wind, hydrogen, biofuels	✓	35 GW of renewable electricity by 2025	Joint ventures with renewable companies

Sources: (Holder, M., 2021), (Equinor, 2021a), (Jewkes, S., 2020a), (Nasralla, S. and Twidale, S., 2020), (Total, 2020a) and companies strategies

In addition to the above activities, all seven companies (as well as some national oil companies) are members of the Oil and Gas Climate Initiative (OGCI), a CEO-led initiative founded in 2014 aiming at leading the oil and gas industry response to climate change and scale up low carbon energy solutions – focusing on areas where OGCI can add value, beyond what individual members can do, or the market already offers. OGCI prioritises its activities around three objectives: i) reducing CH₄ emissions, ii) Reducing CO₂ emissions and iii) removing CO₂ (CCUS).

The following sub-sections briefly present the historical evolution of each company in its approach and commitment (i.e., investments, new business activities, etc.) to renewable energy and low-carbon technologies. Based on Table 1 and the descriptions of the companies, some preliminary conclusions on the companies' engagement in the energy transition are drawn at the end of the section.

BP plc

BP was the first oil major company to diversify into renewable energy, showing interest in renewables from 1980 to 2010 with investments in solar and wind power (in both manufacturing and project development) (Pickl, 2019). In the early 2000s the company rebranded itself as “Beyond Petroleum”, investing USD 200 million in this new strategy, and established BP Alternative Energy to highlight its new commitment to the energy transition. However, due to difficulties in shifting from one line of business to the other, BP had to cancel more than half of its original investments in renewables.

Despite the difficulties in entering the renewable energy business, BP still remains one of the oil companies with the largest such portfolios among its peers. BP still has onshore wind assets in the United States (US) and a CCS joint venture with Chevron, Petrobras and Suncor. The company also owns a biofuel business (sugarcane processing, ethanol production, R&D) in Brazil, which started in 2008 when BP became a shareholder of the Tropical BioEnergia plant. The company now operates three sugarcane processing units in Brazil: two in Goiás and one in Minas Gerais. BP also is partnering with DuPont on a technology called Butamax, which converts

corn sugar into bio-isobutanol – a biofuel that is more energy rich than ethanol and can be blended with petrol in higher concentrations and transported through existing fuel pipelines and infrastructure (BP, 2019).

In early 2018, BP's Chief Executive Officer Bob Dudley declared that the company was scanning opportunities to design strategies for a life beyond oil (Gilblom and Schatzker, 2018). The company returned to a sector that it had withdrawn from more than five years earlier by investing USD 200 million in Lightsource, Europe's largest solar power developer (Sheppard and Raval, 2018). This comeback was followed by three additional steps in 2018 towards a low-carbon future. First, the company acquired a stake in FreeWire, a US company developing rapid charging infrastructure for EVs. Other deals followed, including a USD 20 million investment in StoreDot, an Israeli developer of ultra-fast-charging batteries, and a partnership signed with the Chinese private equity group NIO Capital to invest in “advanced mobility” technology in China (Ward and Hook, 2018).

In 2019, BP committed to becoming a net-zero company by 2050. This means lowering emissions from the company's operations 30-35% and reducing carbon-related emissions in upstream oil and gas production 35-40% by 2030. By 2050, BP aims to tackle around 415 million tonnes of emissions – 55 million tonnes from its operations and 360 million tonnes from the carbon content of its upstream oil and gas production. The company also aims to cut the carbon intensity of the products it sells 50% by 2050 or sooner. Finally, BP is focusing on low-carbon energy, including through a 10-fold increase in low-carbon investment by 2030, and an up to 8-fold increase by 2025, partnering with 10-15 cities and 3 core industries in decarbonisation efforts (BP, 2020). In August 2020, the company announced that it would add 50 GW of renewables (wind, solar and hydropower) to its portfolio by 2030 (up from 2.5 GW currently) (Nasralla and Twidale, 2020).

Chevron Corporation

Chevron made three early attempts (2000, 2014 and 2016) to establish its presence in renewable energy, namely in solar, wind and geothermal. However, the

lower returns of the renewable business compared to oil and gas made the company revisit its strategy and continue focusing on its original core activities, while still owning a small renewables portfolio (mainly wind and solar projects in the US). Chevron's overall engagement with renewable energy is low, with no specific targets or commitments. The company is more oriented towards the expansion of CCS technology, with investments in two of the world's largest CO₂ injection facilities: the Quest CCS project in the Canadian oil sands and the Gorgon Project in Australia. The first is a commercial-scale CCS facility applied to oil sands operation, operated by Shell on behalf of the Athabasca Oil Sands Project (Shell Canada Limited, 2019). The second is one of the world's largest natural gas projects, which in 2020 reached 3 million tonnes of CO₂ extracted and buried underground (Macdonald-Smith, 2020).

While not engaged in direct renewable energy investments like its European peers, Chevron is, however, investing in the research, innovation and application of technologies exploring ways to lower carbon emissions. In 2018, the company launched a Future Energy Fund, with an initial commitment of USD 100 million, to invest in breakthrough technologies that enable the ongoing energy transition to a greater diversity of sources to lower carbon emissions (Krieger, 2020).

In its 2019 *Corporate Sustainability Report* (Chevron, 2019), the company states its commitment to addressing climate change and identifies three focus areas of action: 1) lowering carbon intensity by 2023; 2) increasing renewables in support of its business through partnerships with other companies, exclusively in biofuels, biomethane and novel renewable-based oil technologies; and 3) invest in the future by targeting breakthrough technologies like EV charging networks, autonomous vehicles and CCS.

Eni S.p.A

In response to the Paris Climate Agreement and in line with collective commitments to achieve the 17 United Nations Sustainable Development Goals, the Italian multinational oil and gas company Eni has been developing its own decarbonisation strategy and

integrating it into its business model with actions in the short, medium and long terms. In 2014, Eni started the world's first conversion of a traditional refinery to a biorefinery producing green diesel, green naphtha, liquid petroleum gas and jet fuel (Pickl, 2019). After creating a dedicated department focused on identifying renewable energy growth opportunities, the company has emphasised its interest in renewables by forming several partnerships to develop joint projects with other companies, such as General Electric (GE) and Statoil (now Equinor).

The 2016 agreement with GE covers a wide range of innovative technologies, including onshore and offshore wind generation, solar power, hybrid gas-renewable projects, electrification of new and existing assets and waste-to-energy projects. Meanwhile, the 2017 agreement with Statoil (now Equinor) involves exploring ways to integrate renewable energy solutions (mainly offshore wind) in existing oil and gas fields. With renewables playing a central role in its strategy, Eni aims to invest in and develop renewable energy projects where the company has technological and geographical synergies with its core business, such as solar PV, wind and biofuels. Finally, Eni has established a venture capital fund, engaging with several universities and research centres to conduct R&D of promising renewable technologies and applications.

In 2018, Eni set a target to reduce the intensity of its upstream greenhouse gas emissions 43% from 2014 levels by 2025 (Eni, 2018). This would mean reducing emissions down from 0.19 tonnes of CO₂-equivalent per tonne of oil-equivalent (tCO₂e/toe) in 2014 to around 0.11 tCO₂/toe in 2025. In 2019, to ensure the company's ability to adapt to a low-carbon future, Eni committed to: 1) pursuing energy efficiency in the decarbonisation process and direct greenhouse gas emission reduction, 2) developing a resilient oil and gas portfolio, 3) cutting net carbon emissions to zero by 2030 and 4) developing renewable sources and a green business with a circular approach (Eni, 2019a). Eni is also one of Italy's main producers and distributors of electricity, through its wholly owned subsidiary EniPower, and has put renewables at the centre of its strategy, aiming for an installed capacity of 55 GW by 2050.

Equinor ASA

In 2018, the Norwegian oil major Statoil changed his name to Equinor, to support the company's strategy and development as a broad energy company (Equinor, 2018a). The company's main renewable energy activity originally focused on offshore wind, and Equinor is now leveraging its expertise in operating offshore platforms in the North Sea and its ability to scale small projects into big ones. Besides being a major crude oil seller and the second largest supplier of natural gas to the European market, Equinor is active in downstream electricity.⁵ It is involved in several significant wind power projects worldwide, including three offshore wind farms supplying electricity in the UK: Dudgeon Sheringham Shoal, Dogger Bank and Hywind Scotland Pilot Park. Other projects include Arkona in Germany and Empire Wind in the US. In 2018, Equinor decided to strengthen its position in the renewable electricity sector by acquiring the Danish power and gas trading firm Danske Commodities for EUR 400 million (Raval, 2018). In addition, in 2019 Equinor received a USD 260 million subsidy from the Norwegian government to build a floating wind park to power offshore oil platforms, bringing the first such project closer to realisation (Bloomberg, 2019; Reuters, 2019a).

One of the cornerstones of Equinor's new strategy is to diversify its portfolio of investments in renewable energy technologies in order to establish itself as a supplier of energy in a broader sense. In 2017, Equinor bought a 9.7% stake in renewable energy producer Scatec Solar, raising its ownership to 10%. With this partnership, Equinor entered its first solar development project in 2017 via the Apodi asset in Brazil and in 2018 with the Guanizul 2A in Argentina (Equinor, 2018b). Equinor is also investing in the hydrogen business: blue hydrogen produced from fossil fuels with CCS offers the company a prospect of continued use of natural gas reserves, and it seems a viable option to keep gas valuable in a low-carbon future (Equinor, 2021b). Gas companies have a thrust advantage in this area because of their know-how in this sector as well as their access to pipelines. In line with this, Equinor is

developing a hydrogen power plant in the Netherlands in co-operation with national partners. It is also part of a consortium that plans to develop a hydrogen network in northern England.

In 2016, Equinor established a venture capital fund, Equinor Energy Ventures, as part of its business within New Energy Solutions and reflecting its aspirations to gradually complement its oil and gas portfolio with profitable renewable energy and low-carbon solutions. The fund is dedicated to investing in attractive and ambitious growth companies in renewable technologies such as onshore and offshore wind, solar, storage, transport, energy efficiency and smart grids. The total investment capital is USD 200 million, with a maximum budget of USD 1 million to USD 20 million per company over a period of 4-7 years. Examples of the current portfolio include: ChargePoint, an operator of EV charging networks; Oxford PV solar technology company; and fos4X, a developer of sensor platforms and software for wind turbine optimisation (Equinor, 2019). Equinor also developed the world's largest floating offshore wind farm, the Hywind Tampen project, which has a capacity of 88 megawatts (MW) and aims to provide electricity for two offshore field operations in the Norwegian North Sea.⁶

Following the launch of a new climate roadmap in early 2020 based on reducing carbon intensity and growing renewables (Equinor, 2020a), in November 2020 Equinor announced its ambition to become a net-zero energy company by 2050 (including cutting emissions from the production and final consumption of energy). Building on its previous ambitions to grow its renewables production capacity GW by 2026 and 12-16 GW by 2035, Equinor plans to expand its acquisition of wind acreage while continuing to leverage its position in offshore wind and develop CCS (Equinor, 2020b).

ExxonMobil Corporation

Similar to Chevron and unlike its European oil peers, ExxonMobil has shown little engagement in renewable energy and instead has focused only on limiting

5 www.equinor.com/en/what-we-do.html

6 www.equinor.com/en/what-we-do/hywind-tampen.html

emissions through investments in biofuels or CCS. For example, the company has been funding a broad portfolio of biofuel research programmes of leading US universities (e.g., Massachusetts Institute of Technology and Colorado School of Mines), including algae as well as programmes on converting alternative, non-food-based biomass feedstocks, *i.e.*, cellulosic biomass, to advanced biofuels (ExxonMobil, 2018).

Today, ExxonMobil is working with Synthetic Genomics (a US-based biotechnology company) to develop advanced biofuels from algae with the objective of producing 10 000 barrels of algae biofuels a day by 2025 (ExxonMobil, 2018). In 2020, the company also signed an agreement with Global Clean Energy (an alternative fuel developer) to purchase renewable diesel derived from “camelina”, a plant that does not displace food crops and that could have the potential to reduce greenhouse gas emissions from road transport – a win-win (Energy Factor, 2020a).

CCS technologies are a strong component of ExxonMobil’s portfolio and are considered to be critical enablers for meeting energy demand while reducing emissions (Ali, 2019). ExxonMobil has been capturing carbon since 1970 and claims to have captured more than 40% of cumulative captured CO₂. The company states that it currently has one-fifth of the world’s total carbon capture capacity and captures around 7 million tonnes of carbon per year (LeSage, 2020).

In 2019, ExxonMobil entered an agreement with California-based start-up Mosaic Materials to explore the advancement of CCS technology targeting cost reduction and the enabling of large-scale deployment (Ali, 2019). In 2020, ExxonMobil was working with the University of Genova to research how fuel cells could be used to efficiently capture carbon emissions (Energy Factor, 2020b). In early 2021, ExxonMobil launched Low Carbon Solutions, a new business to commercialise its extensive low-carbon technology portfolio. The initiative will invest USD 3 billion in lower-emission energy solutions through 2025, with an initial focus on advancing CCS opportunities (ExxonMobil, 2021).

In its 2020 *Energy & Carbon Summary* (ExxonMobil, 2020), ExxonMobil described the steps it is taking to

responsibly develop new resources to meet demand while also minimising environmental impacts. The company has committed to reducing methane emissions from its operations 15% and reducing flaring 25% by 2020 (compared to 2016 levels), as well as to reducing the greenhouse gas intensity at its operated Canadian oil sands facilities 10% by 2023.

Royal Dutch Shell plc

Over the past decade, Royal Dutch Shell has changed the emphasis of its activity by evolving from a mere oil company into a natural gas-dominated company. Shell also has important downstream activities in petrochemicals, as well as an extensive oil product distribution system. However, only in recent years has Shell strengthened its alternative energy division and created a strategic framework for resilience by investing in green energy, as a way to play a relevant role in the energy transition. Shell does not plan to stop selling oil anytime soon, but it is exploring ways to deliver clean energy products in order to align with current global environmental goals and concerns.

Shell’s CEO Ben van Beurden has acknowledged that climate change will be “the defining challenge” facing the oil industry for years to come and has told investors that the company will no longer be merely an oil and gas company but an “energy transition” company (Sheppard and Raval, 2018). In 2016, Shell set up its New Energies division, building on its expertise in low-carbon technologies (*i.e.*, EV charging, hydrogen, biofuels and renewable power) and exploring new business and commercial models related to the energy transition, such as integrated energy solutions (*i.e.*, combined wind and solar, connecting consumers with new models for energy through decentralisation and digitalisation).

Shell has been investing in biofuels for a long time. Key examples include the joint venture Raizen in Brazil, where Shell has a facility turning sugarcane waste into fuel, as well as a plant in Bangalore (India) showcasing an advanced biofuel process that turns biomass and waste into fuel that can be put directly into a car, van or truck (BP, 2019). Hydrogen has also been on Shell’s radar for the past few years, with several key investments. In Germany, Shell is part of a joint venture

with industrial gas manufacturers Air Liquide and Linde, the car manufacturer Daimler and energy companies Total and OMV to develop a nationwide network of 400 hydrogen refuelling stations for new hydrogen car models by 2023. In 2017, Shell became the first branded fuel retailer to sell hydrogen at one of its retail sites in the UK; the new hydrogen refuelling station in Cobham (on the outskirts of London) is the first of three hydrogen stations Shell plans to open in England's southeast. Shell also has two hydrogen filling stations in Los Angeles and is partnering with Toyota, with the support of the State of California, to further develop its hydrogen refuelling network (Shell, 2019a).

Similar to Equinor, Shell is entering the power sector. In 2019, Shell's CEO announced that the company aims to become the largest electricity company by 2035, with the intention of playing a significant international role in the production and supply of electric power (Crooks and Raval, 2020).

In recent years, Shell has been investing heavily along the electricity supply chain, from generation to EV charge points. In 2017, the company made two significant deals. First, it signed an agreement to buy NewMotion, one of Europe's largest EV charging providers; the company, which became a wholly owned subsidiary of Shell, covers more than 30 000 private EV charge points for homes in France, Germany, the Netherlands and the UK. Secondly, Shell acquired First Utility, a UK-based electricity and gas supplier, becoming an electricity supplier for UK households.

In its most recent significant deal, in January 2019 Shell acquired US-based EV charging start-up Greenlots, which provides software management for EV charging asset operators. This complements Shell's 2017 acquisition of NewMotion, as it combines the hardware and software charging businesses under one umbrella, and Shell will likely combine the Greenlots platform with the NewMotion one (Shell, 2019b). This is a strategic move and a potential source of revenue growth, complementing Shell's broader push in electrical supply and providing a way to hedge against the long-term impact that EVs will have on reducing fossil fuel demand.

Since 2018, Shell has been active in the wind sector. As part of its strategy to expand its wind technologies, it joined the Global Wind Energy Council that year as a Board Member. The move came as Shell expanded its wind business as part of its New Energy Strategies. Also in 2018, Shell became a partner in the Dutch 680 MW Borssele 3&4 offshore wind project and entered the US offshore wind market by winning two development lease auctions on the East Coast (Shell, 2019c).

Like other big oil companies, Shell is investing in renewable energy start-ups and innovations. Through its venture capital arm, it aims to keep abreast of technologies with potential to disrupt the traditional models and thus to be able to test new business models to adapt and survive throughout the energy transition. Investments are targeted at a broad array of start-ups engaged in technological development, including companies in the mobility sector and home batteries. Key investments include the acquisition of sonnen, a German company that develops home batteries, and of Sense, a tech company that designs, develops and manufactures products that allow users to track energy usage in their home and see which appliances use the most electricity. Both investments are meant to bring Shell closer to its consumers (Shell, 2019d). In addition, in 2018 the company led an equity investment of USD 20 million in Husk Power Systems, an India-based company that provides renewable power to rural communities and businesses through distributed off-grid installations. The investment targeted the expansion of Husk in the African and Asian markets with mini-grids (Deign, 2018).

In addition to investing in start-ups, Shell is promoting energy innovation labs. For example, Shell Idea Refinery⁷ is a key programme in Singapore, acting as a living lab for energy innovation for the nation. The programme aims to increase the mix of energy start-ups in Singapore, by developing companies that have a positive energy impact on society and enabling existing start-ups to explore opportunities in the energy sector through testing and potential commercialisation of clean energy solutions. Government, academics and industry specialists are also involved and partner with innovative

7 www.shell.com.sg/energy-and-innovation/make-the-future-singapore/idea-refinery-start-up-accelerator.html

energy start-ups to share expertise; learn about trends, gaps and opportunities in the energy sector; and ultimately create new business models that can help cope with the energy transition challenges.

As part of its climate strategy, Shell aims to cut the carbon intensity of its products 30% by 2035 and 65% by 2050. In April 2020, Shell announced a commitment to introduce a net-zero emission target for all its own oil and gas production and the energy it uses by 2050. The new target was set despite the challenges the company has faced due to low oil prices and demand cuts resulting from the COVID-19 crisis (Hook, 2020). However, the net-zero target does not include the much larger category of emissions from the fuels and products Shell sells to consumers. The company would face fundamental challenges in reducing these emissions without decreasing sales or shifting the products it sells.

Total SE

Total is one of the main actors and front-runners among oil companies to adjust its core business from a mere oil and gas company to a full energy company. The company's main strategy is to diversify its portfolio of investments across the entire energy value chain, as well as in different renewable technologies. This helps the company to diversify revenues from volatile oil prices and to shift towards developing a strong position and place in overall energy markets.

Historically, Total's renewable energy investments were focused on solar PV and biofuels. Solar PV is at the core of the company's energy ambition, and Total has developed a strong expertise along the entire value chain, from panel manufacturing to operating solar farms and installing decentralised energy solutions. In the area of biofuels, in 2016 Total invested USD 14 million in a new biomass conversion technology from clean tech start-up Renmatix. The start-up is producing a technology using super-critical water to reduce the costs associated with converting biomass (wood or agricultural waste) to cellulosic sugars for biofuels (Kite-Powell, J., 2016). In 2017, Total also transformed its La Mède refinery into the first biorefinery in France, with a capacity of 500 000 tonnes from various types of oils, including vegetable oils (Total, 2019a).

Like Equinor and Shell, Total is laying the foundation for further expansion into the electricity supply chain and has been acquiring companies along this supply chain, from renewable generation to battery storage to EV charging and domestic power (Crooks and Raval, 2019). In 2016, the company purchased Saft, a French battery manufacturing company, as well as Lampiris, a Belgian green power utility (Ward, 2018). In 2019, another top investment followed when Total merged its Direct Energie and Total Spring retail subsidiaries to become France's biggest alternative electricity supplier, taking on former monopolies of EDF and Engie (Reuters, 2019b). Total is aiming to increase its renewable electricity production capacity to 5-10 GW within five years, leveraging the expertise of its affiliates Total Solar, SunPower, Total Eren and Quadran (Total, 2019b).

Total also has been active in investing in energy ventures. In 2007, the company founded Total Energy Ventures International, which operates as an investment arm of Total SA. The main strategy is to invest in a wide assortment of energy technologies while preferring to hold a minority stake; the portfolio includes solar, wind, ocean energy, energy storage, distributed energy technology, hydrogen, biofuels and chemicals. Examples of investments include AutoGrid, a California-based company that has developed a suite of energy internet applications for utilities, electricity retailers, renewable energy project developers and energy service providers; and United Wind, a small-scale wind turbine company based in New York formed in 2013 as a combination of assets and talent from the two industry-leading small wind companies, Talco Electronics and Wind Analytics (Graham, 2017).

Since 2016, Total has prepared reports on what the company is doing to tackle climate challenges as an integral part of its corporate strategy. In its 2019 strategy, Total set a goal of achieving net-zero emission intensity across its own production, as well as across the energy products used by European customers, by 2050. For global production, the company aims to reduce the carbon intensity of its products sold to consumers worldwide by 60% between now and 2050 and to increase renewable power generation (wind, solar and hydro) to 35 GW by 2025 (Total, 2019c).

2.2 PRELIMINARY FINDINGS

Some preliminary findings on oil companies' engagement in the energy transition can be drawn from Table 1 and from the descriptions of activities elaborated above. All seven oil companies are integrating low-carbon technologies in their oil production (through CCS); however, there is a clear division between European and US-based companies with regard to their approach to renewable energy. While the European companies are expanding beyond oil production and investing in renewable technologies and/or in start-ups and innovation hubs, US-based companies are not embracing the transition and are maintaining a "business-as-usual" approach.

Within European companies, another layer of distinction can be made based on the shifts in operational organisation. The first group of companies, comprising Eni, Shell and Total, are not only including renewable energy in their portfolios, but also investing heavily along the entire electricity supply chain, from production to generation and supply. Shell and Total have done this through the acquisition of companies (*i.e.*, generation, battery storage, domestic power, etc.) at a global level, while Eni has been active solely in Italy's electricity market, where it is the second largest electricity provider (after Enel). The second group of companies, comprising BP and Equinor, are focusing only on diversifying their portfolios by including investments in renewables (solar, wind and biofuels) as well as hydrogen and EVs.

3. WHAT ARE THE COMPANIES' ANNOUNCED FUTURE COMMITMENTS?

All seven major oil companies have publicly agreed through their annual reports and statements that climate change is one of the major threats of our times and that they should contribute to the energy transition. However, a major difference exists between European companies (*i.e.*, BP, Eni, Equinor, Royal Dutch Shell and Total) and US-based companies (*i.e.*, Chevron and ExxonMobil) in the urgency and pace with which these companies are planning to transform their activities.

US companies do not face the same top-down pressure to decarbonise their activities as their European peers do (Johnston *et al.*, 2020), and despite the societal demand for climate action, US companies are still betting on a long-term future for oil. Although their investments in renewable energy are few (with marginal involvement in biofuels), US companies are investing largely in CCS as a means to contribute to their pledges to lower carbon emissions, as well as in new energy technologies and efficiency improvements as a way to reduce the emissions of their operations.

Both Chevron and ExxonMobil are keeping up with shale drilling and are trading natural gas, and they are merging with smaller oil companies to help ensure that reserves are always there. For example, in July 2020, Chevron acquired the small oil company Noble Energy, which will give Chevron a presence in Israeli waters where Noble Energy has discovered a large gas deposit (Krauss, 2020a). Commenting on the energy transition, Chevron's vice president announced: *"Our strategy is not to follow the Europeans. Our strategy is to decarbonise our existing assets in the most cost-effective way and consistently bring in new technology and new forms of energy. But we're not asking our investors to sacrifice return or go forward with three decades of uncertainty on dividends"* (Krauss, 2020b). Like Chevron, ExxonMobil's commitment to renewables

is very limited, with investments targeted at carbon capture technologies while producing more oil.

On the other hand, European companies have already started investing in renewable energy while also gambling on a future as electricity providers (Krauss, 2020b). Their efforts to invest in renewable technologies are in line with Europe's efforts to transition to a lower-carbon economy, pushed also by policy and financial pressures. Yet, even if some European companies have made net-zero pledges and set ambitious emission targets, these do not include substantial cutbacks in oil extraction and/or production in the short term. From a business perspective, this could be considered an appropriate strategy that would maximise shareholder returns, but in the broader context of the climate challenges and energy transition it can be considered as short-sighted. There is still a lack of understanding of how their short-term actions are aligned with their long-term targets, as companies' net zero targets announcements are not accompanied by a decarbonisation roadmap, split by value chain, showing a concrete pathway of how to achieve them.

3.1 INTERNATIONAL OIL COMPANIES' LONG-TERM CLIMATE TARGETS

Table 2 outlines the seven oil companies' commitments to the energy transition through their announced long-term climate targets. The type and characteristics of the emission targets can be taken as a proxy to evaluate the companies' views and level of commitment.

While setting net-zero emission targets is praiseworthy, if targets are not linked to a carbon budget or if there are no short-term targets on the pathway to zero (Coffin, 2020a), then these targets are not able to tell the full story and

their credibility can be questioned. Two aspects should be considered when evaluating the companies' targets. Firstly, there is a clear distinction between intensity-based targets and absolute targets. Intensity-based refers to the amount of emissions per unit of energy. As such, these types of targets can be achieved simply by increasing the share of low-carbon energy products, as well as developing carbon sinks without cutting oil production (Grant, 2020). As a result, intensity-based targets do not imply a cut in emissions in absolute terms and rather still allow fossil fuel production. On the other hand, targets with an absolute basis refer to the total amount of emissions being emitted. These recognise that the carbon budget is finite and imply an absolute cut in emissions from oil production (Coffin, 2020a).

Another aspect to be considered is the scope of emissions covered, of which there are three types. Scope 1 and Scope 2 refer to emissions released in operations and in electricity purchased in the supply chain (with Scope 1 emissions being those released as a direct result of company-owned and controlled resources, and Scope 2 emissions being those released indirectly from generation and purchased electricity). Scope 3 refers to emissions from the use of oil coming from the final combustion (*i.e.*, when oil products are actually used) (Schuwerk, 2019). Focusing only on Scope 1 and Scope 2 fails to acknowledge the impact of reduced oil use in the transition, because it factors in all energy produced (regardless of its source). As such, this would allow oil production to grow as long as enough non-carbon energy sources are added to the portfolio (Coffin, 2020b). The correct approach, in contrast, would be to consider the much larger category of emissions from fuels and products that companies sell to consumers (Scope 3), as these make up 85% of total emissions in the sector.

Based on the above explanation, a few considerations can be made regarding the seven companies analysed.

Total and **Shell** have all intensity-based targets, covering emission Scopes 1, 2 and 3. Because they are based on an intensity approach, the targets fail

to embrace the full carbon budget. Notably, Shell has pledged to cut its emissions intensity 65% by 2050. While this target refers to emission Scopes 1, 2 and 3, because it is intensity-based, it leaves the door open for oil and gas expansion. This target is also refined by another goal Shell has of achieving net-zero emissions in its own operations and energy uses. However, the net-zero target applies only to Scope 1 and 2 emissions and not to emissions from the combustion of fossil fuels that the company sells.

In addition, Shell aims to become a “net zero emissions energy business” through the active engagement of its consumers. The company’s strategy states that: “*our customers can take action on their emissions and such actions by our customers can help Shell become a net zero emissions business*”.⁸ The consumer engagement approach is praiseworthy, as is the net-zero emission target for the company’s own operations. Yet without clear short-term targets before 2050, and especially without specific targets for absolute emissions, it is hard to qualify Shell as a net-zero company (Grant, 2020). Total’s case is similar: the net-zero ambition relates to Scope 1 and Scope 3, but only for its European production, while the global target is 60% of intensity reduction.

On the other hand, **BP**, **Eni** and **Equinor** have absolute targets. However, BP’s net-zero target does not include Rosneft,⁹ which makes up 29% of its production, and does not include short-term targets towards achieving the 2050 goal. Moreover, BP does not plan to achieve zero emissions from oil and gas extracted by other companies and processed by BP and resold; rather, it aims to cut the carbon intensity (amount of emissions per unit of energy) from these products 50% by 2050. Notably, the burning of these fuels creates an additional 77 million tonnes of emissions per year (Plumer, 2020).

Eni, meanwhile, seems to be ahead of its peers, because although it has only an 80% target (not a net-zero one), it considers Scope 3 emissions and also has short-term targets for years prior to 2050. Equinor, as well, has

8 www.shell.com/energy-and-innovation/the-energy-future/shells-ambition-to-be-a-net-zero-emissions-energy-business.html

9 Rosneft is a Russian integrated energy company specialising in exploration, extraction, production, refinement, transport and sale of petroleum, natural gas and petroleum products.

announced a target of absolute net-zero emissions (Scopes 1, 2 and 3) by 2050 and still aims to achieve carbon neutrality in global operations by 2030 and to reduce absolute greenhouse gas emissions in Norway by 2050.

By contrast, the two US companies, **Chevron** and **ExxonMobil**, only have short-term goals (2023 and 2025), related to the reduction of Scope 1 and Scope 2 emissions intensity. Table 2 provides an overview of the seven oil companies' climate and emissions commitments.

Table 2: Overview of oil companies' climate and emissions commitments (as of January 2021)

COMPANY	APPROACH	SHORT-TERM TARGET	2050 EMISSIONS TARGET	OVERALL STRATEGY FOR THE ENERGY TRANSITION
BP plc	Absolute approach	-	<ul style="list-style-type: none"> Net zero (Scopes 1, 2, 3) Cut carbon intensity of the products it sells 50% by 2050 	<p>Two key aims by 2050:</p> <ol style="list-style-type: none"> Net zero across entire operations on an absolute basis (Scopes 1 and 2); Net zero on an absolute basis across carbon in its upstream oil and gas production (Scope 3). <p>The company is also aiming to cut the carbon intensity of the products it sells (i.e., oil and gas extracted by other companies and processed by BP) 50% by 2050 or sooner. These goals do not cover Rosneft, which constitutes 29% of its production.</p>
Chevron Corporation	Intensity approach	5-10% oil and 2-5% gas by 2023	-	Aims to cut net greenhouse gas emissions intensity in upstream oil 5% to 10% and in upstream gas 2% to 5% by 2023. Aims to reduce methane emissions intensity 20% to 25% by 2023.
Eni S.p.A.	Absolute approach	30% by 2035 (Scopes 1, 2, 3)	Cut emissions 80% (Scopes 1, 2, 3)	Targets 80% cut in net greenhouse gas emissions by 2050. Plans to cut carbon intensity 55% by 2050 from 2018 levels, with a medium target of 15% by 2035 from 2018 levels.
Equinor ASA	Absolute approach	Carbon neutrality in its operations by 2030	Net zero (Scopes 1, 2, 3)	Aims for net-zero emissions (Scopes 1, 2, 3). It also aims to reduce greenhouse gas emissions from its operating offshore fields and onshore plants in Norway 40% by 2030, 70% by 2040 and near zero by 2050. At a global level, it aims to achieve carbon neutrality in its operations by 2030. Targets are to grow renewable energy capacity 10-fold by 2026, to develop as a global offshore wind major and to have 12-16 GW of installed renewables by 2035.

ExxonMobil Corporation	Intensity approach	15-20% by 2025 (Scopes 1 and 2)	-	The 2025 target will be supported by a 40-50% decrease in methane intensity and a 35-45% decrease in flaring intensity across its global operations. No targets to 2050 and no targets for renewables.
Royal Dutch Shell plc	Intensity approach	30% by 2035 (Scope 3)	<ul style="list-style-type: none"> • Cut emissions 65% (Scope 3) • Net-zero emissions by 2050 (Scopes 1 and 2) 	Aims to cut emission intensity 30% by 2035 and 65% by 2050 (Scope 3). In April 2020, the company announced its aim to become a net-zero emission company by 2050 in its own oil and gas production and energy it uses (Scopes 1 and 2).
Total SE	Intensity approach	-	<ul style="list-style-type: none"> • Net-zero emissions for Europe only (Scopes 1, 2, 3) • Cut emissions 60% globally (Scopes 1, 2, 3) 	Aims for net-zero emissions across its own production, as well as across the energy products used by European customers by 2050. For global production the target is 60% by 2050.

Source: Based on Coffin, 2020b and on companies' sustainability strategies.

3.2 ADDITIONAL FINDINGS

The analysis of companies' commitments allows us to draw some additional considerations. The distinction between European and US companies is further intensified: the European companies all have long-term emission targets, while the US companies have only short-term targets. However, the division within European companies is different than the one presented previously. Based on the type of emissions targets (intensity vs. absolute) and on the type of emissions covered (Scopes 1, 2, 3), two clear groups stand out. The first group comprises BP, Eni and Equinor, all of which have absolute targets and cover all three emission Scopes. However, BP's emission target does not cover the entire production owned by the company, as it leaves out Rosneft, which accounts for 29% of BP's production. Meanwhile, even if Eni's goal does not reach zero emission, the company commits to an 80% absolute target by 2050 and offers short-term/interim

targets to achieve it. The second group of European companies comprises Shell and Total, whose targets are intensity-based and thus fail to include a commitment to an absolute cut in their emissions.

3.3 OIL COMPANIES' FINANCIAL STRATEGIES AND IMPLICATIONS FOR THE ENERGY TRANSITION

The negative effects of COVID-19 on the fossil fuel industry are just part of a declining trend that the industry has been experiencing for the past decade. Table 3 shows the financial strategies of the selected companies for the three-year period of 2017-2019, which can help to assess their financial health as well as investments, and make it possible to draw some more concrete conclusions on their engagement in the energy transition beyond what they have announced in the media.

Table 3: Oil companies' financial strategies (2017-2019)

FINANCIAL STRATEGY	COMPANIES						
	BP PLC	CHEVRON CORPORATION	ENI S.P.A.*	EQUINOR ASA	EXXONMOBIL CORPORATION	ROYAL DUTCH SHELL PLC	TOTAL SE
Total revenue (million USD)	2019: 282 616 2018: 303 738 2017: 244 582	2019: 146 516 2018: 166 339 2017: 141 722	2019: 82 980 2018: 89 868 2017: 82 877	2019: 64 357 2018: 79 593 2017: 61 187	2019: 264 900 2018: 290 212 2017: 244 360	2019: 344 877 2018: 388 379 2017: 305 179	2019: 176 313 2018: 184 050 2017: 149 119
Segments	<ul style="list-style-type: none"> Upstream Downstream Other businesses and corporate Rosneft 	<ul style="list-style-type: none"> Upstream Downstream 	<ul style="list-style-type: none"> Exploration and production Gas and power Refining and marketing and chemicals Corporate and other activities** 	<ul style="list-style-type: none"> Development and production Norway (DPN) Development and production international (DPI) Marketing midstream and processing (MMP) and other 	<ul style="list-style-type: none"> Upstream Downstream Chemical 	<ul style="list-style-type: none"> Integrated gas Upstream Downstream Corporate 	<ul style="list-style-type: none"> Exploration and production Refining and chemicals Marketing and services
Segments' revenue (million USD)	<p>Upstream 2019: 54 501 2018: 56 399 2017: 45 440</p> <p>Downstream 2019: 250 897 2018: 270 689 2017: 219 853</p> <p>Other businesses and corporate 2019: 1 788 2018: 1 678 2017: 1 469</p> <p>Upstream and Downstream include revenue from trade between segments.</p> <p>As Rosneft is only partially owned by BP, the revenue is not disclosed (only profit).</p>	<p>Earnings per segment***:</p> <p>Upstream 2019: 2 576 2018: 13 316 2017: 8 150</p> <p>Downstream 2019: 2 481 2018: 3 798 2017: 5 214</p>	<p>Exploration and production 2019: 27 344 2018: 29 898 2017: 22 649</p> <p>Gas and power 2019: 58 017 2018: 64 600 2017: 58 723</p> <p>Refining and marketing and chemicals 2019: 27 067 2018: 29 251 2017: 25 644</p> <p>Corporate and other activities 2019: 1 950 2018: 1 843 2017: 1 696</p>	<p>DPN 2019: 18 832 2018: 22 475 2017: 17 692</p> <p>DPI 2019: 10 325 2018: 12 399 2017: 9 256</p> <p>MMP 2019: 60 955 2018: 75 794 2017: 59 071</p> <p>Other 2019: 624 2018: 280 2017: 87</p>	<p>Earnings per segment***:</p> <p>Upstream 2019: 14 442 2018: 14 079 2017: 13 355</p> <p>Downstream 2019: 2 323 2018: 6 010 2017: 5 597</p> <p>Chemical 2019: 592 2018: 3 351 2017: 4 518</p>	<p>Integrated gas 2019: 45 602 2018: 48 795 2017: 36 770</p> <p>Upstream 2019: 46 413 2018: 47 733 2017: 40 192</p> <p>Downstream 2019: 294 677 2018: 335 597 2017: 265 821</p> <p>Corporate 2019: 45 2018: 43 2017: 51</p> <p>Integrated Gas, Upstream and Downstream include revenue from trade between segments</p>	<p>Exploration and production 2019: 38 590 2018: 40 226 2017: 28 483</p> <p>Refining and chemicals 2019: 116 973 2018: 124 128 2017: 99 341</p> <p>Marketing and services 2019: 66 887 2018: 69 287 2017: 56 105</p> <p>Integrated gas, renewables and power 2019: 21 056 2018: 19 378 2017: 16 503</p> <p>Corporate 2019: 135 2018: 71 2017: 397</p>
Renewable energy investments (million USD)	2019: 500 (for low-carbon activities, repartition is not specified) 2018: 500 2017: not disclosed	Since 2018: 100 in the Future Energy Fund	R&D in carbon neutrality and circular economy 2019: 119 (of which: 28 in renewable energy)	New Energy Solution Unit (including CCS) 2019: 300 2018: 500	n/a	2016-2019: 2 000 (estimated)	Investments in Integrated gas, renewables and power 2019: 7 053 2018: 5 032 2017: 3 594

FINANCIAL STRATEGY	COMPANIES						
	BP PLC	CHEVRON CORPORATION	ENI S.P.A.*	EQUINOR ASA	EXXONMOBIL CORPORATION	ROYAL DUTCH SHELL PLC	TOTAL SE
Allocation of investments (million USD)	Upstream 2019: 11 904 2018: 12 027 2017: 13 763 Downstream 2019: 2 997 2018: 2 781 2017: 2 399 Other businesses and corporate 2019: 337 2018: 332 2017: 339	Upstream 2019: 17 824 2018: 17 657 2017: 16 388 Downstream 2019: 2 788 2018: 2 193 2017: 2 190 Other 2019: 382 2018: 256 2017: 243	Exploration and production 2019: 8 115 2018: 9 165 2017: 8 977 Gas and power 2019: 267 2018: 250 2017: 165 Refining and marketing and chemicals 2019: 1 082 2018: 1 017 2017: 846 Corporate and other activities 2019: 268 2018: 166 2017: 101	Repartition per segment not disclosed. Totals are: 2019: 14 800 2018: 15 200 2017: 10 800	Upstream 2019: 23 485 2018: 20 194 2017: 16 695 Downstream 2019: 4 371 2018: 3 429 2017: 2 524 Chemical 2019: 3 265 2018: 2 235 2017: 3 771	Integrated gas 2019: 6 706 2018: 4 259 2017: 3 921 Upstream 2019: 11 075 2018: 12 785 2017: 13 160 Downstream 2019: 10 542 2018: 7 565 2017: 6 418 Corporate 2019: 465 2018: 269 2017: 157	Exploration and production 2019: 8 992 2018: 13 789 2017: 10 005 Refining and chemicals: 2019: 1 698 2018: 1 781 2017: 1 734 Marketing and services: 2019: 1 374 2018: 1 458 2017: 1 457 Integrated gas, renewables and power 2019: 7 053 2018: 5 032 2017: 3 594 Corporate 2019: 120 2018: 125 2017: 106
Proved reserves replacement ratio (%)	2019: 67% 2018: 100% 2017: 143%	2019: 44% 2018: 136% 2017: 155%	2019: 92% 2018: 100% 2017: 103%	2019: 75% 2018: 213% 2017: 150%	2019: -25% 2018: 313% 2017: 183%	2019: 65% 2018: 53% 2017: 27%	2019: 157% 2018: 157% 2017: 95%
Profit margins (% of revenue and return over asset) at the end of the year	2019: 0.03% 2018: 1.01% 2017: 0.04%	2019: -19.12% 2018: 9.25% 2017: 8.55%	2019: -11.49% 2018: 1.98% 2017: 9.80%	2019: -1.58% 2018: 15.50% 2017: 15.04%	2019: 9.03% 2018: 8.79% 2017: 12.83%	2019: 1.15% 2018: 5.47% 2017: 4.46%	2019: 5.99% 2018: 2.44% 2017: 2.46%
Share prices in New York Stock Exchange (USD)	2019: 34.96 2018: 33.04 2017: 34.62	2019: 114.05 2018: 98.94 2017: 109.62	2019: 28.90 2018: 27.71 2017: 27.99	2019: 18.62 2018: 18.80 2017: 18.34	2019: 64.34 2018: 60.26 2017: 70.97	2019: 56.17 2018: 52.15 2017: 56.39****	2019: 55.09 2018: 46.40 2017: 46.76
Market value (billion USD) at the end of the year*****	2019: 130.59 2018: 134.61 2017: 137.95	2019: 225.35 2018: 209.23 2017: 235.73	2019: 55.61 2018: 56.72 2017: 59.76	2019: 67.72 2018: 74.25 2017: 70.00	2019: 300.31 2018: 303.81 2017: 355.97	2019: 239.79 2018: 253.61 2017: 280.79	2019: 144.28 2018: 144.81 2017: 135.66

(*): Original values in EUR and converted in USD on 30 October 2020 (EUR 1 = USD 1.16).

(**): The “corporate and financial companies” segment includes results of operations of Eni’s headquarters, and the “other activities” segment comprises results of operations of Eni’s subsidiary Eni Rewind, which runs reclamation and decommissioning activities pertaining to certain businesses that Eni exited, divested or shut down in past years and manages the stream of waste originated from industrial and remediation activities, as well as the Energy Solutions business which engages in developing the business of renewable energy.

(***): Chevron and ExxonMobil report total revenues; for segments they only report “earnings”.

(****): Royal Dutch Shell plc (RDS-A)

(*****): Market capitalisation (or market value) is the most commonly used method of measuring the size of a publicly traded company and is calculated by multiplying the current stock price by the number of shares outstanding.

Sources: Annual reports for 2019, 2018 and 2017 for all selected companies; Equinor climate change questionnaire 2020 and 2019; profit margins from [YCharts.com](https://www.ycharts.com/); market value from [Macrotrends.net](https://www.macrotrends.net/); share prices from Yahoo Finance; overall concept/structure from De Oliveira Gorini, 1999.

Total revenues and profits per segment and allocation of investments

All of the seven companies examined are integrated oil companies, which means that they have both large upstream and downstream operations. The total revenues and revenues per segment of activity between 2018 and 2019 have been declining for all analysed companies (see Table 3), with weak upstream returns reported, despite the large investments. Yet, despite the low returns on capital employed, they all continue to rely on their upstream businesses to fund their investments and drive shareholder returns (Fitz *et al.*, 2020). The increase in investments in the upstream and other segments can be seen for both US as well as European companies, which despite the commitments to cut emissions, are still not cutting back their oil and gas developments. This indicates that companies are still investing to keep future production at the same level and keeping the focus on fossil fuel production for the years ahead.

When it comes to investments in renewable energy, however, financial disclosure is not clear. For US companies, Chevron declared an investment of USD 100 million in 2019 in the Future Energy Fund, a venture fund investing in start-ups developing technologies that lower oil and gas emissions, namely CCS, EVs and batteries. On the other hand, ExxonMobil has only reported investments in biofuels. For European companies, renewable energy investments usually fall under the category of “low-carbon investments” in their financial statements, which also include CCS with no clear distinction per technology.

Eni is the only company reporting investments in “Carbon neutrality and circular economy” with split by sub-categories, including investments for renewable energy, which amounted to USD 28 million in 2019 (Eni, 2019b). The majority of the company’s capital expenditure was focused mainly on the development of renewable projects, circular economy (namely water treatment and waste-to-fuel technologies) and digitalisation. The company reports the installation of 167 MW of solar PV and wind capacity in 2019 (four times the level of 2018), including 82 MW in Italy and around 86 MW outside Italy (in Australia, Kazakhstan,

Pakistan and Tunisia) and almost 70 gigawatt-hours of electricity produced by renewable sources (Eni, 2019c). Despite the announced investments in renewables, the company has reported low returns from the “Corporate and other activities” segment, which includes the operation of Eni’s headquarters, as well as decommissioning and reclamation activities and the Energy Solution business, which engages in the development of renewable energy.

European companies have shown a stronger commitment to cut emissions and invest in renewables compared to their US peers, but the level of investments in revenues from renewables from the majority of the companies is not possible to assess from their financial statements.

In order to invest more radically in green technology, oil companies would need both the financial capacity to allocate enough money, as well as the willingness to hold back more cash from their investors. This is particularly challenging in the context of recent low oil prices, which have made margins slimmer across the oil industry, and as such, spending a large amount of money in green technologies would represent more a loss than a gain.

Moreover, because of the COVID-19 pandemic, all oil companies experienced billion of losses in their earnings in the first and second quarters of 2020. In early 2021, Chevron reported a loss of USD 5.5 billion for 2020 compared to profits of nearly USD 3 billion in 2019 (Matthews and Sebastian, 2021). Similarly, in February 2021 ExxonMobil reported a loss of USD 22 billion for 2020, against profits of more than USD 14 billion in 2019 (Brower and Jacobs, 2021). Among European companies, Shell reported a net loss of USD 21.7 billion. Losses for other European peers have been less severe, BP reported a loss of USD 5.69 billion for 2020 compared with a profit of almost USD 10 billion in 2019 (Ambrose, 2021), while Total’s 2020 profit fell from USD 11.8 billion in 2019 to USD 3.86 billion in 2020, reflecting a drop of 66% year-on-year (Meredith, S., 2021).

Another indicator of an oil company’s operating performance is the proved reserve replacement ratio (RRR). By looking at all oil companies’ RRRs for the three-year period of 2017-2019, it is evident that their operating performance has been shrinking, as

all companies reported a value under 100%, which indicates the minimum level for the company to sustain its production. Total is the only exception, with 157% of RRR in 2019. Among the European companies, BP performed the worse, with 67% RRR, followed by Equinor and Shell at 75% and 76% respectively. BP and Equinor experienced large declines in the past couple of years, while Shell had a small increase, but still below the 100%. On the other hand, Total reported an RRR of well above 100% in the last couple of years. In 2019, both US companies reported the worse result for decades: Chevron 44% and ExxonMobil -25%. Such results among European and US majors may hint at some difficulties the industry is facing in recovering from the 2014 oil price crisis, as well as in facing the current one.

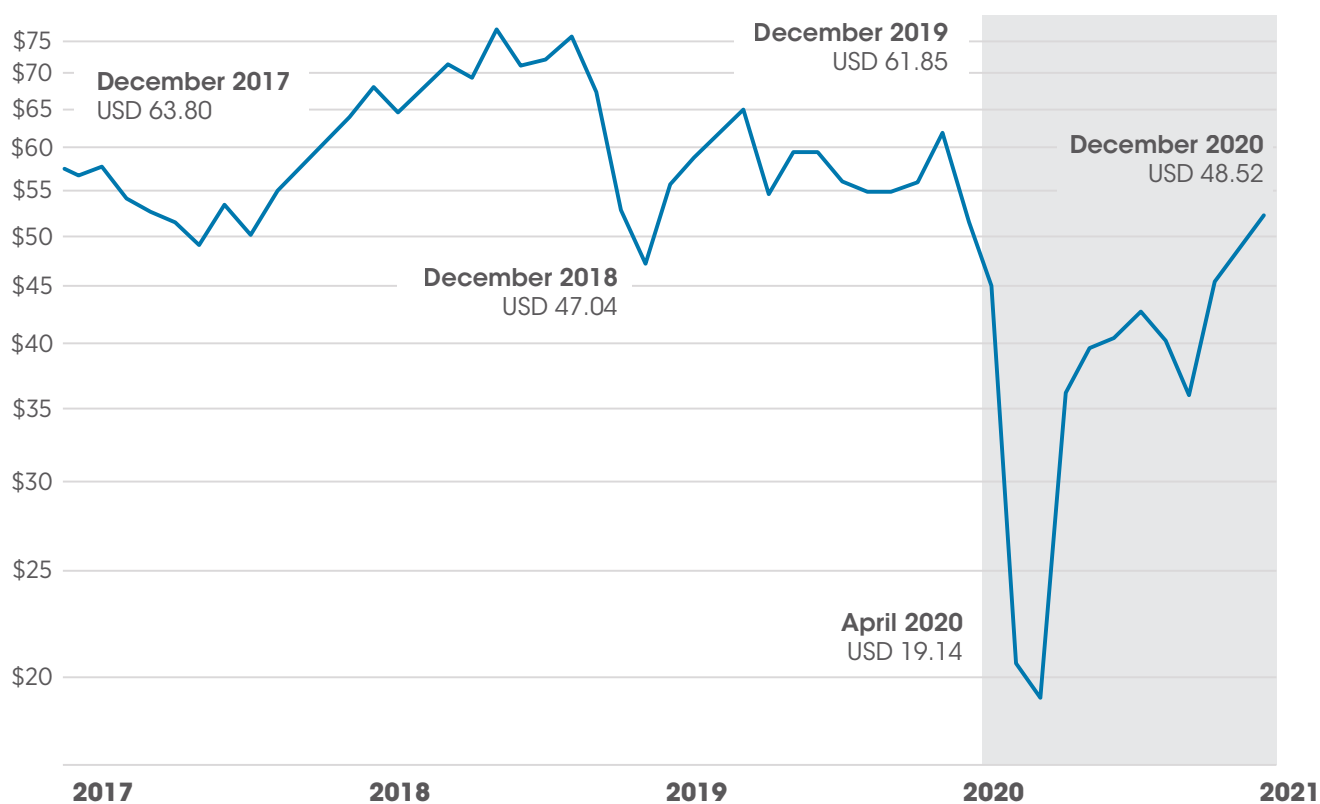
Profit margin

During the 2017-2019 period, profit margins for all seven companies decreased dramatically.

Several factors have influenced this decline, but the key aspect is the fluctuation in the price of crude oil, especially for upstream companies. All companies analysed in this paper are integrated companies, and, as shown, upstream activities have a significant weight on their portfolios and investments. This also makes them vulnerable to oil price variations. The companies are hit very hard when prices fall, since the price at which they sell oil is determined by the market, but their costs of production are largely fixed. If it costs more to produce a barrel of oil than it would fetch on the market, producers will incur losses and eventually go under (Hayes, 2018).

Figure 1 shows the evolution of oil prices during the three-year period of 2017-2019, and the oil prices for 2020. The low oil price in April 2020 (USD 19.14) due to the COVID-19 crisis had a significant impact on the profit margins of oil companies. For example, Shell's profit margin in June 2020 went down to -55.78%, BP's to -53.19% and Eni's to -52.43%.¹⁰

Figure 1: Evolution of crude oil prices (2017-2020)



Source: <https://www.macrotrends.net/1369/crude-oil-price-history-chart>

¹⁰ Retrieved from YCharts.com

Low oil prices pose a key strategic problem for the oil industry, which has traditionally made high profits from upstream activities. The argument of a “profitability” gap between investments in upstream oil projects and investments in renewables no longer holds. With oil prices plummeting and renewables becoming more cost competitive in the power sector, returns in upstream oil projects will inevitably decline, as the oil industry is forced to compete with an energy source that produces energy with a short-run marginal cost of zero and at a much lower cost over the lifetime of a project (Lewis, 2019).

The level of dependence on oil prices of the companies can also be seen by the number of **write-downs** (Table 4). These highlight their exposure to stranded assets and whether they have any plans to avoid the consequences of having them. The two US companies are the most exposed to holding stranded assets in terms of existing and planned projects, especially if the oil price remains low or falls even further. ExxonMobil remains the most exposed and in August announced a possible 20% write-down in oil and gas assets (Crowley and Carrol, 2020).

European oil companies are ahead of their US counterparts. Besides being less exposed to having stranded assets, some of them already announced write-downs in the second quarter of 2020. The first announcement came from BP, which in June announced a write-down of USD 17.5 billion worth of assets. Two weeks later, Shell followed its European peer and announced a write-down of USD 22 billion,

becoming the largest among oil companies “to face a reckoning over the brutal economics of oil and gas as the coronavirus pandemic has warped global demand” (Dunn, 2020). In July, Eni also announced a write-down of around USD 4 billion from the value of its assets after revising down its long-term outlook for oil and gas prices to USD 60 a barrel in 2023 (from a previous USD 70) (Jewkes, 2020).

These three write-downs provide an initial signal of what is yet to come and a message about the fundamental change hitting the entire oil industry. A recent forecast by the climate finance think-tank Carbon Tracker has shown that between May and August 2020 alone, companies including BP, Eni, Equinor, Chevron, Shell and Total, reported downgrades on the value of their assets of almost USD 55 billion (Ambrose, 2020a). The decline in world oil demand due to global lockdowns and the plummeting of oil prices forces companies to reassess their price forecasts as well as review which of their existing projects would still be profitable in the long term.

In August 2020, BP cut its oil forecasts by almost a third, to an average of USD 55 a barrel between 2020 and 2050, while Shell cut its forecasts from USD 60 a barrel to an average of USD 35 a barrel in 2020, rising to USD 40 in 2021, USD 50 in 2022 and USD 60 from 2023 (Ambrose, 2020a). Similarly, the global industry crisis together with the now galloping energy transition will force oil companies to leave many of the unexploited fossil fuel resources in the ground, thus eliminating their value (Dunn, 2020).

Table 4: Overview of oil companies' stranded assets

COMPANY	PRIMARY INDUSTRY	WRITE-DOWNS
BP plc	Integrated	In June 2020, the company announced a write-down of USD 17.5 billion in assets (Dunn, 2020).
Chevron Corporation	Integrated	Chevron is exposed to having stranded assets, with its projects about 20% more sensitive to the value of oil (Shafto, 2020).
Eni S.p.A.	Integrated	Eni is exposed to having stranded assets, with its projects about 10% more sensitive to the value of oil (Carbon Tracker, 2020).
Equinor ASA	Integrated	Equinor is exposed to having stranded assets, with its projects about 10% more sensitive to the value of oil (Carbon Tracker, 2020).
ExxonMobil Corporation	Integrated	ExxonMobil remains the most exposed to having stranded assets, with its projects about 40% more sensitive to the value of oil (Shafto, J., 2020). In August 2020, the company warned of a possible 20% write-down in oil and gas assets (Crowley and Carrol, 2020).
Royal Dutch Shell plc	Integrated	In June 2020, the company announced a write-down of up to USD 22 billion in assets (Dunn, K., 2020).
Total SE	Integrated	Total is exposed to having stranded assets, with its projects about 10% more sensitive to the value of oil (Carbon Tracker, 2020).

Source: Based on Luhalvalja *et al.*, 2020 and on sources indicated in table.

Share price evolution

All companies are quoted on different stock exchanges. However, for the purpose of this analysis, the New York Stock Exchange has been considered, and data on the (adjusted) share prices at the end of any given year has been presented. The share prices did not experience significant drops or highs during the period 2017-2019 but

rather remained relatively stable. However, if we compare the values from 2 January 2020, before COVID-19 hit at a global level, with 31 March 2020, when the spread of the pandemic started, and 31 December 2020 (Table 5), the overall picture changes greatly. Unsurprisingly, the effects of the COVID-19 crisis on the oil industry and on oil prices have been felt by all seven companies, which all experienced drops in their share prices.

Table 5: Comparison of share prices in the New York stock exchange for 2nd January, 31st March and 31st December 2020

COMPANY	SHARE PRICE 2 ND JANUARY 2020 (USD)	SHARE PRICE 31 ST MARCH 2020 (USD)	SHARE PRICE 31 ST DECEMBER 2020 (USD)
BP plc	35.33	22.99	20.52
Chevron Corporation	114.92	72.46	84.45
Eni S.p.A.	29.39	18.50	20.60
Equinor ASA	19.10	11.80	16.42
ExxonMobil Corporation	65.66	35.67	41.22
Royal Dutch Shell plc	56.89	34.89	33.61
Total SE	51.84	37.24	41.91

Source: Yahoo finance

Market value

The market value of most of the oil companies has also experienced a decline in the last couple of years. However, as a result of the COVID-19 pandemic and the low oil prices, nearly all seven US and European companies saw their market capitalisation drop during the third quarter of 2020 (Table 6). According to an analysis by S&P Global Market Intelligence, at the end of 2020 all the large integrated oil and gas companies were worth less than they were six months before (Wheeler, 2020).

The two US companies, Chevron and ExxonMobil, saw their market capitalisation drop by 0.6% and 9.6% respectively between 31 March 2020 and the end of September 2020 (Quarter 3). European companies, such as Shell and BP, saw a larger decline in value of more 30%, also due to the fact that they are currently diversifying their businesses. BP's market value continued to drop at the beginning of the fourth quarter of 2020, and in the last week of October the company was valued at USD 52 billion. To put this in perspective, BP was worth less than Ørsted, a Danish offshore wind developer,

and less than Unilever, which was worth USD 160 billion (Ambrose, 2020b). Similarly, ExxonMobil lost value and was worth USD 141 billion as of October 2020, less than the US renewable energy firm NextEra Energy, which was valued at USD 145 billion (Ambrose, 2020b).

Oil price forecast

Long-term oil price assumptions are important because oil companies use them to determine the economic viability of oil and at what price. The COVID-19 pandemic led the majority of the seven companies to revise their price forecasts in the near future and/or for the longer term (Table 7). European companies have shared their updated assumptions with dramatic results. In the short term (2020-2023), Shell, Eni and Total have similar forecasts, with prices not exceeding USD 55 a barrel in 2022. For long-term forecasts, BP estimates an average price of USD 55 a barrel between 2021 and 2050, which is 27% lower than its previous assumption of USD 75 a barrel (Sardana, 2020). A similar forecast is provided by Shell, with an average USD 56.8 a barrel between 2020 and 2050 (Hook, 2020).

Table 6: Oil companies' market capitalisation in the third quarter of 2020
(Data compiled 1st October 2020)

COMPANIES	MARKET CAPITALISATION (USD BILLION)	CHANGE IN MARKET CAPITALISATION	
		30 JUNE 2020	31 MARCH 2020
BP plc	58.64	-26.7	-34.5
Chevron Corporation	134.44	-19.3	-0.6
Eni S.p.A.	28.06	-21.2	-27.5
Equinor ASA	46.17	-4.0	-0.1
ExxonMobil Corporation	145.16	-23.2	-9.6
Royal Dutch Shell plc	96.54	-24.2	-33.5
Total SE	90.13	-12.6	-15.7

Source: Wheeler, 2020

Table 7: Oil companies' short-term and long-term oil price assumptions (Brent crude)

COMPANIES	OIL PRICE ASSUMPTIONS (BRENT CRUDE)			
	2020	2021	2022	ADDITIONAL INFORMATION
BP plc	Average of USD 55 between 2021 and 2050			
Chevron Corporation	N/A	N/A	N/A	
Eni S.p.A.	USD 40	USD 48	USD 55	
Equinor ASA	USD 80 in 2030			
ExxonMobil Corporation	N/A	N/A	N/A	
Royal Dutch Shell plc	USD 35	USD 40	USD 50	Average of USD 56.8 between 2020 and 2050
Total SE	USD 35	USD 40	USD 50	

Note: N/A = data not available.

Sources: Adomaitis, 2020; Crowley and Rathi, 2020; Hook, 2020; Jewkes, 2020; Sardana, 2020; Total, 2020b

So far, Equinor is the only European major that has kept its long-term price assumptions unchanged to USD 80 a barrel in 2030 (Adomaitis, 2020). On the other hand, the US oil companies, Chevron and ExxonMobil, are not following their European peers and have not disclosed their long-term forecast for oil prices. In addition to the climate change response,

the COVID-19 pandemic has brought uncertainties into the demand outlook for fossil fuels, and the opacity / lack of disclosure from both US companies creates difficulties for investors and shareholders in scrutinising how the companies' investment plans square with expectations for a global transition to clean energy (Crowley and Rathi, 2020).

4. THE WAY COMPANIES SEE THE FUTURE – THE ROLE OF SCENARIO ANALYSIS

There are numerous tools and models to assess low-carbon and energy transition pathways. In general, the usefulness of developing scenarios lies in the ability to provide strategic insights to enable decision makers to think about the possible wider and longer-reaching implications of specific trends. In the context of oil companies, scenarios help to clarify a company's view of the future that is more sensitive to the external environment, as well as to explain their current priorities by providing prospects and visions of how they foresee the future to unfold.

This section summarises the key findings of IRENA's climate-compatible scenario – the Transforming Energy Scenario – a comprehensive analysis outlining the path to decarbonise the energy system in line with the Paris Agreement. This scenario is then compared with oil companies' scenarios.

4.1 IRENA'S TRANSFORMING ENERGY SCENARIO

IRENA's *Global Renewables Outlook* (IRENA, 2020c) shows a path to create a sustainable future energy system through the Transforming Energy Scenario, which describes the energy transformation pathway needed to keep the rise in global temperature to well below 2°C and towards 1.5°C during this century. The scenario calls for considerably faster deployment of low-carbon technologies, based largely on renewable energy and energy efficiency, and focuses primarily on cutting energy-related CO₂ emissions, which make up around two-thirds of global greenhouse gas emissions (IRENA, 2020c).

Under IRENA's Transforming Energy Scenario, **total primary energy supply (TPES)** would fall slightly below today's levels, while the share of renewable

energy will rise from 14% today to at least 65% in 2050. Electrification with renewables is the single largest driver for change in the global energy transformation. The share of electricity in total final energy consumption increases under the Transforming Energy Scenario from just 20% today to 49% by 2050. The **share of electricity** consumed in industry and buildings doubles to reach 42% and 68%, respectively, in 2050, and in transport it increases from just 1% today to over 40% in 2050.

The increasing **use of electricity generated from renewable sources** reduces inefficient fuel consumption. Under the Transforming Energy Scenario, energy efficiency thus improves, owing to an increase in renewables-based electrification, especially in transport and heat. With the electricity mix significantly transformed, the carbon intensity of electricity drops by 90%. The power sector sees the wide-scale deployment of renewable energy and increasingly flexible power systems, supporting integration of variable renewable energy. The **share of renewable energy in the power sector** increases from 24% today to 86% in 2050.

This transformation will require massive investments, as well as new approaches to power system planning, system and market operations, regulation and public policies. The most important synergy of the global energy transformation is created by the combination of increasingly inexpensive renewable power technologies and wider adoption of electric technologies for end uses in transport and heat. That synergy alone could provide two-thirds of the energy-related emissions needed to set the world on a path to fulfilment of the Paris Agreement and the 1.5°C recommendation from the Intergovernmental Panel on Climate Change (IPCC).

By 2050, fossil fuel use would fall by two-thirds from today's levels, given accelerated global uptake of

renewables. Fossil fuels will still have roles to play, providing one-third of the energy supply in 2050. However, **global production of oil** will decline from today's level of around 100 million barrels per day to just above 20 million barrels per day, roughly 80% lower.

Currently, there are several key market components in which oil is still dominant, namely in the transport, industry and power sectors, as well as in heating. However, progress towards the development and adoption of low-carbon solutions is on the way. Realistically speaking, solutions have a different degree of maturity and applicability, but overall, all the sectors will need a combination of approaches for a goal of reaching zero (IRENA, 2020e)

Transport sector

In 2018, oil consumption in the transport sector represented 65% of total oil final energy consumption (IEA, 2020a). Oil still dominates the transport sector and will continue to do so for some time. Yet several low-carbon solutions are already available or under development to substitute oil, and are consistent with the goal of decreasing emissions.

Road transport (passengers and freight)

In 2018, oil consumption in the road sector represented 49% of total oil final energy consumption, making the sector the largest oil consumer (IEA, 2020a). For *road passenger transport*, electric vehicles and biofuels-powered vehicles are the main options. The advent of EVs promises to be a game changer for the world's shift to sustainable energy and particularly to renewable power generation. In addition to reducing emissions from the transport sector, EVs present a viable opportunity to introduce much higher shares of renewables into the overall power generation mix.

Transport will become much more electrified, but not everywhere, not in all sectors and not all at once. While EVs powered by renewable electricity will dominate light-vehicle fleets, they can only enter markets with well-developed power grids. Long-haul transport is unlikely to be fully electrified due to the higher energy density it requires. Hence, the role of biofuels, which

can be derived from a wide range of biomass and might serve as a relatively clean “bridging” or “additional” technology. Besides the first-generation biofuels, biodiesel and ethanol, which are the main renewable transport fuel option commercially deployed today, biogas and biomethane are also being developed.

Road freight transport accounted for 27% of all transport emissions and for 6% of global energy-related emissions in 2017 (IRENA, 2020e). Due to the heavy loads and high-power requirements of freight vehicles, batteries are more difficult to implement in road freight transport. As such, there are two key alternatives to replace oil in road freight. The first is fuel cell electric vehicles, which use electricity produced by a fuel cell powered by compressed hydrogen gas instead of relying on a battery (IRENA, 2020e). Although these vehicles are still at an early stage of development, there are already some examples. By the end of 2018, in China, 500 hydrogen fuel cell-powered 7.5 tonne urban logistics vehicles entered the Shanghai freight market, serviced by two hydrogen fuelling stations. In the US, Toyota is testing 10 fuel cell electric trucks with a 480-kilometre range, and in Switzerland, Hyundai is expected to deliver 1 000 fuel cell electric trucks in the market between 2019 and 2024 (IRENA, 2020e).

The second alternative to replace oil in road freight is advanced biofuels such as biodiesel and renewable diesel (IRENA, 2020e). The use of biodiesel, such as FAME (fatty acid methyl esters), is possible with engine adaptations either blended or not. For example, one of the major truck manufacturers, Scania, produced 220 trucks powered by non-blended FAME for the Australian market in 2014 (IRENA, 2020e). The use of renewable diesel has been tested in some pilots, such as SNEL Logistic Solutions, which has run tests in the town of Deinze, Belgium in its commercial trucks, with good results in CO₂ emission reductions (89%).

Aviation

In 2017, aviation accounted for 11% of all transport emissions and for 2.5% of global energy-related emissions (IRENA, 2020e), while oil consumption in the aviation sector represented 8% of total oil

final energy consumption in 2018 (IEA, 2020a). Demand for aviation is expected to more than double by 2040, making decarbonisation of the sector a priority. The sector is entirely fuelled by oil, and there are three principal options for substituting jet fuel with low-carbon alternatives: 1) biojet fuel, using fuels produced from sustainably sourced biomass, 2) e-fuels use, using synthetic fuels produced from cleanly sourced CO₂ and green hydrogen, and 3) battery-powered aircraft, which use propulsion systems powered by batteries charged with renewable electricity.

Shipping

In 2017, shipping accounted for 10% of all transport emissions and for 2.3% of global energy-related emissions (IRENA, 2020e), while oil consumption in the shipping sector represented 6% of total oil final energy consumption in 2018 (IEA, 2020a). The sector is entirely fuelled by oil (and oil-derived products), and there are two principal options for its substitution. The first is biofuels, which represent an immediately available option to decarbonise the shipping sector either in blends or as drop-in fuels. Their potential is currently limited by uncertainties in the industry regarding their availability, sustainability and cost. However, some major shipping lines are already using biofuel blends in their fleets, such as MSC (Mediterranean Shipping Company), which started using 30% biofuel blends in all its vessels calling at the port of Rotterdam and expects a 15-20% reduction in its overall CO₂ emissions (IRENA, 2020e).

The second option for substituting oil in shipping is hydrogen and e-fuels produced from renewable power, which could play an important role, but their adoption would require substantial adaptations to existing onboard and onshore infrastructure, and thus costs. As such, other hydrogen-based synthetic fuels, such as methanol and ammonia, are being considered. While ammonia is not deployed for shipping yet, methanol has already started being used as shipping fuel; for example by 2016 seven ocean-going cargo ships of 50 000 tonnes each were operating on methanol, and some vessels have also started being retrofitted with methanol engines (e.g., *Sterna Germanica* ferry) (IRENA, 2020e).

Industry sector

In 2018, oil consumption in the industry sector represented 26% of total oil final energy consumption (IEA, 2020a). Of this, 15% came from the petrochemical sector, which represents by far the largest consumer of oil in the industry sector, while the remaining 11% came from other industrial sectors.

Petrochemical feedstock

In the petrochemical sector, fossil fuel feedstocks are used to produce a range of “primary petrochemicals” that are used in the manufacture of a wide variety of materials, such as plastics, synthetic organic fibres (e.g., nylon) and other polymers. Globally, around 644 megatonnes (Mt) of petrochemicals were produced in 2018, and the sector continues to grow rapidly. Plastics, which account for the majority of product in volume terms, grew 20-fold in the past five decades to reach 360 Mt by the end of 2018 and could grow three-fold globally by 2050 in a scenario of unrestricted use (IRENA, 2020e).

There are three key options for replacing fossil fuel feedstocks: 1) the use of biomass for chemical feedstocks – that is, replacing primary petrochemicals with bio-based chemicals or replacing fossil fuel-derived polymers (particularly plastics) with alternatives produced from biomass; 2) the use of synthetic hydrocarbons produced from green hydrogen and clean CO₂ sources – for chemical feedstocks; and 3) combining CCUS and the use of renewable energy.

Heating

Heating accounts for almost half of global energy consumption and has multiple applications, from residential heat to industry. Most of this energy comes either from fossil fuels or inefficient uses of biomass, which represents a major source of air pollution and accounts for over 40% of global energy-related CO₂ emissions (IRENA, 2020f). However, there are several alternatives for the decarbonisation of the sector. The first is switching from fossil fuels to efficient electric technologies powered by renewable electricity, such as heat pumps and electric appliances for buildings,

electrified heating and cooling technologies in industry, and decentralised electrification technologies for productive uses. Secondly, since not all heating and cooling end uses can be electrified at a competitive cost, there is a role for renewable gases such as green hydrogen, biogas and biomethane to replace fossil gases. The final option is transitioning to more efficient use of biomass, which includes the adoption of improved cook stoves and modern biofuels. Biomass can also be used in industrial applications to produce low-, medium- and high-temperature heat (IRENA, 2020f).

Power generation

In 2018, fossil fuels provided 65% of total electricity generation. However, the share of renewable energy in electricity generation has been increasing steadily in the past years, and renewable power technologies are now dominating the global market for new generation capacity (IRENA, 2020c). Wind and solar PV power dominated overall renewable energy additions in the power sector again in 2019, with an estimated 60 GW of wind power (REN21, 2020) and 108 GW of solar PV power installed (IEA, 2020b). This rise is being accelerated by declining costs: four-fifths of solar PV and wind projects to be commissioned in 2020 will produce electricity cheaper than any fossil fuel alternative (IRENA, 2020c).

4.2 SCENARIOS COMPARISON: IRENA AND INTERNATIONAL OIL COMPANIES

As part of their effort to embrace the energy transition, some oil companies are contributing to the energy scenario debate and developing some analysis of what the energy system should look like from now to 2050 in order to fulfil the goals of the Paris Agreement.

IRENA's Transforming Energy Scenario can be compared with scenarios from major oil and gas companies for selected key indicators. The scenarios presented include five decarbonisation scenarios that are compatible with Paris Agreement targets – Total's "Rupture" scenario, the International Energy Agency's (IEA) 2019 "SDS" scenario (referred to by Chevron),

Shell's 2018 "Sky" scenario, BP's "Rapid" scenario and Equinor's 2019 "Rebalance" scenario – and one forecast scenario, ExxonMobil's "Outlook for Energy" (Table 8). The table also presents BP's net-zero emissions scenario (BP's "Net Zero"). Eni has not produced any outlook scenario and is thus excluded from the comparison and following discussion.

All of the scenarios examined, even when consistent with the Paris Agreement targets (according to the scenario authors), show different visions of the future.

Royal Dutch Shell's latest vision of the energy future is described in the 2018 Sky scenario, which outlines what the company believes to be a "*technologically, industrially, and economically possible route forward, consistent with limiting the global average temperature rise to well below 2°C from pre-industrial levels*" (Shell, 2018). The Shell Sky scenario is less ambitious in terms of emission reductions until 2050, which are 18 gigatonnes (Gt) of CO₂/year and assumes negative emissions post-2050. Because total energy use levels are much higher, renewables deployment is even higher in absolute terms in the Sky scenario than in the other scenarios.

Moreover, the company sees electrification as one of the most important energy system trends: the role of electricity as an energy carrier would grow very quickly across the economy, reaching 44% of total final energy consumption by 2050. This is in line with Shell's new strategy of becoming the largest electricity company by the 2030s and reflects the focus on electricity, which is the fastest growing segment of energy consumption. However, it also foresees 43% renewable energy in the total primary energy supply in 2050. While that is lower than the 65% in the IRENA Transforming Energy Scenario, it suggests a similar level of renewable energy in absolute terms given the higher TPES (828 EJ) in the Shell scenario. Oil demand is forecasted to peak before 2030, while its share in TPES would be lower than 20% by 2050.

Similar to Royal Dutch Shell, **BP** is also foreseeing the market for power to be the fastest growing area of the energy industry in its Rapid Scenario. In its long-term energy outlook to 2050, under the Rapid Scenario the

Table 8: Comparison of scenarios – key indicators

SCENARIO	YEAR	TYPE	TPES (EJ)	RE % IN TPES	ELECTRIFICATION RATE	RE % IN POWER SECTOR	EMISSIONS (GT/YR)	% OIL IN TPES	% GAS IN TPES
Current levels	2018	Current status	597	14%	25%	25%	34.6	26%	18%
IRENA Transforming Energy Scenario	2050	1.5°C	538	65%	49%	86%	9.7	8%	12%
Shell Sky Scenario	2050	1.5°C	828	43%	44%	74%	18	19%	14%
Equinor Rebalance Scenario	2050	Below 2°C	504	43%	37%	72%	10.2	18%	22%
BP Rapid Scenario	2050	1.5°C	625	45%	45%	74%	9	14%	23%
BP Net Zero	2050	Net zero	625	60%	52%	83%	1.5	7%	15%
Total Rupture	2040	1.5-1.7°C	719	48%	40%	79%	8	15%	26%
IEA WEO 2019 SDS Scenario (referred to by Chevron)	2040	1.5°C	566	29%	31%	53%	15.7	23%	24%
ExxonMobil	2040	Forecast scenario	715	17%	22%	22%	35	30%	26%

Note: TPES = total primary energy supply; EJ = exajoules; N/A = data not available; WEO = World Economic Outlook; RE: renewable energy

Sources: (Shell, 2018); (IRENA, 2020c); (BP, 2020); (Total, 2020b); (ExxonMobil, 2019); (IEA, 2020c); (Equinor, 2020c)

company expects an electrification rate of 45%, as the progressive decarbonisations of the energy system leads to increasing amounts of final energy use being electrified (BP, 2020). The impact of COVID-19 has caused carbon emissions from energy to fall sharply in the near term. However, even if emissions pick up as the global economy recovers, the level of carbon emissions in the Rapid Scenario does not return to pre-pandemic levels, but rather falls by around 70% by 2050 to a little over 9 Gt of CO₂ (BP, 2020). The share of renewable energy in primary energy increases to 44%, and in the power sector to 74%.

In addition to the Rapid Scenario, BP outlines a more aggressive vision through the Net Zero Scenario. Similar to the Rapid Scenario, a net-zero energy system is likely to be characterised by a substantial increase in the electrification of energy-consuming activities (52%), with the electricity generated from a fully decarbonised (or net-negative) power sector, with renewables making up 83% of power generation. Greenhouse gas emissions from remaining oil production are offset by negative emissions technologies, such as CCUS, bio-energy with CCS, and nature-based solutions (BP, 2020). According to BP's outlook, under both

scenarios, oil demand has already peaked (mid-to-late 2020s), while its share in TPES will be around 14% by 2050 under the Rapid Scenario and 7% under the Net Zero Scenario. The transition outlined in BP's Outlook leads to a fundamental reshaping of the global energy system. There is a significant shift away from traditional hydrocarbons (oil, natural gas and coal) and towards non-fossil fuels, led by renewable energy, which will represent the majority of global energy by 2040 in the Rapid Scenario and even earlier for the Net Zero Scenario.

The **Equinor** Rebalance scenario (Equinor, 2020c) represents a future trajectory for the energy markets that is policy driven, characterised by global co-operation- with the aim of a fast transition of the energy system to meet the well-below 2°C target of the Paris Agreement. In the Rebalance scenario, renewable electricity is key, reaching 72% of electricity generation by 2050, and emissions are reduced to 10.6 Gt of CO₂/year. While the share of renewable energy in total primary energy supply is lower than the 65% in the IRENA Transforming Energy Scenario, it suggests a lower level of total primary energy supply in absolute terms (515 EJ).

As a complement to its strategy, Equinor recently announced that it expects an average annual oil and gas production growth of around 3% from 2019 to 2026. The company is also expecting a gradual decline in global demand for oil and gas from around 2030 onwards, and in the long term it expects to produce less oil and gas than today (Equinor, 2020b). Despite the predominance of renewables in its outlook, as well as in its announced investments and emissions targets, Equinor's business is still dominated by fossil fuels. The company is the largest oil and gas group on the Norwegian continental shelf and is currently facing questions about its exploration plans in the Arctic (Milne and Raval, 2020).

In 2020, **Total** prepared "Total Energy Outlook 2040", a long-term forecast of how energy demand would likely change. The outlook was prepared based on an analysis of the scenarios of the IEA in the *World Energy*

Outlook 2019 (Total, 2020c). One of the two scenarios presented, the Rupture Scenario, is consistent with the climate goals of temperature rising by 1.5°C to 1.7°C. Energy demand is forecasted to increase and TPES would reach 719 EJ by 2040, one of the highest absolute values estimated among the seven oil companies, with renewable energy just below 50%. In recognition of the need to decarbonise the power sector, electrification is also estimated to gain pace, reaching 40% of total final energy consumption by 2040.

Renewables would make up almost 80% of the power generation, with wind and solar leading the way, and with coal almost disappearing the power sector becomes almost carbon neutral. Oil demand is forecasted to peak before 2030, coal almost disappears by 2050, while natural gas would continue to still play a key role, especially in the power system, heat and transport. Emissions would be considerably reduced to 8 Gt of CO₂/year by 2040, and potentially get to zero through the use of CCS.

Finally, **Chevron** does not construct its own scenario, but rather refers¹¹ to the IEA WEO Sustainable Development Scenario (SDS) (IEA, 2020c). The scenario assumes that non-economic barriers to electric technologies are minimised and that the role of electricity in the energy system progressively increases, representing 31% of total final consumption, and that 53% of electricity generation is renewable by 2040. Oil and gas are still foreseen to play a significant role in the future, with gas expected to make up 24% of TPES by 2040, the highest share among all the scenarios.

ExxonMobil's "Outlook for Energy: A Perspective to 2040" provides a forecast and projection of energy demand through 2040 based on likely trends in technology, policy, consumer preferences, geopolitics and economic development (ExxonMobil, 2019). The company supports the Paris Agreement and believes that the world should harness all energy sources and technology advances to achieve the broad climate goals. However, renewables and electrification have a very marginal, if not absent, role in ExxonMobil's forecast. Oil and natural gas remain

11 www.chevron.com/sustainability/environment/the-energy-transition

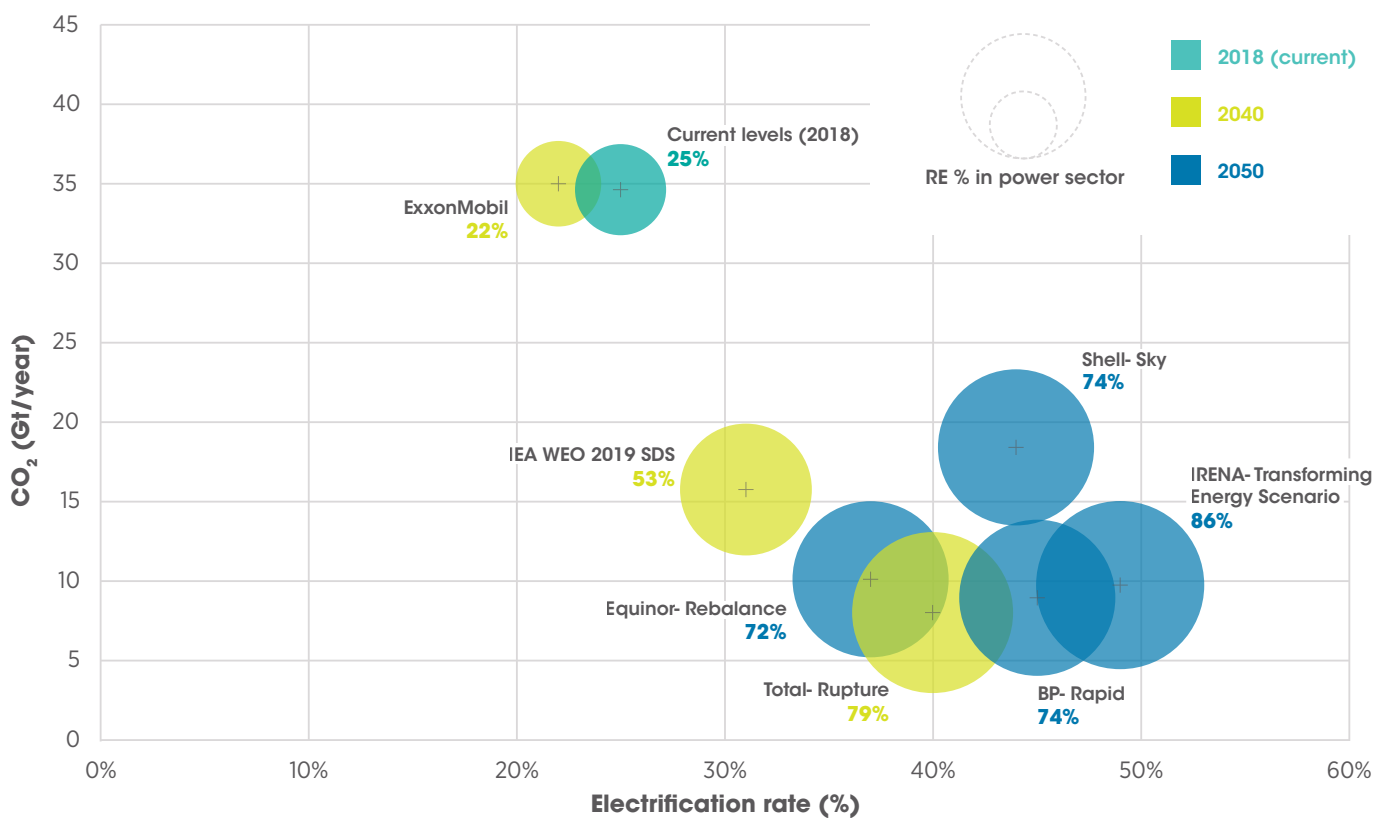
the most important energy sources: by 2040 oil and gas together will continue to supply more than 50% percent of global energy.

ExxonMobil's view of the future reflects its current climate targets and commitments. The company only has goals to 2023 and related to the reduction of Scope 1 and Scope 2 emissions intensity, with no investments in renewable energy technologies. Despite the losses in market value and the difficulties related to the low oil price and the COVID-19 pandemic, the company has not shown any intention to start investing in renewables

and differentiating its portfolio of activities. On the contrary, it has continued to invest in hydrocarbon extraction, which is and is foreseen to remain its main line of business in the future, as also reflected in its energy outlook.

Figure 2 visualises how the different scenarios have a wide range of results regarding the degree of electrification and the depth of long-term decarbonisation realised by the key scenarios considered. The sizes of the bubbles are adjusted according to the share of renewables in the power sector.

Figure 2: Global energy-related CO₂ emissions vs. electrification rate in various energy scenarios (Current levels, 2040 and 2050)



Sources: (Shell, 2018); (IRENA, 2020c); (BP, 2020); (Total, 2020b); (ExxonMobil, 2019); (IEA, 2020c); (Equinor, 2020c)

From the scenario presentation and analysis, a few considerations can be drawn regarding how oil companies see the energy future shaping in the coming decades. Among the European companies, a clear reference to oil demand peak is made by Shell and Total, which foresee it occurring around 2030, and BP, for which it has already peaked this year. Despite this, the share of oil and gas in the total primary energy supply is still significant. Electrification as an energy carrier is foreseen to grow very quickly across

the economy, and renewables would have a prominent role in power generation, with levels above 70%. Low CO₂ emission levels can be explained by the use of CCS. With regard to the two US companies, Chevron does not construct a scenario on its own, but rather refers to the IEA SDS 2019 scenario to explain the urgency of climate change, while in ExxonMobil's recent scenario oil and gas remain the most important energy sources, and renewables and electrification have a marginal role.

5. CONCLUSIONS

IRENA's Transforming Energy Scenario shows that, in order to keep the world's temperature to well-below 1.5°C, the global energy system needs to be transformed from being largely based on fossil fuels to being based on renewable energy. By 2050, global production of oil would decline to just above 20 million barrels per day, roughly 80% lower than today, while renewable energy would dominate not just the energy supply, but also consumption in all end-use sectors, as well as electricity generation. Overall, the pathway for the decarbonisation of the energy sector requires radical changes in the system, but a deep disruption is already taking place. Renewables are increasingly competitive, dominating many markets for new power generation capacity, and are supported by political efforts and investor engagement.

China's recent pledge to reach net-zero emissions by 2060, the European Union's (EU) Green New Deal and the USD 2 trillion clean energy plan proposed by US President Joe Biden mean that the world's three biggest economies are heading towards the same direction. Together with them, many other countries, such as Japan, the Republic of Korea and the UK are following. Similarly, a growing number of governments have set time frames for phasing out sales of new internal combustion engine vehicles or only allowing sales to be electric. Most targets focus on passenger cars and include 17 governments globally. European countries are leading, with Norway and the Netherlands having committed to the most stringent timelines (2025 and 2030 respectively), while other countries have a 10-year horizon (*i.e.*, 2032), such as Denmark, Iceland and Sweden, or a 20-year horizon (2040), such as France and Spain (Wappelhorst and Cui, 2020). Other countries or regions outside Europe with targets include Colombia, Costa Rica and the US State of California.

The COVID-19 pandemic has created additional challenges for the fossil fuel industry. Oil prices fell sharply in 2020, and nearly a third of global oil demand

was wiped out by the pandemic through lockdowns and travel bans (Sheppard, 2020), raising concerns about the sector's volatility and long-term viability. On the other hand, the renewable energy industry, which has already been on the rise in recent years, was also affected by the COVID-19 crisis, but it has not collapsed and has proven more resilient than the fossil fuel industry. In several countries, especially European ones, renewable energy technologies have been put at the centre of recovery plans, with governments and investors keener on supporting low-carbon activities.

This report analysed the strategies and investments of some international oil companies in response to the energy transition and the anticipation of renewables assuming a bigger role and share in the global energy mix at the expense of fossil fuels. The companies' strategies were also put in the context of the recent and ongoing COVID-19 crisis, which has shaken the fossil fuel industry and exposed its inadequacy in the energy system compared to the more resilient renewable industry. The analysis and discussions aimed at answering a key research question: *What are the strategies and current activities of international oil companies related to the energy transition, and how do they compare with what is needed to achieve climate stabilisation?* Specifically, this paper tried to investigate whether oil companies are embracing the energy transition and transforming into energy companies in the broader sense of the term.

The qualitative and quantitative assessment of the historical, current and future renewable energy strategies of the oil companies yielded a general categorisation into two main differentiated groups: 1) European companies – BP, Eni, Equinor, Royal Dutch Shell and Total – as oil companies that have emissions targets (in some cases a net-zero one) and have embarked on a transition from oil companies to energy companies, and 2) US companies – Chevron and ExxonMobil – as oil companies that have chosen to remain pure fossil fuel-focused companies. As such,

five out of the seven analysed oil companies have developed some kind of renewable energy strategy and have started investments in renewable energy projects.

However, when looking at the European companies in detail, different groups can be identified. With regard to their strategies and engagements in the energy transition, Eni, Shell and Total are changing their operational organisation and investing heavily in electricity by acquiring companies along the entire supply chain. The key role that electrification will play in the future is also highlighted in their scenarios. On the other hand, BP and Equinor are focusing on portfolio diversification, through investments in renewables.

This grouping composition changes when looking at emission targets. In this case, BP, Eni and Equinor have absolute targets on all three emission Scopes, and Shell and Total have intensity-based targets. Besides these broader classifications, however, the European companies seem forward-looking, but they are still grounded in the past. Whereas for the long term they have formulated emission targets and taken up efforts to embrace new energy initiatives, in the short term none of the companies is cutting oil production (which would be the most effective way to lower emissions), as demonstrated by their ongoing and large investments in fossil fuels compared to the much lower investments in renewables.

6. THE WAY FORWARD

The surge of climate-friendly commitments and the pressure to accelerate the energy transition from investors, consumers and governments have intensified with the outbreak of the COVID-19 pandemic. The year 2020 was marked by unprecedented events (*i.e.*, very low and negative oil prices), which have further exposed the inadequacies of the current energy system based on fossil fuels and oil companies' business strategies. Unsurprisingly, this has not gone unnoticed, and the majority of oil companies have taken steps towards developing climate-friendly investment plans, as well as announcing or reaffirming commitments to lower the emissions from their activities.

However, the key question is whether these short-term commitments are just a temporary effect of the pandemic and of the oil demand decrease, or if they will continue after the pandemic is over and evolve into long-term concrete strategies. This of course is hard to predict, as it is subject to a key variable: what would happen if oil demand picks up again? Oil price and oil demand are the key factors driving the oil industry's investments.

However, there are two aspects that could be even more decisive in this new context. The first is people's behaviours. The pandemic and the global lockdown effects could permanently modify at least some habits. For example, the positive effects on the environment (*i.e.*, less pollution) and the advantages of working from home could shift people's preferences to less travel or to environmentally friendly alternatives. The second variable is the role of governments and regulators, which are pushing for climate-focused recovery plans. The EU is one of the pioneers, emphasising the need to prioritise clean technologies and renewable energy in the recovery and stimulus packages. Unsurprisingly, it is only the European oil companies that have developed emission targets, and any additional measures from the EU will inevitably and further affect their operations, as they will be forced to comply with them. Things will likely change also for US-based oil companies, with climate measures featuring high on the agenda of President Biden.

Although the long-term effects of the pandemic will take time to show, it is clear that they will be driven largely by innovation and policy, which are both supporting and heading in the direction of the clean energy transition. In this context, oil companies would have to adapt and diversify their business strategies to be able to keep up with all the changes. There are few options among the key decarbonisation tools that are now featuring high in countries' priorities and in which oil companies would have a competitive advantage. These are discussed in the following paragraphs.

- **Hydrogen.** This is an attractive fuel source, which can have different applications, such as for transport, heavy industry, and power and heating, where established renewables (*i.e.*, solar and wind) cannot deliver the necessary heat. Some oil companies, such as BP, Equinor and Shell, have already started investing in hydrogen, which is one of the new markets that oil companies could establish themselves in thanks to their existing expertise in transporting and selling gas.
- **Offshore technologies.** The oil and gas industries, which have operated offshore for over half a century, could leverage synergies by transferring the knowledge acquired to the offshore wind industry (IRENA, 2020a). For example, they could upgrade existing infrastructure from the offshore oil and gas and shipping industries and convert it for offshore renewable energy technologies (*i.e.*, wind). A pioneer among oil companies in offshore wind is Equinor, which has long been active in several significant offshore wind projects worldwide, including floating offshore, as well as offshore wind farms to supply electricity.
- **Electrification.** A key component of the energy transition is renewable electricity, which under

IRENA's climate-compatible scenario would become the dominant energy carrier. Companies like Equinor, Shell and Total are already entering the power sector, with aspirations of transitioning to electricity companies and playing a significant international role in the production and supply of renewable electricity. They have been pursuing this primarily by investing heavily along the electricity supply chain, both in generation (solar PV, onshore and offshore wind) as well as in electric vehicle charge points. This is an interesting path, but it comes with difficulties, namely associated with power systems becoming more complex and demanding to manage.

- **Liquid biofuels.** Many of the oil companies have already been investing in biofuels for decades, especially through research efforts and venture capital spending. They have been placing a bet on the continued demand for combustible fuels (Raval, 2019), especially for modes of transport that cannot make use of electricity (*i.e.*, heavy trucks and airplanes). With many governments planning to phase out internal combustion engine vehicles, investments in liquid biofuels become strategic even in a context of low oil prices.

- **Carbon Capture and Storage (CCS).** This is a technology in which all oil companies are already investing and could help them in keeping their businesses in the short-term in different ways. This includes reducing emissions in their operations, reducing the carbon footprint, and especially driving new business lines, such as clean hydrogen production. This latter is quite important, as IRENA's analysis foresees hydrogen playing a key role in the decarbonisation of the energy sector, with green hydrogen representing two thirds of the production and blue hydrogen one third. In the case of blue hydrogen, natural gas would still have a role to play and therefore CCS would be key for ensuring a clean production. A recent example of oil companies' investment in CCS is the Northern Lights project in Norway, which is the world's first CCS network project signed by Equinor, Shell and Total for a total of USD 675 million (Fawthrop, 2020).

These alternative business opportunities could position the oil industry to be at the forefront of the quest for sustainable and inclusive growth as energy companies of the future, in line with the governments' shift towards low-carbon energy and net-zero policies and strategies.

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