The Oil and Gas Industry in Transition
Case Study: *Eni SpA, ConocoPhillips, and TotalEnergies in Transition*

Alannah Nathan, *Georgetown University*
Laidlaw Undergraduate Research Fellowship

Abstract
To reach net-zero emissions by 2050 and limit global warming to "well-below" 2.0℃ or ideally 1.5℃ above pre-industrial levels, we require nothing short of a "total transformation" in how we produce, transport, and consume energy (IEA, 2022, p. 3). To reach the Paris Agreement, the transformation must take place at an unprecedented speed and scale. Due to the sector's outsized responsibility for current and historic CO_2 emissions, oil and gas companies are faced with increasing pressure from investors, governments, and the public to shift their business models to align with the Paris Agreement. In face of such pressure, large investor-owned oil and gas companies have increasingly included climate change and clean energy in their discourse and made pledges to decarbonize their activities and invest in low-carbon energies. However, oil and gas companies have faced scrutiny for "greenwashing:" deceptively using marketing tactics to miscast their actions and products as environmentally friendly. The extent to which such claims are examples of "greenwashing" must be objectively evaluated. Using an adapted framework, this study builds on a prior research paper by Trencher et al. (2022) which assessed the clean energy claims of BP, Chevron, ExxonMobil, and Shell from 2009-2020. Our study assesses Eni SpA, TotalEnergies, and ConocoPhillips, the remaining three of the seven oil and gas majors listed on the American and European stock exchange (IEA, 2020). We surveyed the companies across three areas between 2015-2021: discourse, business strategies, and investments. To evaluate oil and gas majors' discourse, we identified the frequency of climate and clean energy-related keywords in the companies' annual reports. To evaluate business strategies, we tracked the majors' decarbonization, emissions reduction, and clean energy pledges as well as their concrete actions. Finally, to evaluate the majors' investments, we examined oil and gas majors' production and proved reserves of fossil fuels as well as their investments in low-carbon and renewable energy. While we found a large increase in discourse related to climate and emissions between 2015-2021 and a trend towards net-zero and decarbonization pledges, the financial analysis points to a continued reliance on oil and gas extraction and production and minimal total investment in renewable energy. We conclude that oil and gas majors have not adequately shifted their business models in alignment with the goals of the Paris Agreement. Concern over oil and gas companies' "greenwashing" appears, to date, warranted.

I. Introduction

To reach net-zero emissions by 2050 and limit global warming to "well-below" 2.0℃ or ideally 1.5℃ above pre-industrial levels, we require nothing short of a "total transformation" in how we produce, transport, and consume energy (IEA, 2022, p.3). To reach the Paris Agreement, the transformation must take place at an unprecedented speed and scale. According to the International Energy Agency (IEA), the pathway to net zero emissions by 2050 necessitates an immense deployment of all available clean energy technologies including renewables, electric vehicles (EVs), and developments in energy efficiency. Above all, achieving a net zero emissions target requires a massive decline in the production and use of fossil fuels, including coal, oil, and natural gas.

Oil and gas companies are responsible for the majority of current and historic carbon dioxide (CO_2) and methane (CH_4) emissions. As such, the near-term and long-term decisions of oil and gas companies will have a significant effect on the feasibility of reaching net zero emissions by 2050. Since 1965, just twenty fossil fuel companies are responsible for 35% of all energy-related carbon dioxide (CO_2) and methane emissions (CH_4) (Trencher et al., 2022). Due to their outsized role in carbon emissions, oil and gas companies are facing increased pressure from investors, governments, and the public to shift their business models to align with the Paris Agreement.

The following study assesses the extent to which oil majors have divested from fossil fuels and transitioned toward clean energy. Using an adapted framework, our study builds on prior research by Trencher et al. (2022) which assessed the clean energy claims of BP, Chevron, ExxonMobil, and Shell from 2009-2020. Our research assesses the claims of Eni SpA, TotalEnergies, and ConocoPhillips, the remaining three of the seven oil and gas majors listed on the American and European stock exchange (IEA, 2020).

We survey the oil and gas majors across three areas between 2015-2021: discourse, business strategies, and investments. To evaluate oil and gas majors' discourse, we identified the frequency of climate and clean energy-related keywords in the companies' annual reports. To evaluate business strategies, we tracked pledges and concrete action taken by oil and gas majors related to decarbonization, emissions reduction, and clean energy. Finally, to evaluate oil and gas majors' investments, we examined oil and gas majors' production and proved reserves of fossil fuels as well as their investments in low-carbon and renewable energy.

We contacted the authors of the original study to corroborate the methodology and clarify the meaning and significance of specific numbers.

II. Background

The Fifth Modern Energy Revolution

Energy historian Vaclav Smil defines an energy transition as a "change in the composition (structure) of primary energy supply" and a "gradual shift from a specific pattern of energy production to a new state of an energy system" (Smil, 2010, p. vii). Based on earlier energy transition research (Geels, 2004;

Sovacool, 2019), Fattouh et al. expand the term "energy transition" to include three interrelated dimensions including (1) the tangible elements of the energy transition (technology, infrastructure, production equipment, consumption patterns, and supply chains), (2) actors and their actions including investments and strategies, and (3) socio-technical factors such as regulations and policies, institutions, mindsets, belief systems, discourse, and social practices (Fattouh et al., 2019).

Smil identifies five energy transitions in modern history. The first transition began in 1830 and marked the shift from wood as a primary energy source to coal. Coal-fired steam engines powered trains and ships, transforming industries, transport and construction (Smil, 2019). The second modern energy revolution began in 1892 with Edison's discovery of electricity, leading to new developments in lighting, construction, and other applications (Smil, 2019). The third modern energy revolution began in 1950 with the rise of refined oil products (Smil, 2019). The fourth modern energy revolution marked an increased reliance on natural gas, enabled by the construction of transcontinental pipelines (Smil, 2019).

The past four energy transitions have tended to be relatively drawn-out processes that have taken place over decades (or even centuries). Historical evidence suggests that for a new energy source to become dominant, the energy services they provide (e.g., space and water heating, transport, and lighting) must be cheaper than the incumbent energy source (Fouquet & Pearson, 2012). Furthermore, evidence suggests that a shift from one primary energy source to another is closely dependent and related to the co-evolution of supporting technologies, industries, and institutions (Fouquet & Pearson, 2012).

Today, we are in the midst of a *fifth* energy revolution: a global shift from fossil-fuels to low-carbon and zero-carbon energy sources. Unlike previous energy transitions, the current energy transition is not just a matter of shifting one set of primary energy sources (fossil-fuels) toward another (renewables). Instead, the current energy transition has a fundamental driving force: the prevention of climate change (Smil, 2016). The typical drawn-out time frame of energy transitions is incompatible with preventing climate change.

Trends in the Fifth Energy Revolution

Decreasing Prices of Renewables and Supporting Technologies

While evidence suggests that the current transition away from fossil fuels is still too slow to limit anthropogenic warming to well-below 2.0℃ or ideally 1.5℃ above pre-industrial levels, renewable energy prices have decreased dramatically in recent years. In fact, some scholars have suggested that solar and wind energy have already reached the critical inflection point where the speed of solar and wind adoption will grow at a much faster rate than before. Fattouh et al. conclude from studying a 250-year history of energy markets that wind and solar are inflecting in a such a way that mirrors coal in the nineteenth century and oil in the twentieth century. They predict solar and wind could be equally as transformational in the twenty-first century (Fattouh et al., 2019). The declining price of clean energy technologies is a driving force behind the growing role of renewables in the energy mix. For example, the price of multi-silicon solar modules (the most common type of solar PVs), has decreased

by 90% over the past decade (Gearino, 2021). Prices of wind energy have also decreased tremendously in price, from USD 1,800/kW in 2009 to USD 770-850/kW in 2021, a roughly 50% decrease in the past decade (DOE, 2021). The Department of Energy (DOE) found that wind energy will continue as the cheapest available electricity generation source: A long-term wind electricity price through a power purchase agreement is expected to cost half as less as running a natural gas power plant.

According to the International Renewable Energy Agency (IRENA), nearly two-thirds of the wind, solar, and other renewable energy sources that were deployed in 2020 were cheaper than the cheapest new fossil fuel (IRENA, 2021). Additionally, despite recent price surges due to pandemic-related supply-chain disruptions, the cost of lithium-ion batteries–a critical supporting technology for the adoption of intermittent sources of energy such as solar and wind–have fallen 97% in the past thirty years (Yale Environment 360, 2021).

Shifts in Investor Preferences

Investors and shareholders' preferences and criteria for selecting companies to invest in are also changing. This shift is supported by the growth of Environmental, Social, and Governance (ESG)-focused investing, an approach to evaluate the extent to which a corporation is engaged in social goals including combating climate change (Johnston et. al, 2020). A recent poll shows that 86% of fund managers believe that companies should align their investment strategies with the Paris Agreement (Johnston et. al, 2020). Furthermore, more than 700 investors with over $68 trillion in assets under management have joined the network of Climate Action 100+, an investor initiative to ensure the largest corporate GHG emitters take action on climate change. Companies of focus account for over 80% of global industrial emissions, including BP, Chevron, ExxonMobil, Shell, Eni, Total, and ConocoPhillips (Climate Action 100+, 2022).

Investments in Renewable Energy

From the Paris Agreement's signing in 2015, the annual growth rate of clean energy investment has risen from 2% to 12% (IEA, 2022). Total global clean energy investment is expected to exceed USD 1.4 trillion in 2022 which accounts for nearly three-quarters of total energy investment (EIA, 2022). According to a McKinsey report, though investments in oil and gas are projected to remain stable, their share in the global energy investments mix is expected to decrease from 54% in 2021 to 36% in 2035 (McKinsey, 2022).

Policy Shift in Favor of Clean Energy and Decarbonization

In addition to the Paris Agreement, there is a global shift in policy towards cleaner energy. Policies to disincentivize fossil fuels such as carbon pricing are gaining momentum across the globe (Johnston et. al, 2020). For example, the European Union implemented an Emissions Trading System (EU ETS), a "cap-and-trade" scheme to limit carbon emissions. Additionally, governments have set stricter laws such as methane flaring restrictions and permitting regulation for the oil and gas sector in particular. Governments have offered subsidies to encourage the development and implementation of renewable technologies. Both the European Union and the United States have set an ambition to reach net-zero

emissions by 2050.

Rising Public Concern for Climate Change

The current energy transition is bolstered by a rising public concern about climate change and environmental damage. For example, a Pew survey results show that 69% of Americans say the development of clean energy sources should be a high priority. The same percentage of Americans claims to be in favor of the U.S. taking steps towards carbon neutrality by 2050. However, polls also find that 67% of Americans believe the country should use a mix of renewables *and* fossil fuels (Pew Research Center 2022). Rising public concern for climate change have shifted patterns of consumption, too. For example, sales of EVs doubled between 2020 and 2021. Nearly 10% of total vehicle sales in 2021 were electric (IEA, 2022c).

The Current Energy Mix

Despite the increasing opposition the oil and gas industry faces from a public concerned by climate change, skeptical shareholders, and growing policy in favor of decarbonization, oil and gas remain an integral part of the energy mix. According to the IEA, in 2019 fossil fuels accounted for 77% of total global primary energy supply (coal: 25.4% oil: 29.3% and natural gas: 22.0%). Renewables accounted for the remaining 23% of total global primary energy supply (hydro: 6.4%; nuclear: 4.1%, wind and solar: 3.4%, geothermal: 0.3%, and biofuels and waste: 8.9%).

Demand predictions for oil and gas are contested. A recent Energy Information Administration (EIA, 2022) report predicts that oil and gas will remain the most-consumed sources of energy in the U.S. through 2050, but renewable energy will be the fastest growing. Wind and solar incentives as well as falling technological costs support renewable energy's competition with natural gas for electricity generation. However, given the intermittent nature of solar and wind energy, natural gas will continue to serve as a vital baseload to balance the grid (EIA, 2022) . Furthermore, the International Energy Agency's Sustainable Development Scenario (SDS) and the Shell Sky Scenario (both aggressive decarbonization forecasted scenarios) predict a long-term usage of oil and gas. By 2050, fossil fuels are expected to make up 43% of total global energy demand, down from 77% today.

Contending Visions of the Fifth Modern Energy Revolution

While both parties agree that the energy transition is well underway, climate scientists and oil executives each hold differing conceptions of the fifth energy transition. Climate scientists believe that the energy transition requires a complete phasing out of fossil fuels and a rapid deployment of clean sources of energy such as wind, solar, and nuclear. Conversely, oil and gas executives see the energy transition as a shift toward greater reliance on natural gas (the least CO_2 emitting fuel) (Gelles & Friedman, 2022).

At CERAWeek in 2022, an energy industry conference, oil executives affirmed their view that the energy transition includes the continued use of all sources of fossil fuels for the foreseeable future. Amin Nassar, the CEO of Saudi Aramco, one of the largest companies by revenue in the world, argued

that "all energy sources will be needed to support a successful transition" and affirmed that the oil and gas industry "must play its part, too" (Gelles & Friedman, 2022).

Some scholars argue that discussions over the potential of oil and gas majors to meet self-imposed GHG emissions reduction targets and shift towards low carbon technologies such as carbon capture, utilization, and storage (CCUS) have served as a distraction from the larger question of whether they will phase out the exploration and extraction of oil and gas (Kenner & Heede, 2021).

Oil and Gas Majors' Historic Engagement with Climate Issues

Early Awareness of Climate Issues

Oil and gas majors have a lengthy history of engagement with the climate crisis. In a seminal 1960 article published in the journal *Tellus,* Charles Keeling warned that the concentration of atmospheric carbon dioxide was rising at a rate "nearly that to be expected from the [global] combustion of fossil fuel" (Franta, 2018, p. 1024). He constructed the Keeling curve, a graph that represents the concentration of increasing CO_2 in the Earth's atmosphere.

However, archival evidence demonstrates that the oil industry had prior knowledge of climate change before Keeling published his measurements. In 1954, geochemist Harrison Brown submitted a research proposal to the American Petroleum Institute (API). Brown referenced the "changing carbon dioxide concentration in the atmosphere resulting from industrialization and the consequent burning of large quantities of coal and petroleum" (Franta, 2018, p. 1024). In 1955, the API began funding Brown's research under the name Project 53.

In 1965, US President Lyndon Johnson's Science Advisory Committee warned of the "measurable" effect of fossil fuel combustion on the rise of atmospheric CO_2 and the report was promptly shared with carbon majors. The report predicted: "By the year 2000 the increase in atmospheric CO_2 will be close to 25%. This may be sufficient to produce measurable and perhaps marked changes in climate, and will most certainly cause significant changes in the temperature and other properties of the stratosphere" (The Environmental Pollution Panel President's Science Advisory Committee, 1965, p. 123).

After the danger of the combustion of fossil fuels was brought to President Johnson's attention, the API president addressed industry leaders at an annual meeting. He said, "One of the most important predictions of the report is that carbon dioxide is being added to the Earth's atmosphere by the burning of coal, oil and natural gas at such a rate that by the year 2000 the heat balance will be so modified as possibly to cause marked changes in climate beyond local or even national effort" (Franta, 2018, p. 1025). He acknowledged the links between fossil fuels, CO_2, and global warming. Ikard called on the API's membership to become better "articulators of the industry's point of view" and to "do what [they] can to put on a good cause on a rational track" ("Meeting the Challenges of 1966," 1965). He noted that "there is still time to save the world's peoples from the catastrophic consequence of pollution, but time is running out" ("Meeting the Challenges of 1966," 1965).

Despite the API president's warning, attitudes among industry leaders shifted as the threat to their product became increasingly apparent. Rather than acting to decarbonize their products or shift their portfolio, leading investor-owned fossil fuels created the Global Climate Coalition (GCC) to oppose policies aimed at reducing greenhouse gas emissions. The GCC led an aggressive lobbying and advertising campaign to sow doubt about the scientific evidence of climate change. The GCC helped to successfully prevent the U.S.'s signing of the Kyoto Protocol (Frumhoff, 2015).

According to a report by InfluenceMap, in the three years following the adoption of the Paris Agreement, the five largest investor-owned oil and gas majors (ExxonMobil, Shell, Chevron, BP, and Total), invested over USD 1 billion of shareholder funds in misleading climate-related branding and lobbying (InfluenceMap, 2019). Moreover, major oil and gas companies have poured money into climate focused branding (a total of USD 197 million annually) to garner a climate-positive image amongst the public (InfluenceMap, 2019).

Response to SEC Proposed Climate-Disclosure Rule Change

In March 2022, the Securities and Exchange Commission (SEC) proposed a rule change to enhance and standardize companies' climate-related disclosures including climate-related risks that are likely to have a material impact on businesses' financial performance and strategy as well as climate-related financial statement metrics such as greenhouse gas emissions (Scope 1 + 2 +3) (Corb et al., 2022). Moreover, the proposed rule included required disclosure of relevant risk management processes; information on target, goals and transition plans; and information on whether a company uses an internal price on carbon (including the price and how it is set). The proposed rules are an attempt to standardize current climate reporting frameworks such as the Greenhouse Gas Protocol and the Task Force on Climate-Related Financial Disclosures (TCFD). The SEC opened the proposal to comments. All seven majors and the American Petroleum Institute (API) have provided comments.

ConocoPhillips issued a comment broadly recommending the ESG disclosure requirements, though recommended that the framework include sector-specific metrics. ConocoPhillips proposed a "hybrid approach to disclosure" to minimize "categorical discrimination among industries" and ensure "consistency and comparability across industries" (Rose, 2021, p.2). Furthermore, ConocoPhillips commented that the "SEC should apply existing liability protections and safe harbors found in current reporting regulations" (Rose, 2021, p. 4). ConocoPhillips further advocated that ESG reporting and disclosure should be "furnished rather than filed" (Rose, 2021, p. 4). If a company makes materials misstatement and omissions in reports and information that is "filed," the company is subject to far stronger liability consequences than one that is "furnished." Furthermore, ConocoPhillips noted that they do not believe that Scope 3 disclosures are material.[1] They commented: "Scope 3 emissions represent the use of our production volumes further down the value chain, and we have neither

[1] Information is "material" if there is a substantial likelihood that a reasonable investor would attach importance to it in their decision to buy (or not buy) a security.

visibility nor control over their ultimate end-use" (Rose, 2022, p. 10). Given that Scope 3 emissions account for over 80% energy companies' current and historic emissions, omitting Scope 3 emissions significantly lessens energy companies' perceived impact on climate change.

Eni also issued a comment broadly recommending the ESG disclosure requirements. Like ConocoPhillips, Eni recommended the SEC develop sector-specific guidance and "leave companies the choice of which information is material and needs to be disclosed" (Eni Response 2021, p. 2). Furthermore, Eni proposed a "comply or explain" mechanism as an effective approach to "improve companies' best practices in terms of climate-related disclosure while keeping a certain degree of flexibility and allowing diversified applications of the rules" (Eni Response, 2021). A "comply or explain" mechanism would allow companies to decide if they believe a set of standards is appropriate. If a company doesn't comply to a certain standard, they would be required to provide an explanation.

Lastly, TotalEnergies issued a comment recommending that the SEC's rule changes be integrated. Like their competitors, Total called for standardization across sectors and also called for a "comply or explain" framework on detailed climate related disclosures (TotalEnergies Response, 2021, p. 8). However, unlike ConocoPhillips, Total expressed their agreement to the disclosure of Scope 3 emissions.

Though all three majors stated support for the proposed rule changes, their proposed changes all point to companies' desire to minimize their liability and choose themselves what information they deem material.

Oil Majors' Role in Decarbonization

Two Options

The oil and gas industry faces the key challenge of how to adapt to a changing energy landscape. According to an Atlantic Council report, oil and gas companies face at least two choices in how to respond to the growing calls for decarbonization. First, where energy demand is rapidly growing (such as China, Africa, and India), "oil and gas companies can endeavor to support coal-to-gas switching and investing in infrastructure that enables electrification to meet end user demand support to lower GHG upstream operations" (Johnston et al., 2020, p. 1). Alternatively, oil and gas companies can choose to focus on "using renewables and new technologies not just as a hedge against demand risk or to decarbonize their [Scope 1+2][2] production, but to leverage their expertise with supply chains and market development to support low carbon energy deployment in the energy transition on-the-whole" (Johnston et al., 2020, p. 1). There are a few other areas where the oil and gas sector has a competitive advantage over emerging companies (e.g. young renewable energy companies) including the hydrogen economy, offshore wind technologies, electrification, liquid biofuels, and carbon capture and storage

[2] Scope 1 emissions are greenhouse gas (GHG) emissions from sources in direct control or ownership of an organization (e.g emissions from methane leaks, gas flaring, or oil company vehicles). Scope 2 emissions are indirect GHG emissions and beyond direct control of an organization (e.g. emissions from the generation of electricity or heat that an oil company buys from utilities).

(CCS).

A Successful Transformation: Ørsted

Danish multinational Ørsted A/S successfully implemented the second option. In 1991, Ørsted–then DONG–developed the world's first offshore wind farm in the Baltic Sea with eleven turbines. The wind farm supplied a mere 1% of Denmark's electricity (Doerr, 2021). In 2012, DONG faced financial disaster–a result of the fracking boom in the U.S. which sent gas prices to the floor. At the time, the offshore wind market was minimal. Newly appointed CEO, Henrik Poulsen developed a strategy to transform DONG into a major offshore wind developer. They set an installation cost target of approximately USD 100 per Mwh by 2020. By 2016, they had already reached USD 60. As a first mover in offshore wind, Ørsted had a significant advantage (Doerr, 2021). In 2016, the company went public with a value of USD 15 billion. In 2021, Ørsted's market capitalization reached as high as USD 93 billion (Doerr, 2021). Ørsted has acquired wind farms across the globe, including the Block Island Wind Farm off the coast of Rhode Island. By 2020, Ørsted generated 90% renewable energy. It is now the largest offshore wind developer, supplying power for more than 15 million people (Doerr, 2021). Ørsted is on track to be carbon neutral across its operations and energy production (scope 1 and scope 2) by 2025. Additionally, by 2040, Ørsted has set a target to reach net zero ambitions across the entire value chain, including scope 3 (Doerr, 2021).

Social License To Operate

Oil and gas majors' net zero ambitions and climate pledges are essential to maintaining their social license to operate (SLO), a concept used to address non-technical risks such as negative public debate and opposition (Kenner & Heede, 2021). The concept of a SLO emerged in the late 1990s and was first used by Jim Cooney, a mining executive, in a meeting with World Bank officials (Smits et al., 2016). The term is now used by business people, academics, consultants, and the media to describe the acceptance and/or approval of an activity by stakeholders. Oil executives have acknowledged the significance of the SLO. In a 2014 risk report, Shell affirmed that "real or perceived failures of governance or regulatory compliance could harm our reputation. This could impact our license to operate, damage our brand, harm our ability to secure new resources and limit our ability to access the capital market" (Shell Annual Report, 2014, p. 56).

III. Methodology

Sample Selection

The current study is based on previous research that analyzed Chevron, ExxonMobil, BP, and Shell (all four of which are investor-owned oil and gas companies listed on the European and American stock exchange) (Trencher et al., 2022). Eni SpA (Italian), TotalEnergies SE (French), and ConocoPhillips (American) are the remaining three investor-owned oil and gas companies listed on the European and American stock exchange. We selected these three companies in order to provide, together with the results of Trencher et al.'s study, a comprehensive assessment of the seven international oil companies

listed on the American and European stock exchange. Furthemore, choosing these three companies allows us to evaluate and compare the American and European responses to the energy transition. Lastly, we chose specifically investor-owned companies as they allow us to draw a possible connection between investor pressure to decarbonize and their actions. Together, Eni, Total, and ConocoPhillips are responsible for 2.45% of the world's total fossil-fuel CO_2 equivalent emissions (Heede, 2013).

Study Design and Methods

The aim of the study is to assess to what extent Eni, Total, and ConocoPhillips are transitioning from a business model based on fossil-fuels to one based on clean energy and net-zero production since the adoption of the Paris Agreement in 2015. We surveyed the three oil and gas majors across three areas: discourse, business strategies, and investments. To evaluate oil and gas majors' discourse, we identified the frequency of climate and clean energy related keyword usage in annual reports. To evaluate business strategies, we tracked pledges and concrete actions taken by oil and gas majors related to decarbonization, emissions reduction, and clean energy. Finally, to evaluate oil and gas majors' investments, we examined oil and gas majors' production and proved reserves of fossil fuels. All data steps cover the time period between 2015-2021.

Discourse

In line with Trencher et al.'s prior study, we examined the frequency of 53 keywords in the selected majors' annual reports between 2015 and 2021. Trencher et al. selected keywords based on oil-industry gray literature, then grouped the words into four categories: (i) climate change ("focused on detecting awareness of climate-related concepts"), (ii) transition ("examining discourse reflecting a resolve to transition business models), (iii) emissions ("showing acknowledgement of the need to reduce various GHG emissions), and (iv) clean energy ("reflecting statements related to investments in non-fossil fuel or decarbonized energies") (Trencher et al., 2022, p. 3). We counted the frequency of each of the keywords and their variants in each company's annual reports from 2015-2021 and then divided the total number by the report's total word counts to normalize results.

Climate Change			Transition			Emissions			Clean Energy		
Key Term	**Variants**	**Relevance**	**Key Term**	**Variants**	**Relevance**	**Key Term**	**Variants**		**Key Term**	**Variants**	**Relevance**
1.5 degree(s)	1.5℃	The Paris Agreement aims to keep global warming preferably below 1.5℃ pre-industrial levels.	carbon activit-		Refers to carbon-emitting activities.	carbon abatement		Reduction of the amount of carbon dioxide that is produced through the use of cleaner forms of energy, increases in energy efficiency, CCS, etc.	alga-		Alternative fuel technology; biofuel. Since the 1970s, fossil-fuel companies have pursued research in algae ventures, however many have abandoned their algae efforts due to biological and economic limitations.
2 degree(s)	2℃	The Paris Agreement aims to keep global warming well below 2℃ pre-industrial levels.	carbon business-		The use of a marketplace to buy and sell credits that allow companies to emit a certain amount of carbon dioxide.	carbon dioxide	CO2	Greenhouse gas that absorbs and radiates heat; contributes to recent climate change.	alternative fuel		A fuel other than gasoline for powering vehicles such as natural gas, ethnicity, or electricity.
climate		Indicates acknowledgment of climate change.	carbon credit-		Tradeable permit which allows a company to produce a defined amount of carbon emissions.	carbon emission-		Release of carbon dioxide into the atmosphere when fossil fuels are burned in vehicles, buildings, industrial processes, etc.	alternative energy		Energy that is not derived from fossil fuels such as wind, solar, and hydro.
dual challenge		Refers to both meeting growing demand for energy *and* reducing greenhouse gas emissions.	carbon cost-		Measure of the true cost of carbon, including the external costs of GHG emissions.	carbon footprint		Measure of the cumulative carbon emissions associated with a person or entity's activities.	alternative source of -		Energy that is not derived from fossil fuels such as wind, solar, and hydro.
OGCI	Oil and Gas Climate Initiative	An international oil/gas industry-led consortium that aims to accelerate the industry response to climate change; established in 2014.	carbon offset-		Any reduction of GHG emissions that compensate for emissions that occur elsewhere.	carbon intens-		Number of grams of carbon dioxide that it take to make one unit of electricity (1 kW/hour).	batter-		Batteries are critical to the renewable energy transition as a means to store electricity.
IPCC	Intergovernmental Panel on Climate Change	Intergovernmental body of the United Nations responsible for advancing knowledge on human-induced climate change; established in 1988.	carbon polic-		Policies that require companies to pay a price for each ton of carbon emissions they release.	carbon neutral		Zero net emissions of carbon dioxide; achieved especially through carbon offsetting.	biofuel	biopower, bioenerg-, biomass	Any fuel derived from plants, microorganisms, or animal waste. Though burning biofuels releases carbon dioxide into the atmosphere, the carbon release is offset by. the growing of organic matter.
Kyoto		The Kyoto Protocol implemented the objective of the UNFCCC to reduce greenhouse gas concentrations in the atmosphere; adopted in 1997 and replaced by the Paris Agreement.	decarbon-		Move away from energy systems that produce GHG emissions; lessening GHG emissions from internal combustion engines.	carbon zero-		Zero net emissions; carbon added to the atmosphere is no more than the amount removed.	clean- fuel; clean-energ-		Fuels with fewer associated greenhouse gas emissions.
Paris	(For TotalEnergies: "Paris Agreement" or "Paris Accord")	The 2015 Paris Agreement established a global framework to avoid climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C.	sustainab-		Meeting current needs without compromising the ability of future generations to meeting their own needs.	carbon sink-		Ocean, forest, or another natural environment which absorbs more carbon from the atmosphere than it releases.	electric vehicle	electric mobility; electric transport; EV	Vehicles with an electric motor rather than an internal combustion engine. All-electric vehicles have zero tailpipe emissions.
UNFCCC	United Nations Framework Convention on Climate Change	UN framework for international cooperation to combat climate change; established in 1992.				ccs/ccus	carbon capture, carbon storage, carbon removal	Trapping of man-made carbon dioxide undergraduate to avoid its release into the atmosphere.	electricit-		The current energy transition requires electrification across all sectors.
warming		Indicates acknowledgment of global warming.				energy eff-		Use of less energy to performance the same task.	ethanol	methanol	Renewable fuel produced from plant materials. Adding ethanol to gasoline reduces tailpipe emissions.
						flare	flaring	Burning of excess natural gas associated with oil extraction; results in both methane and carbon dioxide emissions.	geothermal		Type of renewable energy from heat within the earth.
						fluorinat*		F-gases are greenhouse gases with a warming effect by to 25,000x greater than carbon dioxide.	hydropower		Type of renewable energy that generates power from falling or fast-running water.
						greenhouse	GHG	A gas that absorbs infrared radiation and contributes to the greenhouse effect.	hydrogen		Alternative to fossil fuels; potential as energy storage technology.
						hydrofluorocarbon-	perfluorocarbon-	Harmful to the ozone layer; greenhouse gas.	low- carbon		Energy generated using lower amounts of carbon emissions such as wind, solar, or (in the eyes of many fossil-fuel companies) natural gas.
						sulfur (hexafluoride)	sulphur	Man-made gas with a global warming potential 23,500x greater than carbon dioxide.	renewable-		Energy from a source that is not depleted when used.
						methane	CH4	Greenhouse gas with a global warming potential 35x greater than carbon dioxide; oil production is responsible for around 40% of methane emissions.	solar		Renewable energy source derived from energy from the sun.
						net zero	zero net	Refers to state in which greenhouse gases release into the atmosphere are balanced by their removal; Paris Agreement calls for net-zero emissions by 2050.	wind		Renewable energy source derived from energy from wind.
						N2O	nitrous oxide	Greenhouse gas with a global warming potential 300x greater than carbon dioxide.			

Table 1: Keywords selected in discourse analysis (based on Trencher et al.'s study)

The frequency of keywords serves as a proxy to track the level of awareness and emphasis placed on climate change, the energy transition, emissions, and clean energy. While the keywords provide a rough indication of awareness, they don't necessarily correlate to major's actions and investments towards building climate awareness or supporting the clean energy transition.

We examined oil and gas majors' annual reports (as opposed to sustainability, climate, or ESG reports) as they best reflect companies' general communication to stakeholders and shareholders.

Strategies

The second step identifies strategies and pledges majors have taken across the time period. We used 22 indicators compiled by Trencher et al., which are organized across three categories: climate change cognition ("providing the intellectual justification to take action, these indicators serve as preconditions or predictors for pursuing a transition to clean energy"), business model ("this category measures the presence of a concrete transition strategy, along with pledges and actions to reduce exploration or production of non-sequestered fossil fuels due to climate concern and to transition the workforce to clean-energy businesses"), and emissions reduction ("this category measures the presence of pledges and actions to reduce GHG emissions"). We tracked both pledges and disclosures as well as concrete actions.

Note: The original study included three additional indicators in a fourth category: clean energy. Unable to find the relevant data for the study period, we assessed clean energy investments separately (see below).

We sourced data from annual reports, sustainability reports, and climate reports to assess each majors' pledges, disclosures, and actions. We evaluated pledges and actions on a numerical scale (-1,0,1) with the following scoring criteria:

+1: Pledges and actions that implement or reinforce a strategy or commitment in that year.
-1: Pledges and actions that contradict a strategy or commitment in that year.
0: No evidence found of pledges or actions in either direction.

Investments

The third step evaluates majors' financial performance. We tracked annual financial activity across two areas (i) fossil fuel production volumes and (ii) fossil fuel reserve estimates. Additionally, we collected data on investments in clean energy and low-carbon technology.

Firstly, we identified the daily average production volumes for hydrocarbons (oil and natural gas) and converted each to an incremental percentage with 2015 as the baseline in order to minimize fossil fuel price fluctuations.

Secondly, we analyzed each major's annual estimates of proved oil and gas reserves and converted each to an incremental percentage with 2015 as the baseline in order to minimize fossil fuel price fluctuations. We expected that majors with larger fossil fuel reserves are least likely to halt extraction of oil and gas. Proved reserve estimates refer to the amount of oil and gas that are reasonably anticipated to be commercially recovered. They assume recoverability under current economic conditions, governmental regulations, and operating methods.

Finally, we retrieved and examined data on renewable energy investments in an effort to measure majors' transition away from fossil-fuels towards renewable energy. We were unable to track total investments in clean energy as a percentage of total capital expenditures due to insufficient publicly available data.

IV. Findings

Discourse

Fig. 1 shows the normalized results of the discourse analysis. On average, all three majors have increased their use of the keywords from 2015-2021. As a percentage of total word counts, ConocoPhillips has used the keywords the least.

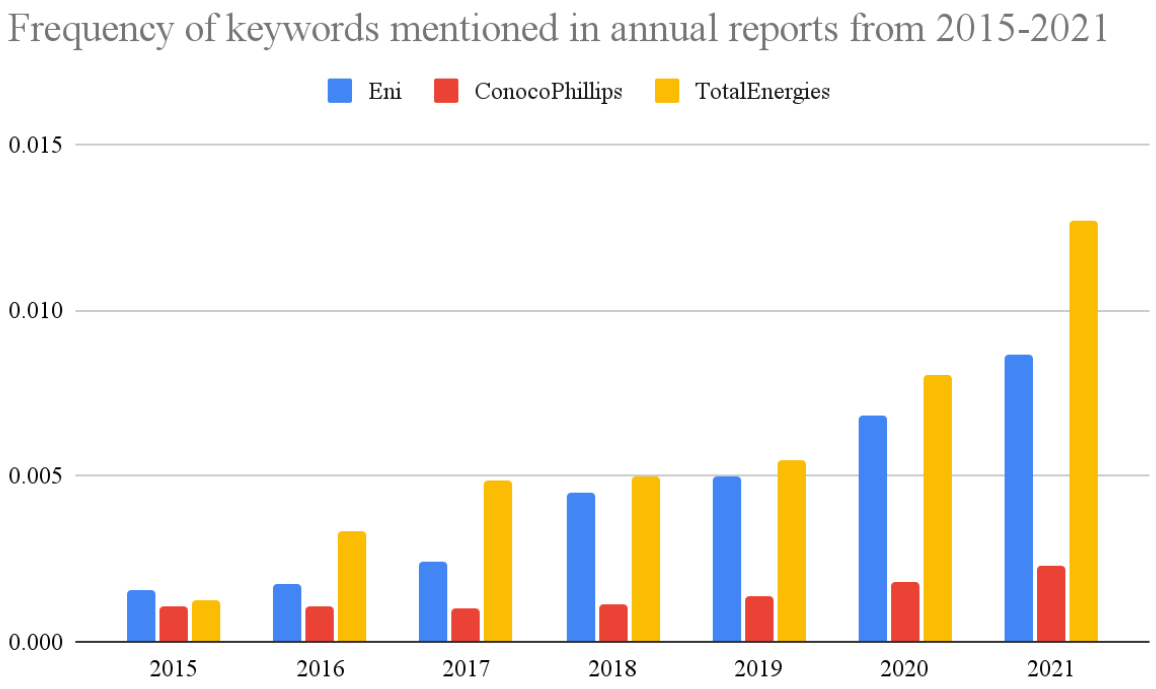

Figure 1: Frequency of keywords mentioned in annual reports from 2015-2021 (normalized by total annual report word count).

The data suggests that European majors place a stronger emphasis on climate, emissions, low-carbon energy, and a shifting business model than their American counterparts. This finding is consistent with Trencher et al.'s findings which show Chevron – an American major – trailing behind its European counterparts in keyword usage.

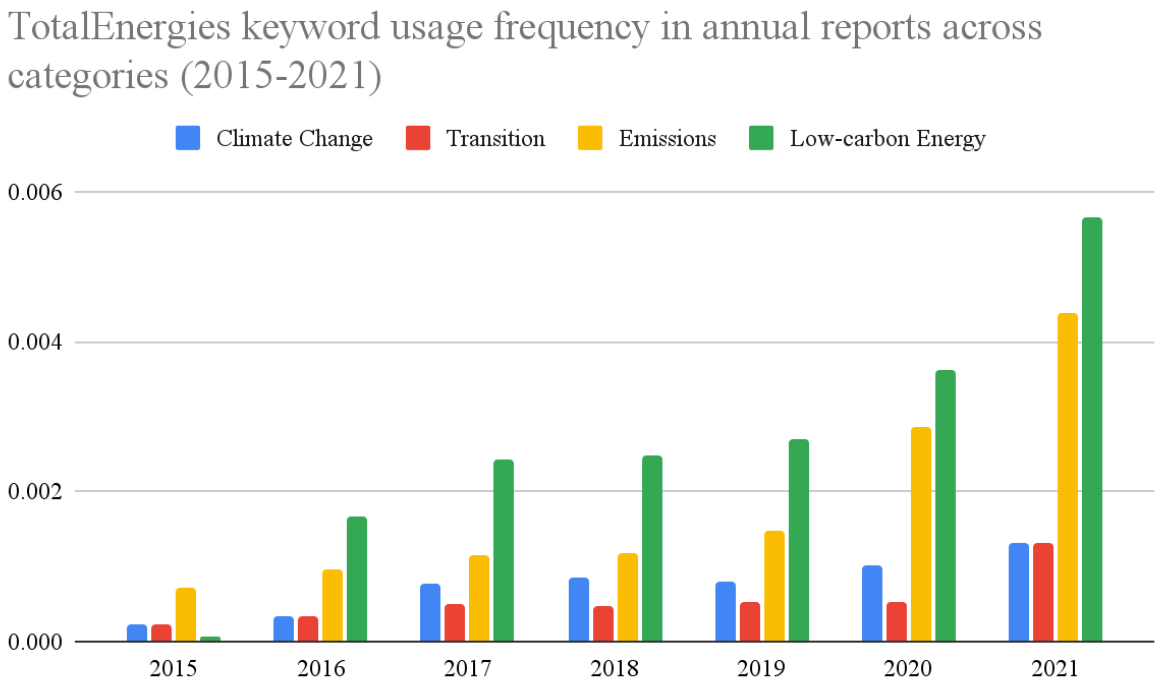

Figure 2: TotalEnergies keyword usage frequency in annual reports across categories (2015-2021) (normalized by total annual report word count).

TotalEnergies shows a steady increase of the keywords across all seven years. Specifically, keywords related to emissions and low-carbon energy significantly increased in the TotalEnergies reports. Within the climate cognition category, Total increased their usage of "climate" almost nine fold – from 38 to 426. Within the emissions category, TotalEnergies notably increased their usage of "net-zero" (0 to 133), "methane" (13 to 247), "greenhouse" (42 to 382), "carbon neutral" (0 to 115), and carbon dioxide (33 to 411). Moreover, within the low-carbon energy category, TotalEnergies notably increased their usage of "wind" (2 to 150), "solar" (163 to 341), "renewable" (21 to 531), "hydrogen" (6 to 171), and "electric vehicle" (2 to 112).

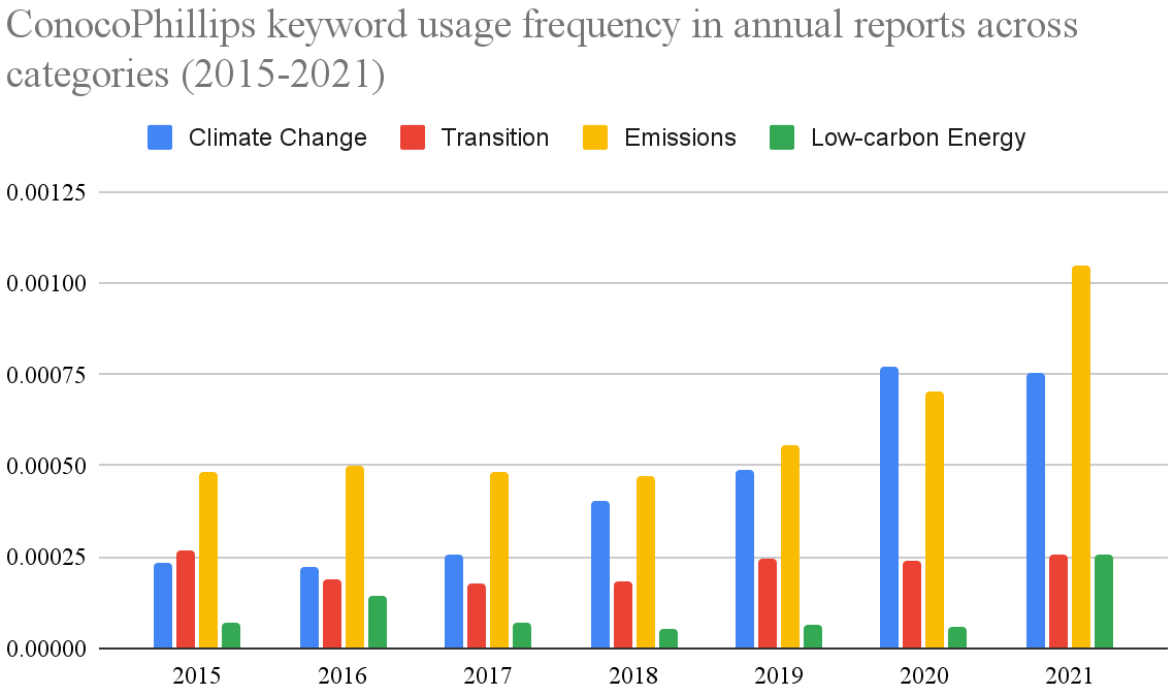

Figure 3: ConocoPhillips keyword usage frequency in annual reports across categories (2015-2021) (normalized by total annual report word count).

ConocoPhillips also shows a steady increase in the use of the keywords. However, the increase is less steady than TotalEnergies. For example, ConocoPhillips shows no steady increase in the frequency of keywords related to low-carbon energy (with the exception of a marked increase from 2020 to 2021). Within the climate change cognition category, ConocoPhillips primarily increased the usage of the term “climate” (16 to 49). Within the transition category, there was almost no change in keyword usage. Within the emissions category, the term “greenhouse” and “GHG” increased the most (16 to 39).

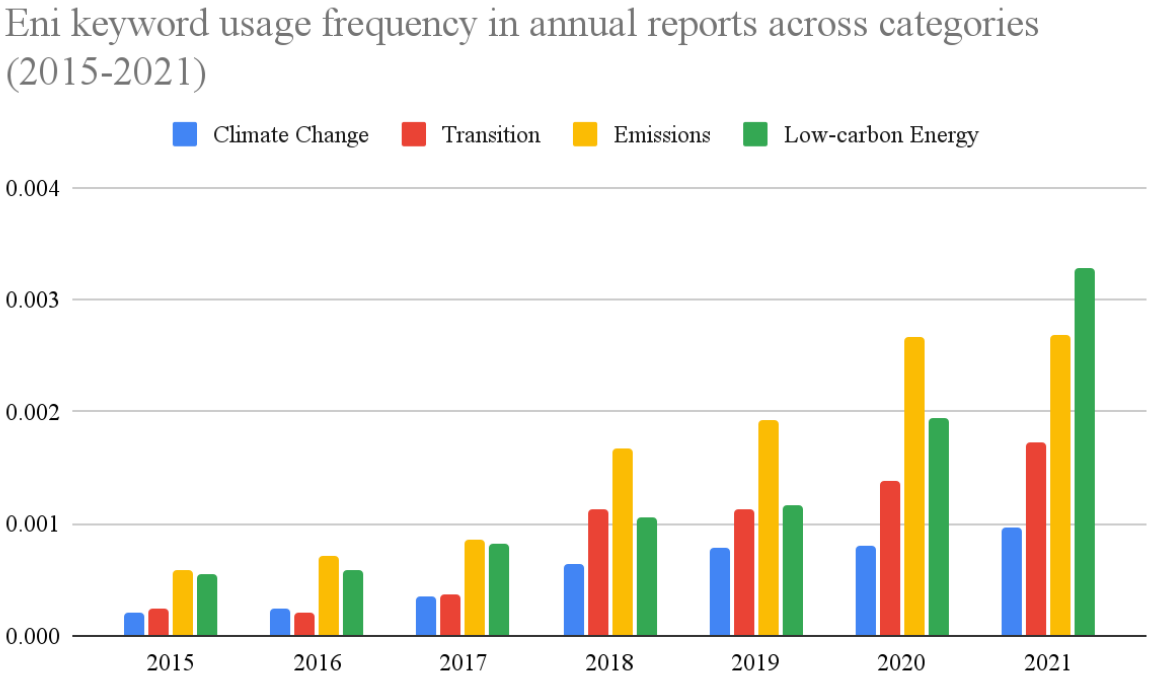

Figure 4: Eni keyword usage frequency in annual reports across categories (2015-2021) (normalized by total annual report word count).

Eni shows a steady increase in the frequency of keyword usage across the study period for all four categories. Within the climate cognition category, Eni considerably increased the frequency of "climate" (39 to 158). With the emissions category, Eni considerably increased the frequency of keywords, such as "carbon dioxide" (12 to 114) and "greenhouse" (47 to 137). Within the low-carbon energy category, Eni considerably increased the frequency of the keywords "renewable" (21 to 141) and "wind" (15 to 163).

Strategies

Figure 5 shows what pledges, disclosures, and concrete business actions each major took that indicate a shift to clean energy. Figure 6 shows the tallied scores for each of the majors from the study period.

Climate-change cognition: While most reports (Sustainability Reports, Annual Reports, etc.) reference climate change and its challenges, fewer studied reports explicitly acknowledged the established link between human activities and climate change. For example, while the 2015 TotalEnergies Annual Report notes that "the scientific community has established a link between climate change and increasing GHG emissions," the language disappears from the following two years' reports (TotalEnergies Annual Report, 2015, p. 62). However, the language used in the 2018 and 2019 report is weak.

Neither European nor American majors explicitly acknowledge the need to shift away from fossil-fuels to reduce climate change. While many acknowledge the need to shift away from oil, all three majors affirm the role of natural gas – the least emitting fuel – in the energy mix now and beyond.

While Eni and TotalEnergies have both been members of the Oil and Gas Climate Initiative since its founding in 2014, ConocoPhillips has not joined.[3] This indicates a stronger engagement with climate issues amongst European majors than American majors. This finding is consistent with Trencher et al.'s findings.

Eni, Total, and ConocoPhillips all acknowledge the regulatory risks associated with climate change. While ConocoPhillips has acknowledged the market risks associated with climate change since 2015, Eni and Total only began acknowledging such risks beginning in 2017. ConocoPhillips, for example, cites the emergence of "alternative energy technologies" (ConocoPhillips Annual Report, 2016, p. 72) as a source of market risks and notes that, "increasing attention to global climate change has also resulted in pressure upon stockholders, financial institutions and/or financial markets to modify their relationships with oil and gas companies" (ConocoPhillips Annual Report, 2019, p. 24). Eni, for example, cites the reputational risk associated with their business model and notes that they may be "perceived by governments, financial institutions and the general public as entities and the general public as the entities mainly responsible for climate change" (Eni Annual Report, 2021, p. 142). Total's language on market risk remains weak across all studied years.

Business Model: From 2015-2021, all three majors cite support for a global carbon policy and implement the adoption of an internal price on carbon in their business decisions. ConocoPhillips internal price on carbon ranged from $8-46 per ton of CO_2 from at least 2015-2017 (according to a CDP report) (CDP 2014). In 2018, ConocoPhillips explicitly acknowledged an internal price of carbon of $40 per metric tonne of CO_2(e) applied beginning in the year 2024. Since 2008, Total has instituted a carbon price of $40/ton (or the current price in a given country) in each of its investment criteria. From 2020, Total expects a carbon price of $200/ton and an annual increase of 2% thereafter. In fact, TotalEnergies estimates "a negative impact of around 9% on the discounted present value of its assets (upstream and downstream)" (TotalEnergies Annual Report, 2021, 298). Eni has factored in an internal price of $40 per ton of CO_2(e) since at least 2010.

None of the three majors acknowledge an explicit shift in their business model away from fossil fuels and towards renewables.

In terms of methane emissions, ConocoPhillips first pledged to reduce methane emissions in 2020, considerably later than its European counterparts. ConocoPhillips pledged to reduce their methane emissions by 10% and noted the 65% methane reductions they had made already since 2015. In 2018,

[3] Notably, the Oil and Gas Climate Initiative supports *voluntary* measures.

Total pledged to reduce emissions intensity[4] to below 0.20% by 2025. In 2021, Total pledged to reduce methane emissions from operated facilities by 50% between 2020 and 2025 and by 80% between 2020 and 2030. Eni was the first major of the three to pledge to reduce methane emissions. In 2016, they announced a pledge to reduce upstream fugitive methane emissions by roughly 80% by 2025 compared to 2014 levels. They also set a target to reduce methane emission intensity of upstream activities to 0.25% by 2025 from the 2017 value of 0.32%. This is significantly more than Total's pledge to reduce methane emissions intensity by 0.20% by 2025.

In terms of net-zero ambitions, in 2020, Total set a target to reach net-zero emissions across worldwide operations by 2050 or sooner (Scope 1 and Scope 2). They also set a pledge to achieve net-zero across all production and energy products used by consumers in Europe by 2050 or sooner (Scope 1, Scope 2, and Scope 3). In 2020, Eni announced a pledge to aim for net-zero emissions across all three scopes by 2050. In 2020, ConocoPhillips also set a target of net-zero emissions in Scope 1 and Scope 2 operations.

Furthermore, all majors have disclosed their emissions across all three scopes since 2015.

Category	Sub-category	Indicator	2015	2016	2017	2018	2019	2020	2021
Climate change cognition		CC1	1	1	1	1	1	1	1
	Awareness of climate change	CC2	-1	-1	-1	-1	-1	-1	-1
	Participation in international framework	CC3	1	1	1	1	1	1	1
		CC4	1	1	1	1	1	1	1
	Disclosing climate risk	CC5	0	0	1	1	1	1	1
Business model		BM1	0	0	0	0	0	0	0
	Transition strategy	BM2	0	0	0	0	0	0	0
		BM3	0	0	0	0	0	0	0
	Fossil fuel production	BM4	-1	0	-1	-1	-1	-1	0
		BM5	0	0	0	0	0	0	0
	Fossil fuel exploration	BM6	-1	-1	0	-1	-1	0	0
		BM7	0	0	0	0	0	0	0
	Workforce reallocation	BM8	0	0	0	0	0	0	0
		BM9	1	1	1	1	1	1	1
	Carbon price	BM10	1	1	1	1	1	1	1
Emission reduction		ER1	0	0	0	0	0	0	1
	Carbon emissions	ER2	0	0	0	0	0	0	1
		ER3	0	0	0	0	0	1	1
	Scope 3 emissions	ER4	0	0	0	0	0	0	1
		ER5	0	1	1	1	1	1	1
	Methane emissions	ER6	0	0	0	0	0	0	1
	Emission disclosure	ER7	1	1	1	1	1	1	1
		Tallied score	3	5	6	5	5	7	12

[4] Emissions intensity is the total volume of emissions divided by total energy production.

Category	Sub-category	Indicator	2015	2016	2017	2018	2019	2020	2021
Climate change cognition	Awareness of climate change	CC1	1	0	0	1	1	1	1
		CC2	-1	-1	-1	-1	-1	-1	-1
	Participation in international framework	CC3	1	1	1	1	1	1	1
	Disclosing climate risk	CC4	1	1	1	1	1	1	1
		CC5	0	0	1	1	1	1	1
Business model	Transition strategy	BM1	0	0	0	0	0	0	0
		BM2	0	0	0	0	0	0	0
	Fossil fuel production	BM3	0	0	0	0	0	0	0
		BM4	-1	0	0	0	-1	0	-1
	Fossil fuel exploration	BM5	0	0	0	0	0	0	0
		BM6	0	0	0	-1	0	-1	-1
	Workforce reallocation	BM7	0	0	0	0	0	0	0
		BM8	0	0	0	0	0	0	0
	Carbon price	BM9	1	1	1	1	1	1	1
		BM10	1	1	1	1	1	1	1
Emission reduction	Carbon emissions	ER1	0	0	0	0	0	1	1
		ER2	0	0	0	0	0	1	1
	Scope 3 emissions	ER3	0	0	0	0	0	1	1
		ER4	0	0	0	0	0	1	1
	Methane emissions	ER5	0	0	0	1	1	1	1
		ER6	0	0	0	0	0	0	1
	Emission disclosure	ER7	1	1	1	1	1	1	1
		Tallied score	4	4	5	6	6	10	10

Category	Sub-category	Indicator	2015	2016	2017	2018	2019	2020	2021
Climate change cognition	Awareness of climate change	CC1	1	1	1	1	1	1	1
		CC2	-1	-1	-1	-1	-1	-1	-1
	Participation in international framework	CC3	0	0	0	0	0	0	0
	Disclosing climate risk	CC4	1	1	1	1	1	1	1
		CC5	1	1	1	1	1	1	1
Business model	Transition strategy	BM1	0	0	0	0	0	0	0
		BM2	0	0	0	0	0	0	0
	Fossil fuel production	BM3	0	0	0	0	0	0	0
		BM4	-1	0	0	0	-1	0	-1
	Fossil fuel exploration	BM5	0	0	0	0	0	0	0
		BM6	0	0	0	-1	0	0	-1
	Workforce reallocation	BM7	0	0	0	0	0	0	0
		BM8	0	0	0	0	0	0	0
	Carbon price	BM9	1	1	1	1	1	1	1
		BM10	1	1	1	1	1	1	1
Emission reduction	Carbon emissions	ER1	0	0	0	0	0	1	1
		ER2	0	0	0	0	0	0	0
	Scope 3 emissions	ER3	0	0	0	0	0	0	0
		ER4	0	0	0	0	0	0	0
	Methane emissions	ER5	0	0	0	0	0	1	1
		ER6	0	0	0	0	0	0	0
	Emission disclosure	ER7	1	1	1	1	1	1	1
		Tallied score	3	4	4	3	3	6	4

Figure 5: Business strategy analysis (2015-2021)

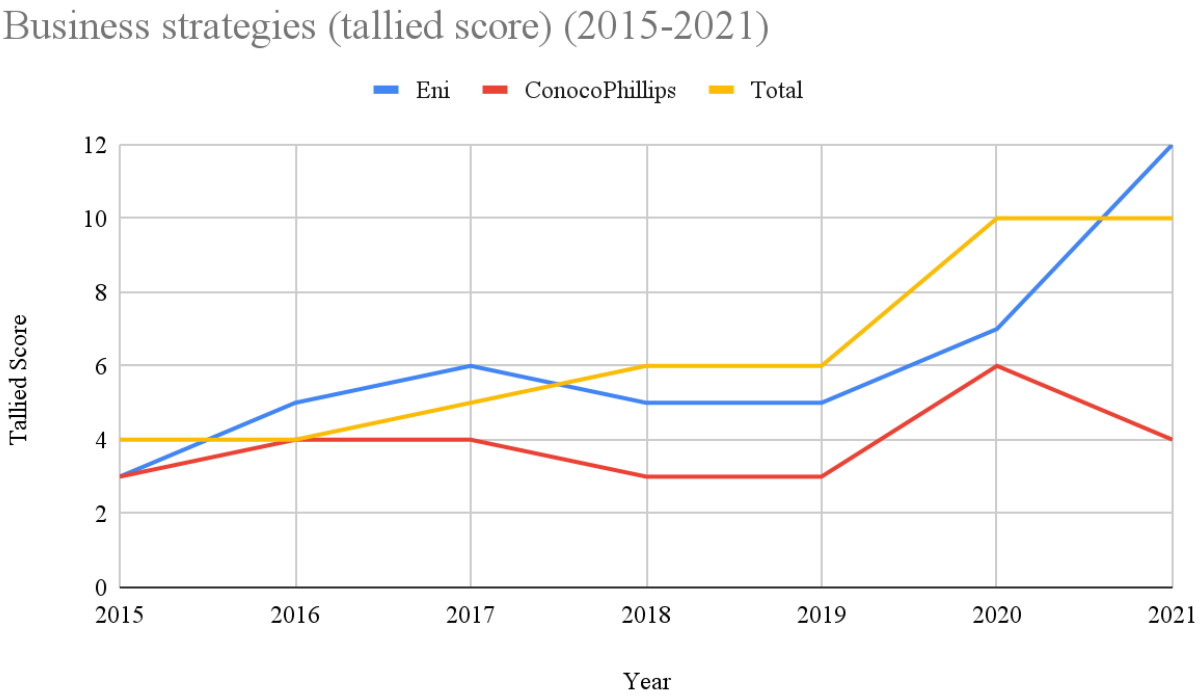

Figure 6: Business strategies (talled score) from 2015-2021

Investments

Upstream Production: Figure 7a shows the average daily volume of hydrocarbon production for liquid and natural gas combined, as thousand barrels of oil equivalent per day (KBOE/D). Figure 7b shows the incremental average daily volume of hydrocarbon production relative to 2015. Both Eni and TotalEnergies, the largest producer of the three majors, increased hydrocarbon production year-to-year from 2015 to 2019. In 2019, all three majors decreased production relative to their 2015 production. ConocoPhillips increased production from 2020 to 2021. ConocoPhillips' increased production from 2020 to 2021 to its highest level since 2015 indicates a lack of commitment to decarbonization.

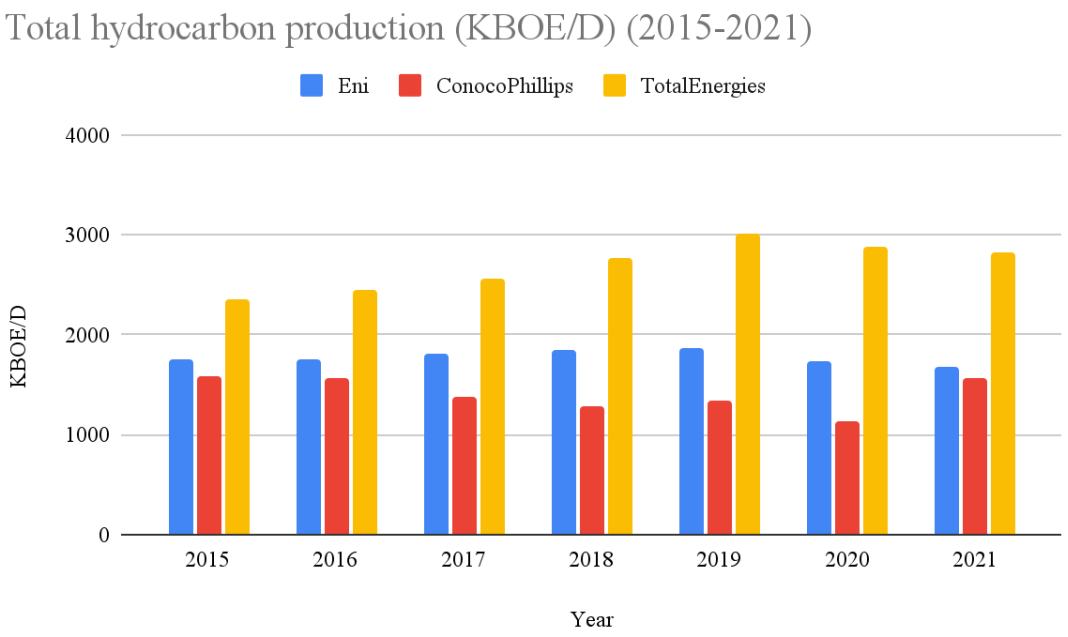

Figure 7a: Total hydrocarbon production of Eni, ConocoPhillips, and TotalEnergies (KBOE/D) (2015-2021).

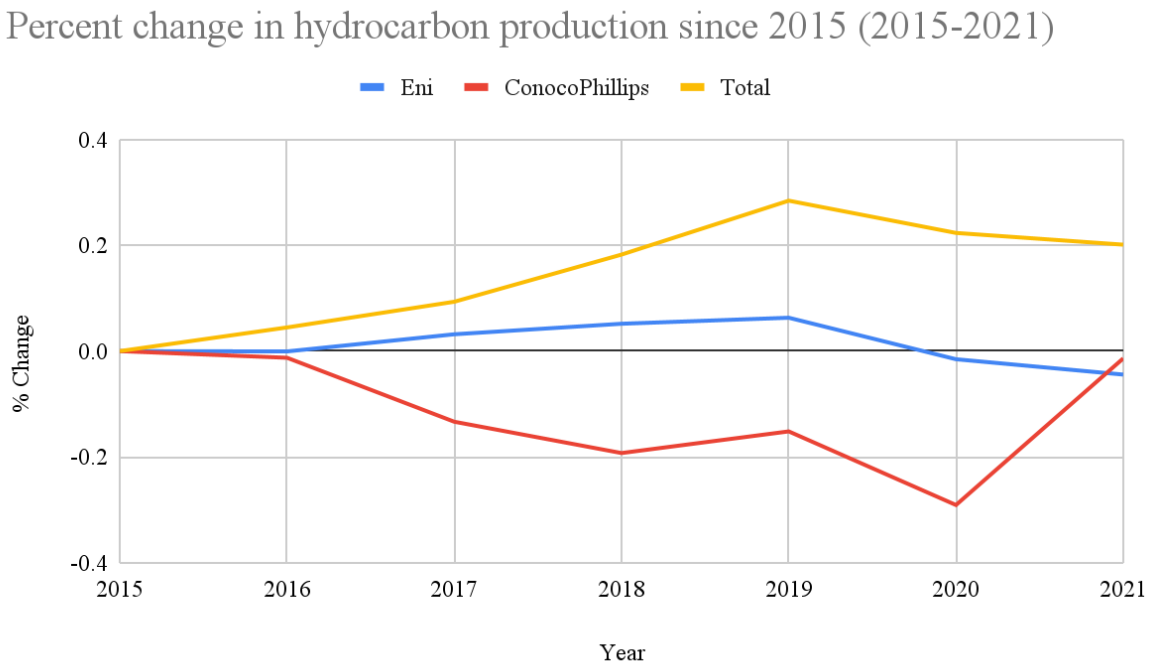

Figure 7b: Percent change in total hydrocarbon production compared to 2015.

Figure 7a (above) shows the total hydrocarbon production of each major across the study period

(2015-2021). Figure 7b (below) shows the percent change in total hydrocarbon production, setting 2015 as a baseline.

Fossil fuel reserves: Figure 8a shows Eni, Total, and ConocoPhillips' total proved reserves (MMBOE) between 2015-2021. Figure 8b shows the incremental ratio of annually estimated averages of provided liquid and gas reserves, with 2015 as a baseline.

Neither Eni nor TotalEnergies show any significant changes in their annual reserve estimates. However, after 2019, both Eni and TotalEnergies show a small downward trend in reserve estimates (Figure 8a). ConocoPhillips shows a sharp decline in reserve estimates compared to 2015. However, their reserve estimates increase in 2020-2021.

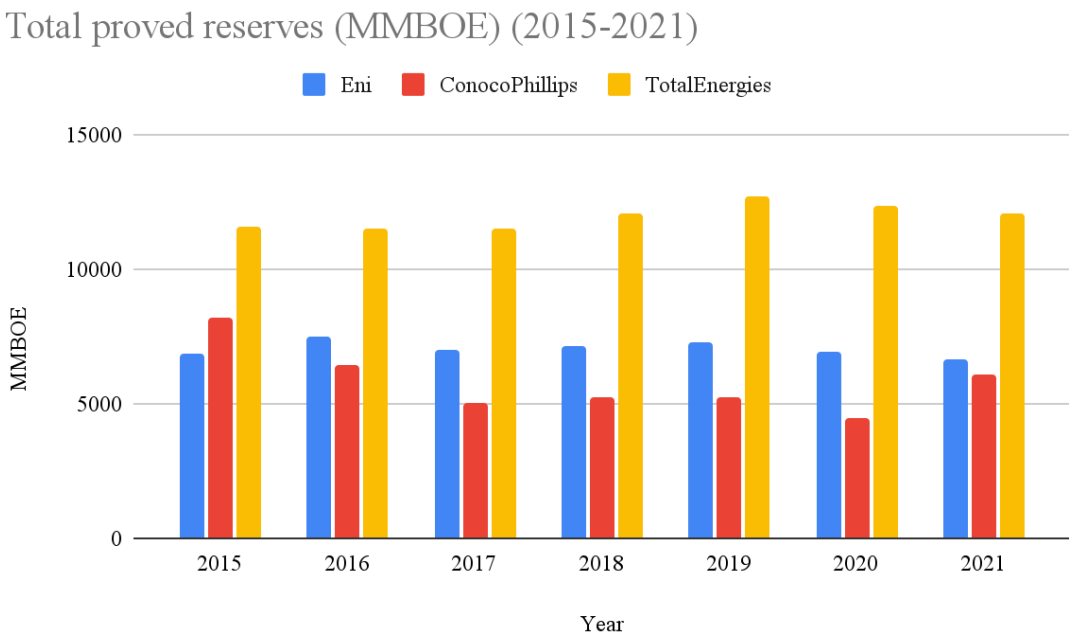

Figure 8a: Total proved reserves estimates for Eni, ConocoPhillips, and TotalEnergies between 2015-2021.

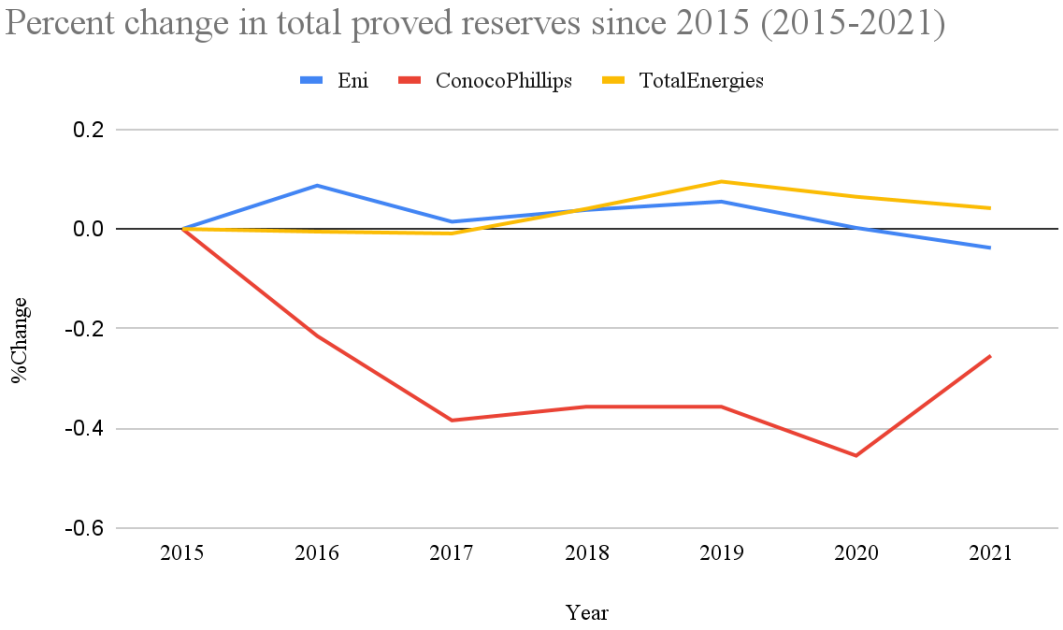

Figure 8b: Percent change in total proved reserves since 2015 (2015-2021).

Figure 8a (above) shows total reserves of each major during the study period (2015-2021). Figure 8b (belows) shows the percent change of reserves of each major during the study period compared to 2015 levels.

Investments in Low-Carbon and Clean Energy: Public availability data on oil majors' investments in low-carbon and clean energy is limited.

ConocoPhillips has publicly announced that its 2022 operating plan capital includes $0.2 million reserved for projects dedicated to reducing Scope 1 and Scope 2 emissions intensity and to fund investments in early-stage low-carbon opportunities (production efficiency measures, methane and flaring intensity-reduce initiatives, asset electrification measures, CCUS, hydrogen). However, the $200 million reserved for emissions intensity reduction and low-carbon projects represents just 2.7% of the companywide annual capital expenditures of $7.2 billion.[5]

In 2021, Eni invested approximately $179 million in research and development and submitted 30 new applications for first patent filings.[6] Eleven of the 30 new applications related to renewable energy sources. Eni has set a target to guarantee that 70% of all investment in R&D is spent on decarbonization efforts. Eni has set a budget to spend $2.3 billion in low-carbon businesses by 2025 with 25% of Eni's investments to be dedicated to new energy businesses, the green power value chain, and sustainability mobility.

[5] ConocoPhillips: Low Carbon Technologies
[6] Eni Annual Report 2021

Total has disclosed that in 2021, investments in renewables and electricity represented a quarter of total investments (over $3 billion). In 2015, investments in renewables and electricity represented a mere 5% of total investments. The $3 billion invested in renewables and electricity is higher than the amount Total invested in new oil and gas projects in 2021 (roughly $500 million, 20% of the total).[7] However, Total still plans to devote roughly half of its total investments ($13-16 billion/year) to maintaining and adopting existing upstream and downstream oil operations.

V. Discussion

This study collected qualitative and quantitative data from Eni, Total, and ConocoPhillips between 2015-2021 to evaluate perceptions of greenwashing. To do so, we examined the extent to which Eni, Total, and ConocoPhillips are shifting their business models toward clean energy in line with the Paris Agreement. We evaluated their commitments across three perspectives: discourse, business strategies, and investments.

The discourse analysis shows a sharp increase in keywords in the annual number of words related to all four categories: climate change, transition, emissions, and low-carbon energy, particularly by the European majors, Eni and TotalEnergies.

However, no majors have identified a clear and strategic plan to transition to low-carbon energy in line with the Paris Agreement. While by 2021, each major has acknowledged the science of climate change, pledges to reduce methane emissions and achieve at least net-zero Scope 1 and Scope 2 emissions by 2050, their continued commitment to fossil fuel extraction and production contradicts their pledges.

Given the discrepancy between majors' discourse, pledges, actions, and investments, we conclude that no major is fully committed to the Paris Agreement. Oil and gas companies remain financially dependent on oil and gas extraction and production. Clean energy investment accounts for roughly 5% of total oil and gas company capital expenditures globally, an increase from 1% in 2019 (IEA, 2022). This conclusion aligns with Trencher *et al.*'s conclusion that accusations of oil and gas company greenwashing are well-founded. Thus, no oil and gas supermajor (ExxonMobil, BP, Shell, Chevron, Eni, Total, or ConocoPhillips) is prepared for the clean energy transition.

VI. Conclusions

To reach the Paris Agreement and limit global warming to well-below 2.0℃ and pursue efforts to limit warming to 1.5℃ above pre-industrial levels, net anthropogenic emissions of CO_2 must approach zero by mid-century (Tong et al., 2015, 373). To date, it remains unclear to what extent oil and gas majors will contribute or hinder the goal of carbon neutrality by 2050 (Tong et al., 2015, 373). However, if oil and gas majors' operate as they have historically been operating, existing infrastructure alone will emit roughly 658 GGt of CO_2, overshooting the carbon budget allowed to reach the Paris Agreement (400

[7] Sustainability & Climate 2022 Progress Report

GGt of CO_2) by about 258 GGt of CO_2 (Teske et al., 2020). Over half of these emissions are predicted to come from the electricity sector. Furthermore, if built, proposed power plants (planned, permitted, or under construction) are expected to emit an extra 188 gigatonnes CO_2. Taken together, the 846 gigatonnes CO_2 from predicted emissions from existing and proposed energy infrastructure shoot past the entire carbon budget to limit warming to 1.5°C (Tong et al., 2015, 373).

The quantitative and qualitative data collected in this study suggest that oil and gas majors have used marketing initiatives to "greenwash" their operations and falsely convince consumers they are taking strides to reach the Paris Agreement and limit climate change.

Given oil and gas majors current levels of exploration and production of fossil-fuels (despite low-carbon and clean energy claims), further external pressure from governments, policymakers, and citizens is vital to achieving the Paris Agreement.

Given that the energy sector accounts for roughly 65% of total anthropogenic global greenhouse gas emissions, which constitute the main driver of climate change, an urgent transition to renewable energy is paramount. Without external pressure on oil and gas companies, climate change will amplify disasters such as heatwaves, droughts, floods, and wildfires. Climate disasters will lead to significant political, social, and economic difficulties and unrest. For example, a study by the Institute for Economics and Peace found that by 2050, 1.26 billion people will live in countries ill-equipped to withstand ecological disaster and could face forced displacement (IEP, 2021).

The effects of climate change also pose notable risks to the global economy. A study by the Swiss insurance company, Swiss Re, estimated that "the world stands to lose around 10% of total economic value from climate change" should temperature increases remain on their current trajectory (Swiss Re, 2021). The report estimated that the USD 23 trillion in economic losses are expected to stem from falls in crop yield, the spread of disease, rising seas, amongst other factors. As such, a transition to renewables has the potential to mitigate the environmental, social, economic, and political risks of a reliance on oil and gas.

Such findings further underscore the importance of our study, as well as other similar ones, as they expose the true nature of intentions and business models of the major oil and gas companies and reveal that their sustainability claims are made to conceal their practices and attract customers and further capital, rather than to protect the natural environment or reduce their impact on the global climate.

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Links to Data:

Consolidated Data (Total, Eni, ConocoPhillips) of

- Business Strategies (Total Energies)
- Business Strategies (ConocoPhillips)
- Business Strategies (Eni)
- Discourse Analysis (Total Energies)
- Discourse Analysis (Eni)
- Discourse Analysis (ConocoPhillips)