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Lisa Knoll & Anita Engels:

Exploring the Linkages between Carbon Markets and Sustainable Innovations in the Energy Sector: Lessons from the EU Emissions Trading Scheme

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The KlimaCampus at the University of Hamburg brings together social scientists, media scientists and economists, meteorologists, oceanographers and ecologists working on a broad range of issues concerning climate change.

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Abstract

The working paper summarizes results of a research project on company behaviour in the EU Emissions Trading Scheme. The study looks at the first trading phase of the EU ETS and combines quantitative surveys with qualitative case studies in four different countries: Germany, the UK, Denmark and the Netherlands. In this paper, we look at seven company case studies in Denmark and Germany to analyze how emissions trading might trigger sustainable innovations within companies in the energy sector in a systematic way. Four potential channels are identified: the allocation of emission rights by the legislator, the CO_2 trading decisions within the companies, the make or buy-decision in the electricity market, and sustainable innovations through technologies or new organizational processes. We conclude from our case studies that the EU ETS has a potential to trigger sustainable innovations in the electricity sector, but that the outcome of the first trading phase is disappointing in this respect.

Keywords: carbon market, sustainable innovation, electricity sector, EU ETS CO_2 performance, emissions trading

Contents

Introduction: Linking carbon markets to sustainable innovation in the energy sector?

The European Emissions Trading Scheme (EU ETS) is a central instrument of European climate policy and the first large-scale multi-national greenhouse gas trading programme in the world. It was referred to as the "grand new policy experiment" (Kruger and Pizer, 2004). One of the central promises of emissions trading is to provide a price signal on the basis of which companies can calculate whether any shortage of emission allowances should be met with buying more allowances in the trading scheme or with reducing CO_2 emissions. From these micro-rational calculations the most efficient CO_2 abatement at the macro-level will ideally emerge, as emissions will be reduced where the costs for reducing them is lowest – “an epoch-making means of cost-effective control which can solve future global environmental problems” (Svendsen, 1999: 232). Emissions trading thus has a potential to trigger sustainable innovations in the sense that companies face incentives to improve their CO_2 performance (Stankeviciute et al., 2008). Still, the EU ETS has been criticised for many short-comings, among others for *not* providing triggers of innovation decisions in companies due to weak price signals. In a recent study on German companies in the CO_2 market the authors point out that most of the CO_2 reduction measures in Phase I of the EU ETS were only an unintended effect of emissions trading (Detken et al., 2009: 6-7). However, while the price of CO_2 allowances was high in the first year of the EU ETS, some electricity providers mentioned having an incentive to supply electricity from gas-fired plants rather than from more carbon-intensive coal-fired plants (MacKenzie, 2009: 169).

As the link between any emissions trading scheme and investments in more sustainable innovations seems to be a function of the price of the CO_2 allowances, there is a long academic debate about the price level and the specific price mechanisms that would effectively force companies into more sustainable investments (DeCicco et al. 1993; Tonn and Martin, 2000; Grubb et al., 2002; Fischer, 2005; Metz and van Vuuren, 2005). In attempts to model pathways towards a decarbonised global economy it is often assumed that technological progress is induced by relatively high prices of carbon (Barker et al., 2006). A recent study on adaptation and mitigation strategies suggests that the costs for mitigation in Europe especially in the energy sector will turn into investments into a profitable future around the year 2050 "when the cumulative savings of energy imports become higher than the mitigation investments" (Schade et al., 2009: 348). The study stresses that for each of the models providing such an optimistic scenario, carbon will have to be given a price. However, the authors also acknowledge that price signals are not sufficient to deliver the necessary incentives and therefore have to be accompanied by sectoral policies. Market signals always represent short-term incentives whereas system transitions require a long-term perspective. Especially in the European energy sector it is necessary, so the authors recommend, that high and stable CO_2 prices are set to foster the phase-out of CO_2 emitting fossil generation, by either using CO_2 taxes or cap and trade systems (Schade et al., 2009: 354).

While the linkage between prices and induced technological changes is well established in the modelling literature, less research has been done on the question of how exactly these linkages can be conceptualised if one looks at real companies in real emissions trading schemes. Empirical innovation studies have demonstrated a range of effective barriers to the diffusion of available sustainable technologies (e.g. Unruh, 2000), and even more so to the innovation process itself. They demonstrate that innovations cannot be generated easily, and that complex institutional conditions influence the way in which organisations develop innovations (Edquist, 1997; Garud and Karnøe, 2003). These approaches have been rarely applied to the question of sustainable innovations induced by carbon markets. This contribution aims at filling this gap by looking at the various channels through which the price of CO_2 allowances enters a company's decision-making processes.

This paper draws from a 3-years-research project on the emissions trading behaviour of companies under the EU ETS.[1] It focuses on case studies in 2 countries (Denmark and Germany) and in 2 industrial sectors (energy and food). We added the food industry to this article (which mainly aims at understanding CO_2 trading in the electricity sector) because it is an energy-intensive industry, where companies often operate their own power plants. The paper is based on case studies, analysing the emissions trading behaviour of 4 companies from the energy sector and 3 companies from the food industry in Denmark and in Germany:

<u>Energy Sector: Electricity, gas, steam and hot water supply</u>

- German municipal utility A
- German municipal utility B
- big Danish energy provider
- small Danish district heating plant (feeding electricity into the Danish grid)

<u>Food Sector: Manufacture of food products and beverages</u>

- Danish malt producer (beverage industry, feeding electricity into the Danish grid)
- German dairy (operating their own coal-based power generation)
- Danish fish meal factory (energy-intensive production)

The case studies were conducted in 2008 and 2009 when the second phase of the EU ETS had just begun. They aimed at understanding how different economic actors

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[1] The project was funded by the German Research Foundation (DFG) from August 2006 until August 2009 (DFG 488/2-1; 2-2), and conducted at the University of Hamburg, Centre for Globalization and Governance. To create a broad picture of the companies' approach towards emissions trading, the Emissions Trading Study conducted a survey in three consecutive years that was responded by 385 (in 2006), 360 (in 2007) and 315 (in 2008) companies. The survey addresses 4 countries (Germany, United Kingdom, Denmark and the Netherlands) and covers all industries participating in the EU ETS (Engels et al., 2008). In addition to a quantitative approach, we conducted 16 company-level case studies in the 4 countries and in 5 industries.

(from different countries, industries and from different company-divisions) cope with the new decision-making problems and how they transform CO_2 price information into economic, financial, or technological measures. The case studies were conducted via either group discussions or single interviews with the persons responsible for emissions trading. In this paper, we explore the potential linkages between carbon markets and sustainable innovations. The concrete decision-making cases of environmental managers, power traders and plant operators allow insights into the manifold factors that may or may not affect decisions on 'sustainable innovations' at various points in time, and also the arbitrariness of these linkages in the current EU ETS.

The term *sustainable innovation,* which is the common theme of this volume, adopts a rather formal and abstract meaning in the context of this chapter.[2] By sustainable innovations, any kind of *technological* or *organisational* innovation is meant that a company may introduce with the effect of lowering its specific CO_2 emission levels or the CO_2 intensity. We call this the improvement of the *CO_2 performance* of a company. In the field of power generation, several technological and managerial options are already available or at least conceivable, among them are fuel switch options, the temporary closing of power plants, energy management systems, improved efficiency factors, carbon capture and storage, and various forms of carbon offsetting. In this paper, we are interested in the specific linkages of the EU ETS and the companies' decision-making processes by which such innovations might be incurred. These specific linkages can be conceptualised at four different levels. (1) At the first level, initial allocation processes define whether a company is over- or under-allocated with emission rights. Our question is if the allocation mechanism is linked to a company's CO_2 performance. (2) The second level refers to the actual trading behaviour of a company once it has been allocated a certain amount of allowances, and engages in sell-, buy-, or hold decisions. (3) On the third level, we examine the make-or-buy decision of energy generation through the electricity market and its potential linkage to a company's CO_2 performance. (4) At the fourth level, decisions that concern investments in technological or organisational innovations aiming at reducing CO_2 emissions are pointed out. In the following sections we analyse the potential linkages between emissions trading and the case-study companies' CO_2 performance at these four levels (fig. 1).

[2] For a general discussion on the term 'sustainable innovation' see Schwarz et al., forthcoming.

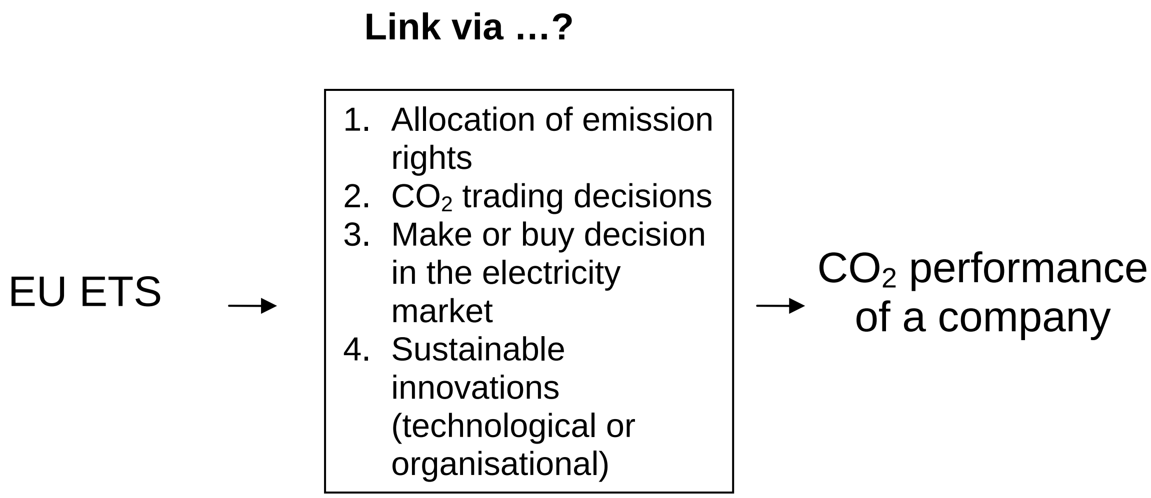

Figure 1: Potential links between the EU ETS and a company's CO_2 performance.

1. Allocation of allowances

One of the basic mechanisms of linking CO_2 trading with the CO_2 performance of a company is the initial allocation of allowances. In the case of the EU ETS, each government is responsible for developing a National Allocation Plan (NAP), which is subject to be reviewed by the European Commission (Ellerman et al., 2007a). Three different ways of distributing the total amount of allowances (cap) to the installations that participate in the scheme are discussed: grandfathering, benchmarking, and auctioning. Grandfathering is the cost-free allocation based on historical emissions. The allocation method considers *absolute* emissions in a specified baseline year only. Benchmarking takes a different approach in which the relative CO_2 performance of a company is taken into account.[3] The CO_2 emissions of a company are compared either with the best available technology or the emission levels of "good performers" in an industry. A relatively good performance is thus rewarded by the allocation procedure. Still, the problem with benchmarking is the heterogeneity of technological and production processes that often hinders comparability (Ellerman et al. 2007b: 352). Auctioning (or the selling) of emission rights allows a Member State to make a revenue out of emissions trading. Even though the EU Trading Directive allowed the auctioning of 5 percent of the allowances covered by each NAP in Phase I, and 10 percent in Phase II, most Member States refrained from auctions and opted for grandfathering as the allocation method of choice (Ellerman et al. 2007b: 362) – despite a critical debate on this allocation method. Michaelowa and Butzengeiger (2005) describe how grandfathering may result in over-allocation, leading to a market with low liquidity and a low CO_2 price. And Neuhoff et al. (2006) criticise that this

[3] For the debate on relative and absolute trading schemes see Kuik and Mulder (2004).

allocation procedure remunerates high emissions and penalises low emissions. The 'dirtier' a company is the more allowances it gets.

In addition to the discussion on the general allocation method, there were complaints about the accuracy of the CO_2 emissions data. Especially in Phase I, the data availability and accuracy was problematic in most EU Member States (Ellerman et al. 2007b: 339-340). In Phase II the data situation has improved, since verified emission reports are available from the first trading period. Even if the overall data situation is much better now – and will be better from trading phase to trading phase – there is a general problem with grandfathering. The allocation method links the cost-free allocation of emission rights to the coincidental capacity utilisation in a certain year. The Danish malt producer in our study, e.g., experienced a significant over-allocation in Phase I, because the company generated a high amount of electricity in the reference year due to temporarily high electricity prices.

> "We were a little bit lucky. They based it [the allocation] on the years where we were running full speed. Everything is, you have to be lucky! That's bullshit, but that's the case!" (Managing director of the Danish malt producer, 2008-06-10)

Competitors in the same industry decided not to enter the electricity market at the same time. They were not running their combined heat and power plant to feed electricity into the Danish grid – for reasons totally unconnected to their CO_2 performance.

> "Our COLLEAGUES[4] in the malting business, who had a co-generation plant much earlier than ours, they were running down. So they have been hit by evaluating the smallest allocation. […] They have been in other… In the beginning you got subsidy also for electricity and therefore they got out of that. So they were not producing so much. So, ah!" (Managing director of the Danish malt producer, 2008-06-10)

This type of miss-allocation still happens in Phase II – in spite of an overall better data base due to verified emission reports. A municipal utility in Germany faced a "lucky" over-allocation in Phase II.

> "I'm glad to say we have an economically sound over-allocation! [...] Because of our manufacturing constellation and a surprisingly positive notice from the DEHSt [German Emissions Trading Authority]. I'll say it carefully, so we have a tremendous over-allocation. [...] We didn't challenge the notice. [...] Of course we were glad. Because of the historical emissions in one installation only one year was made as a reference point, and by chance that was a year with extremely HIGH production portions on our side. Yet, we have on the contrary a small installation, god bless, whose reference point was in a year in which it wasn't running. Logically that means zero. We challenged the notice. But the case isn't decided yet: We're waiting for the outcome. Of course we're unhappy about that, but the over-allocation easily compensates that." (Environmental manager of German municipal utility A, 2009-02-10, translated)

[4] Special intonations are displayed via capitalising words.

The interview sequence with the environmental manager of the municipal utility above-mentioned also shows that filing against under-allocation and accepting over-allocation is an economically suitable practice.

In a Danish fish meal factory, the production load was based on the irregular fishing yields that fluctuate greatly from year to year. Here, too, the allocation outcome was seen to be ‘based on luck’.

> “And the problem is that for a company like ours, our production is very much dependent on the raw material. It will change a lot year for year. So, it's not really when we get FREE allowances based on historical data. It has nothing to do with the future. So for us, it would be much better if you would get the free allowances based on some KEY data, or something like that. […] It's based on luck and it sounds, for us it's not really, it does not feel right that actually these free quotas represent a lot of money and that these big values are given out based on luck. It doesn't feel right, I must say. But that's how it's done.” (Energy engineer of a Danish fish meal factory, 2008-06-11)

The member of the management board of a German dairy that was under-allocated in both Phases I and II also mentions the missing link between the allocation procedure and the CO_2 performance. The company produces its own (cheap) energy in a coal-fired co-generation plant for its energy-intensive processes to manufacture dried milk products for the world-market.

> “For us energy costs are a major factor and therefore we’ve been using co-generation for 25 years now. For us it’s nothing, nothing extraordinary. And therefore the discussion [on emissions trading] was a bit funny. Especially there weren’t any suggestions for energy IMPROVEMENTS. That was pretty curious. [...] Today we have an efficiency of 85 percent in the boiler. Let’s say it this way: the others have TO GET THERE first.” (Technical board of management of a German dairy, 2008-04-14, translated)

As the emissions trading regulation does not differentiate between industrial sectors, but between *activities,* the coal-fired steam boiler of the dairy company is regulated like a steam boiler in the energy sector (Ellermann et al., 2007b: 358). That means that in Phase II were the energy sector in total has been under-allocated to the advantage of other industries, the dairy is regulated like an energy sector company. This case again shows that the allocation mechanism does not reward a ‘good’ CO_2 performance. The absolute emissions of the dairy are significant, since its production processes are based on coal combustion, but on the other hand the processes are highly energy efficient in terms of a high efficiency factor and the possibility to burn organic waste.

The fact that the initial allocation does not adequately reflect the individual CO_2 performance of a company makes emissions trading a rather crude mechanism to promote sustainable innovations at that level. Instead, it fosters a pragmatic (and sometimes fatalistic) stance over emissions trading. EU allowances – in the perception of those managers – are not allocated as a result of good or bad CO_2

performance, but based on the ‘luck’ or ‘bad luck’ of a full or low production in the baseline year. Their capacity utilisation in the base year was – by chance – either unusually high or low. In the energy sector, this can be due to a number of reasons, such as temporarily high or low market prices, temporary breakdown of plants and due to the weather.

2. CO_2 trading decisions

Once the application process is completed and the emission allowances are on the companies’ accounts, managers have to find ways of calculating those virtual assets. In this section we want to shed light on the link between CO_2 trading and CO_2 performance based on concrete decision-making cases. Here, in theory, the market price of carbon allowances should be held against the costs of improving a company’s CO_2 performance. The principal observation drawn from our case studies is that trading decisions are often decoupled from the companies’ CO_2 performance. This can be seen in cases of over-allocation as well as under-allocation.

In cases of under-allocation companies have to find ways of managing their own demand of emission rights on a regular basis. Each trading year ends with April 30th when operators have to surrender the amount of “used” allowances to the Environment Agency. The German municipal utility B decided for a month wise calculation of its CO_2 demand. Allowances are bought when the month wise calculation indicates a demand. This means that CO_2 is bought when CO_2 is emitted and that the CO_2 trading decisions are tied to the company’s CO_2 performance. Still, the power trader perceives this demand oriented buying strategy to be a “risk-strategy”: Buying allowances at the end of a trading year would entail the risk of a high CO_2 price in April when allowances must be surrendered. The buying decisions at the municipal utility B are thus much more concerned with avoiding the price-risk than with calculating CO_2 emission reductions.

In the German municipal utility A, which faced under-allocation in Phase I, we found trading decisions that are completely decoupled from any kind of demand calculation or CO_2 performance. In addition to the demand calculation, the power trader used a certain amount of allowances to speculate on the price gaps in the CO_2 market for the purpose of revenue-making.

> “And then, suddenly, there were price fluctuations on the CO_2 market. That’s when we said, we’ll try to SELL them, and if the prices go down, we’ll buy them back, to, to, just to play around a little bit.” (Power trader of the German municipal utility A; 2008-07-30, translated)

The same German municipal utility faced over-allocation in Phase II and discussions started on what to do with the extra-money. The environmental manager issued a proposal for giving that extra-money into a climate change fund. That proposal is likely to be rejected because of deficits at other municipal divisions, e.g., public transport.

> "The main problem is not only the climate activities, but also high prices and the encumbrances and so forth. Or the overdue investments, which need to be taken, all the way to maintaining public transportation and the losses made by the public swimming pool. One becomes very creative, when dealing with unexpected extra-money." (Environmental manager of the municipal utility A, 2009-02-10, translated)

A small Danish district heating plant used its over-allocation in a similar fashion for balancing its budgetary deficits. The district heating plant is owned and controlled by the customers that are provided with heat from the combined heat and power plant. When the price for electricity is right, the energy manager generates electricity and extra-income for keeping down the price of the heat. CO_2 allowances are an additional commodity that the manager could use to subsidise heat. The duty of the energy manager of the company is to keep the price of the heat as stable and as low as possible. The aim is a balanced budget: neither too much profit, nor too much loss. In both cases the energy manager would have to explain the difference in income to his clients. Under the condition of an unsteady gas price this is a rather difficult target. Therefore, the manager of the district heating plant made a swap of EUAs into CERs to use the revenue in order to avoid "red numbers" in his yearly budget.[5]

> "I think we had nothing to lose in making this conversion to CER quotas. That was a GOOD thing for us and then we got some extra money and we got the same quotas. So there was nothing to lose. The only risk we had was that the quotas will have a higher price in about half a year. But it's in this month we need the money because our budget here is running from the 1st of June till 30th of May." (Energy manager of the small Danish district heating plant, 2008-06-13)

As allowances are treated as assets and/ or financial products, companies tend to solve other than environmental problems with emission rights.

3. Make-or-buy decision on energy generation

In the electricity market, CO_2 has become an automatically calculated cost factor along with coal, gas and oil. In this chapter, we assess the link between the daily market-based decision on whether to run a power plant. To understand this daily make-or-buy decision, one first has to understand the European electricity market. The liberalisation of the EU electricity markets in the aftermath of the EU Directive of 1996 confronted the power providers with exchange-based energy trading. Even for

[5] A Certified Emission Reduction (CER) is a certificate that is generated under the so-called 'Project-based Mechanisms' (CDM and JI) that have their legal origin in the Directive 2004/101/EC which is amending Directive 2003/87/EC. CERs used to be cheaper than EU allowances. Now it is possible to cash in on the price difference by so called swap deals.

the chief power trader of the Danish energy supplier, liberalisation meant learning to regard electricity as a financial product.

> "Everybody started to look at trading as part of their business. And everybody had to learn it from scratch. It has always been just producing power and buying and selling physical power. But now it became more evident, that financial trading would be a part of what these companies would be doing." (Power trader of a big Danish energy provider, 2008-09-01)

The duty of an electricity trading department is to optimise the daily make-or-buy decision based on price signals. At the European energy exchanges, electricity is traded one day ahead (spot market) and in the form of future contracts (forward market). Electricity producers thus plan on the basis of the forward market price and take a make-or-buy decision concerning their own electricity generation every day. This interplay between spot and forward market establishes planning security under the circumstances of a volatile electricity price.

Market-based decisions on the power plant operation are complex and necessitate support in terms of trading know-how. In Denmark, small energy providers have been obliged to mandate an electricity trading company in helping them with their daily make-or-buy decision.[6]

> "We were told by the GOVERNment to HAVE a company to administrate this selling of electricity every day." (Manager of a small Danish district heating plant, 2008-06-13)

The Danish government assumed that these smaller companies did not possess a sufficient level of expertise in energy trading and obliged the companies to employ trading service providers, which furnish the daily prognosis of the electricity prices. The prognosis entails items like the current electricity price, the weather prognosis (wind and rain), and the prevailing power plant capacities. The second basis for deciding whether to produce electricity or not are the own production costs that entail the price for either gas, coal and/ or oil, the CO_2 price and may also entail the US Dollar exchange rate. The manager of the small Danish district heating plant receives the prognosis of the energy price development by its electricity trading company every morning. It shows the electricity price prognosis on the basis on which the manager makes his daily make-or-buy decision. Hence, the manager also has to decide whether he trusts the prognoses or not.

In bigger energy corporations, those functions are spread across numerous organisational departments. The case of the big Danish energy supplier shows the organisation of the price-based electricity production via different departments. The

[6] In 2007, the Danish energy market has been liberalised so that even small combustion plants can sell their surplus energy on the electricity market. Today, the Danish energy market not only covers typical energy suppliers, but also other industries which generate electricity as a by-product. This means that many small Danish providers of district heating (often with less than 4 employees) and many companies of other energy-intensive industries (like the food industry) feed electricity into the Danish grid.

company covers many installations and thus is divided into various divisions and responsibilities. First of all, there are the power plants that focus on surrendering emission allowances at the end of each reporting year. Second, a department manages the physical electricity sales and purchases. The demand for CO_2 emission allowances is calculated and purchased according to the amount of electricity that was sold on the forward market. Third, a power trading department is responsible for trading financial products and serves “as a bank to the whole organization” (Power trader of a big Danish energy provider, 2008-09-01). All company divisions calculate their positions themselves (e.g. gas, electricity, CO_2) and then trade those positions into the central power trading department. Surplus is sold, demand is bought. The power-trading department then trades those positions into the global/ European commodity markets. That means that the managers at the power generation plants need – like the small Danish district heating plant – to make a decision on a daily basis whether to produce electricity or not. This is based on a price prognosis, the power generation capacities, and cost calculations.

CO_2 has come as an additional factor that is included into the daily decision-making procedure on running or not running an installation the next day. Via the daily make-or-buy decision, electricity-generating companies decide on the ‘cheapest’ way of generating electricity, which is not automatically the ‘cleanest’ way. Principally, that means that coal and nuclear based electricity production is the most favoured. If the emission of one ton of the greenhouse gas CO_2 is not costless any more, burning fossil fuel is less attractive from an economic point of view. Still, the daily make-or-buy decision and any possible CO_2 reduction effect is linked to the electricity generation capacities in the electricity market. The case studies presented here are part of the Scandinavian (Denmark) and the Continental European (Germany) markets. The Danish electricity market depends very much on natural circumstances like rain in Norway and Sweden (hydroelectric installations) and wind in Denmark (windmills). In case of heavy weather (rain and wind), the electricity price declines and the conventional carbon-based power plants generate less energy. The German electricity generation, on the other hand, depends very much on the coal price due to its large capacity to generate electricity in coal-fired plants. If the coal price is low, German coal-fired power plants generate more electricity. More than 50 percent of the verified CO_2 emissions in Europe stem from the four big German energy suppliers RWE, E.ON, Vattenfall Europe and EnBW (Schafhausen, 2006: 4). Additionally, the German withdrawal from the nuclear energy programme *(Atomausstieg)* through the social-democratic/ green coalition leads to a support for coal-fired energy-production. That means that the steering effect of the market in terms of environmental performance depends on the ‘clean’ and ‘dirty’ capacities that a national economy provides.

With the introduction of the EU ETS, the burning of fossil fuels should have become more expensive. This implies that electricity-producing companies have to decide, on the basis of their technological capacities, which installation to run and (if technologically possible) which fuel to burn. The steering effect of the EU ETS should therefore, theoretically, lead to a shift towards burning ‘cleaner’ gas instead of ‘dirty’ coal. However, this decision-making process on the company level not only depends on the price for CO_2 but also on the price for coal, gas and on the weather. We will now present a calculation that has been made within a power-providing company. The decision-makers at the German municipal utility B systematically addressed the question of a fuel switch for their own installation park. They came to the conclusion that the price constellation (gas, coal, CO_2) is not supporting the switch from coal to gas.

> “The reaction we had on CO_2-trading is basically the fuel switch from coal to gas, because of CO_2 reasons. We HAVE the possibility to do that in our co-generation plant. We never USED it, BECAUSE coal plus CO_2 was still cheaper than gas and CO_2. That’s why we have theoretically the opportunity in our plant, also in plant XY, yet we never engaged it, because it never was, it has been estimated so many times, it never paid off financially to switch from coal to gas. […] Or let’s say it like this, the price of gas isn’t low enough, or the price for coal isn’t high enough. Therefore one of the prices isn’t right.” (Power trader of the German municipal utility B, 2008-01-15, translated)

The environmental steering effect of the EU ETS unfolds as a by-product of economic calculations at the company level.

4. Investment decisions

This chapter is on “sustainable innovations” in terms of investments in CO_2 reducing technologies at the company level. While make-or-buy decisions and fuel switch decisions imply price observations at power-trading departments, there is another form of *reducing* CO_2 emissions: the reflexive, extensive, and long-term investment in innovations. We will discuss *technological* and *organisational* innovations and their link to emissions trading. We ask how ‘sustainable innovations’ can be directly attributed to the companies’ participation in the EU ETS in our case studies. We found that concrete CO_2 reduction measures have been implemented due to high energy costs (e.g. gas prices) or have been implemented because of other state policies (e.g. energy efficiency agreements with the Danish government), but hardly due to the companies’ participation in the trading scheme.

Technological Innovations

In our quantitative survey (Engels et al., 2008) we asked whether companies invested in technological solutions to reduce CO_2 emissions. Less than one fourth of the responding companies of the German energy sector said so. In Denmark, about one third of the responding energy providers claimed investments in CO_2 abatement measures towards the end of Phase I. In both countries, however, the majority of the responding energy providers did *not* invest in CO_2 reduction measures during Phase I of the trading scheme.

Drawing from the case studies we gain a more detailed picture of the potential link. In the Danish district heating plant, the CO_2 emissions abatement was achieved via a technological innovation in the year 2006. In this case, the CO_2 emission reduction was a side effect of an investment which saved a lot of money. The district heating plant invested in a new flue gas heat exchanger, due to high gas prices. Rising gas prises and the Danish CO_2 tax were the decisive factors for this investment decision. The impact of the EU ETS was only marginal. The calculated extra cost per unit of gas caused by the tax has been 10 times higher than the calculated extra cost caused by emissions trading. This calculation points at the necessity for a high price for burning carbon to make investments into cleaner technology attractive from an economic point of view.

In terms of 'sustainable innovations' the Danish energy tax (also called CO_2 tax) had another advantage. The energy engineer of the Danish fish meal factory points out that the company had been investing in cleaner technology earlier because of the Danish so-called 'Voluntary Agreements on Energy Efficiency' that had been established in the aftermath of the discussions on climate change mitigation in 1996. These agreements are linked to CO_2 tax rebates and thus provide an incentive for the companies to invest in energy efficient technologies. Furthermore, a large share of the tax revenues was used for energy efficiency measures. Companies could apply for a fund to enhance their energy efficiency. Additionally, the state provided a portfolio of standard measures that could easily improve energy efficiency.

> "We DID several projects and got also money for several projects. […] The biggest project was that we bought a new evaporator. [...] It was driven by actually waste-heat, the earlier we had, we had to supply energy for it. So just by using this single evaporator, we could save 20% of our total energy. […] And we had some money for it from this fund that was based from the carbon tax. We also made some smaller investment. We changed some motors and changed some faints, some smaller things. It was more standard." (Energy engineer of the Danish fish meal factory, 2008-06-11)

The case of the Danish fish meal factory points to the fact that money which is spent on buying allowances in the EU ETS is not necessarily directed into carbon abatement measures. The Danish state fund, on the other hand, gave the government the possibility to support companies to improve their CO_2 performance. The money that is traded at European energy exchanges or via traders and brokers cannot be channelled along political priorities.

Another example of a 'sustainable innovation' has been planned under the so-called 'Project-based Mechanisms'. The environmental manager of the German municipal utility A organised carbon abatement projects in South America to generate Certified Emissions Reductions (CERs) that could be used and traded in the EU ETS. His personal interest was not to generate allowances, but to develop projects which have a positive effect on the environment. The project was well advanced to the point that all required letters of intent and the agreements with investors had been collected. But then the price for CERs dropped due to the financial crisis and the projects had to be put on hold.

> "The CDM [Clean Development Mechanim] projects which have either been taken over or the CDM projects which were profitable because of other reasons and were CDM was sort of mounted upon; they have a chance of being realisable. But everything else doesn't. […] After July, the CO_2 prices went principally downhill. [...] We were ready but the financial crisis intervened. The investor told us to wait a little. And during our waiting prices kept falling. [...] You would need an investor calculating with 18 [to establish an environmental suitable project] [...] and now you can work with 7, at the highest, if you include a distribution of risk, which is... That's just a huge difference." (Environmental manager of the municipal utlity A, 2009-02-10).

This example shows the dependence of CO_2 emissions reduction planning on high prices and price stability. The CO_2 price of the EU ETS unfolds in a rather volatile and incalculable way (Convery and Redmond, 2007). Long-term planning processes for 'sustainable innovations' involve various actors and financial and technological planning. A volatile CO_2 price development makes such calculations a rather uncertain process. In Phase I, the significant over-allocation with emission rights induced a price drop; and in the beginning of Phase II, it was the global financial crisis that caused an unforeseeable price drop. One of the main characteristics of a technological innovation is its planning dependency, which is threatened by instable and unforeseeable price developments. Emissions trading is seen as a major political instrument for reducing CO_2 emissions, but the market volatility might become an obstacle to long-term investments in 'cleaner' technologies.

Organisational Innovations

Organisational innovations are another possibility to look for ways of improving a company's CO_2 performance. We will discuss environmental management systems as an *organisational innovation*. Environmental management systems aim at committing a company's employees to evaluate, manage and to improve the respective environmental and/ or energy-efficiency performance.[7] The implementation of such an organisational innovation does not automatically lead to a better CO_2 performance. Such management systems could lead to 'green washing', but they could also lead to the visualisation and thus to an addressability of environmental problems, or to substantial environmental improvements. In Denmark, the government supported such systems at the company level via its 'Voluntary Agreements on Energy Efficiency'. In Germany, the energy providers opposed the idea of industry-wide environmental management and audit systems. They negotiated with the German government against such a regulation in favour of voluntary agreements.

[7] For the sociological discussion on accounting and the environment see Hopwood (2009); Lohmann (2009); Engels (2009).

„There were overall three industry commitments. The first was broadly recognised and signed. The second one, the kind of PRETTY controversial one, that was with the 25 percent reduction until 2005, the one with this specific value. And there’s a protocol notice from the government in which is stated that the government, on the other hand, if the industry signed this commitment, would dispense with the so-called energy audit. This energy audit resulted from a recommendation in the EU’S White Paper, which should be converted into national law. And that’s when the energy providers suddenly felt a strong panic rise. And that resulted into this horse-trading.” (Environmental manager German municipal utility A, 2008-04-23, translated)

Environmental management systems are thus much more common in Denmark than in Germany. Despite this general opposition, one of the German municipal utilities in our study implemented such a system. As a consequence of this, the utility’s CO_2 emissions were documented even before the EU ETS started in 2005.

“The system works like an ecological controlling, maybe a bit more, because we ourselves are the developers. Not only do we control, but we naturally want to encourage and help. This means that the ecological programme yearly pursued by us, with I’ll say between fifteen and forty measures invoked by us, will be coordinated with the ones responsible. Afterwards the implementations are almost all watched over. [...] There’s money in that. (Environmental manager of the German municipal utility A, translated)

In 1996, the Danish malt producer implemented an energy management system that focuses on energy efficiency. Since then, the company has invested a lot into energy efficiency measures.

“If you make an agreement for energy management, which we have had since the beginning, than you can save most of that CO_2 tax. […] Energy saving agreement, today it’s called the energy management. So DOS 24 and 3, that’s the standard. […] Then you have to set up some targets for energy savings, you have to have a company coming in, going through. We had that several times, but also have some specialists coming in, saying here and here and here you can do some savings, and then you make like an ISO System. You make some programmes, and then we have had more than 100 programmes, more or less. So it’s been good for us, because we have actually saved quite a lot of energy. And at the same time, we don’t have to pay this tax. So we have focused, have HIGHLY focused on energy. […] It’s also a big money question.” (Managing director of the Danish malt producer, 2008-06-10)

With respect to the questions on how the emissions trading system affects decisions on CO_2 emissions reductions, the manager of the company answered:

“We don’t plan in CO_2 we plan in energy reductions.” (Managing Director of the Danish malt producer, 2008-06-10)

Energy management systems usually are combined with some kind of external control but also with expertise on energy efficiency potentials. The Danish fish meal factory also profited from the consultancy that is provided if a company joins the voluntary agreements on energy efficiency (see chapter on technological innovations). In these cases the ‘good’ CO_2 performance depended on the interplay of price signals (high energy costs), financial incentives (reduction of the CO_2 tax), the input of consultancy and know-how, and a regular documentation (control) of the progress. This demonstrates that a company's CO_2 performance may also depend strongly on social, legal, and organisational factors, like institutionalised decision-making tools.

The topic of 'accounting for carbon' and thus the internalisation of the CO_2 abatement at the organisational level is a vital one, due to the fact that the emission of one ton of the greenhouse gas CO_2 got a price. Projects like the Carbon Disclosure Project (Carbon Disclosure Project, 2009) and auditing companies (PWC, 2009; ACCA, 2009) develop and distribute tools for accounting for carbon. Such developments are the consequence of a price building mechanism. Furthermore, they show that the simple fact that CO_2 is not priceless any more is not easily transformed into organisational carbon calculations. The internalisation of external costs via prices is a rather complex undertaking that has to be managed and made manageable first. Moreover, the cases at hand indicate that a trading system is not the only way to foster institutionalised ways of accounting for carbon. Still, the expectation of a price may foster the economic calculation of something that was not represented in business decisions at all.

Quintessence

The path towards a so-called 'low carbon society' may be pursued by adopting various mechanisms, technologies and regulations. This article examined the EU ETS and its potential linkages to a company's 'CO_2 performance', with a special focus on the energy sector. The question was how and to what extent economic actors transform the price signals from CO_2 trading into company-level CO_2 reduction measures. This paper is based on qualitative case studies and does not argue at the aggregate macro-level of the 'cap and trade' system. It aimed to shed light on four levels at which CO_2 trading possibly constitutes a link with the CO_2 performance of a power company: (1.) the allocation mechanism, (2.) the CO_2 trading decisions, (3.) the make-or-buy decisions in the electricity market, and (4.) technological and organisational innovations. In general, we found that the link between CO_2 trading and the CO_2 performance is rather weak and depends on several organisational and institutional circumstances that are external to the CO_2 market.

(1) Several companies in our case studies criticised the missing link between the allocation process and their CO_2 performance. The allocation of cost-free allowances in Phase I and Phase II depends on the emissions in a baseline year, so that companies get punished for a temporarily low capacity utilisation (maybe due to a plant revision), or get rewarded for a temporarily high production (maybe due to high electricity prices or the production cycles that depend on the appearance of fish in

the North Sea). It has been claimed that the allocation had nothing to do with a ‘good’ CO_2 performance of a company. The problems of the allocation procedure ‘grandfathering’ are well known. Especially the ‘wind-fall profits’ of the electricity sector are an anathema to the European Commission. For any post 2013 agreement, the Commission claims on its website that “[a]uctioning of allowances will be the rule rather than the exception. No allowances will be allocated free of charge for electricity production, with only limited and temporary options to derogate from this rule” (European Commission, 2009a). For a free allowance allocation, the Commission aims at ‘benchmarking’ instead of ‘grandfathering’ and at overcoming the problems of heterogeneity and comparability of industrial processes. “The Commission shall adopt Community-wide and fully harmonised implementing measures for the allocation of free allowances, including the ex-ante benchmarks by 31 December 2010” (European Commission, 2009b). At the level of the allocation of allowances, the missing link between the emissions trading scheme and the CO_2 performance of a company is to be solved probably in the third Phase of the trading scheme – after 8 years of testing and trying.

(2) The EU ETS explicitly aims at flexibility and the micro-level decisions of economic actors. The question of reducing CO_2 emissions is delegated to the level of the firm, where rational economic actors are supposed to calculate their CO_2 abatement costs. The price mechanism of demand and supply (the ‘invisible hand’) will then unfold its steering effect: any CO_2 reduction measure is steered by a company’s economic calculation. Concrete CO_2 trading decisions show us that CO_2 emission rights are assets that decision-makers can use for many purposes. The virtual assets can be used to enhance a company’s liquidity or budget management, for the purpose of revenue-making or even for an investment in climate change mitigation measures. In our case studies we found companies which tended to solve financial problems or generate financial gains from the carbon market instead of investing in climate change mitigation measures.

(3) The fact that CO_2 carries a price has an effect on the calculations of economic actors in the electricity sector, where the price signal is quasi automatically transformed into the daily decision of making or buying electricity. The liberalisation of the European electricity market, with its spot and forward trading of electricity contracts, is a context that is flexible enough to react on daily price developments in the CO_2 market. Price volatility, here, is fairly unproblematic for decision makers. Still, it is unclear *to what extent* such market-based planning on electricity generation (that includes a price for CO_2) unfolds a steering effect towards emission-reduction measures. Generally, a pure price effect does not privilege a ‘clean’ electricity generation in the first place; it privileges ‘cheap’ electricity generation.

Even though we found that the price signals from emissions trading were not strong enough for our case study company to encourage a fuel switch from ‘dirty’ coal to ‘cleaner’ gas, emissions trading made the company calculate its CO_2 abatement costs. This is important, as we know from our quantitative survey that about two thirds of all responding companies did not know or did not know well their own CO_2 abatement costs in Phase I (Engels, 2009: 492; Knoll and Huth, 2008: 84). We conclude from the case studies that putting a price on carbon at least makes the electricity companies calculate CO_2 – which is a precondition for reducing CO_2.

(4.1) For long-term investments in technological innovations price-volatility matters a lot. Technological investments are grounded on a long-term planning security, which is threatened by the volatility of the CO_2 price. Technological investments involve various players that have to cooperate for a certain time-span (investors, technological experts, company managers). To keep those parties on track, the (price) basis of the cooperation should not differ too much. We discussed three concrete investments that show the planning dependability of technological innovations. We found that a constantly high price for burning fossil fuels fosters investments for a better CO_2 performance. The Danish CO_2 taxes, e.g., gave a price signal *and* secured a long-term planning. Another factor influencing technological innovations is the available expertise on green technologies. The 'carbon industry' (Voß, 2007) that emerged with the introduction of the EU ETS harbours a growing number of experts. It would be interesting to assess the relative importance of financial and trading experts compared to technological experts (who can bring about the technical innovations which are necessary for lowering the emissions after all). At length, tax revenues – other than traded emission rights – could be used to support companies to improve their CO_2 performance.

(4.2) With reference to organisational innovations we asked how the EU ETS could link up to environmental or energy management systems. The debate on 'accounting for carbon' pushes the idea of internalising external costs at an organisational or management level. Book-keeping and risk management, so it is assumed, provide a necessary starting point for dealing with carbon in an institutionalised way. Some of our case study companies had environmental or energy management systems implemented even before the EU ETS was launched. For the Danish malt producer, e.g., energy consumption was such a big cost factor that energy-reduction planning became a central management issue. From the manager's point of view, the CO_2 trading scheme is not coupled with the CO_2 performance of the company and did not contribute to its performance at all.

We conclude from our case studies that emissions trading has a potential to trigger sustainable innovations in the electricity sector, but that the EU ETS might have realised this potential to a disappointing extent only. In accordance with the literature listed in the introduction, one reason for this missing link is the price of the CO_2 allowances that has been *too low* and *too volatile* to provide an economic incentive strong enough to be felt along with the price of gas or coal. The price volatility of the allowances might push the companies to invest in financial risk management strategies rather than in the physical reduction of energy consumption or in CO_2

abatement technologies. If we only look at the price level, the conclusion is obvious: emissions trading and sustainable innovations are loosely coupled at best. However, the case studies reveal more complex (potential) linkages. In particular, they demonstrate the many ways in which book-keeping and environmental or energy management are necessary preconditions for carbon abatement strategies at the company level. Price signals do not simply allow for an economic decision-making, but have to be translated by calculative tools into incentives for sustainable innovations. In line with this reasoning, the most important and most valuable effect of the EU ETS might be that companies started to develop these tools and are more and more able to account for carbon. In the long run, however, only measurable CO_2 emission reductions will count as an indicator for an improved CO_2 performance.

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