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Diversify or die: Strategy options for oil majors in the sustainable energy transition

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ABSTRACT

Mitigating climate change requires an urgent transition of the oil and gas industry. We develop two typologies of the corporate strategy and diversification options for international oil companies (IOCs) in the sustainable energy transition. Data from semi-structured interviews with oil industry professionals are thematically analysed and considered in the context of the wider literature. The resulting framework of corporate strategy options is more comprehensive than has been previously published. We find gaps in the companies' strategic readiness for the energy transition, especially in preparing for the ramp-down of the fossil fuel-based core business. Diversification options are evaluated in terms of the fit between different strategies and companies' capabilities. Many diversification options fit at least some of the existing capabilities of oil majors, but while there is potential for the companies to contribute positively to the energy transition, the current scale of change remains inadequate for meeting global climate goals. The strategic dilemma that the energy transition creates for IOCs is an essentially existential one. Future research should investigate whether IOCs can and should play an active part in the sustainable energy transition and how to drive the necessary action.

1. Introduction

Mitigating global greenhouse gas (GHG) emissions to meet the goals of the Paris Agreement requires a fundamental transition in the oil and gas (O&G) industry. O&G companies' own emissions need to decrease rapidly, but more significantly, the use of oil and gas in all sectors of the economy has to fall [1]. Global pathways that show decarbonisation is possible need to be translated into the real-life investment and operational decisions by businesses, as meeting globally-agreed climate targets is conditional on changes at the level of individual companies [2].

To understand how climate mitigation might play out in the global oil industry, we must look to the behaviour of firms and markets and their interaction with policy and wider society [3]. Here, the exploration of business strategy is especially useful, as it concerns the ways in which firms can position themselves in the market to thrive [4]. Identifying and describing plausible strategies for oil companies in the energy transition adds clarity around what actions can support future decarbonisation. Understanding the available transition pathways also shows how far international oil companies (IOCs) currently are from adopting a sustainable strategy.

To this end, both the academic and businesses communities have started mapping out possible ways for oil companies to bring their business models in line with the goals of the Paris Agreement. This paper explores what strategic options there are for oil companies in the energy transition. It creates a more comprehensive typology of options than currently exists in published literature, through the following objectives:

1. Identify and describe corporate strategy and diversification options for IOCs over the course of the sustainable energy transition
2. Understand the views of oil and gas professionals on the business potential of the identified strategies for IOCs during the energy transition
3. Critically examine the views expressed by the professionals in the context of the energy transition literature

Although the focus is primarily on strategic options for IOCs, the results are also informative regarding national oil companies (NOCs) and related industries.

This study differs from previously published frameworks of O&G industry transition strategies in three ways. Firstly, the analysis builds

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on in-depth interviews with professionals from the oil and gas industry, which brings a novel angle to the topic often studied through document analysis alone. Secondly, this paper takes a step back from the starting point of other research by considering the full range of strategic options, not only O&G companies' transformation into integrated energy companies through investment in renewables, which is the only strategy included in most studies. Thirdly, the study examines in more detail specific energy-related diversification options and their relevance for IOCs.

This study focusses on oil and gas production and the energy transition away from both fossil fuels. Researching a strategic shift from oil and gas production to natural gas as a stand-alone business is out of scope. This is because we do not consider a business strategy focused on natural gas to be aligned with the goals of the Paris Agreement in the long run [5].

The rest of the paper is structured as follows. Section 2 presents background literature on business strategy, business in the energy transition, and the oil industry in the energy transition. Section 3 explains the methods. In Section 4, the results of the interview study are presented and discussed in the context of relevant literature. Section 5 concludes.

2. Background

The conceptual basis for this study is the business management literature on strategy, competitive advantage, and diversification. This section introduces key concepts from this literature, combined with insights from the technology-transitions literature, which focusses on the role and future of the oil industry in the energy transition. We present previous studies on the possible future business models of oil companies in the energy transition to highlight the research gap this study addresses.

2.1. Strategy and the evaluation of strategic options

Business strategy is defined as 'the set of goal-directed actions a firm takes to gain and sustain superior performance relative to competitors' [6] (p.38). Generally, such actions aim to establish and maintain competitive advantage, which is a capability or circumstance of a firm that leads to superior performance compared to other firms in the same industry [4]. There are two high-level approaches to evaluating a company's options to secure competitive advantage: external and internal analysis [6] (p. 66).

External analysis starts from the operating environment of the firm. One example of a classic framework for this is Porter's Five Forces [7], which conceptualise the competitive landscape of a business in terms of existing competition, potential new entrants, potential substitutes for the industry's products, and the bargaining power of customers and suppliers.

Internal analysis focusses instead on the characteristics of a specific firm as determinants of competitive advantage. One conceptual framework that can be used for this type of analysis is the resource-based view of the firm, in which a firm is seen as a collection of tangible and intangible assets, and advantage is determined by the firm's access to resources which are specific to it and cannot be easily copied by competitors [8]. Blondeel and Bradshaw [3] propose the use of this framework, among others, to provide new insight in future studies of the oil industry in the energy transition.

2.2. Business in the energy transition

Sustainability transitions are significant changes in socio-technical systems towards closer alignment with sustainability goals [9]. Businesses can play many roles in sustainability transitions, such as the development of new products, business models, and industries [10,11]. Especially incumbent industries, which stand to lose in the transition, can also actively hinder transitions [12,13]. Most research on business in the sustainability and energy transitions focusses on the development of new business and innovations rather than changes required of the existing industries, although there are exceptions (see e.g. [14–16]).

The theoretical background for this study builds on the concepts of transition strategy, diversification, and divestment. Transition strategy, which has become a growing field of academic study, refers to the strategic plans and activities companies undertake to anticipate and respond to a transition [17–19]. Diversification is a strategy by which companies seek new growth opportunities or, more relevant in transition studies, build resilience in a changing business environment by entering business areas outside their core business [20,21]. Divestment as a response to transition pressures has arisen primarily as a strategy for investors to decrease their exposure to the risk of stranded assets and reputational damage [22], but is also becoming relevant for companies that may want to remove e.g. highly polluting fossil fuel production assets from their balance sheet [23].

2.3. International oil companies in the energy transition

The oil industry contributes significantly to global warming [1]. The largest part of the industry's emissions are the 'Scope 3' emissions from the use of sold products [24], which account for 70–90 % of the industry's lifecycle emissions [25].

The industry, especially IOCs, have in recent years begun to acknowledge their contribution to climate change and address this through renewable energy investment [26,27] (even though 2023 saw major oil companies reduce their climate ambition in favour of more investment into fossil fuels [119]). Nearly all oil majors explicitly include climate and emission goals in their strategies [28]. However, a multi-method study of decarbonisation in the oil sector found no evidence that oil majors had engaged in meaningful decarbonisation – at best, they have been 'hedging' by slightly diversifying their business models [29]. Oil companies have also been found to obstruct the transition through e.g. greenwashing and using strategic communication to block and delay transition measures [30–35,120].

Existing literature describes several classifications of oil industry business models in the energy transition. The early examples of academic assessments of oil companies' strategic response to climate change are from the beginning of the 2000s [36,37]. Blondeel and Bradshaw [3] present the 'Transition Strategy Continuum', distinguishing between companies that: i) prioritise their core business (fossil fuels), ii) become integrated energy companies, or iii) carry out a radical transformation and abandon fossil fuels altogether. Somewhat similarly, Green et al. [29] evaluate the business behaviours of oil companies in the energy transition as 'business as usual' or 'disruption' based on the amounts of investment in fossil fuels and 'other' business. Other authors have analysed the extent of oil companies' renewable investment [26,38], while Hartmann et al. [39] focus on O&G companies' 'management commitment to renewable energy' as a key driver of engagement in the energy transition. Most studies in the recent academic literature classify companies based on the extent to which they focus their business activities away from fossil fuels, implicitly assuming that the appropriate strategy for oil companies in the energy transition is to expand into other forms of energy, especially renewables.

Strategy frameworks for O&G companies in the energy transition also appear outside of academic literature. The International Energy Agency (IEA) classification differentiates between actions that reduce emissions from O&G operations and diversification into carbon capture and storage (CCS), low-carbon fuels, or other types of energy [40]. Conversely, Caldecott et al. [28] do not include emission reductions as a strategic option, but instead consider the high-level options of diversification and being either the 'first one out' or the 'last man standing' in the upstream oil market. Faria et al. [41] consider similar high-level options: diversification into other forms of energy and carbon management, the pursuit of a new direction, or managed decline of the oil

business.

2.4. Strategic fit of diversification options for oil companies

The strategic fit of different diversification routes with oil companies' existing business models has received little attention. Investing in renewables is the strategy on which at least some data are available, for example the successful transformation of the Denmark's DONG Energy into the wind energy company Ørsted [40]. The company is not directly comparable to IOCs, however, as it was smaller, majority controlled by the Danish government, and already a 'first mover' [42] in wind energy before the transition [43]. Another real-life example is the investment into solar energy by BP, Shell, and Total in the early 2000s [44]. BP and Shell divested their solar units in the 2010s following the loss of market share to specialised solar companies [26,44,45], while Total continued investment despite growing competition [46]. Pinkse and van de Buuse [44] theorise that Total's success was based on integrating the new business closely enough with the core operations. Davis [47] argues that the main challenge O&G companies face when attempting to integrate renewables into their portfolio is the general absence of complementarity between new renewable investments and their existing business.

Zhong and Bazilian [48] evaluate oil company investments into solar, wind, and biofuels based on how tightly the new investments are integrated into the companies' operations and the extent to which the investments actively diversify the companies' operations outside fossil fuels. The most transformative of the resulting categories is 'integrating oil and gas competencies into producing renewable energy', concerning situations in which renewable energy production benefits from and thrives using the capabilities that already exist in the oil companies. This idea of finding ways in which the transition strategies of oil companies might be a good fit for what they already know, and for oil companies to have competitive advantage in their potential new business areas, is a key motivation for the questions asked in this study.

2.5. Summary

The main findings from this literature review are that:

- Strategic options can be evaluated either outside-in (focus on market characteristics) or inside-out (focus on firm characteristics). For inside-out evaluations, the desirability of a strategic opportunity can be approached through the fit with a firm's existing capabilities and assets.
- Literature on business models in the energy transition tends to focus on new entrants and innovations rather than incumbents.
- International oil companies have made business decisions that respond to the energy transition. However, the scale of these changes remains negligible.
- Several frameworks in the literature assess the strength of the oil industry's strategic response to climate change. The classifications tend to focus on the extent to which oil companies have invested in renewable energy. This study draws on these sources to provide a more comprehensive typology than any of them in isolation.

3. Methods

The main method of data collection in this study was semi-structured interviews with current and past oil industry employees. The purpose of the interviews was twofold: to evaluate whether the views of professionals with direct experience of the oil industry match those expressed in literature, and to generate new insights about the strategic options of oil companies in the energy transition.

The research uses both deductive and inductive reasoning [49] (pp. 9–10). Purposive sampling of a homogenous group [50] (pp. 321–322) was used to recruit interview participants by extending invitations to a wide group meeting the participation criteria. Following a 'snowball' approach [50] (p. 323), further participants were recruited after being identified by previous interviewees.

Interviews were conducted with 12 participants in person and via online video conference between July 2021 and January 2022. Eight participants worked for IOCs at the time of the interviews, while two had left the oil industry due to retirement and two because of career changes. All participants worked or had worked in roles directly related to the energy transition, such as transition strategy, corporate sustainability, the development of sustainable technology within IOCs, or senior leadership roles with a significant sustainability component. The interviewees comprise of employees of seven different oil companies, four of which are headquartered in Europe and three outside of Europe. The interviews lasted between 25 and 56 min (median length 35 min), and the discussion covered areas related to IOC strategy in the energy transition as well as the position of IOCs in the energy transition more broadly. These interviews also covered discourse around climate change, which has been analysed in a separate paper [90]. All interviews were held on the condition of anonymity, so the names of participants or the companies they work or worked for cannot be disclosed on ethical grounds. Although the sample size is small, it is nonetheless considered appropriate for gaining an in-depth of understanding of the experts' views and reasoning, particularly as the interviewees related specifically to the sustainability functions within the IOCs [51].

Each interview was guided by a list of key questions and themes. The structure of the interviews was flexible, allowing participants to focus on the strategies and other themes they judged to be the most relevant. The interviews were recorded and transcribed except in the case of one participant who did not consent to recording. In this case, detailed interview notes were taken. To minimise interviewer bias, all participants had the opportunity to review and amend their own interview transcripts and shorter summaries of them written by the authors [52].

Thematic analysis of interview transcripts [50] (pp. 651–652) was carried out using the computer-assisted qualitative data analysis software NVivo [53]. The data were coded to strategy-related themes. The coding process resulted in a hierarchical mapping of the business model and strategy related concepts that emerged in the interviews, shown in Fig. 1.

The interview data were combined with the literature discussed in Section 2 to develop novel frameworks that illustrate the business options faced by oil companies in the energy transition. The frameworks were constructed by structuring the information interviewees gave on different strategic options, and their opinions on the strategic fit of different options for IOCs. The framework of high-level strategy options (Fig. 2) differentiates between activities relating to 'melioration' and 'transition', using language from Green et al. [29] which is consistent with many other studies of oil industry behaviour in the energy transition as discussed in Section 2. The second axis differentiating between oil business and other business was developed in the process of coding and structuring the output of the interviews. The frameworks of diversification options (Figs. 3 and 4) focus on a resource-based view of the firm and the theory of competitive advantage [4]. The axes used in Fig. 3 are the skills and infrastructure existing in the companies, as these themes were strongly present across the interviews and enabled the division of the activities into categories based on the views of the participants.

Throughout the analysis, academic sources were used to evaluate the claims of the interviewees. The sizes of potential emission reductions for Melioration strategies (Table 1) were calculated using literature sources. As the emission reduction potential depends on uncertain factors such as the future of oil demand, the details of the types of oil supplied globally, and production methods used, the purpose of these calculations is to give a high-level estimate rather than a single accurate number. Emission reduction potential of Melioration strategies was calculated under the assumption of business-as-usual oil demand for the year 2050 from the IEA's Net Zero by 2050 and Stated Policies scenarios [54] using figures on oil supply chain emissions from the IEA [25], the emission

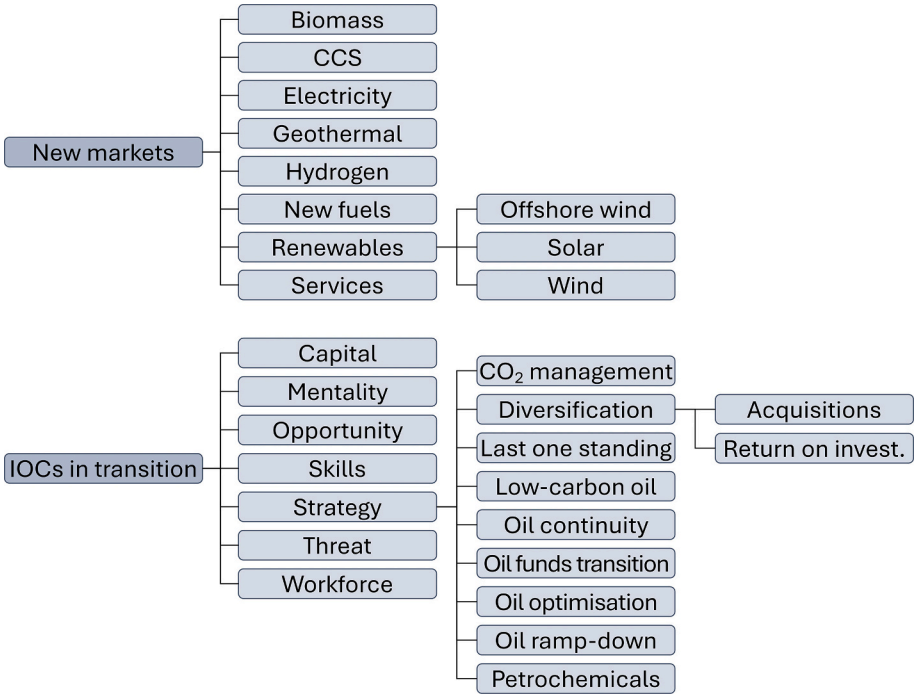

Fig. 1. Categorisation of the business-related themes that emerged from coding interview transcripts.

Table 1
Literature estimates for the potential size of IOC strategy opportunities in oil business melioration under the IEA's Net Zero by 2050 (NZ) and Stated Policies (SP) scenarios.

Strategy	Emission reduction potential ($GtCO_2$-eq/year)	Background	Source
Low-carbon oil	0.55 (NZ) to 1.86 (SP)	The average indirect (scope 1 and 2) emissions of oil are 95 $kgCO_2$-eq/boe. The corresponding emissions for the lowest-emission 10 % of oil are 45 kg CO_2-eq/boe. Emissions from the use of oil for energy account for 70–90 % of the lifecycle emissions of oil.	[25]
Portfolio optimisation	0.55 (NZ) to 1.86 (SP)	Switching the highest-emission heavy oil for other types of oil would reduce the median lifecycle emissions of oil by 50 $kgCO_2$/bbl. Switching to lower-carbon oil could reduce 10–50 gigatonnes of CO_2eq cumulatively in 2018–2050.	[55]
Offsets	10	An ambitious estimate for the emission-reducing potential of nature-based solutions (NBS) is 10–20 Gt/year of CO_2. Relying on this strategy to offset oil emissions would require most or all of NBS globally to be used on offsetting oil.	[60]
Total oil emissions	> 13	Global CO_2 emissions from oil combustion 2021 were 10.8 Gt in 2021. The most recent figure for oil industry supply chain CO_2 emissions is 2.86 Gt in 2017.	[25,54]

reduction potential of using lower-emission oil from Brandt et al. [55], and conversion factors for the energy content of oil barrels from Staffell [56].

3.1. Limitations

An important limitation of this study is that it does not differentiate between IOCs, even though they vary in their asset breakdowns, management styles, and shareholder and regulatory pressures. Subsequent studies could account for these differences, which do not impact the high-level strategy frameworks, but may explain why different companies follow different transition approaches. It would also be instructive to carry out external strategy evaluation to complement this internal study, looking at the different diversification options in terms of how attractive specific markets would be rather than focussing on companies' internal characteristics. To expand upon this study, it would also be insightful to work with a larger set of interviewees, and other methods such as quantitative economic analysis and case studies.

A second limitation is the limited number of interview participants and a relative lack of different perspectives. All interviewees were selected on the basis of their experience of the oil industry and the energy transition. Including responses from people working in different parts of oil companies or adjacent fields outside of O&G could lead to different answers. The results of this study give a particular interpretation of the business possibilities – focused on the internal dynamics of oil companies with a strong energy transition lens – which is appropriate given the focus on options that are viable in a Paris-aligned world. The results presented here act as a useful starting point for future enquiries while leaving several angles open for exploration.

Thirdly, the research in this chapter combines information from different literature sources with the perspectives of the interviewee participants. It is highly likely that some of these sources use different definitions for specific strategies and cannot be mapped one-to-one, even though we have tried to be as consistent as possible when combining sources. Furthermore, the very concept of 'strategy' is not well defined, especially when it comes to drawing boundaries between different types of strategies and deciding what actions are needed for a company to be pursuing a specific strategy. These factors add to the

vagueness of the results, but we hope that they still serve as a useful starting point for the analysis and evaluation of IOC transition strategies.

Finally, this study takes as its starting point the perspective of business management research, thus exploring the possibility that business action by IOCs is a viable solution to the climate emergency. The views expressed by interview participants are influenced by the narratives put forth by oil companies, which are often constructed to delay the transition through e.g. greenwashing, techno-optimism, and avoidance of responsibility. Significant strands of the sustainability scholarship argue instead that a transition is only possible by moving power away from incumbent industries such as oil and gas, and that to focus on more business-driven transition perspectives delays and distracts from this urgent project. From this perspective, the value of the present research changes: by clearly laying out the options IOCs themselves believe they have in a business-led transition, we show the magnitude of changes that would be required, which can be interpreted as evidence of the unrealistic nature of assuming a positive leadership role for IOCs in the sustainability transition.

4. Results

This section first presents an overview of the business activities interview participants described when asked about the future of oil companies in a decarbonising world. This is followed by a deeper dive into the strategic option of diversification, which was most frequently identified by interviewees. Finally, we discuss the general themes arising from the interviews concerning the role and prospects of IOCs in the energy transition.

Illustrative quotes from the interviews are included (in italics). To maintain anonymity, these quotes are not attributed. The purpose of the quotes is not to show consensus or rank the strategies relative to each other, but simply to broaden the understanding of the strategies and include a range of viewpoints. References to the wider literature are used to contextualise the views of the participants.

4.1. High-level strategy options

When asked about the future of the oil industry in the energy transition, interview participants brought up business activities ranging from incremental sustainability improvements to the current business model to large strategic shifts that would change the nature of the IOCs. To give structure to these strategic actions, Fig. 2 divides them based on whether the aim is Melioration, which means making incremental changes that work in a 'business as usual' world, or Transition, which includes strategies that can redefine the direction of a company or business area in a world undergoing a sustainable energy transition [29]. The vertical axis divides strategies based on whether they set the direction for the core oil business of the IOCs (bottom half) or for an IOC business area outside of oil-related activities. The framework builds on the interviews as well as a number of published strategy frameworks [3,26,28,29,40,41], but is more comprehensive and detailed than any of them. Showing all different strategy options in one place demonstrates how limited the IOCs' options are and enables an assessment of how aligned individual companies' green strategy initiatives are with a full-scale energy transition. The options represent the space of actions available to IOCs as responses to the sustainability transition and can co-exist and be combined in different ways.

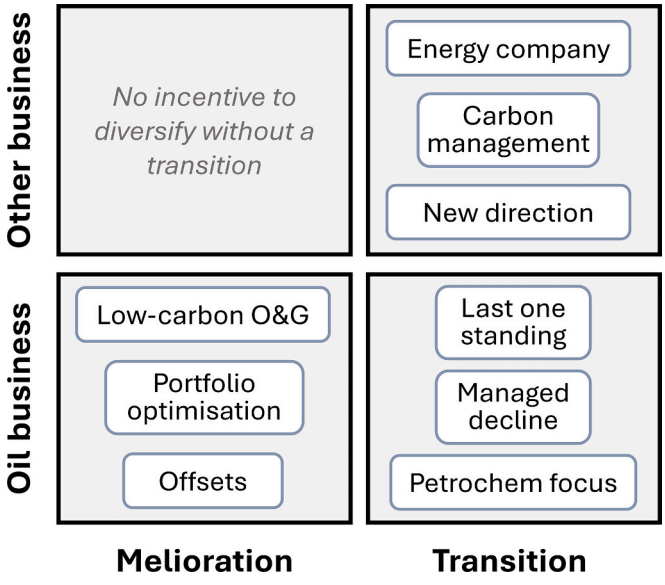

Fig. 2. High-level strategy options for international oil companies in the energy transition. The framework is based on expert interviews and literature. The options are categorised along the dimensions of how significant the change is from business as usual (Melioration/Transition) and how related to the core business (oil business/other business).

The Melioration activities focus on incremental sustainability improvements within current business models. These can result in some relatively fast emission reductions, but do little or nothing to the IOCs' main source of greenhouse gases (the Scope 3 emissions from burning the oil and gas they sell). These emissions can only be reduced through structural changes to the way energy is produced and used in society.

The Transition activities in the right half of Fig. 2 correspond to strategic decisions that would make sense in a world undergoing a large-scale energy transition away from a fossil fuel-based system. Such a transition will not simply result from the actions of any one company, but companies can contribute to creating the conditions for a transition by partaking in activities that support it, e.g. the development of the required infrastructure [17]. The business activities in the transition half of the matrix show what today's IOCs could look like in the future, although there are large differences between the options.

4.1.1. Melioration of the oil business

Melioration of oil business refers to activities that improve the sustainability of the IOCs' core business. 'Low-carbon O&G' refers to activities that reduce the direct greenhouse gas emissions from oil and gas production, such as reducing methane leakage and using renewable energy for oil extraction. 'Portfolio optimisation' means buying and selling production assets so that the average emissions produced by a company's assets decrease. It differs from 'low carbon O&G' because it includes decarbonisation through removing assets from a company's portfolio rather than making physical changes that would result in real-world decarbonisation. 'Offsets' encompass all ways of compensating for a company's emissions through reducing emissions or removing greenhouse gases elsewhere.

Reducing scope 1 and 2 emissions, which refer to the direct emissions created by a company's activities and energy consumption [24], was the first action mentioned in most interviews. The consensus seemed to be that aiming for 'low-carbon O&G' [40] in this way is not a strategic choice, but a necessity for IOCs under increasing scrutiny over their environmental impacts: '*Cleaning up our own operations [...] goes without saying, it's like a compliance issue.*'

'Portfolio optimisation' was discussed as a way of sustaining production activity in a transitioning and volatile world. This option entails strategically choosing what kind of production assets to own and invest in based on carbon intensity and profitability, and divesting less desirable assets: '*Instead of developing new assets, oil companies will probably focus on existing small fields near producing assets – there is still plenty of money to be made from those. There will be less development drilling, more in-field drilling to keep oil flowing in existing assets.*' The strategy can be motivated by carbon emissions, aiming to '*move away from tar sands and heavy oils that are more energy intensive to extract and refine, and having the entire upstream business line be less carbon intensive.*' Financial motivation

is likely to be an important driver: '*Companies are likely to become more careful about investments and reduce break-even prices to be resilient under any price scenario.*' This strategy can potentially reduce a company's emissions across all scopes, although the divested assets will continue emitting under new ownership.

The 'offsets' category includes the use of nature-based solutions such as tree-planting, contributions to projects that reduce greenhouse gas emissions, or the use of carbon capture and storage (CCS) technologies as a way of reducing the net impact of a company. CCS came up more often as ways of diversifying business in the energy transition and are discussed further below. Offsetting was viewed somewhat sceptically by some participants: '*some offsetting solutions are just smoke and mirrors*'. A major reason is that it is difficult to justify a way of allocating offsets between companies and industries – '*aspects of the strategy could be questioned, such as whether the company is claiming a larger share of nature-based solutions than it is entitled to*'. Most participants said that offsets should be viewed as '*the last resort*' on the road to net-zero emissions, but also said that oil companies are likely to require them: '*offsetting will remain a part of portfolio, although there will be challenges to it.*'

Overall, the emission reductions available through these strategies are limited. Accepting them as viable stand-alone strategies relies on oil demand staying at its current level or increasing, even though many across academia and industry believe that oil demand will peak in the next few decades [1,57].

Estimates for the potential size of the emission reduction opportunities, based on literature, are presented in Table 1. To obtain a range of potential values, the calculations for 'low-carbon oil' and 'portfolio optimisation' are carried out under the assumptions of both ambitious demand reduction from the IEA's Net Zero Emissions by 2050 scenario and business-as-usual oil demand from the IEA's Stated Policies scenario.

'Low-carbon oil' and 'portfolio optimisation' target the same operational emissions, so the maximum reduction across both options is 1.86 Gt. Reaching the full potential of the 'offsets' category requires all global nature-based offsetting to be used for oil emissions, which is a highly unlikely an undesirable scenario, since actual emission reductions are preferable to offsetting [58], and some offsetting is likely to be required for other hard-to-abate sectors such as agriculture and heavy industry [59].

The only strategy that can come close to accounting for most of the oil industry's emissions is 'offsets', but it is unlikely be available to the oil industry at the required scale.

4.1.2. Transition of the oil business

Under the assumption of a large-scale energy transition away from fossil fuels, business as usual is not a tenable long-term strategy for IOCs. If oil demand shrinks – which is a controversial projection despite its importance for successful climate change mitigation [1] – there will be new kind of competition in the market. This view was shared by the interview participants, although many also believed that such a shift in the market is still several decades away.

'Last one standing' refers to a strategy of responding to overall market decline by growing market share to capture more of the profits and outcompeting rivals through economies of scale [28]. This does not necessarily mean that the company needs to be the last one in the market, but that it aims to outcompete rivals as success becomes more difficult: '*Someone needs to be the last man standing, because society will not have moved fully beyond fossil fuels even in one lifetime.*' Most interview participants who discussed this strategy shared the view that in the long term, this approach is more likely to work for NOCs who have access to large low-cost reserves: '*The last barrel of oil that is ever extracted from the Earth is likely to come from a national oil company.*' One interviewee disagreed with this view, however: *'The quality and low production costs of the assets of some IOCs mean that they can be the last man standing.*'

The second strategy is 'managed decline' [28,41,61]: the activity of purposely ramping down the oil (and gas) activities of an IOC and either returning the freed capital to shareholders or investing in other business activities. For example: '*We've seen some companies make the call not to explore any longer. I think that's tremendously bold and shows a lot of confidence and leadership.*' Although some outside the industry consider this the best option from the perspective of investors [62], most interview participants either did not engage with this option or considered it unrealistic, as the idea of ramping down one's core business goes against what are considered the basic principles of business management. '*It isn't really something people talk about, to be honest. I don't think that they're really looking at ramping it down.* [...] *They'll ramp it down kind of in line with what the government says that they have to and no more.*'

'Petrochemical focus' is included here for completeness because of its presence in public discussion as a potential strategy in a transitioning world [63]. Some interviewees pointed out that even if oil demand for energy uses decreases, petrochemicals can offer the industry a lifeline as '*there are hydrocarbon-based products that we would struggle to replace with renewables – things like plastics and asphalt*' and '*petrochemicals are likely to grow, especially in Asia*'. Petrochemicals are forecasted to drive most of the global oil demand growth, so this strategy can work to some extent; however, it is unlikely that increase in global demand for plastics and other petrochemicals would be large enough to offset the oil demand decrease that would result from bringing energy emissions in line with global climate goals [64].

There is a lot of uncertainty around IOCs' strategic choices regarding the oil business in the energy transition. Despite the urgency of climate change mitigation, the general belief in the oil industry (as described by the interviewees) is that planning for significant reductions in oil demand is not urgent, as there is still consistent and high demand for their products. This fact is concerning, because if global oil demand does not begin to decrease, global warming will quickly reach a dangerous level [65]. Continuing 'business as usual' in fossil fuel production is incompatible with climate change mitigation, so any oil company that believes in the energy transition must prepare to follow at least one of the strategies in this quadrant.

These strategies do not support business-as-usual continuation of oil demand, and therefore imply reductions in the overall business activity of the oil industry unless accompanied by new business development in other areas. Petrochemicals demand was nearly 15 million barrels per day (mbd) in 2021 (15 % of global demand) and expected to grow by up to 3 mbd by 2050 [64]. This would support <20 % of today's oil production. Both 'last one standing' and 'managed decline' can support any oil demand scenario, but both imply an overall shrinking of the oil market.

4.1.3. Melioration through other business

The top-left quadrant of Fig. 2 is purposely empty. The current business model of IOCs is profitable, and there is robust demand for their products, so there is no reason for the companies to diversify into other business unless they believe in and want to be part of an energy transition.

4.1.4. Transition through other business

The final quadrant includes business models raised by participants as options for diversifying IOCs' business into new fields.

The most often mentioned strategy is transitioning into a broader 'energy company' [26,28,40,41], which means expanding and refocusing a company's business scope from fossil fuels to energy more generally: '*We will see oil and gas companies moving to be more integrated energy companies.*' This strategy is also included in the public communications of many IOCs, such as Shell's declared aim to become the world's largest electricity company [66]. IOCs taking action towards this business model often act through acquisitions and partnerships. The interviewees consider the success potential of this strategy to vary depending on the type of energy as well as the characteristics of oil companies. As one less enthusiastic participant remarked, '*The big question, and I would say sort of the continental divide [between the US and Europe], is that, do oil and gas companies have a place in renewables?*' Different energy technologies that

could provide avenues for diversification are discussed in more detail in section 4.2.

Transitioning to a 'carbon management' company is about diversifying into providing services in greenhouse gas emission management which go beyond offsetting the company's own emissions [41]. Tools used for this could include carbon capture, storage and utilization (CCUS) technologies, direct air capture (DAC), or the creation and management of different carbon markets. Oil companies '*could use their technical expertise to do things like CCUS and effectively be a service provider to for example the cement industry*' with one participant saying that '*managing CO_2 [carbon dioxide] and going into new partnership arrangements as either an off-taker or a supplier of CO_2 for carbon and climate solutions is a unique opportunity*'.

This strategy usually assumes a that a market for carbon management services is created through changes in policy, for example by having a high price for unabated carbon emissions or setting quotas on emissions by different actors. '*We're keen to invest in carbon removal technologies like direct air capture, H_2 [hydrogen] based removal solutions, or biogenic CO_2 with storage. But the kind of policy framework isn't there to encourage that today.*' Many modelled climate mitigation pathways rely on a high level of CCS [67,68], so it is possible that new policies promoting the technology will be introduced to make this business model more attractive. Interviewees considered CCS investment to be a '*bold bet*', since '*currently, our carbon utilization is not priced*'.

'New direction' includes diversification into unrelated business areas, as in principle there is no limit to where IOCs could choose to expand with their capital [41]. In practice, it may be difficult to find businesses that have strong synergies with the current business and capabilities. IOCs have made acquisitions outside of energy for example in the 1980s, but these have been small side activities rather than anything comparable to their core business [69].

Quantifying the size of the opportunities in this quadrant remains a topic for further research. The potential of different diversification options is discussed qualitatively below.

4.2. Diversification options

Fig. 3 summarises all energy-related diversification areas mentioned in the interviews and in relevant literature [26,38,40,48,70,71]. The views of the interviewed experts and the literature were used to divide strategies on two axes: the similarity of the technical skills they require to those that IOCs have developed in their core business, and the similarity of the required infrastructure to that already owned by IOCs. Treating all IOCs as a homogenous group is an over-simplification, but one that was necessary to protect the anonymity of the interviewees and the companies they represent and reflects this work's position as an initial analysis of the area.

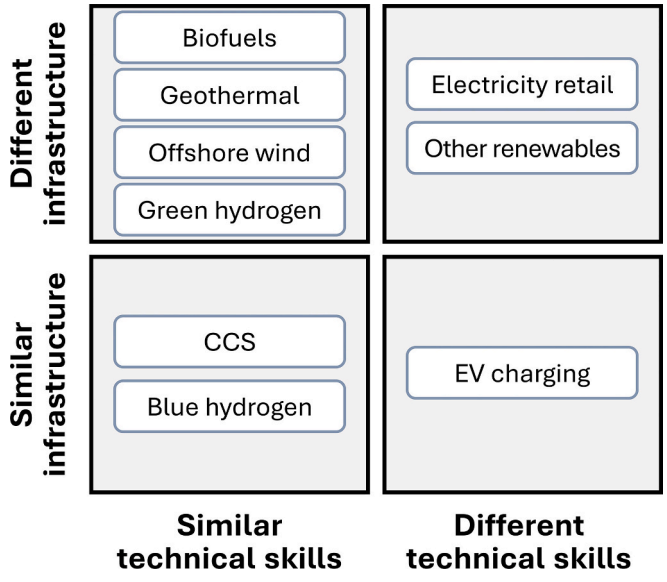

Fig. 3. Diversification strategies for IOCs in the energy transition. The framework is based on expert interviews. The strategies are grouped by the similarity of the technical skills and infrastructure they require to those used by IOCs in their core business.

This division of activities considers the desirability of different business areas from the perspective of oil companies and does not account for the market characteristics associated with different technologies (such as the level of competition or the relative profitability of different markets). In other words, this strategy analysis is internal rather than external [6] (p. 66). External analysis is touched upon below where interviewees made specific comments about e.g. the competitiveness of certain markets, but a more detailed analysis is outside the scope of this study and a potential area for future enquiry.

4.2.1. Similar skills, similar infrastructure

This category includes the activities that appear to be the best fit for oil companies, as they rely on competencies and assets that many IOCs already possess.

CCS technology was mentioned by far the most frequently in the interviews as a good fit for oil industry skills: '*CCS brings together all the skills: integration, engineering, subsurface.*' The theoretical possibility of storing captured CO_2 in depleted oil and gas fields also provides a strong fit with existing assets: '*a lot of what that entails is what we already do as far as subsurface characterization, drilling and monitoring wells*'. One interviewee asked: '*Which other industry is going to have the capability to build CCS and deploy at scale?*'

Despite this, the scale of global CCS uptake remains small [72]. Most existing projects are related to enhanced oil recovery, which often creates more emissions in scope 3 than it saves in the form of captured carbon [73]. While there are commercial-scale CCS projects underway [74], historically, most planned CCS projects have been cancelled or delayed indefinitely due to uncertain revenues and the lack of policy incentives [75]. From the perspective of climate change mitigation, opinions in literature vary regarding the scale of CCS that is feasible or desirable compared to other mitigation technologies [76]. Despite the fitness for IOCs' core business, the fundamental dependence of CCS on regulatory pull currently makes the strategy untenable.

Several interviewees discussed the competitive advantage IOCs could have in hydrogen, which is considered a potential low-carbon fuel for the energy transition: '*In hydrogen, oil companies have an inherent advantage, kind of a semi-incumbency*'. Participants also spoke of '*decarbonisation of products, meaning moving to blue hydrogen*' and stated that fossil fuels can '*be used to make hydrogen, provided the carbon dioxide is captured and stored*'. These statements mostly refer to grey or blue hydrogen, which are produced from natural gas, as opposed to green hydrogen produced through water electrolysis. Blue hydrogen requires that the CO_2 released in the production process is captured and stored (or used), whereas for grey hydrogen it is emitted to the environment [77]. From a greenhouse gas reduction perspective, grey hydrogen is therefore not a viable strategy.

Blue hydrogen has its own feasibility challenges [78] as well as implicitly relying on CCS technology and therefore having to overcome the obstacles mentioned above. There is also controversy around whether blue hydrogen in fact has lower emissions than the direct use of natural gas for energy [79,80]. Countries such as Germany seem increasingly focused on green hydrogen [81], which is not as obvious a fit for fossil fuel companies (see section 4.2.2). Many of the interviewed oil company employees emphasised the importance of blue hydrogen as a 'bridge' fuel to enable faster emission reductions, using much of the similar language that has been used with respect to natural gas in public discourse [82]. However, the scale of investment needed to create a 'hydrogen economy' and competition in many use-cases from

electrification [83] leave the future of this technology unclear, and similar to CCS, dependent on government policy [84].

While the potential of CCS and hydrogen as diversification targets for IOCs featured strongly in interview responses as in company communications, the progress in both technologies has stalled, and they are yet to become mainstream despite great enthusiasm for them since the early 2000s [85–89]. Because the large-scale adoption of either technology would require significant infrastructure investment and government interventions around regulations and publicly subsidised markets, focus on these technologies potentially enables oil companies to shift the blame for lack of progress away from their own inaction on climate issues [90].

4.2.2. Similar skills, different infrastructure

This category includes technologies which the interview participants considered to be a good fit for IOCs' technical skills although they would not significantly make use of their existing physical assets.

Firstly, participants mentioned that '*sustainable biofuels would fit [oil companies'] existing capabilities*'. Biofuels share skill requirements with the oil industry especially on the side of refining, as for example '*sustainable aviation fuels use process technologies that are very familiar to O&G companies*'. While converting oil refineries into biorefineries is likely to require investment, the relative ease of substituting bio-based fuels for some transport applications makes this an attractive option [91]. The downside of biofuels lies in the availability and sustainability of suitable biomass feedstocks [92]. This has been mired in controversy as with growing populations and pressures on agricultural land in the warming world, energy crops compete for land with food production and natural environment protected for biodiversity reasons [93]. Using 'biofuel' as a blanket term is also in many instances misleading, as there are large differences between the environmental impacts and other characteristic of fuels based on different feedstocks, crops, production methods, and locations [94,95].

The least often mentioned technology in this category is geothermal energy. The participants who mentioned it were of the opinion that it would be a good fit for the oil industry's geological skills. The availability of geothermal energy varies by location, however, and there is debate especially about the acceptability of the technology to local communities [96,97].

The third category is offshore wind. While 'renewables' as a general entity were not necessarily considered a good fit for the oil industry (see Section 4.2.4), many interviewees mentioned the offshore oil and gas related '*transferable skills*' that could be used for wind energy: '*For example, geophysicists can carry out site surveys, seabed surveys, studies for the foundations of wind turbines.*' The success of Ørsted in making this transition was quoted as an example.

The final technology in this category is green hydrogen. As mentioned above, while many interviewees flagged hydrogen as a good fit for IOCs, they generally referred to blue hydrogen (chemical processing of natural gas) rather than green hydrogen (electrochemical splitting of water). One interviewee stated that '*oil companies are good at high energy density fluids and large-scale process engineering, but they should do it on a low-carbon basis*', suggesting that any kind of hydrogen would be a good fit. However, building the infrastructure or procuring the large amount of green electricity needed for green hydrogen production would require significant investments [98]. As with blue hydrogen, the importance and scale of this technology in the future energy market is still unclear [99].

4.2.3. Different skills, similar infrastructure

The business area in this quadrant differs from the others in that it only includes one technology, which is not available to all IOCs, as '*there is a difference between traditional upstream players and more retail-focused companies*'. In the interviews, electric vehicle (EV) charging was considered a good strategic fit for companies that already have retail presence in the form of petrol stations. While the technology of EV charging is different from gas pumps, the interviewees said that the switch to electricity could work e.g. through partnerships. Several IOCs are have announced large-scale plans in this area to be ramped up before 2025 [100,101].

However, not all oil companies, even large ones, have retail presence. This strategy is not easily available for those which focus only on upstream and midstream. Some participants also mentioned that even for well positioned companies, '*it is going to be a very competitive field.*'

4.2.4. Different skills, different infrastructure

The final category is about technologies which were mentioned as potential avenues for IOCs in the transition, but which do not share technical skill or infrastructure requirements with the traditional business of IOCs.

Renewables as a general category (excluding the special cases of offshore wind, biofuels, and geothermal) received mixed opinions from the interviewees. The field is considered to have large growth potential, but it is generally far from the traditional business of the oil industry: '*We will utilize low or zero carbon power wherever we can, but we're not going to create a business around that because we don't have the capability and resources in place.*' Many participants remarked that several companies have had time to develop technologies and establish themselves as incumbents, likely to be difficult to compete with: '*What oil companies don't have the capability to do is have factory-based operations building millions of solar panels, for example. The people who are good at devices should do that.*'

Although many interviewees did not consider renewables a perfect fit to IOCs' technical skills, that does not mean that the strategy cannot work. This is evidenced by the progress several IOCs have already made in this area [102,103] making use of non-technical skills around e.g. project management and financing (see Fig. 4). Participants were divided on the total potential of renewables as a growth area for their companies. It is possible that expanding in this area through mergers and acquisitions, as many IOCs have started to do, is a way around the obstacles. Of course, when there are limited synergies between the acquiring company and the target, the optimality of the acquisitions can be questioned [69]. The level to which IOCs manage to integrate the acquired renewable divisions into their core business may prove a success factor, as suggested by a study of the varying success of the renewable investments of IOCs in the early 2000s [44].

The second example is electricity retail to stationary customers, as opposed to EVs. Many IOCs have expressed interest and taken steps towards being major electricity retailers (see e.g. [104]). However, most of the interviewees expressed concerns about the attractiveness of this field, especially in terms of the level of competition, potentially low margins, high levels of regulation, and the presence of incumbents. For example, '*You have fierce competition where margins are quite narrow. That's a different concept for many oil and gas companies, working on volume, not margin,*' and '*building [electricity] skills is going to be a big challenge, either within the companies or through acquiring new companies.*'

On the other hand, even in electricity retail, IOCs could benefit from many of their non-technical assets: large financial capital, political knowhow and global reach allowing them to hedge across many markets.

4.2.5. Other skillsets of IOCs

In addition to the technical skills discussed above, interview participants emphasised the importance of several transferable skills that IOCs possess. These include e.g. '*engineering and large-scale energy projects*', '*complex industrial projects*', '*technical integration*', '*risk management*', '*building relationships with governments and local partners*', and working across '*lots of very different regulatory, policy and physical environments*'. These skills, most interviewees argued, will be essential for carrying out an energy transition on the scale required by the Paris Agreement, as '*there are some other industries that manage projects on that scale, but not many*', and oil companies '*can make the transition happen faster*'. Fig. 4 recategorizes the technologies from Fig. 3 according to these broader

categories of skills, illustrating that the options that do not seem to fit IOCs' capabilities from the perspective of technical skills or infrastructure can still make use of project management or trading expertise in the organisations.

4.3. The role of IOCs in the energy transition

It is unsurprising that participants working in oil companies would emphasise the strengths of the industry in the transition. Of the areas in which IOCs are not well prepared, the most significant was that these large companies tend to be slow-moving and set in their ways, making it difficult to adapt to a fast-changing world. '*[IOCs] are quite top heavy because all investments are so enormous.*' This becomes an issue especially if the pace of the transition accelerates, which is a possibility given the rapid cost decreases of renewables [105], although highly uncertain [106–108]. One interviewee, for example, discussed the divisions inside an oil company between people advocating for rapid change and those preferring a slower 'wait and see' approach: '*The older members of my team don't really seem to have any interest in learning about the renewable sides of the business. They're very happy to defend the fossil fuel side of the business and think it should still be growing, whereas the younger people tend to have a more progressive view.*' There were also concerns about any company's ability to change their strategy at the pace required by the energy transition: '*We need to be realistic about how fast you can pivot a company. There is need for upskilling and pivoting existing skillsets.*'

Another benefit mentioned by many interviewees is the capital owned by IOCs. Few industries can mobilise as much capital as the historically very profitable oil industry. Some interviewees even suggested that it would not be possible to cover the costs of an energy transition without support from the IOCs.

While persuasive, this argument assumes that IOCs' historical profitability will continue through the transition. As discussed earlier, the transition requires a shift away from fossil fuels, which would erode the traditional revenue streams of these companies. Unless IOCs start large-scale investments into the energy transition pre-emptively before their core business is at risk – for which there is little economic incentive at present – they might not have as much capital to contribute as they do today.

The clearest disagreement between the participants is whether IOCs are capable of completely shifting the focus of their business and succeeding in new areas in a time span of mere decades. One interviewee said: '*It seems tough to me to think that oil and gas companies are going to compete in that space when they don't really have any competitive advantage.*' Another discussed the competitive landscape: '*There are already companies that spend all day thinking about solar and offshore wind. And they've hired the best and brightest minds in that field. […] How many Fortune 100 companies totally pivot their business model and succeed?*' It is true that the renewable industry now has its own 'majors' [109], and the aforementioned case of Ørsted remains the only example of a full business model pivot in this space [43].

On the other hand, many interviewees expressed positivity and enthusiasm for the transition, focusing on the transferable skills of IOCs: '*A lot of the times what you need isn't necessarily knowledge in renewables, what you need is knowledge in how energy systems work and how they're regulated and all the bits and pieces that make it work […] And if you're a big energy company, you already do that. […] You have people with all of the skills and expertise to make that happen.*' The interviewees working for IOCs that have made strong public commitments to renewables and becoming 'energy companies' tended to be more positive about the ability of IOCs to succeed in these markets than other participants.

A final unresolved question arising from the interviews is whether continued hydrocarbon production by IOCs can be justified on climate grounds on the basis that the companies need the generated revenue to build up their energy transition business areas. '*Gradually, [IOCs] will sell off hydrocarbon assets, use the money for investments in renewables and other systems, and gradually shift from being a hydrocarbon-based business to a renewable energy-based business.*' The justification sounds sensible, but so far there is limited proof of its working in practice. In the first half of 2022, as high oil price inflated oil producers' profits, the largest European IOCs invested only 2.5–6.3 % of their profits in low-carbon energy [110].

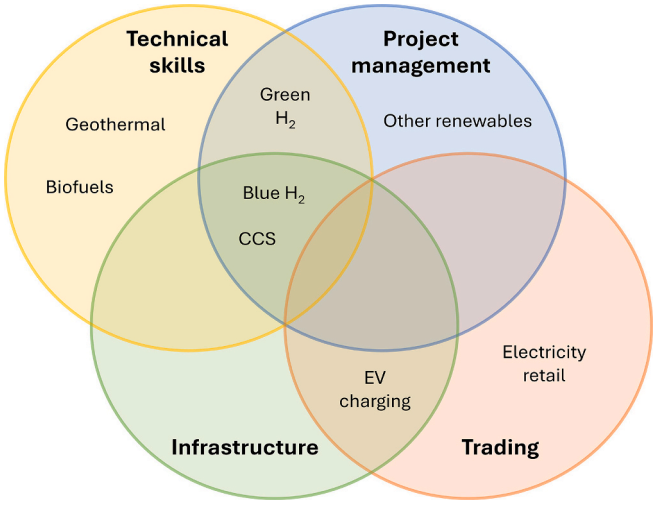

Fig. 4. Strategic fit of diversification options to IOCs' capabilities. The placement of the options is based on interview data and the authors' own analysis.

5. Conclusion

In this study, semi-structured interviews with oil industry professionals were used to collect information on the strategic options available for oil companies in the energy transition. We categorised the high-level strategies as either Melioration or Transition, and analysed specific diversification options in terms of their fit for oil companies' capabilities and assets. Presenting the high-level options on one comprehensive framework makes it clear that the energy transition poses an existential strategy challenge for IOCs. The companies have to either deny the reality of the energy transition, claim that they will be the 'last one standing', accept a decline in their overall business, or diversify aggressively.

The diversification strategies most closely aligned with oil companies' core business – CCS and blue hydrogen – are ones that have remained in limbo for decades as they critically rely upon large changes to current regulatory frameworks to become successful. The fact that other diversification options are not such a close fit does not mean they cannot work, simply that developing a successful business with them is likely to require more concerted efforts and organisational changes. As one interviewee remarked, companies have their own 'DNA' which may be nearly impossible to change. Perhaps some oil companies have good 'dynamic capabilities' and the ability to adapt to changing markets [3], but if this is not the case, a ramp-down of fossil fuel production while returning capital to shareholders might be the only long-term option. At the moment, IOCs show little sign of embracing the transition, as evidenced by e.g. BP's rolling back of its scope 3 emission target [111] and ExxonMobil's comment that a net zero pathway is not viable and therefore requires no strategic consideration [112].

Even though much of the focus of this study has been on diversification, that by itself is not enough to align oil companies with the goals of the Paris agreement, as the 1.5° goal requires fossil fuel use to decline [113]. Only large cuts in fossil fuel production can accomplish this, because otherwise the significant Scope 3 emissions of oil companies remain. Hence, some form of ramp-down, or at least portfolio management, must be part of the strategy of any oil company that claims to be Paris-aligned. Even if a company diversifies effectively, a part of it must still die. Of course, it can be argued that this will not help if the assets are

acquired by another company – as global emissions stay the same so long as those assets remain in operation, regardless of which company makes money from them [23]. But if the long-term aim is the energy transition, then change has to start somewhere. Perhaps it is with 'greener' oil companies and their investors focusing efforts on building the infrastructure for the energy systems of the future rather than continuing to develop the polluting systems of the past.

The size and severity of the current climate and ecological crises arguably transcend the capabilities of traditional business management research [114]. Strategic management literature studies the rise and fall of companies as result of market shifts, while in our situation the market response lags behind the imperative to avoid a looming crisis on the scale that has not been experienced since the development of modern economics. Strategy research can no longer be carried out in a vacuum without taking into account the stark reality of the planetary crisis – especially in the case of the oil industry, which is so at odds with global climate goals. Management literature has not been developed for situations where entire industries are forced into decline to protect human society, or conversely if societies and markets collapse as a result of runaway climate change [115,116]. Still, the budding literature on the oil industry in transitions can benefit from taking tools from the strategy literature and moving from high-level case studies to understanding how transition pathways are likely to be affected by business concepts such as management capabilities, incentives, and organisational behaviour, and how companies can build the capabilities for change and renewal [3].

This research points to many possible future research directions. It would be instructive to carry out case studies of specific strategies and diversification options to understand in more depth their business potential and the IOCs' potential for competitive advantage. Transition studies could benefit from an organisational change perspective to study what internal and external factors could trigger meaningful change in the incumbent companies and bring about a business transition. Finally, this study explores the O&G sector's transition from the perspective of business strategy, omitting considerations of how business relates to the wider political economy in which it is embedded. This leaves aside important questions about power and the desirable role of current incumbents in the sustainable energy future [117]. For example, would a transition in which IOCs play a large role lead to the entrenchment of existing inequalities, bypassing the opportunity to build a fairer energy system [118]? Does it even make sense to expect oil companies, largely responsible for global warming, to be productive agents of the energy transition [32]? Such questions are an important part of research on future of the oil industry.

If we accept that the options presented here cover the possible strategies for oil companies in the energy transition, one thing is clear: time is quickly running out for an orderly transition of the O&G sector towards sustainability. The strategic dilemma that the energy transition creates for IOCs is an essentially existential one. Carrying out any of the discussed strategies at a large scale would require tremendous effort, investment, and change. So far, IOCs have made only small shifts towards the energy transition, while their core business has remained unchanged. Either wholesale and proactive change needs to start right now; or the transition will be forced and chaotic; or we must accept that it is simply not possible to meet any meaningful climate goals. The latter would be a disastrous outcome for the whole world, including the O&G sector.

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.

Data availability

Data will be made available on request.

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