

Original research article

The role of incumbents in energy transitions: Investigating the perceptions and strategies of the oil and gas industry

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ABSTRACT

The study focuses on sustainability transitions in the oil and gas industry, particularly its strategies and perceptions towards mitigating climate change. The paper offers a quantitative analysis of survey data collected from 116 questionnaire responses involving representatives of oil and gas companies, academia and young professionals, supplemented by a qualitative analysis of selected companies' reports and outlooks.

The empirical results show that the oil and gas industry is attentive towards climate change and has the capacity to transit towards sustainability. There are significant differences in how the industry perceives climate change mitigation policies and treats public debate on climate change, which can be explained by geography and the related socio-political context. We point to the importance of stability of macroeconomic factors, such as oil prices, for oil and gas companies to diversify and transit, as well as underline the need to gain a deeper understanding of the effect of external pressures. We argue for clearer and more inclusive regulation, coordination and dissemination for climate policies, and wider engagement of oil and gas companies in sustainable energy transition.

This paper contributes with a meso-level assessment of sustainability transitions, and suggests a more diverse picture of incumbents by highlighting the need to revise their role in sustainability transition processes. We offer additional perspectives on transition pathways for policymakers.

1. Introduction

Climate change raises many urgent questions regarding the future development of the global energy system and requires a dramatic change in the existing principles of energy production and consumption. Meanwhile, global energy demand continues to increase, driven by population and economic growth, despite disruptions caused by the COVID-19 pandemic [1]. As a result, growing energy consumption stimulates further increases in greenhouse gas (GHG) emissions.

The oil and gas industry currently satisfies more than 57% of global energy demand [2]. The industry is viewed as a major cause of climate change and environmental problems and is under significant pressure to transform to a more sustainable way of operating. At the same time, the industry has the capacity and resources to re-shape the traditional energy business [3,4]. This is why future changes in the global energy system depend largely on if and how the oil and natural gas industry will

respond to the emerging issues related to climate change mitigation and sustainability transitions.

Sustainability transitions research mainly investigates complex interactions in large socio-technical systems to enable radical shifts to the new kinds of systems [5], where the underlying reasons for such shifts are environmental and climate problems, and societal challenges. One of the fundamental questions within sustainability transitions research is how to facilitate the change in the required direction [5–7]. A large proportion of the sustainability transitions literature focuses on creation and facilitation of innovations [5]. Much of the focus is on accelerated deployment of renewable energy innovations and green niche innovations [8], which are seen as the key element to transit [cf. 9]. The broader perspective to sustainable energy transitions includes many other aspects, such as politics and power [10], as well as institutional and governance processes [11]. There is growing interest in the resistance of incumbent actors, and “creative destruction” in the form of

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destabilisation of existing regimes [12].

As the dominant part of sustainability transition research implements a case study approach focusing on the resistance to change, phasing out, “challengers”, and facilitating the diffusion of radical innovations outside the existing socio-technical regimes [13], the role of incumbents in sustainability transitions is marginalised. Some studies have highlighted the need to purposefully destabilise the existing fossil fuel socio-technical regimes in favour of a low-carbon future [e.g., 8], mainly because incumbents are seen as resisting climate change mitigation and struggling with new entrants [14].

Some recent studies have found supporting evidence for a more diverse picture of incumbents and their capabilities to contribute to change [15,16], bridging the Schumpeterian creative destruction with a more encompassing view on sustainability transitions pathways. For example, Turnheim and Sovacool [13] suggested “pluralising incumbencies” by looking at different types of actors and transition contexts. According to them, incumbent characteristics can be observed in actions of other actors and not only traditional industries, while the latter are to undertake radical response strategies.

However, the topic of sustainability transitions in relation to the oil and gas industry remains largely uncovered, mainly because it is viewed as contradictory to sustainable development [17] and is often associated with environmental and climate change problems, as well as an interplay of global powers for vested interests [5]. This is not to deny that political advocacy is present and can hinder transition efforts [8]. The conceptual challenge in sustainability transitions is that the research community in general tends to be sceptical about the oil and gas industry's claims to be committing to the energy transition [18], while there is clearly room to contribute towards reaching the United Nations' Sustainable Development Goals (SDG) [4,15], and the oil and gas sector's motives are clearly justified by the need to adjust to the new business realities.

Contrary to the “*flip-side*’ of transitions” studies [5] – that is, destabilisation and phasing-out of existing socio-technical regimes – only limited attempts have been made to investigate the innovation and diversification potential of the oil and gas industry. One example is Simensen and Thune's [19] study on how innovations emerge in resource-based industries illustrated by the Norwegian oil and gas industry. Those authors concluded that the Norwegian oil and gas sector is highly innovative and dynamic and possesses the desired capacity to contribute to socio-technical transitions, while the main impediment is policies and their application. Furthermore, the results of Chaiyapa et al.'s [20] discourse analysis of Thai oil and gas business diversification towards biofuels showed that oil and gas companies are willing to consciously transform and diversify their core business, but require a more streamlined guidance and clearer policy communication. In their study of Norwegian oil and gas and hydropower incumbents, Steen and Weaver [15] demonstrated that firms do possess innovation and transition capacity and are willing to pursue new business opportunities, but may lack stable institutional environments, among other things.

Adding to the rising theoretical discourse on the role of incumbents and “incumbency” as a condition within the sustainability transition perspectives [13,21], these selected empirical examples from the Norwegian and Thai oil and gas sectors show how crucial it is to assess the way the broad variety of oil and gas companies act in relation to the sustainable energy transition challenges and how they can contribute to form the transition pathways. At the same time, much of the work in the oil and gas business towards sustainability and higher involvement in climate change mitigation is left aside from sustainability transition studies, as corresponding industrial coalitions and associations (such as the Oil and Gas Climate Initiative [22], the Global Methane Initiative [23], the Climate and Clean Air Coalition [24]), companies that act as first-movers in climate change mitigation and greening strategies, and overall changes in the institutional environments of the industry.

The aim of the present paper is to complement the current sustainability transitions literature by investigating the strategies and

perceptions of oil and gas companies towards energy transition, as well as explore their capacity and will to contribute to climate change mitigation. The study had the following research question:

What are the strategies and perceptions of the oil and gas industry on the energy transition in the context of climate change?

We answered this research question by combining qualitative and quantitative approaches. First, we looked at the strategies of the oil and gas companies by reviewing their official statements and outlooks. Second, we used statistical analysis of survey data in order to go further and obtain insights into the perceptions of the issues related to sustainability and climate change by oil and gas industry professionals. Thus, our study commits to the meso-level assessment of sustainability transitions [14] while integrating qualitative and quantitative analytical attempts. This helps to shed light on the relation of the oil and gas incumbents to climate change, suggesting additional perspectives on transition pathways for policymakers. The rest of this paper is structured as follows. Section 2 offers an overview of the oil and gas companies' visions and outlooks on the future of the industry. Section 3 describes the methodology of the qualitative part of the study. Section 4 presents the survey results, followed by a discussion and implications in Section 5. Section 6 concludes.

2. Overview of projections and strategies

Global climate discourse places increasing pressure on oil and gas companies across the world to find sustainable ways for providing energy supply. As Dietz et al. [25] pointed out, even in 2017 there were no oil and gas companies that declared goals related to reduction of the carbon intensity of their energy products. It is currently an established practice in the industry to set environmental targets and announce commitments to contribute to climate change mitigation.

Table 1 offers an overview of publicly available materials (outlooks, reports, official web pages) by selected 11 major oil and gas companies and the Organisation of the Petroleum Exporting Countries (OPEC) (for simplification, we refer to them as the 12 companies). The intention behind the choice of the companies was to ensure reasonable coverage, both in terms of geographical location and with respect to the plurality of the views on climate issues. Thus, the sample includes companies that actively attempt to rebuild their reputation as energy companies, as well as companies that have less focus on climate and sustainability. The information is organised loosely around the topics investigated further in the survey.

Approximately half of the investigated companies produce their own scenarios of the development of energy markets and publish outlooks, while the other companies build scenarios based on those produced by the International Energy Agency (IEA). The underlying data predominantly come from the same sources (such as the IEA and the United Nations) but there are significant variations in the resulting scenarios. The purposes of these scenarios also differ, from strategy planning (Chevron, ENI, Gazprom) to contributing to public discourse (BP, Equinor). Some companies (Royal Dutch Shell – further Shell) also investigate possible paths to achieve climate goals.

The estimates of the oil and natural gas share in the future global energy balance are relatively close across the companies' scenarios and comprise an average of 52%, while there are some more radical views on the future global energy balance, such as Shell's Sky scenario (a 16% share of natural gas and oil combined in 2070, needed to meet the Paris goals) and Equinor's Renewal scenario (a combined 41% share of oil and natural gas in 2050).

Population, economic and energy consumption growth, technological development, and policies are commonly stated as the most important factors that influence the development of the global energy system. In addition, companies underlined various factors that are distinctive to them. For example, BP and ExxonMobil highlighted the

Table 1
Overview of outlooks and reports^a of major oil and gas companies.

Companies	BP	Chevron	CNPC	ENI	Equinor	ExxonMobil	Gazprom/ Gazprom Neft	OPEC	Petrobras	Repsol	Royal Dutch Shell	Total
Share of oil and natural gas in the future global energy balance (by scenarios)	Evolving transition: oil 27%, gas 26%. Rapid transition: oil 23%, gas 26%	–	–	Oil & gas 53%	Renewal: oil 19%, gas 22% of TPED; Reform: oil 26%, gas 24% of TPED; Rivalry: oil 30%, gas 22% of TPED	Oil 30%, gas 26% of TPED	Gas 24%	Oil 28%, gas 25%	Oil still the main energy source	Oil 28%, natural gas 25%	Sky (2070): oil 10%, gas 6%, of all energy sources	Momentum gas 26%, oil 27%; Rupture gas 28%, oil 21%
Factors determining strategic choices of oil & gas companies	Environment and sustainability, capability and scale, safety and risk, investment economics, cash flow certainty, optionality	The most significant factor is the price of crude oil and natural gas	China's economy growth; the need for a low-carbon, secure and efficient energy system	Price for Brent and other commodities; climate change (incl. energy transition risks: legislative, technological and reputational), geopolitical, political and social instability	Geopolitical shifts, industry fundamentals, market dynamics and the need for a low carbon future	Energy needs worldwide, energy alternatives, GHG emissions, government policies	Gas business: LNG competition, geopolitical issues, EU decarbonization policies. Oil business: oil price and currency fluctuations; drilling and production results; reserve estimates; environmental and physical risks	The need for diversification and long-term economic sustainability of their economies	Oil price, domestic market and economy, competitiveness of alternative energy sources, regulation	Economic trends, currency exchange rates, oil price, geopolitics, digitalization	Macroeconomic risks (oil and gas prices), regulations, technologies, climate change risks	Volatile and changing energy markets, energy demand growth, energy transition, climate change
Importance of climate change for the company's strategic choices/ company's strategy related to the energy transition	Climate change is the agenda; Intent to contribute to designing climate policies, including carbon pricing	Climate change is treated as an important risk; aim to provide affordable and reliable energy	Strategic foundation is to provide clean energy, minimise environmental impact and reduce emissions	Climate change is one of the top strategic risks; aim at playing a decisive role in the energy transition to a low carbon future	Climate change as a core principle in decision-making, use their low carbon advantage as a leverage in competition; aim to set an example for the oil and gas industry	Doing its part in the critical challenge of providing energy while managing emissions	Report being already the leader of the oil & gas sector in terms of carbon intensity, and additional efforts to diminish carbon footprint and promote sustainable development	Include climate change concerns into their long-term planning and strategy, believes in the need to achieve equitable economic development in a sustainable way, "help map out a possible pathway for oil and energy in the future"	Work towards a more environmentally sustainable portfolio	Aim at leading the energy transition in line with SDG, drive forward transformation into a multi-energy company	See climate change as the greatest global challenge; tackle their own emissions and help customers reduce theirs by expanding the choice of lower-carbon products	Aim at integrating climate into company's strategy; pragmatically and sustainably diversify their energy mix
Company's contribution to the sustainable energy transition	Net zero operations, net zero upstream oil and gas production, halving carbon intensity of the products by 2050 or sooner, a 50% reduction in the methane intensity of operations, increase the	Make operations more energy efficient, reduce flaring, manage methane emissions, invest in low-carbon technologies	Have begun to formulate the roadmap for low-carbon development and started to establish the carbon emission control system, joined the Oil and Gas Climate Initiative	Increase energy efficiency, reduce GHG emissions, invest in forestry, develop a low-carbon and resilient oil and gas portfolio, invest in development of renewables and	Grow renewable energy capacity tenfold by 2026, direct 15–20% of investments towards new energy solutions by 2030, aim to reach carbon neutral global operations by 2030, reduce the net carbon intensity of	Expand natural gas share, improve energy efficiency in operations, develop CCS, reduce flaring and methane emissions, develop products to help consumers reduce emissions,	Support international and national climate mitigation regulations, improve company's GHGs monitoring, adding climate change to the risk management system	n/a	Ensure the sustainability of oil and gas production, act profitably in the renewable energy segment, commit to zero growth of absolute operating emissions; 8%, reduction of emissions in the value chain by 2040	Strategy to become a net zero emissions company by 2050	Reduce the net carbon footprint of the energy products by 65% by 2050, increase natural gas share to replace coal, develop CCS, implement energy efficiency measures where reasonably practicable, develop advanced	Further improve efficiency of operations, increase natural gas share, develop a profitable low carbon electricity business, promote sustainable biofuels, invest

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Table 1 (continued)

Companies	BP	Chevron	CNPC	ENI	Equinor	ExxonMobil	Gazprom/ Gazprom Neft	OPEC	Petrobras	Repsol	Royal Dutch Shell	Total
	proportion of investment into non-oil and gas businesses			circular economy, R&D	energy produced by at least 50% by 2050	conduct research in advanced technologies; and engage in climate policy discussions			biofuels and hydrogen for transport			in carbon sink businesses, reduce GHG emissions with 15% by 2025
Relevance of public debate on climate change	Consider social preferences			Consider reputational risks	Engage with stakeholders to secure industrial legitimacy, its social contract, trust, and strategic support	Consider consumer preferences for new technologies, and environmental awareness		Rise of public awareness on climate change issues is becoming more apparent	Seek to strengthen the bonds of trust with society	Listen to stakeholders, integrate them into company's decision-making process	Ambition to maintain a strong societal license to operate, consider seriously reputational risks	Actively involve public authorities, businesses and consumers

TPED - total primary energy demand; EU – European Union; LNG – liquefied natural gas; CCS – carbon capture and storage.

^a Sources: BP - BP Energy Outlook 2019, Annual report 2019, <https://www.bp.com/>; Chevron - Annual report 2019, <https://www.chevron.com/>; CNPC - Annual Report 2018, <http://www.cnpc.com.cn/en/>; ENI - Annual report 2019, Eni for 2018: Path to decarbonization, The New ENI: creating value through the energy transition (2019); Equinor - Energy Perspectives 2019, Climate Roadmap 2018, <https://www.equinor.com/>; ExxonMobil - Outlook for Energy: a perspective to 2040 (2019), 2020 Energy & Carbon Summary, 2919 Summary Annual Report, <https://corporate.exxonmobil.com/>; Gazprom/Gazprom Neft - Gazprom Investor Day 2020, www.gazprom.ru, www.gazprom-neft.com; OPEC - World Oil Outlook 2040 (2019); Petrobras - Annual Report 2018, Strategic Plan 2040 and Business and Management Plan 2019–2023; Repsol - Integrated Management Report 2018, Repsol Strategic Update June 2018, Repsol Climate Roadmap (undated), <https://www.repsol.com>; Royal Dutch Shell - Annual Report 2019, Shell Energy Transition Report (2018), Shell Scenarios Sky (2018); Total - Total Energy Outlook 2040 (Feb 2019), Strategy and Outlook presentation 2019, Report “Integrating Climate into our Strategy” (Nov 2019).

importance of consumer behaviour and preferences. ENI focused on reputational issues, while CNPC paid attention to exploration and production investment growth. Equinor [26] emphasised “the ability of political systems to regulate and reinforce market developments in order to change investment and consumer behaviour”. Only four companies – BP, Gazprom, OPEC, and Petrobras – directly specified GHG emissions as a factor that affects the development of the global energy system.

Among the factors that influence the strategic choices of oil and gas companies, eight of the twelve companies underlined the importance of macroeconomic indicators and energy markets dynamics. Six companies directly indicated the importance of the oil price. Furthermore, five companies pointed out the issue of legislation, while three also highlighted the factor of geopolitics. Climate, environment and sustainability issues are significant factors that affect companies' strategic choices (nine of the 12 companies).

Through their reports, the oil and gas companies expressed very different attitudes and levels of acceptance of climate change within their strategic choices, despite the similar factors of influence and a similar origin of the background data. Some companies considered climate change to be an important part of the company's development strategy and decision-making process, while others attributed climate change issues to global challenges. Some, like BP and Shell, were early to recognise the climate challenge as well as related new business opportunities, while others, such as ExxonMobil, have been slow to acknowledge the need to adjust to the changed operating conditions. Two companies, Chevron and ENI, described climate change as a high-level risk. Nevertheless, the latest sustainability reports of major oil and gas companies show that no company has ignored climate change, despite a rather recent response [25].

However, the action trajectories are quite similar between the companies and are largely realised in similar patterns of strategic choices, such as GHG emissions reduction and increased investment in low-carbon and renewable energy. The majority of the investigated companies stated their readiness to improve their businesses towards being more environmentally friendly and sustainable. Many have applied a rather modest approach, seeing their role in supplying affordable energy, consistent with the changes in the landscape they operate in. Only a few companies aim to expand the scope of action and internalise environmental impacts outside their own operations, by such means as helping consumers to reduce their emissions (Shell), while a few (BP, ENI, Shell) explicitly tie climate change mitigation goals to other factors of their performance. Meanwhile, five of the 12 companies aim for larger outreach, including leadership roles in the energy transition, expressed, for example, as to “re-imagine energy” (BP), “play a decisive role in the energy transition” (ENI), and “set an example for the oil and gas industry” (Equinor).

Last but not least is the relevance of public awareness for oil and gas companies in relation to the energy transition and climate change. The current literature provides evidence of the importance of public debate in facilitating the energy transition [27,28]. Some oil and gas companies have also paid attention to this factor, but in different ways. The majority of the companies cooperate with stakeholders, whereas three (Equinor, Petrobras, Shell) aim to earn a social license to operate, two (BP and ExxonMobil) focus on consumer preferences, and two (ENI, Shell) specifically refer to reputational risks.

Nevertheless, it is challenging to evaluate how serious oil and gas companies are about their actions with respect to the strategies. There are significant concerns about the gap between “rhetoric” and “actions” of the oil and gas companies in mitigating climate change and following the net-zero carbon future [17]. The specific strategies can be seen as greenwashing rather than greening processes [29] in the face of corresponding pressures. Despite the aforementioned concern, “the spill over” [29] of climate and environmental challenges is clearly visible in the industrial dynamics of the oil and gas industry.

To summarise, this overview is of interest for at least two reasons. First, several important aspects in the companies' views on the future

Table 2
Description of the questions and the distribution of answers.

Short name	Question formulation in the questionnaire	N	Alternatives	n (%)
Q1 Vision 2050	What is your vision of the oil & gas industry in 2050?	113	Strong presence in all the industrial sectors, business-as-usual	23 (20.3)
			Dominant in some sectors and negligible in the others, changing paradigm	61 (54)
			Residual presence, strong diversification to other business assets	29 (25.7)
			Negligible presence	0
			Other	0
Q2 Factors of strategic choices	In your opinion, which factor has the strongest influence on the strategic choices of the oil & gas companies in your region:	113	Oil price and its volatility	54 (47.8)
			Internal company factors (e.g., costs)	15 (13.3)
			Climate policies	9 (8)
			Increasing competition from renewable energy technologies	20 (17.7)
			Other	15 (13.2)
Q3 Climate policies as a threat	Climate change mitigation policies are a threat to the oil & gas business in your region.	112	1 (totally disagree)	7 (6.2)
			2	20 (17.7)
			3	24 (21.2)
			4	31 (27.4)
			5	15 (13.3)
			6	8 (7.1)
			7 (Completely agree)	7 (6.2)
Q4 Effect of public debate	Public debate on climate change affect the strategic choices of oil & gas companies in your region	111	1 (totally disagree)	9 (8.0)
			2	20 (17.7)
			3	22 (19.5)
			4	24 (21.2)
			5	17 (15)
			6	14 (13.4)
			7 (Completely agree)	5 (4.4)
Q5 Position on climate change	How would you characterize the position of oil & gas companies in your region with respect to climate change?	113	Proactive (taking action)	31 (27.4)
			Reactive (acting in response)	64 (56.6)
			No action	16 (14.2)
			Other	2 (1.8)
Q6 Solutions to global energy challenges	In your opinion, how can oil & gas companies contribute to the solutions of global energy challenges? Please choose the most important one.	113	Invest in more carbon-efficient technologies in the petroleum sector	22 (19.5)
			Diversify assets by investing in renewable energy technologies	27 (23.9)
			Support R&D related to sustainable technologies	37 (32.7)
			Support other climate change mitigation measures and improve corporate social responsibility	12 (10.6)
			Other	15 (13.3)
Q7 Climate change risks and investment	How do the risks associated with climate change and environmental policies affect the investment decisions of oil & gas companies in your region?	110	No effect	25 (22.1)
			Increase the required rate of return	22 (19.5)
			Postpone the investment decisions	15 (13.3)
			Speed up the investments	17 (15)
			Limit long-term investments	19 (16.8)
			Other	12 (10.6)
Q8 Global energy system	In your opinion, what is the main factor that influences the global energy system at the moment?	113	Oil price and its volatility	33 (29.2)
			Climate change mitigation policies	9 (8)
			New energy technologies	22 (19.5)
			Energy geopolitics and regional issues	36 (31.9)

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Table 2 (continued)

Short name	Question formulation in the questionnaire	N	Alternatives	n (%)
Q9 Barriers to energy transition	In your opinion, what is the main barrier to a sustainable energy transition?	112	Other	13 (11.5)
			Insufficient technological development	30 (26.5)
			Lack of efficient political framework	29 (25.7)
			Overreliance on fossil fuels	18 (15.9)
			Resistance to change from incumbent industries	27 (23.9)
Q10 Affiliation	What is your affiliation:	112	Other	8 (7.1)
			Oil & gas company	61 (54)
			Academia/Research/Student	32 (28.3)
Q11 Geography	What is your geographic region? (Where are you based?)	113	Other	20 (17.7)
			Central, Western, Southern, Northern Europe	21 (18.6)
			Eastern Europe and Russia	67 (59.3)
			Asia, Australia and Oceania	7 (6.2)
			Middle East, Africa	7 (6.2)
			America	11 (9.7)

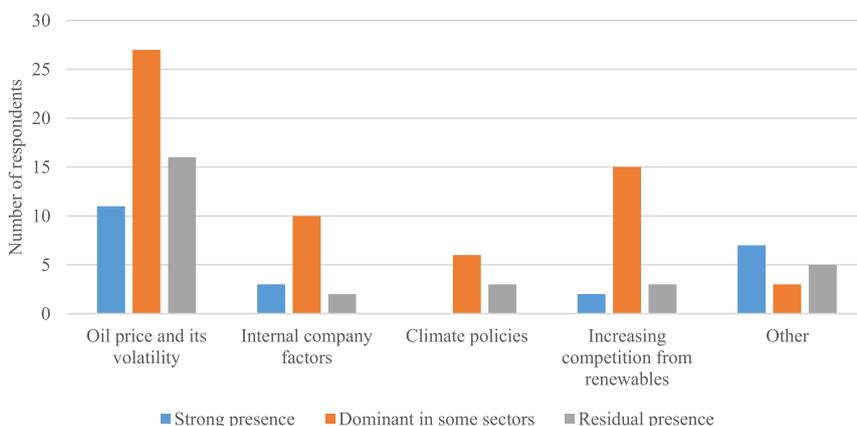


Fig. 1. Association between Q1 Vision 2050 and Q2 Factors of strategic choices.

development of the global energy system and their attitudes towards climate change differ notably, despite similar backgrounds. The differences may reflect the social and political context in the regions in which

the companies operate, and signal a very different understanding of the current positioning of the sustainable energy transition for oil and gas companies and the underlying factors. Second, the declared long-term

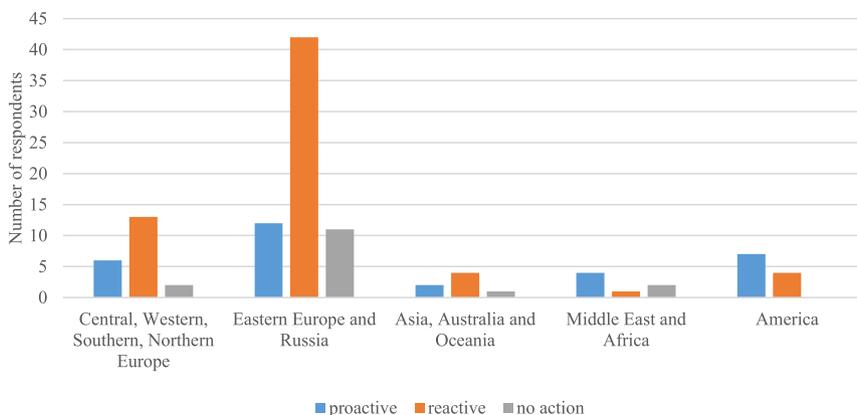


Fig. 2. Association between Q5 (Position on climate change) and Q11 (Geography).

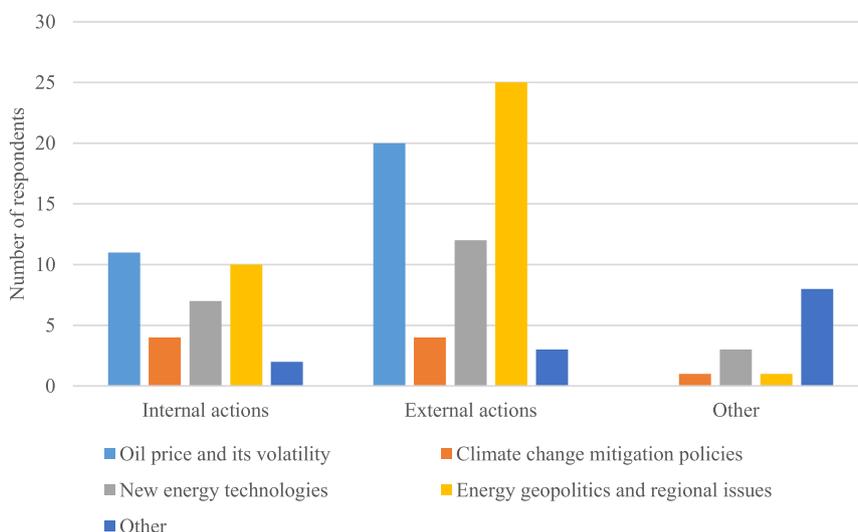


Fig. 3. Association between Q6 (Solutions to global energy challenges (aggregated)) and Q8 (Global energy system).

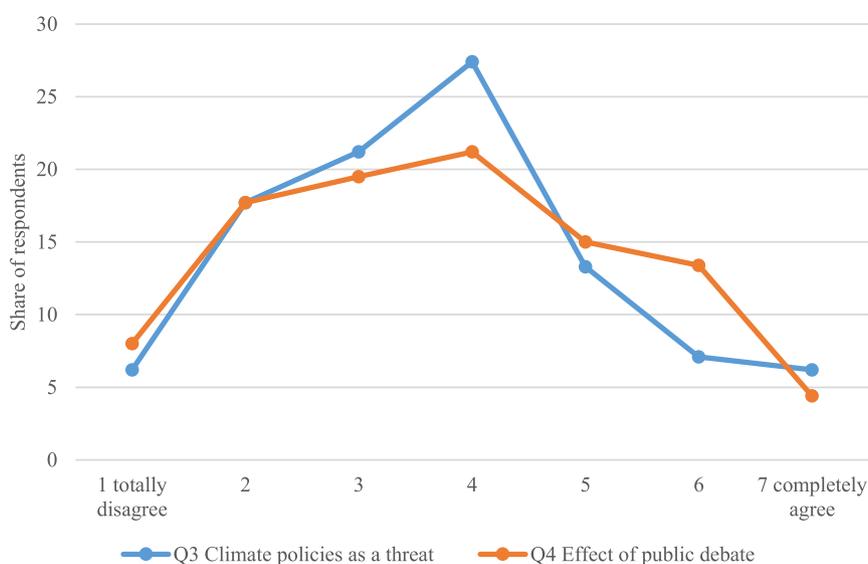


Fig. 4. The distribution of answers on Q3 (Climate policies as a threat) and Q4 (Effect of public debate).

visions may not necessarily determine the short- and mid-term choices of the companies. Therefore, the actual perception of climate change by oil and gas companies is vital for understanding whether the oil and gas industry is ready to contribute to the sustainable energy transition. In light of the above, we move on to the core part of our investigation.

3. Methods

3.1. Quantitative data collection

Our principal method in conducting this study was a structured questionnaire. This methodological choice was justified by the research question, which focuses on perceptions within the oil and gas industry. Since perceptions are neither directly measurable nor observable, the natural way to investigate them is to interrogate industry representatives directly.

Table 3
Differences in Q3 and Q4 between the categories of geography.^a Mean ranks (mean values).

	Central, Western, Southern, Northern Europe	Eastern Europe and Russia	Asia, Australia and Oceania	Middle East and Africa	America	
Q3 Climate policies as a threat	58.26 (3.76)	50.24 (3.39)	68.29 (4.29)	58.50 (3.71)	81.91 (5.09)	$n = 112, \chi^2(4) = 10.618, p = 0.031$
Q4 Effect of public debate	73.98 (4.62)	46.92 (3.29)	55.50 (3.67)	53.36 (3.57)	78.09 (4.91)	$n = 111, \chi^2(4) = 17.552, p = 0.002$

^a Kruskal-Wallis H test.

Table 4
Difference in Q3 and Q4 between the categories of Q5.^a Mean ranks (mean values).

	Proactive	Reactive	No action	
Q3 Climate policies as a threat	70.19 (4.42)	51.73 (3.53)	41.20 (3.00)	$n = 110, \chi^2(2) = 10.907, p = 0.004$
Q4 Effect of public debate	67.15 (4.39)	54.94 (3.73)	31.69 (2.56)	$n = 109, \chi^2(2) = 13.691, p = 0.001$

^a Kruskal-Wallis H test.

The questionnaire was distributed in a paper version in two languages (English and Russian) on a major international conference site dedicated to the challenges of the oil and gas industry development in the summer of 2019. The conference had 1100 attendees, from the oil and gas industry from 62 countries. We collected 116 questionnaire responses, which corresponds to 10.5% of the total number of the conference participants.

In order to increase the chance of completing the questionnaire by the respondents in the setting of a major event with a very tight programme, it needed to be concise and clear. Therefore, the questionnaire consisted of only 11 questions with multiple-choice answers. Two of the 11 questions targeted demographic data (affiliation and geographical distribution of respondents). The questionnaire was distributed randomly by the authors of this paper.

3.2. Data analysis

The answers were processed anonymously to digital form and then coded. Three of the received responses were considered unusable, resulting in 113 analysed responses. Eight responses had missing values (not more than one missing data point per respondent), which represents 5.6% of the dataset.

A summary of the main descriptive information and abbreviations of questions' formulations used in the text are presented in Table 2.

Most of the questions had the option "other" with a possibility to specify the answer. In the statistical analysis, we treated such answers as one category, while discussing them in detail qualitatively. Several respondents marked multiple alternatives on the questions where we asked them to identify what they considered to be the most important factor. Such answers were categorised as "other" for the statistical analysis.

Two of the questions are based on the 7-point Likert scale, providing ordinal data. We took the ordinal nature of these data into account by using Kruskal-Wallis H test for statistical testing, rather than ANOVA; however, we provided mean values for the ease of interpretation. The other questions provided nominal data; we used the one-sample Chi-Square test where eligible. For bivariate analysis, however, the usual Chi-Square Independence test was not appropriate, since the count in many cross-tabulation cells was lower than 5, due to the sample size and the nature of the questions. Fisher's exact test was used instead.

3.3. Limitations, reliability and validity

Questionnaires, like any other study design, are open to bias, such as self-selection bias and bias related to the level of expertise of the respondents. We aimed to minimise those biases by designing the study to be reliable, verifiable and triangulated. We applied combined research paradigms [30,31]. All the questions were formulated using secondary literature sources. The results were triangulated [32] to reach internal and external validity. Specifically, some questions (such as questions 5 and 7) were formulated in such a way as to verify the internal consistency of the answers. During the design process, the questionnaire went through two pre-studies, including 12 test-respondents. After the pre-studies, the necessary adjustments to the questions and the structure

of the questionnaire were made to ensure their consistency, accuracy and clarity.

Since the data for the study were collected during a major international event specifically aimed at issues related to the oil and gas industry future prospects and sustainable energy transition, we found the outcome empirically and analytically generalizable. There are some limitations in the data set. First, approximately half of the respondents come from one category – "Eastern Europe and Russia", which is explained by the geographical location of the event. Second, the distribution of the respondents' affiliation is not proportional: more than half are practitioners from the oil and gas sector, which is also explained by the nature of the event.

Initially, the question on the affiliation of the respondents included six categories: NOC, IOC (both with sub-categories of upstream, midstream, downstream, vertically integrated), public authorities, academia/research, student, and other. Since several categories had very few answers, we aggregated them into three larger categories, as presented in Table 2. The analysis showed that the answers to all of the other questions in the questionnaire were not associated with the affiliation of the respondents.

Despite the above limitations, we believe that results provide important insights and are of interest to the research community. Limitation concerns are believed to be met through diverse empirical context [24].

4. Results

4.1. Vision 2050 and factors of influence

The distribution of answers on Q1 *Vision 2050* is not surprising: the majority (54%) of the respondents state that by 2050 the oil and gas industry would dominate in some sectors and be negligible in the others, anticipating the change of the paradigm. However, about 20% of respondents visualised business as usual, with a strong presence in all the industry sectors. About a quarter of the respondents envisioned the industry would only be residually present, with strong diversification to other assets. A notable finding is the consensus that the oil and gas industry still plays a role in 2050 – none of the 113 respondents chose the "negligible presence" alternative.

It is hard to deny the significance of the oil and gas industry for the global energy system, at least in the medium term and despite the expectation that global oil demand will flatten out in the 2030s [1]. Our analysis of the outlooks also shows that nearly all of the oil and gas companies see a future where at least a half of the global energy mix is covered by oil and gas. The views expressed in the companies' visions and outlooks are highly consistent with the results of the questionnaire.

In the distribution of the answers to Q2 *Factors of strategic choices*, the primary observation is that 47.8% of respondents found "oil price and its volatility" to be the factor that has the strongest influence on the strategic choices of oil and gas companies. This is confirmed even further by the findings within the "other" category: eight respondents chose a combination of "oil price..." with another alternative. "Climate policies" was the least frequent answer (8%). Among the answers specified by the respondents themselves were "shareholder activism", "a vision of perspectives", and "new discoveries and technologies". Several respondents listed geopolitics, governmental policies, and taxation.

The bivariate analysis of Q1 and Q2 (Fig. 1) provides a statistically significant result ($F(8, n = 113) = 15.430, p = 0.037$). Notable findings were as follows: (1) none of those who saw that the oil and gas industry will be strongly present in 2050 considered climate policies as the most important factor affecting the strategic choices of the companies (not even in combination with other factors in the "other" category); (2) those who saw the industry as "dominant in some sectors, changing the paradigm" named the increasing competition from renewables as the strongest factor most frequently (15 times, out of 20 in total); (3) more than half (55.2%) of those who saw that the industry will only be

residually present in 2050 found the oil price and volatility to be the strongest factor, while for those who saw the industry will be strongly present or dominant in some sectors, this share was less than half (47.8% and 44.3% respectively).

The question regarding the factors that affect the strategic choices of oil and gas companies (Q2) corresponds with the question on factors affecting the global energy system (Q8). In Q8, "Oil price and its volatility" was also a frequent answer (29.2%), but it is marginally surpassed by "Energy geopolitics and regional issues" (31.9%). "Climate change mitigation policies" was the least frequent answer (8%) as in Q2. "New energy technologies" was named as the most important factor in 19.5% of the cases, but 10 respondents named this factor in combination with other factors.

We also asked about opinions regarding the main barrier to the sustainable energy transition (Q9 Barriers to energy transition). The answers were distributed evenly, with no clear consensus on the matter (the "other" category includes combinations of different alternatives, also without a clear pattern). One notable detail is that "overreliance on fossil fuels" was chosen 15 times by the respondents from Eastern Europe and Russia out of 18 times in total.

4.2. Climate change: current positions and potential solutions

More than half of the respondents (56.6%) characterised the position of oil and gas companies with respect to climate change (Q5) as "reactive (acting in response)", while 27.4% viewed oil and gas companies as being proactive. However, the analysis of the geographical distribution of answers ($F(8, n = 111) = 15.446, p = 0.026$) offers some notable observations (Fig. 2), although three categories are relatively small: (1) very few respondents in Central, Western, Southern, and Northern Europe saw no action from oil and gas companies with respect to climate change; (2) "proactive" was the most frequent answer in "America" and "Middle East and Africa".

A natural follow-up question is how, specifically, the companies can contribute to solving global energy challenges. Q6 (*Solutions to global energy challenges*) offered four alternatives. Two of them ("invest in more carbon-efficient technologies in the petroleum sector" and "support other mitigation measures and improve corporate social responsibility" respectively) assumed conservative actions within the "known terrain" for the oil and gas companies. The other two alternatives offered actions out of the scope of the customary oil and gas business: "diversify assets by investing in renewable energy technologies" and "support R&D related to sustainable technologies". An important observation is that the actions within the group of "known terrain" were chosen by less than a third of all respondents (30.1%), while more than a half chose the actions from the second group (56.6%). The "other" category includes several notable comments: "work with customers to change the nature of demand so that supply can be adapted", or more critical: "ignore but pursue their goals and care about the environment".

Fig. 3 aggregates the two groups into "internal actions" and "external actions" respectively, and depicts how the answers on Q6 are distributed across the categories of Q8 (*Global energy system*) ($\chi^2(16, n = 113) = 36.914, p = 0.002$). The pattern is noteworthy. Those that chose external actions to contribute to solving the global energy challenges viewed the oil price and its volatility and geopolitics as the most important factors even more often than those that were ready to contribute only by internal actions.

4.3. Climate policies as a threat, and the effect of public debate

Questions Q3 (*Climate policies as a threat*) and Q4 (*Effect of public debate*) were placed next to each other in the questionnaire, and both offered answers based on a Likert scale, even though they investigated principally different aspects. The distributions of the answers to these two questions are quite typically bell-shaped (Fig. 4).

However, the answers show a notable pattern related to the

geography of the respondents (Table 3). The significant difference in distributions is explained particularly by the difference between three categories: "America", "Eastern Europe and Russia", and "Central, Western, Southern, and Northern Europe". The respondents from Eastern Europe and Russia tended to perceive climate policies as a threat to the oil and gas industry to a significantly lower degree than the respondents from the other regions. The same applies to the effect of public debate on the strategic choices of oil and gas companies. In contrast, the respondents from America were significantly more inclined to see climate policies as a threat, and to agree that the public debate affects the choice of oil and gas companies more strongly than respondents from the other regions. The respondents from Central, Western, Southern and Northern Europe clearly differentiated between the two questions. On one hand, this group agreed with the respondents from America that the public debate on climate change strongly affects the choices of oil and gas companies. On the other hand, climate policies were not perceived as a threat – a response that is similar to that of the respondents from Eastern Europe and Russia.

We also explored whether the answers on Q1 (*Vision 2050*) are associated with Q3 or Q4. We obtained statistically significant results for Q4 (*Effect of public debate*): Kruskal-Wallis H test: $\chi^2(2, n = 111) = 8.193, p = 0.017$. The mean rank rose from 42.26 for "strong presence", 55.77 for "dominant in some sectors", to 67.79 for "residual presence" (mean values are 3.04, 3.70 and 4.39, respectively). This suggests a negative association between the perceived effect of public debate on the strategic choices of oil and gas companies and the vision of the role of the industry in the future. In other words, the respondents who are more perceptible to public debate on climate change are less optimistic about the development of the oil and gas industry in general, including its transformation towards more sustainability.

Q5 (*Position on climate change*) is also clearly associated with Q3 and Q4 (Table 4). In both cases, the mean rank rose from "no action" to "proactive". The pairwise comparison signifies two important observations. First, for Q3, there is no statistically significant difference in the answers between the "no action" and "reactive" categories of Q5, while the "proactive" category is significantly different from the other two. Without attempting to specify any causal relationship, we may highlight the pattern: the perception of climate policies as a threat to the business may be associated with a transition of oil and gas companies to a proactive position with respect to climate change. Second, for Q4, the "proactive" and "reactive" categories are not significantly different, while the "no action" category is significantly different from the other two. The pattern may be formulated as follows: the effect of public debate on climate change may be associated with a shift from a completely passive to an active (either pro- or re-) position with respect to climate change.

Statistical testing also provided significant evidence for the association between Q4 *Effect of public debate* and Q6 *Solutions of global energy challenges*: $\chi^2(3, n = 111) = 11.592, p = 0.021$. The analysis of this association supports the logic applied in Section 4.2, where we grouped potential contributions of oil and gas companies to the solutions of global energy challenges into "internal actions" and "external actions". There is no statistical difference in the distribution of answers on Q4 within these two groups of Q6, but such a difference does exist between the groups (mean ranks are 61.64 and 71.63 within the group "internal actions", and 43.38 and 50.91 within "external actions", respectively). This result suggests that those who rely on the actions within the scope of the customary business found the effect of public debate on climate change to be significantly more important than those who chose solutions related to renewables and R&D in sustainable technologies.

4.4. Effects on investments

Question Q7 (*Climate change risks and investment*) aimed to further explore the relationship between the perception of climate change and the actions of oil and gas companies in more specific terms of investment

decisions. The answers are distributed evenly among the offered alternatives, which can support the general idea that there is no dominating solution [4,33,34].

Investigating the distributions of the answers on Q3 (*Climate policies as a threat*) and Q4 (*Effect of public debate*) across the categories of Q7, we found statistical evidence for a significant association (Kruskal-Wallis H test: $n = 109$, $\chi^2(5) = 13.48$, $p = 0.019$ and $n = 108$, $\chi^2(5) = 16.767$, $p = 0.005$, respectively). The distributions generally follow each other. In both cases, “no effect” has the lowest rank and mean value (42.34 and 3.08 for Q3; 36.98 and 2.79 for Q4). This may be seen as evidence of the internal consistency of the survey results: if climate policies are not perceived as a threat and public debate on climate change does not affect strategic choices, then the climate change risks should not affect the investment decisions. The results also suggest that those who chose “postpone the investment decisions” (66.25 and 4.29) and “limit long-term investment” (63.55 and 4.21) found that public debate affects strategic decisions more than those who chose “speed up investment” (49.88 and 3.47) and “increase the required rate of return” (51.32 and 3.50).

Exploring the association between Q7 and Q5 (*Position on climate change*) ($F(10, n = 108) = 17.405$, $p = 0.046$), we found further evidence of the above-mentioned consistency: those who stated that climate change risks do not affect the investment decisions of oil and gas companies consistently specified the “no action” position with respect to climate change. Another interesting observation based on this association is that “limit long-term investment” is the most frequent answer among those who specified the proactive position with respect to climate change. Therefore, a stronger perceived effect of public debate might be associated with more careful investment strategies – companies decide to postpone investment decisions and limit long-term investment.

5. Discussion

One of the main discussion points regarding climate change these days is whether oil and gas companies are a part of the problem or they are a part of the solution [33]. The study shows that the oil and gas industry already recognises itself as part of the problem and acknowledges that significant changes are still to come. Moreover, the industry is ready to actively participate in the sustainable energy transition where there are many possibilities to that [4]. However, we found that aspects such as socio-political context, public involvement, outer pressures, social dialogue, clear and inclusive policy landscape, among others, need to be involved and carefully utilised to make this participation capable of facilitating sustainable energy transition.

Overall, the results of the quantitative part of the study are highly consistent with the outcomes of the qualitative analysis: oil and gas companies are attentive towards climate change. However, our investigation shows that the perceptions of climate change differ and the variation may be of a different nature. For example, we see a clear variation in the perceptions of climate policies as a threat to the oil and gas industry. In Eastern Europe and Russia, climate policies may not be perceived as a threat simply because such policies are not yet mature enough to be seriously affecting the activities of oil and gas companies [35]. In contrast, climate policies in America and the rest of Europe are much more developed and consistently applied so that the oil and gas business has to react and adjust. In America, however, climate policies are perceived as a threat to a much higher extent than in the rest of Europe. This may be dependent on the socio-political context in which companies operate [cf. 36]. Our quantitative analysis even shows that the perception of climate policies as a threat to the oil and gas industry may be associated with a transition of companies to a proactive position with respect to climate change. A deeper analysis of the socio-political context is beyond the scope of this paper; however, as some research has suggested, industry regimes are dependent on the context in which they unfold and are affected by the socio-political changes at macro- and

meso- levels [15].

The difference in perceptions between Central, Western, Southern, Northern Europe and America is even more remarkable when viewed in conjunction with the answers on whether public debate affects the strategic choices of the companies: in both regions, the perceived effect of public debate is high. Notably, despite a similar context (active general public, developed public policies, etc.), perceptions are different. While companies in America perceive climate policies as a threat to the status quo, the companies in Europe see them as a new objective reality to which they must adapt and find new ways to operate and be profitable. A further explanation may be the level of agreement on climate change issues in society in general, as well as readiness of the oil and gas companies for a social dialogue.

Public debate and social dialogue clearly stand out as powerful facilitators of recent transition efforts internationally [37–39]. The survey data suggest that public debate facilitates the oil and gas industry towards sustainability, where the results of the qualitative analysis witness the presence of these factors in oil and gas companies' strategic views. However, it is worth underlining that, in the survey under public debate, we mean the influence of external stakeholders, while the qualitative analysis shows that most of the companies' reports directly address internal stakeholders. The companies' relationships with the general public, or external stakeholders, are much less clear (though few companies associated public debate with their commercial value). Despite external stakeholders cannot directly affect companies' choices, growing public awareness shows their significant influence through different communication channels [cf. 28,40]. Therefore, the effect of public debate on oil and gas companies' strategies is a complex issue that requires further investigation. Our analysis shows that public debate may be regarded as a trigger for oil and gas companies to shift their positions from completely passive to active with respect to climate change. In addition, public debate is more critical for those that are not ready to contribute to the energy transition beyond the scope of the customary oil and gas business (for example, diversifying portfolio into renewables). There is also a possibility that extensive public debate may be a factor that restricts the transformation capacity of oil and gas companies and limits their ambitions for development, especially when accompanied by unclear regulations. The effect of public debate may be U-shaped (by analogy to Barnett and Salomon [41] and Cadez et al. [36]), where overwhelming external pressures produce contrary results.

The findings about respective strategies of the oil and gas companies do not fully correspond with the general hypothesis that incumbents tend to choose the established business practices instead of exploring new business opportunities [cf. 8,42]. The qualitative analysis in our study indicates that oil and gas companies, along with developing their core business, test other available sustainable pathways. Some companies undergo deeper structural changes, such as incorporating climate change mitigation results into employees' remuneration [43–45], and link sustainable development goals with their broader strategic business perspective. Moreover, some companies seek to initiate change and aim for climate and environmental leadership, which may provide them with a first-mover advantage in new market conditions [cf. 29].

While not all the oil and gas companies seem to be ready to take a proactive position in sustainability transitions, our findings suggest a different angle on what motivates incumbents to explore sustainable business opportunities. While some of the sustainability transitions literature argues that increasing pressures (specifically policies and taxes) should force incumbents to work for more radical business solutions and move towards sustainable options [8], our study does not provide clear evidence to support this idea. Rather, the results of our study suggest that overwhelming external pressures, including macro-economic conditions, produce a contrary effect on the companies' diversification potential and may limit their will to explore alternative technological paths, as also highlighted in [46]. The most visible example in this context is the oil price and its volatility, which is often underestimated as a crucial factor for the oil and gas companies to

transit [cf. 47]. It stood out as a key factor according to both our qualitative and quantitative study, and we also found some supporting evidence in other studies [15,48]. This may sound trivial, as external factors obviously shape the business environment and affect the investment opportunities in the customary domain – low and volatile oil prices undermine the financial stability in the oil and gas sector [49,50]; however, the factor of stable macroeconomic conditions should receive more attention in the context of energy transition, since oil and gas companies appear to be more eager to invest in sustainability, climate change mitigation and renewable energy sources in a stable macroeconomic environment. Our survey results show that a stable oil price is of even higher importance for the oil and gas companies, which actively diversify their business, invest in renewables and support sustainable technologies, than for those that operate in the customary domain. Destabilisation of incumbents and associated divestment is clearly not the most efficient strategy to facilitate sustainability transitions, as achieving SDGs obviously requires participation from all the parties involved.

6. Conclusions and implications

Sustainability transitions literature in general tends to “black-box” the transition capacity of oil and gas companies [e.g., 15], conceptualising the latter as resistant incumbents not capable of radical innovations [16]. Despite the urgency of climate change and the need to find viable and efficient solutions to the common challenge, such simplified conceptualisations of the oil and gas industry in sustainable energy transitions may be one of the reasons why current changes towards sustainability in the global energy system are not sufficient. This alarming tendency has been already highlighted in the recent literature [13,21], where our research provides empirical evidence for a more diverse picture on incumbents and calls for revising their role in sustainability transition processes. The belief that certain industries play a key role in society should also be treated with care [29]; nonetheless, it is clear that some of them do possess the capacity and resources to transit and even lead the change.

Climate change mitigation efforts have become increasingly consolidated worldwide and some oil and gas companies have already taken a step forward and initiated actions to mitigate climate change, the role of the oil and gas industry remains highly disputed. Meanwhile, policy- and vision-makers seem to provide weak incentives to the oil and gas industry to deeply engage in other transformative activities (diversification, new business models, etc. [3]). General unwillingness to acknowledge the transformation capacity and scepticism towards the climate initiatives declared by oil and gas companies hampers the industry in developing a unified agenda, with a joint understanding and a clear statement of their strategies and actions towards the sustainable energy transition. Currently, there is no visible shift from the “naming and shaming” approach [51], which limits the possibility of finding constructive solutions and may even limit the development of sustainable energy solutions [referring to 15]. As the present study has shown, even more efforts should be made to develop more inclusive and stable institutional frameworks.

Furthermore, a widely accepted approach to climate change mitigation is the reduction of internal GHG emissions from industrial processes (in accordance with the “polluter pays principle”). However, the oil and gas industry is special in this respect. Merely reducing the GHG footprint of oil and gas production and transportation (and often covering the relevant costs of the pollution) is not considered a sufficient contribution, even though evidence suggests that the upstream part of the natural gas value chain can be nearly emission-free under certain circumstances [e.g., 52]. Thus, the industry is confronted for the very product it creates, rather than the way it is created. Some researchers have already described this approach to change as one-sided [29] because the greening processes in the industry cannot be properly understood when looking just at one measurement parameter, but the

change seems to be under way both in research and policymaking.

The overall confusion around climate policies may visualise the still relevant dramatic lack of stable institutional environments and guidance along the sustainable energy transition journey [cf. 53]. This kind of policy mismanagement limits the “proactiveness” of incumbents and diminishes their transition efforts. Therefore, it is very important to keep oil and gas companies, as well as other incumbents, engaged in the sustainability transition process as society cannot afford ignorance or selective managerial approaches in climate change mitigation while facing a climate emergency.

Clearer regulation, coordination and dissemination are needed, specifically addressing the oil and gas industry with attention to geographical context. Even though the Paris Agreement and the Sustainable Development Goals of the United Nations [4] provided some clarity for the strategic choices of oil and gas companies (which is, for instance, expressed in the fact that no oil and gas company ignores climate change [25]), the present study shows that perceptions of the energy transition in the context of climate change among the companies are very different and have no clear consensus, despite the presence of a unified global agenda. At the same time, far more active change towards sustainability in Europe can be explained by more consistent and encompassing climate policies, which define a new business reality.

As our study is bound by certain limitations, there are some important directions for future theoretically oriented analysis that would be a great continuation of this research. Further studies may investigate in more detail the effects of external pressures on changes in socio-technical regimes and specifically incumbents' response strategies. We see the importance of looking at the potential role of incumbents in sustainability transitions as first-movers and innovators, as well as resource- and knowledge-holders.

With respect to the oil and gas companies in sustainable energy transitions, there are a few avenues for future research that we would like to highlight. With relation to public debate, it will be of importance to look in detail at how pressures asserted by internal stakeholders affect oil and gas companies' strategies. Another important direction to investigate in more detail is how country-level specifics and the socio-political context affect strategies and perceptions in the oil and gas industry. Finally, it is important to look at the current state of oil and gas greening strategies, and to verify their strategies to “confirmed” actions, which can, among other things, focus on establishing the weight of respective strategies and actions.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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