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Governance by EU Emissions Trading
Resistance or innovation in the oil industry?

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Abstract: Studies of the EU Emissions Trading System (ETS) abound. Much is known about the economic incentives they contain to promote abatement and innovation, and studies are focusing on the short-term aggregate effects at sector and system levels. Less, however, is known about how the EU ETS affects companies, including their strategies, long-term innovation plans, and deployment of low-carbon solutions. This article presents an analytical framework of how companies are likely respond to regulation like the EU ETS, subsequently applied to companies in the oil industry, represented by the major multinationals ExxonMobil and Shell. The analysis finds that these companies had quite different initial responses to the ETS, whereas their long-term strategic responses to carbon pricing show signs of convergence.

Key words: EU climate policy, EU ETS, corporate climate strategies, oil industry

List of Abbreviations

ACCF	American Council for Capital Formation
BIR	Business Improvement Review
CCS	Carbon Capture and Storage
EII	European Industrial Initiatives
EPTB	Environmental Products Trading Business
ET	Emissions Trading
ETS	Emissions Trading System
GEMS	Global Energy Management System
IETA	International Emissions Trading Association
MRV	Monitoring, Reporting and Verification
NER	New Entrant's Reserve
STEPS	Shell Tradable Emission Permit System
ZEP	Zero Emissions Fuel Power Plants

1. Introduction

The EU aims to put Europe on track toward a low-carbon economy by 2050. EU leaders have agreed to cut GHG emissions by 20% by 2020 from 1990 levels and by 80–95% over the longer term to limit the rise in global temperature to 2°C. The key climate policy instrument in this stunning challenge is the EU Emissions Trading System (ETS), intended to reduce GHG emissions in a cost-effective way. In the short term (until 2020), the ETS seeks to achieve these goals at the lowest possible price. Over the long term, however, climate policy instruments must incentivize the development and diffusion of new breakthrough technologies in the sectors and companies covered by the system. New technologies will reduce the risk of locking in highly carbon-intensive technologies, which could make industries uncompetitive if carbon prices rise (Egenhofer et al. 2011).

The ETS is a cap-and-trade system covering more than 10,000 installations in the electric power- and energy-intensive industries that produce almost half the CO_2 emissions in the EU.[1] Developed from the late 1990s, the system was formally adopted in 2003 and started functioning in 2005, with a pilot phase from 2005 to 2007 that was followed by the Kyoto Protocol commitment phase from 2008 to 2012. A third trading phase for 2013–2020 was adopted by a revised Emissions Trading (ET) Directive in December 2008. The system has no deadline and is intended to continue beyond 2020.[2]

Studies of ETS abound (Asselt 2009; Convery 2009). The story of how the system was initiated, decided, and implemented has been analyzed in detail (Skjærseth and Wettestad 2008; 2010). We know a great deal about the economic incentives that are intended to promote abatement and innovation. We are also learning more about short-term aggregate effects at the sector and system levels (Ellerman and Buchner 2008; Ellerman et al. 2010). However, we know less about how the EU ETS actually affects companies, their strategies, long-term innovation plans, and deployment of low-carbon solutions. Such knowledge is especially important since "climate-friendly" innovation unfolds mainly in the private sector, and climate change is a long-term challenge.

This article outlines an analytical framework for exploring whether, how and why companies have responded to the ETS. The framework is then applied to the oil industry, represented by the two major multinationals, ExxonMobil and Shell. The final section summarizes the findings in light of the future prospects of the ETS. ExxonMobil and Shell have responded quite differently to the ETS, so they offer insights into the conditions under which different responses occur. These companies are affected by the ETS in the short term by holding emission allowances particularly in the refining sector, and more strategically in the longer term by carbon pricing and the possibility of diffusion beyond Europe. The oil industry makes its living from the key sources of anthropogenic climate change, so it is a crucial sector for achieving a low-carbon economy.

2. Analytical Framework[3]

Regulatory pressure is a key cause of corporate climate strategies. How companies are likely to respond to regulation is, however, a contested issue. Various strands of business environment management theory explain how companies will respond to environmental regulations in general, and emissions trading in particular. Below, we introduce two perspectives on how companies are likely to respond to regulation.[4] These perspectives, treating companies as unitary actors, are in turn extended to incorporate company-internal and wider external factors.

[1] Aviation is included from 2012

[2] The EU ETS applies to the 27 current EU member states. In addition, Norway, Iceland and Lichtenstein have emissions trading systems linked to the EU ETS.

[3] The framework forms part of a larger FNI project on the consequences of the EU ETS for corporate climate strategies in companies and sectors, including power, steel, cement, pulp and paper, and oil.

[4] A third perspective concerned with the social risk of environmental challenges is included in the FNI project, but excluded here due to space limitations. This perspective links regulatory response to corporate norm-guided behavior (e.g. Flohr et al. 2010), Corporate Social Responsibility (e.g. Barth and Wolff 2009) and the crowding-effect linked to environmental motivation (e.g. Frey and Stutzer 2007).

Companies as reluctant adapters

The most parsimonious perspective assumes that a single rational manager will make decisions based on cost calculations to maximize profits. Regulation will lead to additional costs, to which managers will respond by minimizing these costs.[5]

This model of regulatory response is grounded in the mainstream economic view of the firm as a unitary rational profit-maximizing agent (Gravelle and Rees 1981; Ambec et al. 2011).[6] Higher regulative costs reduce competitiveness independent of the type of regulation, as long as companies must allocate labor or capital to abatement – i.e., to costs that are not "productive" from a business perspective. Capping emissions and putting a price on CO_2 will charge companies for a by-product of their activity that was previously free. Administrative costs from compliance activities like monitoring, reporting and verification (MRV) of emissions data pull in the same direction, diverting capital away from productive investments. Company options will be restricted and their profits reduced. If profitable opportunities existed to reduce pollution, profit-maximizing companies would already be taking advantage of those opportunities. All profitable opportunities for innovation have already been discovered, since all managers have perfect information about them. The metaphor often cited is that 10-dollar bills are never found on the sidewalk, because someone will have already picked them up (Porter and van der Linde 1995b: 98). This notion of profit maximization leads to a trade-off between regulation and competitiveness; between ecology and economy, where the social benefits arising from strict environmental standards conflict with the industry's private costs for abatement (Porter and van der Linde 1995a).

This perspective would first predict that all environmental regulations, including the ETS, will be resisted. The ETS will be seen as a regulatory threat to company profitability and competitiveness that might lead them to defeat or weaken the system, depending on cost-benefit calculations of lobbying activities versus compliance. Secondly, the model predicts that when/if the system is adopted, the choice of whether and how to comply will depend on what pays off in the short term. Since non-compliance can be detected and penalties for non-compliance are established (higher than the market price of allowances), the response will most likely be reluctant compliance.[7] Companies will rank solutions according to costs (abatement, trading, or relocation of production), phasing in the lowest-cost options first. The company will respond with only low-cost incremental business-as-usual abatement options. Long-term R&D aimed at new large-scale low carbon is not expected.

This does not necessarily imply that all companies will respond in the same way. Regulatory pressure may vary among companies and among sectors, even if everything else is assumed to be constant, including carbon prices, technology, customer needs and products.

Companies as innovators

The traditional perspective on the relationship between regulation and competitiveness has been challenged, most notably by the work of Michael Porter and van der Linde (Porter and van der Linde 1995a; 1995b), who turn the above line of reasoning on its head. Regulation, they hold, can strengthen international competitiveness and make companies more profitable. More stringent but properly designed regulation will not only facilitate short-term compliance, but stimulate exploration, experimenting, learning and innovation in firms.[8] Versions of this argument, known as the Porter

[5] This is a static perspective where everything except regulation is held constant.

[6] The reason is not necessarily a belief that profit maximization offers an accurate description of how all companies always will behave in the real world, but rather that the assumptions permit the development of parsimonious theory.

[7] The penalty is EUR 100 for each tonne of CO_2 equivalent emitted by the installation for which the operator has not surrendered allowances. Payment of the penalty will not release the operator from the obligation to surrender the allowances required. The penalty for the first trading phase (2005–2007) was EUR 40 per tonne.

[8] A point of departure is Schumpeter's (1934) definition of innovation as the discovery and commercial or industrial application of something *new* — a new product, process or method of production; a new market or source of supply; a new form of commercial, business or financial organization. This definition is widely applied also by scholars of more specific "environmental innovation.

Hypothesis, have received significant theoretical and empirical attention (e.g. Johnstone and Labonne, 2006; Lanoie et al. 2007; Ambec et al. 2011).

The innovation perspective recognizes that companies strive for profits, but companies fail to make optimal choices for various reasons, including bounded-rational managers and organizational inertia. This perspective assumes that managers evaluate options in terms of costs *and* benefits to their companies. Manager responses to regulation are shaped by bounded rationality, risk aversion, habits, and routines in a world of dynamic competition — managers must constantly seek innovative solutions to pressures from competitors, customers, and regulators.

The main implication from the Porter Hypothesis is that myopic companies need regulation to see new innovative opportunities that may benefit the company (Porter and van der Linde 1995b). The proverbial 10-dollar bills are often left on the ground, as with unrealized energy efficiency potential, because people have not looked in this direction. Regulation can raise corporate awareness, instigating new learning about resource inefficiencies and potential technological improvements, reducing uncertainty about future investment, creating pressures that motivate innovation and progress and offset compliance costs. Innovation may provide early-mover advantages – new technologies, processes or products can later be marketed, to the extent that domestic regulations are consistent with but predate international trends in environmental protection.

We thus first expect that companies will accept or support the ETS by emphasizing new opportunities rather than additional costs. Once the system is adopted, companies will comply and increasingly learn more about new innovative activities and early-mover advantages.[9] Incremental innovation (short-term abatement beyond what is needed for compliance) and long-term R&D and activities directed at new large-scale innovation can be expected, since company management is concerned with benefits and new opportunities as well as costs and risks. However, to spur innovation, environmental regulation must be "appropriate" (Porter and van der Linde 1995a; 1995b). This means it is essentially characterized by market-based instruments, like cap-and-trade, which are stringent, harmonized, and in line with or slightly ahead of other countries, to minimize competitive disadvantages. Whether the ETS qualifies as a properly designed instrument is an empirical question that will form part of the analysis.[10]

Company-internal and wider external factors that affect corporate responses

The two perspectives above treat companies largely as unitary actors and as homogenous, and build on the assumption that the principal external intervening factor is new regulation such as the EU ETS. This section briefly explores how the two perspectives can be extended by including factors from the "inside" as well as the "outside" of the company.

With regard to company-external factors, research has shown that the national political context is important for company attitudes, culture and strategies.[11] This is also the case for private multinational companies with global operations (Rowlands 2000; Skjærseth and Skodvin 2003). One type of influence is likely to be found in the regulatory style of the home-base country, where the company has its historical roots and headquarters (Vogel, 1986). The strongest impact of national context can be expected when history, headquarters, and activities are located in the same country. Corporate response to regulation can be affected by societal demands for environmental protection,

[9] It is also conceivable that companies resist regulation in prospect but, once faced with it, come to the Porter Hypothesis view.

[10] The Porter Hypothesis has been tested in various ways. Here we use the "weak" version: properly designed regulation tends to spur innovation. This version is weak in the sense that it does not say anything about whether the innovative activities are good or bad for company competitiveness. The "strong" version holds that innovation tends to offset any additional regulatory costs, making companies more competitive. There is also a "narrow" version: that flexible regulatory policy give firms greater incentives to innovate and are thus better than prescriptive forms of regulation.

[11] Also international regimes like the UNFCCC and the Kyoto Protocol also affect climate strategies (Skjærseth and Skodvin 2003).

governmental supply of climate or R&D policies, and the political institutions linking demand and supply through company–state relationships.[12]

With regard to the "reluctant adaptation" perspective, national context is relevant only for the geographical location of installations which can affect regulatory costs. The "innovator" perspective, however, concerns the consequences of coordination and harmonization of regulation. It seems reasonable to assume that a high degree of institutional fit between the ETS and pre-existing or evolving relevant national policy instruments will promote company acceptance.[13]

The literature on corporate environmental and climate strategies has also indicated various company-specific internal factors that may affect climate strategies and company response to regulation (e.g. Levy and Kolk 2002, Skjærseth and Skodvin 2003, Kolk and Pinkse 2004, Pinkse and Kolk 2007).[14] Regulatory risk and dynamic innovation capabilities appear particularly important. First, company regulatory risks are likely to differ as a result of varying carbon intensity.[15] The inherited general business strategy, including technologies, products and markets, will follow a specific carbon intensity creating variation in risks to any regulation that places a price on carbon emissions. The general assumption is that the more carbon-intensive fossil-fuel portfolio, the higher the risk. The implication of the "reluctant adaptation" perspective is that high carbon intensity will increase the costs of regulation, making companies (even) more resistant to regulation. Concerning the "innovation" perspective, high carbon intensity will increase the regulatory pressure. Incremental adjustment will become less likely and radical long-term innovation more likely.

Second, dynamic capabilities refers to the leeway available to managers for doing more than merely serving as administrators of given resources within a given locked-in business strategy and structure (Penrose, 1995). Dynamic capabilities focus specifically on managerial capabilities for entrepreneurship and innovation (Eisenhardt and Martin 2000, Winter 2000). The relationship between company "culture" and management figures prominently in this literature, which assumes that bounded rational companies will respond normatively or routinely to new challenges. Companies will differ in routines concerning how readily internal and external resources are amassed and utilized for new opportunities through innovation. In the context of climate strategies, 'strong' dynamic capabilities can be understood as suitable routines for discovering new market opportunities and utilizing resources for low-carbon solutions, such as R&D and investment in CCS or renewables. 'Weak' dynamic capabilities means unsuitable routines for identifying and exploiting new opportunities: companies stick to their core business, as with oil companies that focus exclusively on oil and gas exploration and production. Weak dynamic capabilities can be hard to change unless strong external or internal signals are provided, for instance in the form of stringent new governmental regulations or replacing central company management or top leadership (Cohen and Levinthal 1990; Winter 2000). A new leadership or CEO could signify changes in company routines, with the new brooms seeking to sweep clean.

The concept of dynamic capabilities or change in leadership is simply irrelevant for the "reluctant adaptation" perspective. Any manager will maximize profits and optimize the organization. Concerning the "innovator" perspective, the Porter Hypothesis holds that when companies face an external intervention in the form of stringent regulation, that may actually make the management look in new directions for opportunities hitherto unheeded. However, the most innovative strategic response would be expected from companies already equipped with strong dynamic capabilities.

To summarize: the main focus for explanation is companies' response to climate regulation according to three criteria: position on regulation, short-term abatement and long-term low carbon solutions. Too explain companies' response strategies, we focus on two perspectives emphasizing regulatory pressure and -design as key variables. These perspectives are in turn extended to include

[12] The notion of 'organizational fields' holds that organizations adopt practices to adapt to changes that are considered proper, natural or legitimate (DiMaggio and Powell, 1991).

[13] Implementation theory, which focuses on institutional fit, emphasizes the critical role of the pre-existing institutional context in which new policy instruments such as emissions trading are introduced. Emissions trading is frequently implemented alongside existing national policy instruments, like carbon taxes and voluntary agreements (see Sorrell and Sijm 2003)

[14] These factors include company size, leadership, capital availability, human resource availability, ownership, regulatory risk, stakeholder influence, actions of other companies and dynamic capabilities for innovation.

[15] Carbon intensity is determined by the relative importance of coal, oil, gas, renewable and nuclear energy sources. Another factor affecting regulatory risk is exposure to international competition.

national political context, regulatory risk and dynamic capabilities. This extension takes into account that corporate response strategies to regulation tend to be co-produced by company internal factors and the wider context in which companies operate.

3. Shell and Exxon: responses to the ETS

Here we explore how Shell and ExxonMobil have responded to the EU ETS, by looking at their position and reaction to the initiation of the system, short-term abatement activities, and long-term low-carbon solutions.

Initiation of the system

The EU ETS is the first mandatory international climate regulation directly targeting a significant share of oil company CO_2 emissions. Both Exxon and Shell responded actively to the introduction of the system, but in completely different ways.

When the ETS was initiated in the late 1990s, Shell responded enthusiastically by shifting attention to the emerging new European carbon market. In January 2000, Shell launched an internal GHG emissions trading system, Shell Tradable Emission Permit System (STEPS), intended to use tradable emissions permits to help meet self-imposed emissions targets. The same year, the company incorporated future costs of CO_2 emissions into its financial planning of and decisions on major projects. In 2001, it created an Environmental Products Trading Business (EPTB) within Shell Trading. This EPTB team became the first to execute a trade in the ETS, in February 2003. Shell's STEPS system and incorporation of carbon prices in 2000 were explicitly implemented *in anticipation* of future regulated carbon markets (Shell CDP 2008: 6). By participating actively in the initiation of the ETS, the company made the upcoming ETS important for its anticipatory actions.

ExxonMobil, by contrast, opposed the introduction of the EU ETS. Private US interests lobbied intensively against ratification of the Kyoto Protocol and the emerging European emissions trading system. Shortly after the ET Directive was formally proposed in 2001, the American Council for Capital Formation (ACCF) published studies predicting adverse consequences for the European economy and employment if Kyoto Protocol targets were to be met by emissions trading in Europe. As late as in 2009, ExxonMobil contributed $25,000 to the ACCF (Exxon Contributions 2009). ExxonMobil has continued to oppose the ETS (ExxonMobil CDP 2009: 36). Cap-and-trade in general and the ETS in particular have been characterized as unnecessarily costly, complex and ineffective; the allowance market takes the emphasis away from reducing carbon emissions (Tillerson 2010).

Short-term abatement

For the first (2005–2007) and second (2008–2012) trading periods under the ETS, Shell and ExxonMobil received all allowances for free. Both companies have also tended to hold close to actual emissions or long positions from 2005 to 2010. A long position indicates a lenient cap. Nevertheless, Shell had anticipated fewer allowances than expected emissions (Shell Sustainability Report 2005: 8), forcing some facilities to invest in emissions reductions and encourage trading of surplus allowances. When the EU ETS was officially adopted in 2003, Shell announced that the system would affect nearly one third of the company's global GHG emissions. However, Shell was confident that its energy-efficiency programs and experience of Shell Trading would position the company well in the new market. After 2003, Shell prepared by "developing the business processes required, *identifying potential emission reduction projects* and building capacity in Shell Trading" (Shell Sustainability Report 2005: 9, emphasis added).

In 2005, Shell's ongoing energy efficiency program (Energise™) was integrated into the new Business Improvement Review (BIR), and a three-year capital investment program was launched specifically to boost energy efficiency at refineries (Shell Sustainability Report 2005: 9). This would indicate that the EU ETS had actually strengthened ongoing abatement programs. Still, energy efficiency at Shell's refineries has declined since 2004. One reason relates to a conflict between EU requirements as to fuel quality and CO_2 emissions: extra energy is needed to produce more environmentally-friendly lower-sulfur fuels (Shell Sustainability Report 2009).[16]

Exxon opposed the ETS but had to adapt, since the system was mandatory. Like Shell, ExxonMobil has been heavily affected. In 2005, the ETS system covered nearly 90 installations operated by Exxon or joint-venture partners (Exxon Citizen Report 2005: 38). Exxon managed to meet its obligations without purchasing extra allowances. Gains from sale of allowances in 2005 (before the carbon-price collapse) were offset by the cost of administrative procedures and rising costs of electric power (ExxonMobil CDP 2008). In 2007, Exxon consumed energy at a cost of $10 billion, representing 15% of total operating expenses. In addition to strengthening ongoing energy efficiency programs, the initial impact of the ETS cap on Exxon was mainly related to emission monitoring, reporting and verification. In 2003, the company began systematic reporting of GHG emissions. The "appropriate measurement of overall emissions", stated the company, is part of "preparatory work" regarding regulations (Exxon Citizen Report 2004).

Exxon's Rotterdam refinery sought to play a leadership role in establishing monitoring protocols for the refining industry in Europe. Esso Nederland BV worked closely with Dutch authorities to develop monitoring protocols for CO_2 and NOx in preparation for the ETS (Exxon Citizen Report 2004: 40). Some, such as the German petroleum industry, adopted the protocol's general structure (Exxon Citizen Report 2005). Since then, the EU's approach has become more harmonized for the second and third trading periods.

ExxonMobil has improved energy efficiency at refineries since the company launched the Global Energy Management System (GEMS) in 2000. According to Exxon, energy efficiency has grown two to three times faster than the industry average (ExxonMobil CDP 2010: 11) not least because Exxon's refineries are more than 60% larger than the industry average (ExxonMobil Financial & Operating Review 2009: 79). Larger capacity means more flexibility to optimize operations and produce high-quality products with lower feedstock and operating costs. Unlike Shell, Exxon does not espouse the argument according to which extra energy is needed to produce more environmentally-friendly lower-sulfur fuels at refineries. The ETS has not caused energy efficiency programs in Exxon, but provided additional incentives for programs already in place.

Until early 2000, Exxon was extremely skeptical to the thesis of human-induced climate change (Skjærseth and Skodvin 2003: 47–48). Then it started to soften its position, culminating in its 2007 acknowledgement of responsibility to help solve the problem (Exxon Citizen Report 2007: 15). The company then declared a halt to its funding of several public policy research groups whose "position on climate change could divert attention from the important discussion on how the world will secure the energy required for economic growth in an environmentally responsible manner" (Exxon Citizen Report 2007: 39).[17] The company also accepted carbon pricing by international taxation, but not cap-and-trade. Although difficult to verify, Exxon's 2007 cautious change in strategy seems related to the ETS, European climate policy targets and the significant attention to climate change that year. On June 21, 2007, the Texas-based company announced the change at the Royal Institute for International Affairs in London. The location was not accidental, as the European audience was clearly a prime target for the company.[18]

Long-term low-carbon solutions

The main importance of the ETS for the oil industry lies in the long-term strategic consequences of

[16] This conflict may be aggravated by the 2009 EU Fuel Quality Directive, specifying the quality of petrol, diesel and gas-oil. Other reasons for low efficiency include unplanned shutdowns requiring extra energy to re-start and drops in demand linked to the global financial crisis: installations have run below full production capacity, hence less efficiently (Shell Sustainability Report 2009).

[17] The company claims that it has stopped funding such organizations, but Greenpeace has challenged this claim (Webb 2007).

[18] According to the company, Exxon's acceptance of the problem of human-induced climate change as a reality and responsibility for helping to find a solution was linked to better knowledge about the causes and consequences of climate change between the 2001 Third IPCC Assessment report and the Fourth Assessment report on climate change in 2007 (ExxonMobil 2007).

carbon pricing. As noted, Shell introduced carbon pricing in projects in 2000 in anticipation of regulated carbon markets. The system prices CO_2 emissions consistently into project economics while recognizing that each investment decision is unique (Shell CDP 2009). The planning premise for CO_2 is $ 40 per tonne. While this figure is not a forecast, Shell uses it in economic modeling before taking investment decisions. It helps to lower CO_2 emissions by building measures into the design of new projects to avoid expensive retrofits. The main consequence of incorporating carbon costs linked to the ETS is that it makes projects in Europe emitting less CO_2 more beneficial. This approach has, according to Shell, helped to drive the design of new facilities or expansion of existing facilities towards optimal performance (Shell CDP 2008: 18). With a price on carbon, new installations will be designed more energy-efficiently.

In 1997, Shell established Shell International renewables as a fifth core business activity, and aimed to become an energy company by capturing a 10% share of the renewables market before 2005. Shell divested itself of its forestry business and in 2006 sold its entire silicon-based solar panel business (Shell Sustainability Report 2005: 13). Shell is still involved in some wind projects in Europe and North America, but in 2009 announced its intention to terminate all new investments in wind, solar and hydrogen energy, and focus on oil, gas and biofuels (*The Times* 2009).

While Shell has stepped down in renewables, carbon capture and storage (CCS) has become increasingly important in its climate strategy. With 414 patents, Shell is the second-largest patent holder of carbon capture technologies (Lee et al. 2009: 39).[19] It is involved in various demonstration projects to develop CCS technologies, as well as in plans for full-scale CCS projects. As the company sees it, the future of CCS depends on its becoming financially viable and widespread, which will require a sufficiently high CO_2 price. Shell participates actively in the International Emissions Trading Association (IETA) which promotes emissions trading around the world: indeed, Shell's climate-change advisor is the IETA vice-president. Since 2005, Shell has spent $2 billion on CCS and alternative energies, including biofuels (Shell CDP 2010).

Perhaps the most concrete example of innovative consequences of carbon pricing has been Shell's CCS plans for the Pernis refinery in Rotterdam. The intention was to capture 400,000 tonnes of CO_2 a year, which at a CO_2 price of €20 per tonne would deliver annual revenues of €8 million (Shell CDP 2010: 12). Pernis, Europe's biggest refinery, has a track record of innovative solutions. In 2005, the refinery started supplying pure CO_2 to local greenhouses (Shell Sustainability Report 2005:10). This project was technologically feasible and economically profitable because of the carbon price, but proved politically unacceptable. [20]

The EU ETS has stimulated Shell's growing activity in CCS. First, it is considered by the European Commission as the principal policy instrument for facilitating future CCS projects within the EU (IEA/OECD 2008: 118). The ETS recognizes captured CO_2 emissions as CO_2 that is not emitted. In addition, the revised system adopted in 2008 mandates the use of 300 million allowances from the New Entrant's Reserve (NER-300) to support up to 12 CCS demonstration projects and projects demonstrating renewable energy technologies. These financial resources are linked to the EU-led Technology Platform for Zero Emissions Fuel Power Plants (ZEP) on CCS technology (ZEP 2008).[21] Shell holds the chairmanship in ZEP.

Shell has produced long-term scenarios since the 1970s. The long-term scenario "Energy 2050" envisions two possible futures (Shell Energy 2008). In the Scramble scenario, greenhouse gas emissions are not seriously addressed until there are major climate shocks. In the Blueprint scenario, GHG emissions are addressed by a price on a critical mass of emissions, giving massive stimulus to the development of clean technologies. Shell has indicated a preference for the interaction or collaboration between state and society actors underlying the Blueprint scenario, and is convinced that this scenario can be achieved with the right mix of policy and technology, though it will not be easy.

As for Exxon, it has not reported factoring in a specific CO_2 price. However, the company conducts "sensitivity" analyses in evaluating capital projects where GHG emissions and regulations

[19] Carbon capture is necessary for storage, but has mainly been used in various industrial contexts such as enhanced oil recovery.
[20] In November 2010, the Netherlands ended Shell's CCS project in Barendrecht, mainly due to local opposition.
[21] In June 2010, the EU launched the first-ever European Industrial Initiatives (EII) comprising CCS, wind, solar (photovoltaics & concentrated solar power) and electricity grids.

are also included (ExxonMobil CDP 2009: 32). Like Shell, ExxonMobil invests in fundamental R&D on long-term GHG emissions reduction, including gasification, biofuels, CCS and hydrogen. Exxon is a founding sponsor of the Global Climate and Energy Project at Stanford University, focusing on breakthrough energy technologies. Since 2005, Exxon has invested $1.3 billion in activities to improve energy efficiency and reduce GHG emissions (ExxonMobil CDP 2010: 32) – a significant increase, according to the company. Exxon was the first oil company to explore CCS technology (Tjernshaugen 2010). It is also the world's top carbon-capture patent holder, with 978 patents (Lee et al. 2009: 39). ExxonMobil participates in the CO2ReMoVe project under the 6th EU Framework Program for Research, aimed at developing and demonstrating methods for monitoring CO_2 storage in geological reservoirs. An important goal is to formalize a European methodology for qualifying CCS in EU ETS (CO_2 REMOVE website). Exxon's participation includes financial support and the provision of expert technical guidance.

In contrast to Shell and despite long experience with CCS, Exxon has been hesitant in exploring CCS in collaboration with public authorities and less eager to promote commercialization (Tjernshaugen 2010). Exxon does not participate in the EU-led ZEP or the IETA. It produces forecasts in the form of Outlook for Energy, used to assess the business environment and future investments. The major change in these forecasts after the ETS is that climate policy has gained prominence (ExxonMobil 2009; 2010). The ETS, the European carbon market, and the possibilities of diffusion to the USA and elsewhere are important reasons why Exxon includes climate policy and carbon prices in its forecasts. Climate change and an expected increase in carbon prices underpin Exxon's R&D strategy with regard to CCS, energy efficiency, and natural gas.[22]

The upshot is that Shell responded enthusiastically to the initiation of the ETS as a new business opportunity, whereas ExxonMobil actively perceived it as a regulatory risk and opposed the system. With regard to short-term abatement, both companies have strengthened ongoing energy efficiency programs, Exxon has, as Shell, implemented MRVs and cautiously changed it strategy in a more "offensive" direction. However, the principal importance of the ETS for the oil industry lies in the long term strategic consequences of carbon pricing that may diffuse to other parts of the world. For the long-term, Exxon foresees higher carbon prices and has stepped up low carbon R&D, advanced biofuels, CCS and natural gas investments. Shell's development is more mixed. On the one hand, Shell has tempered its once innovative ambition to become an oil industry leader on renewables. On the other hand, Shell has increased low carbon R&D and cooperation to make CCS commercially viable and is still engaged in wind power. The development in strategies of Shell and Exxon are thus somewhat mixed, but can generally be characterized by *convergence* over time, including elements of innovation. The ETS has — to different degrees — been an important driver for these developments.

4. Company-internal and wider external factors

The development of the strategies of Shell and ExxonMobil is somewhat mixed, but can as noted above generally be characterized by convergence over time, with the ETS as an important factor. Still, there are also some striking differences: Why did Exxon and Shell respond differently to the ETS? Why did Exxon initially oppose the system and then adopt a more offensive stance? Why did Shell lose some of its enthusiasm, particularly regarding renewables? And why is Shell more engaged than Exxon in commercially-oriented joint EU innovation on CCS?

As both companies have received relatively generous allocation of allowances for free, differences in regulatory pressure are unlikely to explain the varying responses. We start with other external factors than the ETS. Both Exxon and Shell are high-profile multinational oil companies exposed to range of risks and opportunities worldwide. Both have to deal with regulatory diversity in all the countries they operate, and have experienced significant public criticism related to social and environmental incidents and accidents (Skjærseth and Skodvin 2003; Skjærseth et al. 2004). High exposure to society and public activity are important for understanding how these companies behave, but unlikely to explain differences in their ETS response. However, the national context of ExxonMobil and Shell's home-base countries has been found to be an important explanatory factor

[22] In 2009, Exxon bid $41 billion for XTO, the largest natural gas producer in the USA and a leader in the development of unconventional oil and gas supply. The merger was completed in 2010.

for Shell's adoption of a proactive climate strategy and Exxon's reactive strategy prior to the ETS (Skjærseth and Skodvin 2001 and 2003; Levy and Kolk, 2002). In Europe, relatively high public demand and governmental supply of climate policies based on public–private participation informed Shell's offensive strategy. Shell is a Dutch–British company – based in two countries that have long supported the idea of emissions trading in Europe. In the USA, the national climate policy context facilitated Exxon's strategy of resistance, but it was also shaped by Exxon's political strategy (Skjærseth and Skodvin 2003, Meckling, 2011). Different strategies adopted before the ETS fed into these companies' initial responses to the ETS.

Company-internal factors are equally important for understanding ETS response and wider climate strategies. Carbon intensiveness is, however, unlikely to explain the differences, as both companies have quite similar portfolios, their key business areas being oil and gas exploration, production, and refining. The concept of dynamic capabilities may provide more insight. Shell and Exxon are both highly innovative companies in the petroleum industry. Both have increased R&D investment steadily from 2003 to 2008. In 2009, Shell was investing most in R&D of the EU oil and gas majors, and ranked 33 among the top 1000 EU companies independent of sector. The corresponding figures for ExxonMobil were no. 2 of the non-EU oil and gas companies and 74 in the top 1000 non-EU companies independent of sector (EU Industrial R&D Investment Scoreboard 2010). High R&D expenditure is in line with our observations on both companies' involvement in innovation, particularly CCS and advanced biofuels.

ExxonMobil is often described as a "super-tanker" that sticks to its core business and changes course only gradually. It is also a highly centralized concern, with all major investment or strategy decisions taken in Irvine, Texas. Between 1993 and 2006, ExxonMobil was led by Lee Raymond, known for his top–down management style, and described as a conservative corporate leader notoriously skeptical to governmental intervention. He has reportedly branded European suggestions that Americans should use smaller cars as neo-colonialism: "Most Americans like to make that decision themselves – that's why they left [Europe]" (Skjærseth and Skodvin 2003: 97). Exxon kept to its core oil and gas business and refused to consider new business opportunities from climate change policies, indicating weak dynamic capabilities.

In 2006, Raymond was replaced by Rex Tillerson as both chairman and CEO. The green movement saw some hope in Tillerson, who couldn't be worse, they believed, than Raymond. That same year, Tillerson stated that the company could have done a better job of putting forward the climate case (*Sox First* 2006). Moreover, Tillerson to a greater extent communicates the reasons for his decisions, emphasizing climate-change knowledge. Exxon's more offensive strategy, with a prominent role for climate policy, can thus partly be understood as an exercise in adjusting the rhetoric to actions and knowledge with energy efficiency and CCS clearly linked to climate-change mitigation. A more offensive strategy was also facilitated by a change in the regulatory context with the EU ETS and EU climate policy, as noted above. Still, this has not been sufficient to shift the company's core business routines into active engagement in commercialization of CCS in collaboration with the EU. This is in line with our expectation that the most innovative strategic response can be expected from companies already equipped with strong dynamic capabilities.

Shell is more "outward-looking" than Exxon and has aimed to transform itself into an energy company by means of high ambitions in renewables.[23] However, the global financial crisis delivered an external shock that can help explain Shell's termination of new investments in renewables. Company results show a drop in income from $26 billion in 2008 to $13 billion in 2009. Returns on average capital employed decreased from 18.3% in 2008 to 8.0% in 2009 (Shell Annual Review 2009: 6). In the words of Shell's CEO, "Our 2009 earnings were sharply reduced by the recession, despite Shell's self-help programs and $2 billion of costs savings. Although oil companies have been cushioned from the recession by OPEC's action on quotas and oil prices, Shell has been disadvantaged recently, due to our higher exposure in to refining and natural gas, where margins are hard-wired to the

[23] For example, Shell responded to the widening Corporate Social Responsibility agenda before the introduction of the ETS by emphasizing the fight against corruption, support of the Universal Declaration of Human Rights, and collaboration with NGOs and international organizations (Skjærseth et al. 2004).

economy".[24] Shell responded to the downturn by restructuring and becoming more competitive (Shell Annual Review 2009). The decision to drop new investments in renewables was part of this process. According to Shell's head of gas and power, "wind and solar struggle to compete with other investment opportunities we have in our portfolio" (*The Times* 2009). Shell's termination of new investment in renewable indicates that although strong dynamic capabilities matter, profit decides.

5. Brief analysis

The first and most parsimonious "reluctant adaptation" perspective held that companies would oppose the initiation of the ETS; that compliance strategies will depend on what pays off in the short term, and that no new long-term, large-scale climate innovation will be initiated.

The ETS was the first mandatory international climate policy instrument that directly targeted oil companies' CO_2 emissions. Importantly, the actual distribution of costs was uncertain when the system was developed, so companies' initial response strategies were shaped by *expectations* of regulatory pressure and carbon prices. ExxonMobil and Shell responded markedly different ways. The European oil major Shell supported and participated actively in the initiation of the ETS, while US-based ExxonMobil lobbied against mandatory regulation, including the ETS. Only to a very limited extent can this difference in response be traced back to differences in regulatory pressure and risks.

Allocation of allowances has been roughly balanced between emissions and caps, but rising electricity prices partly as a result of the ETS have added some pressure. As regards short-term abatement, neither company chose deliberate non-compliance as a response strategy. This is consistent with expectations, as the penalties for non-compliance have been significantly higher than the market price for allowances. A profit-maximizing manager would not choose non-compliance. Despite Exxon's initial opposition, the company had to accept that the ETS was adopted. Both ExxonMobil and Shell have identities as "law abiding companies" that precludes certain options such as bald-faced non-compliance. Exxon has implemented monitoring, reporting and verification activities as a result of the ETS, and the system has provided additional incentives to ongoing abatement programs. Shell's compliance strategy has mainly been a combination of strengthening energy efficiency programs and active trading. These observations are largely consistent with expectations based on the "reluctant adaptation" perspective. What does not fit this perspective is Shell's opportunity-based response, and that both companies are engaged in some long-term large-scale "climate-friendly" innovation.

The second "innovation" perspective, based on the Porter Hypothesis, assumes that stringent and appropriate regulation can help managers discover new innovative opportunities that may benefit the company. Companies would accordingly support the ETS by emphasizing new opportunities, comply by implementing new forms of short-term abatement, and invest in long-term low-carbon solutions.

Shell chose an opportunity-based response to the initiation of the ETS. Seeing the emerging system as a business opportunity, the company aimed at becoming a trading leader within the oil industry. The main reasons can be found in the extended version of this perspective including company-internal and wider external factors. First, Shell expected significant regulatory pressure from the ETS and a relatively high carbon price. Secondly, Shell was exposed to high regulatory risk as a multinational company involved in oil and gas. These conditions can be seen as necessary but not sufficient, as they apply to ExxonMobil also. The third important factor can be found in the notion of 'strong' dynamic capabilities. The ETS fed into Shell's proactive climate strategy already adopted – a strategy partly shaped by Shell's home-base context. This strategy was based on high ambitions in renewables and pioneering implementation of company-internal emissions trading, which positioned it well to benefit from the ETS in a "climate-friendly" direction.

The ETS mainly strengthened and expanded ongoing abatement programs. Shell had introduced carbon pricing in projects already from 2000 in anticipation of the ETS and possibly other regulated carbon markets. In addition to seeing trading as a new business opportunity, Shell has actively promoted emissions trading around the world within the IETA. With regard to ExxonMobil, one observation is clearly in line with the new attention and opportunity way of thinking: the ETS

[24] Shell Media Releases, 16 March 2010, Royal Dutch Shell plc updates on strategy to improve performance and grow. http://www.shell.com/ (accessed 26 January 2012).

mandated monitoring, reporting and verification of emissions, which led Exxon's Rotterdam refinery to play a leadership role in establishing monitoring methodology for the refining industry in Europe. The ETS and change in leadership also contributed to Exxon's cautious change in climate strategy in 2007. Still, these external and internal changes have not been sufficient to significantly alter Exxon's pre-existing relatively 'weak' dynamic capabilities in the context of climate change.

The main importance of the ETS for the oil industry lies in the long-term strategic consequences of a political agreement on carbon pricing which sends a price signal that may be copied elsewhere. The system also encourages CCS, which, in the case of Shell, has led to more R&D and specific CCS projects. Most of these activities are not entirely new to the company, but they include new elements, like Shell's CCS plans for the Pernis refinery and supply of CO_2 to local greenhouses. However, Shell has since terminated new investments renewables due to the financial crisis. With ExxonMobil, the main impact is that the ETS has contributed to step up low-carbon R&D and change Exxon's visions of the future, with a carbon price emerging as an important premise for long-term forecasting and investments.

ExxonMobil and Shell have responded to the ETS with greater attention and awareness, searching for new opportunities and, to varying degrees, by stepping up long-term activities to bring emissions down. Still, responses appear to be less widespread, new or "deep" than might have been expected according to the Porter Hypothesis. These companies remain petroleum companies based on expansion in fossil fuels rather than a low-carbon economy. In the foreseeable future, the main bulk of their investments will still be in fossil fuel exploration and production to meet the rising global demand for energy (Forbes 2011).

The Porter Hypothesis is based on the assumption that regulation should be "stringent" and "appropriate." Porter cites cap-and-trade arrangements like the EU ETS as an example of appropriate regulation. As yet, the system is too new, lenient, and narrow to generate large-scale, concerted and radical low-carbon change in these multinational companies. Caps have not been sufficiently stringent, allowances have been distributed for free, and rules on import of credits have been lenient. In addition, the carbon price has fluctuated significantly (mainly between €10 and €30 /tonne) and the global financial crisis has meant a surplus of allowances and downward adjustment in carbon price expectations until 2020.

Coordination between the ETS and other relevant EU policies exposes sectors and companies to types of regulation that may pull in different directions. Negatively, more stringent regulations to improve fuel quality at refineries will require more energy, entailing higher CO_2 emissions. This dimension has become increasingly relevant with the adoption of the 2008 EU climate and energy package where the ETS will interact at several levels: new policies on renewables, sectors not covered by the ETS, CCS, fuel quality standards, and more stringent car emission standards will affect industry sectors and companies differently. The actual synergy and conflict between these policies will become clearer in the policy-implementation stage. As industry starts to deliver on renewable energy and energy efficiency, the need for allowances under the ETS will go down and allowance prices may fall, actually weakening the incentives for companies to deliver on other climate technology solutions like CCS.

Finally, "appropriate" regulatory pressure from the ETS is also related to the criterion that regulation should be in line with or slightly ahead of other countries, to counter competitive disadvantages. No major rival or partner of the EU (be it China, India, Russia, or the USA) has implemented comparable emissions trading to the EU or equivalent measures or targets.[25] The USA had planned a climate/energy package, including a federal cap-and-trade system, but this stalled in Congress in 2009. Against this backdrop, it has been argued that the EU is moving too fast (MacKillop 2011). Concerns over competitive disadvantages and carbon leakage make a transition from free allowances to auctioning politically difficult. Moreover, tightening the ETS cap to increase regulatory pressure becomes more challenging when others do not follow, and early-mover advantages

[25] Still, some diffusion has taken place. Switzerland, New Zealand and the USA also have emissions trading systems. The USA has one system covering California and one regional system (Regional Greenhouse Gas Initiative, RGGI) covering nine eastern states. A Western Climate Initiative is under development, including California and four Canadian provinces. Emissions trading systems are also being developed in the Republic of Korea, Japan and China (with pilot systems in several cities and provinces).

become less certain. The downstream sector of Europe's oil industry, represented by the industry association Europia, opposes a tightening of the ETS cap. It has recently painted a dark picture of the future of the European refining industry due to regulatory pressure, imbalance between petrol and diesel production and decreasing demand for petroleum products.

7. Conclusion

The EU aims to put Europe on track toward a low-carbon economy by 2050. This will require long-term low-carbon strategies in the private sector. The key climate policy instrument is the EU Emissions Trading System (ETS), aimed at reducing GHG emissions cost-effectively and incentivizing the development and implementation of climate-friendly technology in the sectors and companies covered by the system. This article has explored how ExxonMobil and Shell have responded. Stimulating such major oil companies to adopt innovative solutions is important for to achieve a low-carbon economy in Europe and abroad.

How companies are likely to respond to a regulation such as the EU ETS is a contested issue. Two seemingly competing perspectives have been explored — one expecting reluctant adaptation to regulation and the other expecting innovation. These models each describe well the initial responses of the two companies: Shell viewed the upcoming ETS as new business opportunity whereas ExxonMobil saw the system as a regulatory threat. Over time, however, these companies' response strategies have converged. The salient point is accordingly not whether companies are likely to respond to regulation such as the ETS by resistance or innovation, but under what conditions different responses occur and develop over time. Identifying such conditions necessitates studying company-internal as well as wider external factors. How different types of regulation co-produce response strategies is an important avenue for further research into how the private sector can contribute to a low-carbon economy in the long-term. In this endeavor, the relationship between corporate norm-guided behavior and regulation should be included.

Oil companies base their investments on long-term strategies in the form of forecasts or scenarios. These long-term outlooks indicate that global energy demand and GHG emissions will increase significantly outside Europe and the OECD – and, for the foreseeable future, company investments will focus on fossil fuels to meet this demand. Nevertheless, carbon prices have become important for the type of energy mix they see in the crystal ball. The ETS has affected these companies' expectations of the future and has shown the potential of carbon pricing.

In 2009, the EU's negotiation position towards the Copenhagen summit included an ambition to facilitate an OECD-wide carbon market by 2015 based on the EU ETS and President Obama's intention to create a US cap-and-trade system. The same year, US plans for a federal cap-and-trade system stalled in Congress, and an OECD-wide carbon market now seems unrealistic for the foreseeable future. The ETS has also experienced internal challenges with the economic crisis, which has been "blamed" for an 11 percent drop in EU ETS emissions in 2009 compared to 2008. While emissions reduction will contribute to attainment of the short-term EU 20% reduction goal, the demand for allowances has fallen along with the carbon price, resulting in more permits than needed. Surplus allowances available in the second trading period can be saved for use up to 2020 and traded without any abatement taking place. In consequence, company incentives to invest in new breakthrough technologies may drop alongside the falling carbon price. A weak carbon price threatens demonstration and deployment of e.g. CCS, intended to play a key role in meeting EU long-term climate targets. The EU has tried, unsuccessfully as yet, to tackle this by various measures, including raising the unilateral goal to a 25% cut by 2020, part of which will be taken from tightening the ETS cap.

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