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Environmental policy for power stations

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Preface

At the moment, there is an apparent inconsistency between the actions undertaken by power producers and the climate change goals of governments. The Netherlands has formulated ambitious targets to reduce greenhouse gas emissions, but at the same time new coal-fired power plants are being built. This study aims to shed light on this situation. It identifies reasonable explanations for the behaviour of actors and subsequently derives potential policy consequences.

We would like to thank Hans Spiegeler (VROM), Ad Seebregts (ECN) and our former project manager Machiel Mulder for their input and response.

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Summary

There are several potential explanations for the fact that ambitious CO_2 emission reduction goals co-exist with continued existence and even building of high-emission power plants. Three hypothesis have been analyzed in this study, whereby two of them actually seem to occur in practice. First, it is reasonable to assume that long-term public policy regarding climate change is so vague that companies are not able to take them into account. Second, the Dutch allocation mechanism of emission rights under the European Emission Trading Scheme (EU ETS) appears to be biased towards high-carbon technologies. The hypothesis that firms are myopic, in the sense that they ignore future public policy when they make investment decisions, is not backed by empirical evidence.

The policy consequences of these findings can be twofold. First, short term government regulation can direct firms towards the adoption of low-carbon technologies. Several technical measures that would be effective in reducing CO_2 emissions have been mentioned. However, the government might not want to prescribe companies which action to undertake. There is a risk that they would force investments in technologies that turn out to be less efficient than ex-ante expected. It might be better to rely on the EU market for emission rights, provided that it works well. Unfortunately, the current EU ETS system seems to suffer from some distortion due to applied allocation mechanisms of emission allowances. A second policy consequence is therefore to improve the distribution of emission rights among participants. Benchmarking can be done, but it should be as independent of historic use and fuel type as possible. The auctioning of emission permits is also an option. Whether significant alternations to the system will be made and which changes are to be expected is, however, uncertain. It highly dependents on the political climate in Brussels and in the EU member states.

This leads us to the conclusion that reliance on each of the two identified policy responses is surrounded with uncertainty and risk. The Dutch government might choose to combine the two policy options in order to reduce the overall risks of its (non)actions. It could, for instance, decide to prescribe solely low-carbon technologies that have low probabilities of cost-ineffectiveness (so called “no regret” options) whereas, at the same time, it attempts to improve allocation under EU ETS.

1 Introduction

1.1 Current situation

The public power sector in the Netherlands today produces approximately 85 TWh_e of the total 110 TWh_e consumed annually in the Netherlands. Its production results currently in CO_2 emissions of approximately 54 Mtonnes annually, compared to 40 Mtonnes in 1990.
Existing greenhouse gas policy aims at limiting greenhouse gas emissions of industry and public power sector to an aggregated level of 112 Mtonnes/a in 2010 and includes several more specific targets for the public power sector:

- A target for a 10% share of electricity from renewable sources in 2010, produced both in the Netherlands and abroad.
- A general energy saving target of 2% annually till 2020.

If the 112 Mtonnes/a target will not be met, extra Clean Development Mechanism (CDM) and Joint Implementation (JI) carbon credits will have to be bought by the Ministry of Economic Affairs. It is unclear however whether the costs for these purchases will be transferred to the industrial sector and power sector.
The renewable energy target has meanwhile been met and subsidization for supporting renewable energy has been halted temporarily. The energy reduction target is more demanding, certainly for electricity. The Energy research Centre of the Netherlands (ECN) forecasts an autonomous increase in electricity consumption of 2% annually. At the same time import volumes are expected to decline to virtually zero within the next 10 - 15 years as a result of price leveling between Dutch electricity prices and electricity prices in surrounding countries.

Partly in response to the increasing electricity consumption, the import dependency and partly for replacing older gas fired power plants the power sector has announced a series of investments in new power plants. Total announced capacity amounts to more than 15,000 MWe. Of the announced new plants a total of 4,300 - 5,200 MWe is scheduled to be realized as coal-fired capacity to cover increased base load demand.

Increased electricity consumption, reduced imports and realization of additional coal-fired base load capacity are expected to result in an autonomous increase of the CO_2 emissions of the public power sector to a level of approximately 70 Mtonnes annually.

1.2 Problem definition

The previous section revealed that Dutch authorities have ambitious goals to reduce greenhouse gas emissions. They pursue environmental policy regarding power generation, whereas a European-wide Emission Trading Scheme (ETS) is already in place to cap emissions and stimulate efficient emission reduction. Prices of CO_2 allowances are expected to increase in the future, thereby increasing the effectiveness of the system. At the same time, however, new coal-fired power plants are being built. Why is that? Is additional public policy required?

This study investigates whether there is a need for national regulation besides ETS given that firms no not invest into cleaner technologies. One of the following three hypotheses might describe the current situation. Each option has different policy consequences.

Hypothesis 1: Market failure
Companies are short-sighted. They fail to take future public policy on emissions and CO_2 prices into account when they make investment decisions. This can be considered as irrational market behaviour. As a result, producers do not implement options to reduce emissions of their own accord. The government needs to address this market failure.

Hypothesis 2: Unclear policy goals
Companies are rational players, but future environmental policy is afflicted with uncertainties. The government has ‘vague’ long-term goals and implements short-term policy measures to guide companies into the right direction, for instance by prescribing technological standards for power plants. This is the current approach of the ministry of Housing, Spatial Planning and the Environment (VROM).

Hypothesis 3: Strategic behaviour and ETS
Companies act rational and environmental policy is well-defined. The fact that companies do not take the appropriate measures is part of a strategic game by which they attempt to influence government policy. For instance, producers build coal-fired power plants in order to obtain more emission permits in the future. To avoid such behaviour, the initial allocation of permits in the European Union’s Emission Trading Scheme (EU ETS) needs reconsideration.

1.3 Approach

In the next three chapters we will consider each hypothesis separately. First of all, more background information will be provided. What does theory say about the respective hypotheses? Then, attention is paid to each hypothesis' probability of occurrence in practice. One hypothesis will be more likely to reflect the current situation than the others. Attention is paid to empirical evidence that supports or contradicts the hypotheses. Subsequently, policy consequences and potential measures will be evaluated. This results in an overview of costs and benefits per policy option, on which conclusions are based.

2 Hypothesis 1: Market failure

In this chapter, the first hypothesis will be discussed: companies act irrational as they do not reckon with longer-term public policy when they make investment decisions. They are short-sighted. Section 2.1 provides the theoretic basis for this argument, while section 2.2 gives an overview of available empirical evidence. Section 2.3 shows which policy consequences can be attached to the findings.

2.1 Theoretical background

The interaction between individual well-being and welfare of society as a whole is subject to a longstanding debate. It has been argued that when individual economic actors pursue their self-interest, this automatically results in a situation that is optimal for society. Yet, this 'invisible hand' of Adam Smith (1776) might not always work. There are cases in which markets are not able to allocate resources efficiently. Due to a so-called market failure, a wedge is driven between private and social costs and/or benefits. Examples of market failures are imperfect competition, imperfect information, externalities, etc.

Several types of market failure can be present in the power sector. The natural gas market, for instance, is responsive to inefficiencies following from market power. This is due to geopolitical factors, economies of scale and regional restrictions on trade. Former results from growing import dependence and the fact that governments are still heavily involved in energy markets. The presence of huge economies of scale in transport together with regional restrictions in trade give suppliers in regional markets power to charge high prices. Besides, there can be environmental externalities associated with production and consumption. A private gas producer might not by itself fully internalize the effects of its production on other producers, on future consumption or on the environment (CPB, 2006a). The most obvious market failure in our case is, however, a potential divergence between private and social optimal outcomes, created by differences in time horizons. Firms might be more short-sighted than governments, so that former do not take information on long-term policy measures related to CO_2 emissions into account.

The dissimilarity in time preference is best reflected by discount rates. A discount rate is used to compute the present value of costs and benefits that accrue in future periods. Which rate is chosen is somewhat arbitrary. There are several market interest rates and opportunity cost measures that could be used as benchmark, each with its own drawbacks. The choice of discount rate is crucial because it determines the relative importance of the future. If firms behave myopic, their would use a relative high discount rate. After all, effects that occur in the longer run will hardly count then. As a result, the expectation that CO_2 prices will rise significantly in the future has a negligible impact on today's investment decisions. From a societal perspective, a relative low discount rate might be preferable so that more value is attached to impacts on the environment and future generations. Key issue is therefore, whether the government discount rate (acting on behalf of society) is actually lower than the discount rate used by private investors.

2.2 Empirical evidence

Based on empirical evidence, the hypothesis can be rejected. The announced plans for new capacity do not point in the direction of the type of market failure discussed in this chapter. Despite some debate in economic literature, it is generally perceived that governments should use the same discount rate as companies (CPB, 2006b). We found no indication that the social discount rate is lower than the one power companies apply in decision-making.

Besides, there are some practical examples that reveal the long term vision of power companies and thus lead the rejection of our hypothesis. Companies seem well aware of potentially reduced emission ceilings and anticipate by incorporating in the designs for new coal-fired power plants possibilities for cofiring high percentages of biomass. They also claim that the designs will be 'capture ready', technically adapted in such a way that in the future a CO_2 capture installation can be added without requiring any changes in the original power plant. The Enecogen concept in which CO_2 capture is integrated in a gas fired power plants seems to indicate that at least energy company Eneco is aware of the fact that within several decades beyond 2030 even more ambitious reduction targets for greenhouse gas emissions will have to be met in order to limit the effects of climate change.

2.3 Potential policy reactions

Since there is no market failure, no additional policy options are needed. In fact, this outcome is logical. If the hypothesis applied to the power sector, it would be likely that it would hold for all economic activities in other sectors as well. Such a conclusion would reflect the belief that only governments should make economic investments, since market actors are not sufficiently capable of making them in a responsive manner. The consequences for the public sector would have been significant then. Several measures would have been required to make sure that projects that are profitable from a societal point of view, but not from an business perspective, are executed. Examples are subsidies and fiscal facilities. Since we found no evidence that market actors are myopic, these measures are not needed in the power sector to prevent or solve short-sighted firm behaviour.

3 Hypothesis 2: Unclear policy goals

The second hypothesis will be the subject in this chapter; there is a difference between the ambitious emission goals of governments and their actual policy. In section 3.1 we will give theoretical backing to this argument. Section 3.2 handles empirical evidence. Finally, section 3.3 identifies the consequences for public policy.

3.1 Theoretical background

When companies want to take (future) public policies on emission reduction into account, they face uncertainty at different levels. At the moment, they have to consider the European Union Emission Trading Scheme (EU ETS) that is in place and face several national regulatory measures.

With respect to emission trading, there remains uncertainty how the EU ETS system's design will evolve in the future. First of all with respect to the total allowable emissions. There is criticism that caps have not been restrictive enough, making it relatively easy for member states to keep emissions within the limits[1]. The predominant free allocation of CO_2 entitlements is also subject of debate, as well as the way emission rights are distributed among parties (see chapter 4). It is unknown what will be the outcome of the debate. Given the uncertainty surrounding al these aspects of ETS, firms have difficulty taking them into account. They can hardly interpret the signals coming from the European Commission, their national government and other member states.

In addition, future allowance prices under EU ETS play a role. When there is price uncertainty, investments in technology will be delayed. The longer a company waits, the more knowledge it can obtain about future CO_2 prices. Besides, risk aversion might reduce investment. The risk of low CO_2 prices makes low-carbon investments less attractive, whereas high CO_2 prices would encourage investment in low-carbon technologies. Obviously, companies are prepared to bear risks, but they generally prefer to take risks in their core business, where the additional management attention can at the same time create strategic opportunities (Grubb and Neuhoff, 2006). The level of CO_2 prices is generally expected to increase in the future. However, the sensitivity of power sector emissions to gas prices increased the volatility of CO_2 prices, and this linkage is unlikely to vanish in the coming years (Grubb and Neuhoff, 2006). Greater stability in price expectations would reduce risks and increase investment in low-carbon technologies and energy efficiency improvements.

[1] Countries face internal political restrictions to lower the cap.

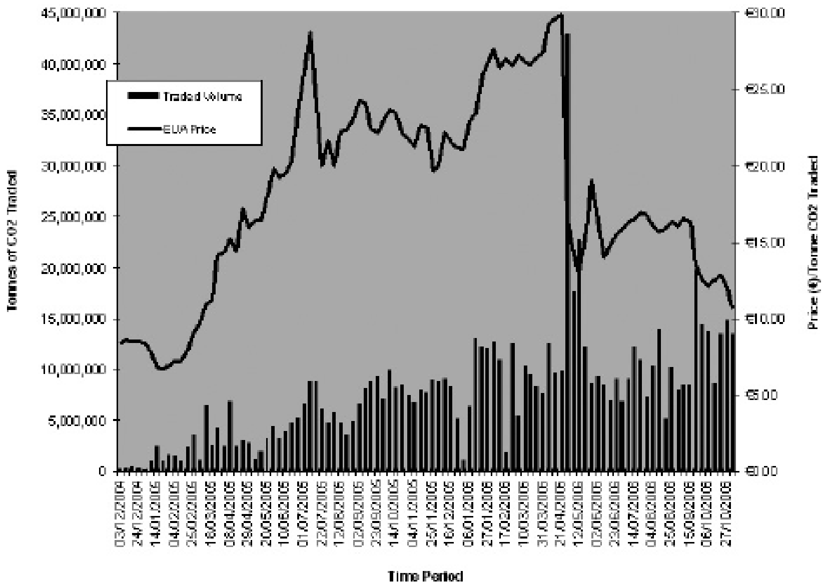
With respect to national energy policies, companies also face uncertainty. Longer term policy objectives and accompanying policies are frequently rather vague. The course of regulation highly depends on the political climate, so that firms might be skeptic about ambitious goals and even on the maintenance of existing policy. Even open-ending policies can be closed down. This is illustrated by the recent discontinuation of subsidies on sustainable electricity production. Irrespective of whether this decision is justified or not, fact is that these kind of government actions do not promote the inclusion of public policies in private investment decisions. If existing policies are surrounded by uncertainty, future policies are not even considered.

3.2 Empirical evidence

Based on empirical information, the hypothesis that political signals for the longer term are unclear can be accepted. For instant, there are no decisions for the post-2012 period regarding ETS. Allocation mechanisms and prices are uncertain.

On the one hand, we can look at the expectations regarding future CO_2 prices. During the first trading period, prices were volatile. This is shown in Figure 1. It turned out to be difficult to predict prices. Prices during 2005 were higher than most analysis expected (Convery and Redmond, 2006). Movements in energy prices have had most significant impact on allowance prices, especially oil prices (Redmond and Convery, 2006). Besides, exogenous factors played a role in price developments, for example long strikes in the Finish paper and pulp sector (Grubb and Neuhoff, 2006). The price crash in spring 2006 occurred because some member countries published 2005 emission data and it became clear that there was an overall surplus of allowances in the market.

Figure 1 Weekly EUA price and traded volume development



Source: Convery and Redmond, 2007.

At the time of this writing, there are several predictions for the next trading period available. Prices are generally expected to increase as the market for allowances tightens. Based on the National Allocation Plans, total supply of emission rights is expected to decrease (Convery and Redmond, 2007). Futures prices for the 2008-2012 period range between 23 and 25 €/ton (European Energy Exchange, 2007). For prices after 2012, there are mixed expectations. The European Union relies on 30 €/ton in 2020, 65 €/ton in 2030 and 115 €/ton in 2050 (EU, 2005), while some global simulation models (MiniCam, MESSAGE) provide estimates that lie even under 20 €/ton up to 2035 and reach the 65€/ton not until 2065. These low prices probably refer to a global ETS in which developed countries can buy relative cheap emission rights in developing countries by subsidizing relative cheap projects in these developing countries. The higher prices for the same years probably refer to an ETS in which emssion rights can be purchased only withing the EU. Two other estimates are also worth mentioning:

- An estimation by ECN, applied in Dutch climate policy amounts to approximately € 10/tonne for 2020 (ECN, 2005). This seems rather low even compared to current prices.
- In the Green4sure scenario analysis (CE Delft et al., 2007) maximum costs for measures within the power sector were estimated at approximately € 60 /tonne

On the other hand, it is interesting to see how high future CO_2 prices need to be so that coal-power stations are no longer cost-effective. Where is the break-even point? Under current market conditions[2] and with current state of the art in technology investment in a gas fired power station is more attractive at CO_2 market prices from € 30,-/tonne upwards, taxing the entire CO_2 emission of both plants. With current coal price and taking into account current estimations of investment costs and operational costs for CCS[3], adapting CCS is more economic from approximately € 40,-/tonne upwards, taxing the entire CO_2 emission of the coal fired power station. These estimations are based on the CAFE investment model for power stations, developed by CE Delft (CE Delft, 2006). Price escalations of 1% for coal, 2% for gas have been taken into account.

In a global ETS prices will probably remain that low that there is a significant possibility that CCS, biomass cofiring and replacing coal by natural gas will remain too expensive compared with the market values of CO_2 emission rights. In a EU ETS prices might rise to a level that makes emission reduction cost-effective. At the moment, however, a real comparison of expected and needed CO_2 prices is undoable since CO_2 projections are so unsure and widespread. Therefore, we are unable to predict whether future CO_2 prices will be high enough to fuel the technological change that is needed to reduce emissions significantly. Nevertheless, we are able to draw a conclusion, based on the identified price uncertainty: it is reasonable to expect that the current price uncertainties cause (risk averse) firms to postpone or reduce investment

2 Gas price = ± € 6/GJ and coal price = ± € 2,50/GJ.

3 Carbon Capture and Storage. This includes separation of CO_2 at the power station, transportation of supercritical CO_2 by pipeline and injection of the captured CO_2 in the deep subsurface.

decisions in clean technologies (see section 3.1). Therefore, addition policy measures seem to be required.

3.3 Potential policy reactions

Since policy goals are indeed unclear, policy action seems to be required. In order to clarify long term public policies, the Dutch government needs to fill in the ETS system in a more concrete manner. However, this will take some time, due to both internal political barriers and interdependence with other EU member countries. Harmonization of approaches among EU countries is welcomed. Consequently, alternative approaches are required to solve the above-mentioned problem. The government can translate long-run objectives into tangible policies in short term. They will push firms into the right direction. Potential policy options are provided in section 3.3. However, there are also risks attached to such an regulatory approach. These will be discussed in section 3.3.2.

3.3.1 Policy measures

Several policy options are available. The government can subsidize certain technical improvements and impose all kinds of technical prescriptions. For instant, making CCS compulsory or even prohibiting coal-fired power plants. An overview of measures available for the required extra reduction are given in Table 1. They are technically feasible at the moment and are in fact (far) more reliable than large scale onshore and offshore wind power and CCS at new coal fired power stations. Some of these measures will be required in addition to the measures already taken into account in the Dutch government coalition agreement of February 2007 in order to reach the current emission reduction targets (see figure 2).

The mentioned measures are partly aimed at new production capacity and partly concern measures that can be applied at both new and existing power plants. Only changing from coal to natural gas at existing coal fired power plants concerns a measure only applicable at existing power plants. Changing from coal to gas of course means changing to a less carbon intensive fuel, just as cofiring of biomass or derived fuels (e.g. pyrolysis oil, biogas).

Changing to natural gas will require no extra investments since coal-fired plants are already designed for multifuel operation and include a number of multifuel burners capable of firing natural gas or separate natural gas burners in view of both start up requirements and legally required fuel flexibility. Biomass will very probably require extra investments for biomass handling and storage and for either new multifuel burners or installing separate biofuel burners. Both biomass and natural gas are more expensive fuels compared to coal and changing to these fuels will mean increasing operational costs.

Table 1 Measures to reduce CO_2 emissions

	Relative CO_2 reduction				Costs (€ per tonne avoided CO_2)				Potential reduction (Mtonnes)	Investment	Infra + logistics	
	Existing plants		New plants		Existing plants		New plants					
	Coal	gas	Coal	gas	Coal	gas	coal	gas				
CCS	90%	90%	90%	90%	45 - 57	50	35 ± 8	42 ± 9	> 54 Mtonnes (theoretically)	50% - 80% off costs power station	- -	Totally new infrastructure required
Biomass or biofuels	70%?	100%	70%?	100%	40	75 - 80	40	75 - 80	22 – 40[4]	€500/kWe existing capacity	-	Extra handling, separate fuel market
Gasfiring in coal based power plants	40%	Not relevant.	40%	Not relevant	85		85		22 - 40[4]	None	+ +	Directly applicable
Increased availability of existing gas power plants instead of new coal fired power plants	Not relevant	Not relevant	35%	Not relevant			25		1	None	+ +	Directly applicable
New gas fired power plants instead of new coal fired power plants	Not relevant	Not relevant	52%	Not relevant			40 - 45		12 - 14	Lower investment	+ +	Gas transmission pipeline is required anyway.
Repowering of coal fired power plants with gasturbine	4%	Not relevant	8%		Profitable	Not relevant	Profitable		+1 – 3	€500/kW_e	+ +	Infrastructure present

4 Total substitution of coal in currently existing power plants (22 Mtonnes emissions), or production capacity projected for 2020.

Figure 2 Gap between emission reduction targets and reduction potential with current policy

The reduction target of 30% relative to 1990 will, when translated one on one to the power sector, require a reduction in greenhouse gas emissions from public power sector of

- 26 Mtonnes or 50%, compared to current level.
- 40 Mtonnes or 60% compared to the emission level anticipated for autonomous developments in 2030.

The measures included in the coalition agreement of February will no doubt result in a significant reduction, the measures being:

- 20% share of renewable energy by 2020 of total energy consumption, consisting of a mix of green electricity, green gas and biofuels.
- 2% energy savings per year.
- 4 Mtonnes of CO_2 stored.

However, the aspired energy conservation ratio will primarily mean a stand still in electricity consumption development and will mean a consumption rate comparable to current annual level of approximately 110 TWhe.
The ambitions defined for CCS will mean that CCS will contribute little in 2020. Secondly, studies as those conducted for EnergieNed indicate that CCS is a financially relevant option only for new coal fired power plants. The new coal fired production capacity realized in the period up to 2020 is expected to be limited to the 2 – 3 plants mentioned above, these probably being used to cover the gap between production capacity and market demand and/or import reduction. This again means that this measure will at best only result in limiting greenhouse gas emissions from Public Electricity and Heat Production sector to approximately current level.
The ambition of a 20% share of renewable energy will also have a limited effect. Current import and inland production of renewable energy already amounts to 13 TWhe. For reaching a target of 20% a production from renewable sources of 32 TWhe is required. The extra ± 20 TWhe is expected to result in an extra CO_2 reduction compared to fossil fuel based production of approximately 15 Mtonnes/year. Only this reduction can be considered a true reduction compared to current emission level.
This still leaves a considerable gap of 10 - 15 Mtonnes/year to be covered by additional policy.

CCS is an end of pipe technology. It CO_2 capture installations and installations for processing of captured CO_2 (drying, compression), that – for a coal fired power plant - add probably another 50% to the investment compared to the investments in the actual power plant. But the expenses don’t stop there. For the storage part of CCS infrastructure in the shape of pipelines is required for transportation of the captured CO_2 from power plant to storage facility. In the Netherlands these facilities (depleted gas fields) are located tens of kilometers from the location where a new power plant may be realized or from existing power plants. Infrastructure will probably require investments of billions of Euro’s. Next to this, regeneration of the fluid applied for capturing CO_2 requires large amounts of process heat. Supplying the heat by utilizing draw-off steam will mean reduction of plant net efficiency and decreasing income from power sales.

Prohibiting of coal fired power plants while at the same time allowing an increase in electricity consumption will require production of electricity from alternative primary energy sources, cheapest of which is gas. One can either build new gas fired power plants or – economically probably more attractive – increase the availability of existing gas fired power plants. This means having them running more hours a year and producing more kWhe annually. On the other hand, new gas fired power plants can be designed to be combined heat and power plants (CHP-plants) at which the energy content of the consumed natural gas is utilized optimal. Up to a certain level the extra production capacity can also be generated by adding a gas turbine to an existing coal fired power plant, the heat of the gas turbine off gases being utilized as combustion air and heat source in furnace and boiler of the coal fired power plant.

3.3.2 Risks

Government regulation might ensure that above-mentioned technical measures are implemented. However, public involvement also embodies several risks. First of all, the government forces companies to invest, to make costs. This is precarious since these investments might not be cost-effective in the longer run. When emission prices turn out to be low, current investments in low-carbon installations become unprofitable from a private perspective.

This is especially truth for CCS, which as mentioned before not only requires high investments in CO_2 capture installations, but also in infrastructure for transportation of captured CO_2 from power station to storage location. To a lesser extent this also applies to application of biomass because of the required investments in storage and handling installations and in multifuel burners. Utilizing fluid and gaseous biofuels may not give this risk. A third measure incorporating this risk is realization of new gas fired power plants instead of coal fired power plants for covering increases in base load electricity consumption.

The recognition that abatement does not seem to take place at the lowest cost under regulation, led to the set up of Emission Trading Schemes Through these trading systems, each country/ producer ideally has the opportunity to abate emissions at the lowest costs. Unfortunately, emission trading systems are not totally free of drawbacks at the moment. Some of the issues are discussed in chapter 4.

A second risk is a potential technical lock-in. Currently it is anticipated that the most obvious way of getting CO_2 from capture point to storage point is by a pipeline infrastructure. Such an infrastructure will however require billions of Euro's in terms of investment and will bind the investing companies to the CCS option and will draw away money from alterative technologies (see also CE Delft, 2005).

Next to this, there are still significant opportunities for CHP in the industry, that are probably also implementable at low CO_2 reduction costs, if realized at the right moment e.g. simultanious with retrofits and modernisation of large heat consuming industrial process installations (see ECN, 2005). Investing now in coal fired power plants will probably mean these power plants taking up at least part of the electricity market that could also be served by these industrial CHP plants, making realization of these CHP-plants unattractive. On the other hand reduction of the CO_2 emissions at the coal fired power plants will probably be more expensive in terms of costs per unit of avoided CO_2 emission than realization of the aforementioned CHP-plants.

Finally, a third type of risk comes from international competition area. If regulation is national and other countries impose lower restrictions, then the position of national companies worsens. Chapter 5 shortly handles with the international context.

4 Hypothesis 3: Strategic behaviour and ETS

In this chapter, we will go more deeply into the third hypothesis: companies act rational and public emission goals are clear, but the allocation mechanisms applied in the European Union's Emission Trading Scheme (EU ETS) provoke strategic business behaviour. Section 4.1 gives the theoretic funding for this argument, where after section 4.2 provides available empirical evidence. Section 4.3 discusses policy consequences.

4.1 Theoretical background

The initial allocation of emission allowances is one of the most important and controversial parts of the trading process. The conventional wisdom held that the initial allocation would have no impact on cost-effectiveness; any ineffectiveness associated with the initial allocation would be eliminated by subsequent trading. In practice, however, this is not necessarily true (Tietenberg, 2006). Two possible methods for allocating initial entitlements are (1) administrative rules based upon eligibility criteria (grandfathering) and (2) auctions. Former commonly means that permits are freely distributed based upon historic emissions or output.

Under the EU ETS, each member state proposes its National Allocation Plan which includes the total amount of allowances and the distribution among participants in the trading scheme. The plans must be approved by the EU Commission. Phase I covers a three year period (2005-2007), phase II et seq involve five-year periods (2008-2012…). In these periods, Member States are allowed to auction up to 5% respectively 10% of the total allowances issued[5]. The rest is freely distributed.

On the one hand, the EU ETS is indeed close to an economist's ideal structure for internalizing a market externality with minimal competitive impacts. On the other hand, however, it might clash considerably with this ideal. 'The combination of large free allocations, flexibility over the allocation methodology and separate negotiations for each five-year period, create risks of a substantial divergence from theoretical efficiency as well as room for dispute and distortion between different participants' (Neuhoff et al., 2005, p.4).

With respect to the total number of emission rights, it has been frequently pointed out that national caps on emissions have not been restrictive enough, at least in the first trading period. It has been relatively easy for member countries to comply. Besides, governments can buy extra Clean Development Mechanism (CDM) and Joint Implementation (JI) carbon credits. The pressure on firms to reduce emissions also seems to be low as they can freely buy permits. When, however, companies do exceed their emission quota, there are sanctions. For

[5] After phase II, the share of auctioning is unspecified, although it is generally expected to be greater than 10% (Ellerman and Buchner, 2007).

each ton of CO_2 equivalent emitted for which a firm has not surrendered allowances, the penalty is 40 €. As of January 2008, the fine will be 100€ per ton CO_2 (EC, 2003). Furthermore, companies generally receive free allowances. Since permits are valuable, a free-distribution location provides an opportunity for firms to capture this value (Tietenberg, 2006). They can sell allowances they have not paid for. This brings us to the discussion of national allocation methodologies.

First of all, the updating of emission rights is under dispute. Repeated negotiations of allocations create challenges for the EU ETS since companies start to belief that higher emissions today will be rewarded with bigger allocations in subsequent periods. This promotes inefficient strategic behaviour. Perverse incentives for both operation and investment decisions are created. Firms' motivations to reduce emissions at present are undermined (Grubb and Neuhoff, 2006), whereas it is even encouraged to inflate historic use though new investments in older technologies. The problem is often referred to as the 'early action problem'.

In addition, this form of updating distorts electricity prices. If tomorrow's allocation can be influenced by today's CO_2 emissions, it can create a wedge between allowance prices and opportunity costs (Neuhoff et al., 2005). First, allowance prices are likely to be higher than they would be in a cap-and-trade program with other allocation mechanisms. For instance, when entitlements are auctioned or allocated once-only based on historic emissions. This inflation can distort inter-sectoral, international and inter-temporal production and emission reduction decisions. Second, the opportunity costs for CO_2 emissions can be reduced below the efficient allowance price. As a result, final electricity prices may not adequately reflect the environmental externality, inducing excessive consumption and restraining the attractiveness of energy efficiency programs (Neuhoff et al., 2005).

In order to cope with the updating problem, the EU Commission has specified that decisions about the initial distribution of allowances in phase II must depend on measures undertaken prior to 2005 (Ahman et al., 2005). This would avoid giving firms an incentive to adjust their behaviour to receive a larger share of emission rights.

However, two other aspects of National Allocation Plans may affect firm behaviour as well; the treatment of closures and new entrants. Most EU governments reserve entitlements for new entrants to cover emissions from new facilities that enter during the trading period. The intention is to facilitate competition by lowering entry barriers. It decreases the cost of new investments. However, this process may distort the technology choice for new power plants away from less CO_2 intensive plants toward more CO_2 intensive technologies (Neuhoff et al., 2005). With respect to existing units, the question is whether, or for how long, facilities that close retain their emission allowances (Ahman et al., 2005). This determines how long they are kept in operation.

Grubb and Neuhoff (2006) give a clear overview of all the distortions due to allocation mechanisms under EU ETS through their pyramid of potential distortions. Table 2 illustrates that there is a range of periodic allocation options which introduce different degrees of perverse incentives. It reveals step-wise how the distortions increase when moving from auctions (top) to allowance allocation based on historic emissions, like in EU ETS (bottom).

Table 2 Effect of allocation methods to power sector incumbents

	Impacts	More expenditure on extending plant life relative to new build		Increase plant operation		Less energy efficiency investments
Allowance allocation method	**Distortions**	Discourage plant closure	Distortion biased towards higher emitting plant	Shields output (and consumpt-ion) from average carbon cost	Distortion biased towards higher emitting plant	Reduce incentives for energy efficiency investments
Auction						
Benchmarking	capacity only	X				
	capacity by fuel/plant type*	X	X			
Updating from previous periods'	output only	Y		X		
	output by fuel/plant type*	X	X	X	X	
	emissions	X	X	X	X	X

Note: X indicates a direct distortion arising from the allocation rule. Y indicates indirect distortions if allocation is not purely proportional to output/emissions.
* Differentiating by plant type adds additional distortions compared to purely fuel-based distinctions.

Source: Grubb and Neuhoff (2006).

When allowances are equally distributed per unit of installed capacity, solely the closure of inefficient plants is discouraged. If allocation depends upon fuel type of production process, the distortion can be stronger. Higher-emitting plant types get more allowances per unit output then. Note that 'these incentives refer to incumbents, but if the previous period's new entrants expect to receive the same free allocations as incumbents in subsequent periods, these distortions may transfer to the actual investment decision, with the potential for particularly perverse consequences' (Grubb and Neuhoff, 2006, p. 17). Basing allocations on historic production figures creates distortions associated with to plant operation and pricing, those related to closure and new entrants might be somewhat reduced. Finally, allocation can be related to historic CO_2 emissions. Most allocation methods under phase I and II are of this type. In addition to the abovementioned distortions, the incentive for companies to improve the energy efficiency of existing or new plants is reduced.

4.2 Empirical evidence

Whether problems are as huge as indicated above, depends among others on the exact content of the National Allocation Plans. Dutch procedures under phase I and II are evaluated. They reveal that there are indeed several flaws in the current ETS system that encourage strategic firm behavior: the hypothesis can be accepted.

In both trading periods companies gain emission allowances by being allocated a number of them. Whenever needed, they can buy additional allowances, although the use of JI/CDM is limited to 10% per year per installation under NAP II. Excess emissions penalties have already been mentioned in former section. Companies that do not need all of their allowances to cover emissions can sell their extra allowances. This indeed encourages firms to try to receive as many initial allowances as possible.[6] This brings us to the allocation mechanism.

At first instance, they indicate that the updating problem seems to be limited (EZ/VROM, 2004; 2007). With respect to phase I allocation, the reference periods for historic use is 2001-2002, whereas the base-years for distribution under phase II lie between 2001 and 2005. The idea is to avoid that CO_2 reduction measures in the first period would be punished by lower emission rights in the second. However, we did found some indication that strategic behaviour is still rewarded. Base year adjustments can be made for installations that are extended during the period 2002-2006. If an individual company can make sufficiently clear that it is crucial to include particular extensions in the allocation decision, the government might decide to take emissions in the year 2006 as reference. Take-over purchases can also be taken into account (EZ/VROM, 2007; p. 39)

Nevertheless, the number of distortions is reduced due to some benchmarking (see Table 2). In the Netherlands, allowance distribution not only depends on emissions in previous periods. The energy efficiency of installations is also considered. A simplified formula of allocation among incumbents is given in Figure 3. For energy conversion installations fixed conversion factors are used as reference. They are derived from the Benchmark Covenant.

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6 In addition, there is indication that the power sector has earned some 'windfall profits' since producers pass prices of emission rights on to consumers even though the government has freely distributed those rights. In order to reduce this problem and avoid further expansion of these activities in the future, existing producers that have limited international competition face a cut of 15% in emission allowances under NAP II.

Figure 3 Simplified allocation rule for incumbents

A = HE x GF x EE x C

A	: assignment to individual organization
HE	: historic emissions (three-year average from period 2001-2005)
GF	: growth (2006-2010)
EE	: relative energy-efficiency (of energy related emissions, n/a energy conversion installations)
C	: correction factor in order to keep emissions within cap

Source: EZ/VROM, 2007.

Such a differentiating approach would have been beneficial if fuel types were treated alike. Unfortunately, this is not the case. The efficiency of power generation is 52% for gas and oil, 39% for coal and 40% for off-shore oil and blast-furnace. As a consequence, coal-based plants receive more emission allowances than gas stations. There is allocation bias towards higher emitting plants. Investment in new coal facilities is rewarded (by incumbents), which conflicts with objectives to tackle climate change.

With respect to new entrants (including installations that are significantly extended after December 31, 2006), assignment is based on state of the art technologies and estimated production figures. Former is determined on the basis of emissions of comparable commercial installations that are technically on top of the world. Information on leading technologies is derived from actual benchmarking. In proportion to efficient incumbents, new entrants receive less emission rights (EZ/VROM, 2007). Plan closure is therefore discouraged. The fact that firms retain granted allowances when their installation is closed at least until the end of the trading period (EZ/VROM, 2007; Ellerman and Buchner, 2007), diminishes this effect.

Companies that participate in the so-called 'Kolenconventant' face a reduction of 50% emission rights if they receive MEP subsidy and have the required environmental permits.

4.3 Potential policy reactions

Since strategic firm behavior seems to be rewarded under the current EU ETS system, policy action is needed. First of all, it is important to alter the allocation mechanism. Governments need to use benchmarks that are independent of fuel type and historic use. Benchmarking should be as general as possible so to avoid bias in favour of high-CO_2 technologies. Power as a final product is homogenous, but the ways to generate is are heterogeneous. A solution could be to allocate on the basis of emissions per unit of product.

In addition, Table 2 reveals an option to improve EU ETS. Given the drawbacks of various allocation mechanisms, auctioning emission entitlements is the best option. Governments could release a greater share of allowances through auction. The European Commission is in favor of auctioning (Ellerman and Buchner). It even considers ways to auction all emission allowances (FD, 2007). A disadvantage of complete auctioning is, however, that all energy use will be charged. Public revenues need to be pumped back in the private sector to compensate for that, which is a complex task. In the academic literature, (partial) auctioning is also judged positively. Especially a joint minimum-price auction is advisable (Grubb and Neuhoff, 2005), since it promotes harmonization among EU member states. Besides, it is important for the effectiveness of the system that a minimum price is guaranteed. When CO_2 prices are too low, hardly abatement takes place.

So far, the Dutch government has been in favor of auction, but has never included it in her National Allocation Plans. According to the minister Cramer it is ‘a bridge to far’ (FD, 2007). The underlying causes are unclear, but a main bottleneck seems to be that firms covered by EU ETS have strongly opposed auctioning. Latter brings the choice for allocation mechanisms into the political domain. For political reasons, governments might have refrained from auctioning, whereas from an economic efficiency perspective it would have been advocated.

5 International context

So far, we have analyzed the situation of the Dutch power sector. However, the fact that straitening of emission goals evolves with the building of CO_2 intensive, coal-fired power plants is also observed in other countries. Therefore, section 5.1 shortly discusses the international application of the three hypothesis. In addition, it should be noted that the Netherlands is not an autarky. Interaction with the rest of the world (ROW) needs some attention. This is done in section 5.2.

5.1 Hypotheses

With respect to the first hypothesis, regarding market failure through myopic firm behavior, it is unlikely that companies abroad have different attitudes than Dutch companies in the power sector. Therefore, this hypothesis needs no further attention in an international context.

The second hypothesis, pointing at unclear policy goals, might not only describe the situation in the Netherlands but also in several other countries. It is a commonly cited problem that long term goals are not directly related to short term aims and consistent policies. Subsequently, firms are left with uncertainties.

The third hypothesis, relating to EU ETS and the allocation of emission rights in particular, might or might not hold for other countries. It depends on the national allocation plans. Appendix A shows the allocation mechanisms applied in all European countries during phase I. It reveals that, so far, all governments use more or less exclusive grandfathering for allocating emission permits among incumbents, i.e. allocation according to historical emissions. Benchmarks are solely used by Austria, Denmark, Lithuania and the Netherlands. Most governments have not shown real interest in auctioning permits. During phase I they could auction up to 5%, but only Denmark, Hungary, Ireland and Lithuania have exercised this option (Convery and Redmond, 2007). They auctioned respectively 5, 2.5, 0.75 and 1.5% of their totals (Ellerman and Buchner). For the next trading period, only seven of the 19 countries that submitted their allocation plans proposed auctioning (0.3% in Belgium to 7% in UK) (Ellerman and Buchner, 2007). As mentioned in chapter 4, the low attention for auctioning might be due to political constraints.

In addition, the problem of updating allocation will arise in some countries since they chose base periods (which are used to determine historic use) that cover part of phase I: 2002, 2003 and even up to 2004 in Malta. In these years firms might have behaved strategically since they knew the allocation rules. They might have inflated 'future' historic use by building new installations or by deciding not to invest in emission abatement.

Whether allocations are biased in favor of coal, can not be derived from Appendix A or from a quick scan of national allocation plan summaries (see UBA, 2005). What does become clear is that a few countries introduced special rules to reward operators which qualify for early action[7], because they implemented measures to reduce CO_2 emissions in the past. These countries are Germany (compliance factor of 1 for 12 years after implementation of reduction measure), Estonia for the energy sector, Latvia in the case of fuel substitution and energy efficiency improvements, as well as Poland, the Czech Republic and Hungary by providing a bonus for early action (partly coming from an early action reserve). Belgium allows the substitution of one year from the base period 2001-2003 by a year from 1990-2000 (UBA, 2005). Early action can also be rewarded indirectly through the provision of benchmarks for incumbents (Austria, Denmark, Belgium/ Wallonia, Lithuania, Slovenia, the Netherlands), although we have seen that efficiency benchmarks have not been used in the Dutch power sector. For energy conversion installations fixed conversion factors have been used as reference, which biased in favor of coal. Another option to reward early action indirectly is defining an early base period (like Cyprus with a base period starting in 1990).

With respect to new entrants, all countries except Sweden offer free allowances. Benchmarking is mostly chosen as allocation technique, but also here it remains uncertain whether there is differentiation of fuel type. Closure rules are not always included in national allocation plans, but those countries who did have closure provisions decided that closed installations do not receive any further allowances. The Netherlands is thus an exception (closed installations may keep their allowances for the whole trading period).

5.2 Interaction with ROW

It has been mentioned that JI and CDM carbon credits can be bought and sold between countries. It could be cheaper for the Netherlands to reduce emissions abroad than to invest in domestic abatement. For instance, the average age of the European power stations is approximately 30 years and most coal fired or lignite fired power plants are even older, many having reached the end of their technical live. The average efficiency of these coal fired and lignite fired power plants is approximately 30%. So one can expect that in the coming decade much of the current production capacity will be replaced by new and far more efficient power plants, that are also cheaper to operate than the old inefficient ones. This trend is already visible in Germany since several years. Other cheap measures will be implementation of CHP plants and mitigation of methane emissions from landfills.

Purchasing emission rights outside Europe will also be cheap. Current prices for JI and CDM projects often amount to approximately € 10/tonne CO_2. At such low prices many measures other than energy conservation in the Netherlands will be uneconomically

[7] Not to be confused with the ‘early action problem’ defined in chapter 4.

6 Conclusion

In this report, we identified three hypotheses that could explain why ambitious CO_2 emission reduction goals co-exist with continued existence and even building of high-emission power plants. Two of them seem actually to occur in practice. First, we found indication that long- term public policy regarding climate change is so vague that companies are not able to take them into account. Second, the Dutch allocation mechanism of emission rights under the European Emission Trading Scheme (EU ETS) appears to be biased towards high-carbon technologies.

The policy consequences of these findings can be twofold. First, short term government regulation can direct firms towards the adoption of low-carbon technologies. Second, Dutch national allocation mechanisms can be changed.

With respect to the first consequence, we have mentioned several technical measures that would be effective in reducing CO_2 emissions. At the same time, however, it is acknowledged that prescribing companies which action to undertake embodies a risk. The enforced technical innovations might turn out to be cost-ineffective in the longer run. After all, governments put a cost on companies today, while future CO_2 prices and technical innovations are uncertain. When emitting CO_2 turns out to be cheap, current investments in low-carbon installations become unprofitable from a private perspective. This especially holds for measures that require high investments such as CCS, building gas fired power stations instead of coal fired power stations for covering increases in base load requirements, solid biomass firing. In other cases the power plant operator can simply stop with implementing the measure, i.e. firing natural gas in coal fired power stations or biofuels in gas and coal fired power stations.

As a result, technical prescriptions are solely justified if ETS does not work well and improvement is not likely to occur in the near future. This could either be due to improper design features, some of which has been discussed in this report, or due to the fact that ETS gives insufficient incentives for changes in behaviour (see CE Delft et al., 2007). The current ETS system leaves much to be desired, both with respect to caps on total emissions as regarding the way emission rights are distributed among participants.

This brings us to the second policy consequence: improvement of national allocation mechanisms for emission allowances. It has been advocated that benchmarking should be as independent of historic use and fuel type as possible. The auctioning of emission permits is also an option. Whether significant alternations will be made and which changes are to be expected is, however, uncertain. It highly dependent on the political climate in Brussels and in the EU member states.

This leads us to the conclusion that reliance on each of the two identified policy responses is surrounded with uncertainty and risk. The Dutch government might want to combine the two policy options in order to reduce the overall risks of its (non)actions. It could, for instance, decide to prescribe solely low-carbon technologies that have low probabilities of cost-ineffectiveness (so called “no regret” options) whereas, at the same time, efforts are undertaken to improve allocation mechanisms under EU ETS.

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Environmental policy for power stations

Annexes

Report

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A National allocation plans phase I: Allocation and scope of application

EU member state	Allocation procedure for existing installations	Auctioning	Sectoral differen-tiation	Growth factor/ Reduction factor	Base period	Allocation procedure for new installations	Reserve in Mt CO_2 p.a. (in % of ET budget)	Considera-tion of process-related emissions	Special rule 'early action'	Special rule 'CHP'
Austria	Grand-fathering in conjunction with benchmark elements	No	Yes	Yes/Yes	1998-2001	BAT benchmark	0.3 (1.8%)	Yes, via potential factor	No, indirectly via bench-marks	Yes, bonus in potential factor
Belgium	Differen-tiated for Brussels, Flanders, Wallonia	No	Differen-tiated for Brussels, Flanders, Wallonia	Differen-tiated for Brussels, Flanders, Wallonia	Differen-tiated for Brussels, Flanders, Wallonia	Differen-tiated for Brussels, Flanders, Wallonia	2.54 (4%)	Differen-tiated for Brussels, Flanders, Wallonia	Differen-tiated for Brussels, Flanders, Wallonia	Differen-tiated for Brussels, Flanders, Wallonia
Cyprus	Grand-fathering	No	Yes	Yes/No	1990-2003, for ceramics 2001-2003	New instal-lations must observe BAT standards	0.04 (0.7%)	No special rules	No, indirectly via long base period	No CHP installation
Czech Republic	Grand-fathering	No	Yes	Yes/No	2 years in 1999-2001	BAT benchmark	3 (3.1%)	No special rules	Bonus	Bonus
Denmark	Grand-fathering in conjunction with benchmark elements	5% of ET budget	Yes	Yes/Yes	1998-2002	Fuel-inde-pendent benchmark, as with DK CO_2 tax	1 (3.0%)	Yes, per sector budgets	No, indirectly via bench-marks in electricity sector	Yes, benchmarks for energy sector
Estonia	Grand-fathering	No	Yes	Yes/No	Heat plants: 1995-2003; Industry: 2000-2003	Average benchmarks	0.65 (3.4%)	No info	Yes, for energy sector	No info
Finland	Grand-fathering	No	Yes	Yes/Yes	1998-2002[3]	BAT benchmarks	0.83 (1.8%)	Yes, over sectoral target	No	Yes, own sector target
France	Grand-fathering	No	Yes	Yes/Yes	1-7 years, depending on sector (e.g., 1996-2002)	BAT benchmarks	7.9, of which 2.18 for new installations (5.1%)	Yes, no compliance factor	No, indirectly via long base period	Bonus regulation and no progress factor
Germany	Grand-fathering	No	No	No/Yes	2000-2002	BAT benchmark	3 (0.6%)	Yes, no compliance factor	Yes, no compliance factor	Bonus, double benchmark for new installations
Greece	Grand-fathering	No	Yes	Yes/Yes	2000-2003	Based on reported emissions (some with compliance factor when new entrant unknown)	3.2 (4.25%)	Yes, no CF	No	Yes, no compliance factor
Hungary	97.5% Grand-fathering	Yes, 2.5% of ET budget	Yes	Yes/No	Varies: Average for 98-03 until planned emissions for 2005-07	BAT bench-marking or best technology applied in Hungary	0.6 (1.9%)	No special rules	Bonus	Time before convention in CHP as base period

EU member state	Allocation procedure for existing installations	Auctioning	Sectoral differen-tiation	Growth factor/ Reduction factor	Base period	Allocation procedure for new installations	Reserve in Mt CO_2 p.a. (in % of ET budget)	Considera-tion of process-related emissions	Special rule 'early action'	Special rule 'CHP'
Ireland	99.25% Grand-fathering,	0.75% of ET budget	Yes	Yes/ Yes	2002-2003	BAT benchmarks	0.34 (1.5%)	No info	No	Yes, for new instal-lations
Italy	Grand-fathering	No	Yes	Yes/partly Yes	2000-2003	BAT bench-marking, fuel-inde-pendent in future	38.9 (16.7%)	Yes, via sectoral budget	No, indirectly via production factor	Yes, for new instal-lations
Latvia	Grand-fathering	No	Yes	Yes/Yes	Energy: 1997, 2001 or 2002 Industry: installation-specific	free, based on reported emissions	0.52 (11.5%)	no info	Yes	No
Lithuania	98.5% Grand-fathering, in conjunction with BM elements	1.5% of ET budget	Yes	Yes/Yes	1998-2002	According to bench-marks	0.6 (5%)	No	No, indirectly via bench-marks	Yes, for new instal-lations
Luxem-bourg	Grand-fathering	No	No	Yes/No	3 years in 1998-2002	Fuel-inde-pendent BAT benchmarks	0.4 (11.9%)	Yes, no compliance factor	No	Yes, no compliance factor
Malta	Grand-fathering	No	No	Yes/No	1995-2004	BAT or "clean technology"	0.762 (26.3%)	No	No	No CHP installation
Netherlands	Grand-fathering in conjunction with BM elements	No	Yes	Yes/Yes	2001-2002	BAT benchmark (+ NL-SV)	2.5 (2.6%)	No, reduction factor also for PE	No, indirectly via bench-marks	Yes, double benchmark for existing installations

EU member state	Allocation procedure for existing installations	Auctioning	Sectoral differen-tiation	Growth factor/ Reduction factor	Base period	Allocation procedure for new installations	Reserve in Mt CO_2 p.a. (in % of ET budget)	Considera-tion of process-related emissions	Special rule 'early action'	Special rule 'CHP'
Poland	Grand-fathering	No	Yes	Yes/No	1999-2002, excluding lowest-emissions year.	New instal-lations must adhere to BAT values	0.94 (0.4%)	No special rules	Bonus	Bonus for efficient CHP instal-lations
Portugal	Grand-fathering	No	Yes	Yes/partly Yes	2000-2002 or 2001-2003	Bench-marks	3.1 (8%)	No info	No	No
Slovakia	Grand-fathering	No	Yes	Yes/No	1998-2002	Bench-marks	0.7 (2.3%)	No info	No	No
Slovenia	Grand-fathering	No	Yes	Yes/Yes	1 year in 1999-2002	BAT benchmark	0.066 (0.8%)	Yes, no compliance factor	No	Yes, CHP bonus
Spain	Grand-fathering	No	Yes	Yes/Yes	2000-2002	Not yet determined	6.3 (3.6%)	Yes, no compliance factor	No	Yes, no compliance factor
Sweden	Grand-fathering	No	Yes	Yes/Yes	1998-2001	Fuel-inde-pendent BAT benchmark	0.73 (3.2%)	Yes, no compliance factor	No	Yes, extra reserve for new good quality CHP
United Kingdom	Grand-fathering	No	Yes	Yes/ Yes	1998-2003, 1 year to be struck	BAT benchmark	15.6 (6.3%)	Yes, via emissions projections	No	Yes, extra reserve for new good quality CHP