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## The neglected importance of corporate perceptions and positions for the long-term development of CCS

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### Abstract

Many companies that produce fossil fuels or fossil fuel-derived products show a strong belief in a large and continuing role for fossil fuels in the global economy up to 2050 and beyond. These companies are generally expected to be amongst the primary consumers of carbon capture and storage (CCS) technology. So far, however, fossil fuel companies have shown only moderate interest in CCS. Whilst a lot of potential operational barriers to CCS adoption have been identified in the literature, the value of CCS from a corporate strategy perspective has sometimes been assumed, but rarely explored. This paper asks the following question: What are the perceptions and positions of fossil fuel companies on CCS and how does this inform their decision-making on CCS investment and advocacy? This paper addresses this issue by presenting the results of in-depth interviews with high-level CCS experts from major multinational oil and gas companies and major coal mining firms. The results indicate that CCS would require a significant change within the business strategy of fossil fuel companies. This is contrary to the common argument that CCS is attractive because the technology is regarded as not being very disruptive to the incumbent energy system as it leaves most of the existing infrastructure, actor constellations and institutions intact. While fossil fuel companies engage in CCS development, it is often to familiarise themselves with technologies that might have future value if markets for these technologies take off. In several cases, CCS engagement has served the strategic need to weaken the link between fossil fuel extraction and climate change, build up shareholder trust, and improve public perception. However, there is little evidence that these companies engage in CCS to develop a strategic insurance against climate policy risks to their core businesses.

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## 1. Introduction

After COP21, there is a scientific and policy consensus on stabilizing concentrations of greenhouse gas (GHG) in the atmosphere [1]. Carbon capture and storage (CCS) regularly plays a critical role in energy scenarios, as it is the only technology that offers the possibility to significantly reduce GHG emissions while allowing the further exploitation of fossil fuels [2, 3]. The prospect of addressing climate change and the energy challenges of the twenty-first century with a single technology that is compatible with the predominantly fossil fuel based economy of today, is appealing to governmental and corporate decision-makers alike. Governments try to stimulate CCS investment by subsidizing pilot projects and developing price incentives through carbon markets [4]. Although the fossil fuel industry is promoting CCS as a panacea against climate change, most corporate activity so far has focused on participation in basic CCS related research activities and lobbying governments for subsidies [5]. As a consequence, the development of CCS has been slower than anticipated and is lagging behind what energy scenarios deem necessary to reduce CO<sub>2</sub> emissions in time to keep climate change below 2°C warming [6].

In the literature, many barriers to CCS adoption have been identified. The common opinion is that the faith of CCS is ultimately tied to a robust carbon price, as only commercial motivations can stimulate a wide-range deployment [7]. The high costs that are associated with capturing the carbon [8], remaining technological uncertainties [9], the relatively low public acceptance of the technology [10], and missing or ineffective liability and regulatory regimes [11] have been discussed extensively. However, as Bowen [4] pointed out, *“even with a strong carbon price signal, there are recognized uncertainties about the viability, affordability, effectiveness and public acceptability of CCS”*. Whilst much of the discussion on CCS has often focused on the technically optimal integration of CCS technologies into energy systems, corporate decision-making rationales that will determine uptake in the real world have not been thoroughly studied. The conducted in-depth interviews provide such insights. The paper shows the technology aspects that are perceived as a risk rather than a business opportunity and what parts of the CCS system corporate decision makers regard as potentially sustaining or disrupting their future value. In particular, this paper asks the following question: What are the perceptions and positions of fossil fuel companies on CCS and how does this inform their decision-making on CCS investment and advocacy? It is argued that CCS investments are made with regard to a firm’s overall corporate strategy [12]. To be able to highlight some of the prevalent complexities and interdependencies in the fossil fuel sector, oil and gas companies and coal mining companies are included in the analysis.

## 2. Methods

To capture the internal perception fossil fuel companies have towards CCS, 4 in-depth interviews with high-level CCS representatives from oil and gas companies as well as 4 interviews with high-level coal mining representatives were conducted. The interviews were part of a master thesis which the authors of this study wrote, respectively supervised. To find interview partners, a purposive sampling technique was used [13]. There are only a few companies that have the power to shape the fossil fuel sector’s commitment towards CCS. The goal was to interview representatives that work for major international companies with market-leading positions in the fossil fuel business. The eight resulting interviewees have a long-lasting professional attachment to CCS and can therefore be called experts.

The interviews were conducted by telephone in August 2015 and lasted approximately one hour. A semi-structured interview technique with mostly open-ended questions was used. Open-ended questions are typically used in expert interviews because informants can provide contextual richness to their responses and are not limited by fixed choices [14, 15]. Names of interviewees and companies as well as site-specific project information have been omitted in this paper. The assured anonymity allowed the interviewees to speak freely, which was an essential part of the interview. In the result section, quotations from coal mining representatives are abbreviated “CM”, respectively “OG” for oil and gas representatives. The overarching objective of the interviews was to gain a better

understanding of the role fossil fuel companies assign themselves in the development of CCS. A first set of questions focused on the internal value proposition of CCS within fossil fuel companies. A second theme that is relevant for this study concerned the public presentation of CCS-related activity by the interviewed companies. The interviews were recorded and subsequently transcribed which allowed for a thematic coding of the data with the *atlas.ti* software.

The position of fossil fuel companies in the development of CCS is evaluated using publicly available documents of expert panels and policy hearings from the EU and the UK. For that purpose, the online archives of the relevant energy agencies were searched. In addition, academic literature that evaluates the role of fossil fuel companies in the development of CCS was included in the analysis.

### 3. Results

#### 3.1. Oil and gas companies frame CCS as an incremental innovation

With their subsurface exploring technology, experience with injecting CO<sub>2</sub> in geological formations for enhanced oil recovery (EOR), massive pipeline infrastructure, large workforce and investment capabilities, oil and gas companies control valuable resources that are essential for the long-term-development of CCS. These characteristics lead to an assumed compatibility of CCS with oil and gas companies which are expected to be both the drivers of CCS deployment and its primary consumers. An analysis of how oil and gas companies frame CCS in policy contributions shows that this compatibility is actively reinforced by the industry [16]. In an analysis of *Statoil's* and *Vattenfall's* media statements, for example, Buhr and Hansson [17] showed that the two companies used every opportunity to stress the benefits of CCS and the necessity to deploy the technology if the world is serious about mitigating climate change. This exemplifies a shift that most companies in the fossil fuel sector performed in the last couple of years regarding their climate change communication strategy [18]. Tjernshaugen [19] who focused the cases of *ExxonMobil*, *BP* and *Statoil*, concluded that the compatibility with CCS technology had put fossil fuel companies in a strategic dilemma as they needed to admit their influence on global emissions if they wanted to promote the technology. Correspondingly, Stephens [20] remarks that fossil fuel companies “*actively supported research and public campaigns that highlighted uncertainties and weaknesses in the theory of anthropogenic climate change*” in the past. As the scientific case for climate change strengthened, however, firms deliberately shifted their strategy towards a CCS engagement to weaken the link between fossil fuel extraction and climate change. A study that specifically focused on fossil fuel companies’ role in the development of CCS argues that the industry’s engagement in CCS is explained by the prospective of a prolonged extraction of fossil fuels even under severe policy restrictions that may be introduced in the future [21]. CCS enabled businesses that rely on fossil fuel extraction, production or use to accept their influence on global emissions and provided them with a possible solution where there was none before. Accordingly, the technology is often regarded as a sustaining innovation, which is interpreted as a reinforcement of the carbon lock-in by critics [22]. Before this backdrop, it might come as a surprise that the interviews show how several aspects of CCS systems are perceived as “*potentially disruptive*” (OG4) by fossil fuel companies. The following two examples are used to illustrate, however, why there are strong incentives for incumbent firms to publicly portray CCS as an incremental innovation from a technological point of view.

Whilst post-combustion capture technology is regarded as an end-of pipe solution that is generally compatible with large, centralized oil and gas firms by the interviewees, they stressed that pre-combustion technology could potentially lead to a completely different technological trajectory with unfavourable implications for their company. Consequently, although carbon capture technology has so far not developed a dominant design and several methods are conceivable, they decided to focus on the promotion of post-combustion capture. Interviewees mentioned that this general approach allowed their companies to focus on CCS technologies and processes that they are familiar with from their daily business activity. Out of the 15 CCS pilot projects that are currently operating worldwide, 11 use post-combustion technology [23].

Also the second example demonstrates that firms generally look for opportunities to “*build upon their existing knowledge base*” [24] instead of considering options that are new to them when making technology decisions. A coal industry representative remarked that “*understanding the subsurface geology, understanding how fluids or*

*supercritical gases behave in the subsurface, [...] is the bread and butter for oil and gas*” (CM1) which is why “*oil and gas [companies] prefer storage options they know from their core business*”. Indeed, all four oil and gas interviewees stated that they prefer geological storage options over other possibilities, such as CO<sub>2</sub>-mineralisation.

The interviews suggest that oil and gas companies make optimistic public statements towards specific future CCS technology options fitting their skills and know-how. This allows them to gain access to policy processes, which is essential in this still early stage of CCS development with various potential technological pathways in the capture, transport and storage part of the CCS system. As there are very few CCS systems in operation, these policy processes and the subsequent funding mechanisms are heavily influenced by technology choices of incumbents. Another reason why oil and gas companies promote technologies or processes they are accustomed to is shareholder trust. All four oil and gas interviewees mentioned that fossil fuel companies take part in CCS projects to show a level of confidence with recent technological developments to their shareholders and demonstrate that they are prepared in case the commercialization of CCS is required to maintain or enhance competitiveness.

### 3.2. Fossil fuel companies position CCS as a crucial part of climate change mitigation

All eight interviewees assert that their company is only willing to take part in CCS projects if governmental support is attached to the commitment: “*The business model of CCS relies strongly on governmental policy. In fact, without governmental support there is no business model for CCS*” (OG1). Similarly, Statoil emphasized that “*the main economic and operational responsibility for establishing CCS rests with the state*” [17]. The following paragraph describes the arguments that are adopted by the fossil fuel industry to promote CCS to policymakers.

In 2013, the European Commission (EC) undertook a public consultation on the future of CCS in Europe [25]. Nearly all contributions from fossil fuel companies stressed the value of national and international roadmaps that outlined emission reduction pathways until 2050 and beyond. The reason for this is that contemporary national and international mitigation scenarios rely heavily on CCS. The International Energy Agency, for example, estimates that a fifth of the total emission reduction that will be needed to stabilize the CO<sub>2</sub> concentration in the atmosphere by 2050 have to come from CCS [26]. Moreover, energy scenarios consistently find that CCS drastically reduces the overall cost of global decarbonisation [9]. The circumstance that energy modelling shows that CCS will be needed to mitigate climate change at an affordable cost is used to full capacity by the fossil fuel industry.

Because they lack the know-how of the deep-subsurface, coal producers need to employ a different strategy why they should be a key player in CCS development in general and policy processes in particular. A coal mining representative stated that his company tries to like link the supply of cheap, reliable and stable energy to economic growth and fairness towards developing countries. With this argument, the coal industry relates CCS to the long-standing environmental protection versus economic growth debate and thereby strengthens the case for CCS equipped coal-fired power plants.

According to the interviewees, CCS is the only option that would enable deep emissions reductions for many energy intensive processes such as the production of steel, cement, or chemicals. They argue that once CCS is sufficiently developed, it becomes a transferable technology that would be able to secure high-level jobs in energy-intensive sectors. This argument can also be observed in various statements in the *CCS Development Forum* that was organised by the UK Department of Energy & Climate Change (DECC) between 2012 and 2015 to facilitate exchange between CCS stakeholders [27]

### 3.3. The dark side of the moon: Discrepancies between the public appraisal of CCS and the pessimistic outlooks of the interviewees

As described above, the strong association of CCS technology with fossil fuel companies can partially be attributed to the industry’s engagement in promoting the technology. Statoil, for example, emphasized that a large-scale CCS deployment is only feasible with large fossil fuel companies backing it [17]. Interviewee OG2 pointed out that the usually optimistic public framing of the technological parts of CCS serves the strategic purpose to tie CCS development to the actions of the fossil fuel industry. This can also be observed in an oral evidence session held by the House of Commons to discuss the future CCS policy in the UK. Representatives from Shell and other CO<sub>2</sub>-intensive companies stated that from a technical point of view, CCS is mature enough to be deployed since the industry knows how to inject CO<sub>2</sub> into the deep subsurface since 30 years due to experiences with EOR [28].

Another example of the same argumentation is provided by an oil and gas interviewee: *“The oil and gas industry has the necessary experience with projects that cost several hundred millions of dollars or a billion dollars. That’s routine for us. It is also clear that the oil and gas industry can handle the operational parts of the project. If anything goes not how it was planned, we know how to react. Because we have the experience and the engineering skills”* (OG4). Likewise, a Delphi study from the UK showed that CCS experts stressed non-technical barriers (such as regulatory frameworks and costs) rather than technological challenges as main reason for the slow CCS uptake [29].

Combined with the urgency to mitigate climate change, the assumed comparability of fossil fuel companies with CCS, leads to the expectation that a wide-scale CCS deployment is imminent. Recent energy scenarios thus project a massive CCS deployment at rates that are in some cases comparable to the expansion of the oil industry at the beginning of the century [30]. The interviewees, however, believe that these deployment projections are *“completely unrealistic* (OG2)”. Whilst several studies show that experts are in general overly confident and optimistic concerning the technology they are involved in [31-33], this is not the case in this sample. In fact, none of the interviewees thinks that the deployment targets outlined by the IEA in 2015 [26] to limit global warming to 2°C can be reached. Asked about the value of CCS for the company they are working for, interviewees were not reluctant to state that CCS has little or no value to them at the moment: *“Look at the numbers. You very quickly come to the conclusion that CCS has very low value to fossil fuel companies. Otherwise, we would be investing a lot more money”* (CM1). Asked for the reasons why his company invested in CCS at all if the technology had little value to them, CM1 pointed out that *“investment is the wrong word, it is not an investment at all, it is charity”*. Moreover, the interviewees question that the company they work for would take a leading role in a forthcoming CCS development, even if a global carbon price is installed.

A first reason that was supported by four oil and gas representatives and one of the coal mining representatives is that their company already uses an internal carbon price (a range of \$30 to \$60 dollars was named) to evaluate large engineering projects and hedge their long-term planning. This suggests that a carbon price would not trigger an immediate large-scale diffusion of CCS across the fossil fuel industry.

Secondly, whilst interviewees agreed that a carbon price would incentivise CCS deployment -*“if there is a viable business, driven by a carbon price policy, then someone will provide that storage service”* (CM1) - they remarked that it would happen in a geographically and temporally fragmented way, with mainly spin-offs from the oil and gas sector offering transport and storage services to coal companies in an early phase. This clearly contradicts the projections of numerically-based energy scenarios that rely on input assumptions and boundary conditions to simulate CCS development and usually portray deployments paths that either do not take off at all or at a tearing pace.

A third reason for the doubtful CCS outlook that many interviewees have is the contradiction of CCS with the core business strategy of fossil fuel companies. Most interviewees were rather generic in that respect: *“We like to remain where we are the strongest as an oil and gas company. We provide energy. We are not a service company”* (OG1). However, one interviewee went into details: *“It is our culture to take a lot of risk. It is our job to invest in businesses that are risky. For example the explorations where we want to find oil or gas. So we are ready to use a lot of money in risky operations. But in return, we want to have a high profitability when we discover oil or gas. It is a high risk, high reward game. The way we frame CCS business is different. The price to store CO<sub>2</sub> has to be as low as possible, so that it can be done worldwide. We don’t see a future where a company that stores CO<sub>2</sub> is rewarded at a high level”* (OG2). Whilst certain technological parts of CCS may indeed be compatible with fossil fuel companies and oil and gas companies in particular, organisational inertia and a strong focus on existing business models currently prevent the technology to really spark the interest of corporate decision makers. One example is that the characterisation and valorisation of geological storage capacity, which is likely to be reliant on the resources and skills that are found in today’s oil and gas sector, lies outside of the oil and gas sector’s current strategic value proposition.

#### 4. Discussion

In contrast to the picture presented in policy contributions, the representatives of fossil fuel companies that were interviewed for the purpose of this paper indicate that CCS is perceived as much more controversial within individual firms. One key divide is between oil and gas and coal firms. Coal producers are responsible for about 40% of global CO<sub>2</sub> emissions but lack the CCS relevant knowledge and skills the oil and gas industry has [34]. This imbalance creates interdependencies between the two competing industries. Several oil and gas representatives mentioned their fear that oil and gas companies take a deliberately unhurried stance in CCS development because coal producers are likely to be affected by carbon regulations earlier than oil and gas companies are: *“The oil and gas industry is a competitor to coal. So they are not necessarily interested in advancing the benefits of CCS more generally”*. Although this tactic was denied by the oil and gas interviewees, recent U.S. carbon regulations that require new coal-fired but not natural gas or oil powered power plants to employ CCS indicate that at least the apprehension of coal producers to be affected by carbon policy first is not too far-fetched [35]. One interviewee identified this competition as the main reason for the oil and gas firms’ intensive lobbying for a global price on CO<sub>2</sub> emissions: *“The only way you’re going to make gas as competitive as coal is through a carbon price. Because that will push up the price of coal more than it will the price of gas”* (CM3).

However, climate change and climate change regulation can influence the environmental and economic performance of all companies in the fossil fuel business positively or negatively. Consequently, all of them need to make assessments of their exposure to the so-called carbon risk [36]. Several interviewees outlined that CCS is one part of a broader climate change risk mitigation strategy applied in their respective company. Other actions that are taken include virtual carbon prices to calculate investment risks (CM2; OG1-4), switch to resources with a lower calorific value whenever the cost-benefit analysis allows them to do so (CM1,2; OG1-4) various efficiency measures (CM1-4, OG1-4) and setting up a renewable technology portfolio (OG2,3). As firms have different perspectives when it comes to future energy developments [37], they are likely to attribute different levels of importance to CCS. Whilst some national fossil fuel companies, for example in the U.S. and Australia, have evolved in relatively stable and protected environments with a lot of regulation, other players have more experience with risk exposure and international project management, which also influences a company’s CCS-related interests and capabilities [38]. In addition, whilst fossil fuel companies in general have a lot of experience with uncertainties, for example through options pricing, some have more than others. *Shell* for example is using scenario planning since the 1970s, which enabled them to be better prepared for the first oil crisis than any other oil company [39].

Furthermore, also the CCS system itself is highly differentiated. Whilst carbon capture can be addressed by energy equipment manufacturing firms or utilities with turbine experience, carbon transportation is probably going to rely on the pipeline infrastructure of major oil and gas companies or ocean carriers in case of a ship-based transport, whereas carbon storage is relevant for both oil and gas companies as well as oil field service providers [4]. The impression that CCS is supported and undisputed by the whole fossil fuel industry that one can get when analysing public industry statements is artificially created. The promotion of CCS allows fossil fuel companies to receive the associated public perception boosts (which seven out of eight interviewees regard as an important reason for the CCS activity of their firm) and increases the prospect of policy influence with subsequent funding opportunities [40]. To date, however, a strong and lasting interest in the commercialisation of CCS cannot be identified among fossil fuel companies. Therefore, the activity in CCS projects that almost all privately owned fossil fuel companies engage in is not a sign of an imminent wide-scale CCS diffusion, but rather a low-hanging fruit for fossil fuel companies to be invited to policy contributions, demonstrate their level of preparedness to shareholders and delay immediate or more radical emission reduction measures. In that sense, the quote *“We see CCS as a way to mitigate our emissions in cases where policy, cost and funding and other factors allow us to do so”* (OG1), strongly resembles what Meadowcroft and Langhelle [41] coined the *“CCS when absolutely necessary; but surely it is not necessary quite yet”* position.

#### 5. Conclusion

A large gap has emerged between the technocratic discourse concerning the promise of carbon capture and storage and the de facto scale of deployment. This discrepancy has been the starting point of this study. Previous

energy transitions suggest that relatively long periods of experimentation are a normal development in energy transitions. Whether CCS advocates can draw hope from these findings is doubtful. Because the technology offers no tangible value to energy producers or end-users besides lowering their exposure to climate change-related penalties, its economic value is intertwined with that of carbon pricing and thus permanently exposed to policy risk. This poses the question of whether a policy-driven (rather than policy-enabled) energy transition is comparable to historical transitions that were driven by better and ultimately cheaper energy sources and technologies.

To date, fossil fuel companies regard governmental commitment and financial support as a prerequisite for own investments. Policy makers must acknowledge, however, that innovations are more likely to come from businesses at the periphery of the fossil fuel industry. While fossil fuel companies do engage in CCS development, it is often to familiarise themselves with technologies, such as CO<sub>2</sub> injection and storage management, that might have future value if markets for these technologies take off.

The fossil fuel sector has successfully positioned CCS as a necessary emission reduction technology. By being optimistic about overcoming the technological challenges and emphasizing the scale to which CCS can contribute to climate mitigation, the fossil fuel industry builds expectations. These expectations increase the possibility to attract financial resources for CCS projects. Although fossil fuel companies use the promise of future emission reductions as an instrument to resist calls for immediate abatement measures, there is little evidence that they engage in policy process and assorted projects to develop a strategic insurance against climate policy risks to their core businesses. CCS activity is embedded in the broader corporate strategy and usually not the only carbon risk management action companies take. Being aware of corporate positions and perceptions is crucial in order to be able to interpret the actions and interests of the fossil fuel industry. It is important to move towards a better understanding of why companies engaged in CCS take their respective positions and decisions. Such understanding can inform better policy for CCS and for climate change mitigation more generally.

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