



The EU Emission Trading Scheme After One Year

Experiences and outlooks

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Foreword

The Climate Change Policy Working Group of the Nordic Council of Ministers is a co-operation between energy and environmental division under the Nordic Council of Ministers. The most important task of the Nordic group for Climate Change Issues is to look into international climate change policy issues linked to the UN Framework Convention on Climate.

The Climate Change Policy Working Group has commissioned ECON Analysis to prepare this report "EU Emission Trading Scheme after one year: Experiences and outlooks". The report analyses the effect off the price of emission allowances on the electricity price in the Nordic electricity market during 2005.

The Climate Change Policy Working Group does not necessarily share the views and conclusions of the report, but looks at it as a contribution to our knowledge about the EU Emission Trading Scheme and the effect on the electricity price in the Nordic electricity market.

Oslo, Mars 2006
Jon D. Engebretsen
Chairman

Executive Summary

Abstract

The prices of emission allowances within the EU emissions trading scheme have turned out much higher than most expected before the system was launched. There are several explanations for this. Substantial cuts in the allocation of allowances were made during the Commission review process. High gas prices have increased the cost of fuel switching from coal to gas within the power sector, and increased the marginal abatement costs. These are the two most important explanations. Using ECON's carbon market model we estimate the quantitative effect this has had on the allowance price. The high allowance price has also increased the price of electricity. The model simulation indicate that a with a allowance price of €20 the electricity price in the Nordic area is increased with approximately 10 öre/kWh, compared with no emissions trading. If the allowance price increased to €30 it adds an additional 10 öre/kWh to the electricity price.

Background

On 1 January, 2005 the EU Emission Trading Scheme (EU ETS) was launched. Despite delays in the submission and approval of National Allocation Plans (NAPs) and in setting up the administrative systems this market has started to work. The larger part of the trade in emission allowances (EUAs) is done on the OTC-market, but the trade on exchanges is also growing rapidly. The most surprising development has probably been in the prices of the EUAs.

Before the system was launched a number of price prognosis were presented. Most of those indicated low prices, at least below €10 per ton CO₂ and in many cases clearly lower than this.

The EUA price has instead increased considerably during 2005. In January 2005 EUA prices were first at a level around €6, but then started to rise throughout the spring and peaked around €30 in the first week of July. After this peak the prices dropped and were for a short while below €20 again before stabilizing at levels of €20-25. During January 2006 the prices again rose above €27.

A number of explanations to this increase in the EUA price have been presented. The two most important ones are probably the allocation of EUAs and fuel price development. The allocation of EUAs has been much stricter than most expected, as the EU Commission made substan-

tial cuts in the allocation. This of course leads to a much higher net demand, driving prices upwards. Secondly, gas prices have increased considerably throughout 2005. Fuel switching from coal to gas within the power sector is generally seen as one of the most important abatement possibilities. With higher gas prices a higher price on EUAs are required to trigger such fuel switching for a given coal price.

Problem statement and method

The prices on emission allowances have been much higher than was indicated by the price prognosis made before the start of the EU ETS. This report analyse the potential explanations for this development. In general terms there are a few possible explanations:

- Cuts in the National Allocation Plans,
- Larger than expected business-as-usual emissions,
- Higher abatement costs, or
- Changes in the abatement costs due to fuel prices, etc.

These possible explanations are analysed in the report. The development during 2005 is described, and model simulations are conducted to assess the quantitative importance of various changes.

Secondly, emission trading has contributed to an increase in the price of electricity. The impact of EUA price on the electricity price is also analysed and simulated.

Conclusion and recommendation

Substantial cuts were made in the allocation of emission allowances from the submission of the original NAPs, until they were finally approved by the Commission. In total the cuts correspond to 300 million ton of CO₂ for the period 2005-2007. The gap, i.e., the difference between the projected business-as-usual emissions and the cap is roughly of the same size. This means that without the cuts, it is questionable if there had been any shortage and hence, whether the carbon price would have been significantly above zero.

Secondly, business-as-usual emission estimates have been increased by several countries in the NAPs compared with other previous estimates. Changes in these estimates will, however, not affect the market equilibrium given that the underlying reality has not changed. The individual participants are not primarily interested in the aggregate balance, but in their own abatement costs and the price of EUAs. The changes in estimates do affect assessment made by market observers and analysts, and

may therefore affect expectations. Since the price level depends on the balance over the entire period, expectations are crucial for the price formation.

Specific events during 2005 that have had a direct impact on the emission do however not seem to have contributed to a higher net demand. In Spain reduced hydro and nuclear production has increased emissions, but at the same time the Nordic region has been characterized by high hydro inflow which has decreased emissions. In addition there are some signs that indicate that some industries have decreased their emissions due to a lower production level.

There are still uncertainties regarding the marginal abatement costs. In this report we present model simulations based on ECON's newly developed carbon market model. The model provides us with a new and more sophisticated tool to assess the marginal abatement costs.

The marginal abatement costs have clearly increased due to changes in fuel prices. The effect on the equilibrium price on EUAs is however fairly small. According to the model simulations the estimated equilibrium allowance price, given an assumed gap of about 300 Mt and observed gas prices (during 2005 and forward prices for 2006 and 2007) is about €29. In our low gas price scenario the price drops to €25, which is still far above the estimates made before the system was launched.

The limited effect on the EUA price is to some extent related to demand responses in the power sector. Higher gas prices increase the power price, which reduces equilibrium demand. The model may however overestimate the short-run electricity demand response.

The uncertainty relating to the net demand are however still large. Based on the allocation and the business-as-usual estimates provided by the EU member states, the shortage is about 300 million ton CO₂. The business-as-usual estimate given by the model, i.e., the emissions at a EUA price of €0, is much lower than the estimates made by the member states.

The model simulations also show that emissions trading have a significant impact on power price. Given the actual precipitation levels during 2005, electricity prices in the Nordic area would have been around 22 öre (Swedish) without emissions trading, and with an EUA price of €20 the power price will be approximately 10 öre/kWh higher, and an EUA price of €30 adds an additional 10 öre/kWh to the power price. With normal precipitation levels, the power price would have been some 3-7 öre/kWh higher depending on market area.

1. Introduction

The EU Emissions Trading Scheme (EU ETS) has now been functioning for about 1 year. There have been considerable delays in the administrative procedures with several National Allocation Plans (NAPs) not being approved until well into 2005 and national registers not coming online in time.

In spite of these delays the market has started to work. The larger part of the trade in emission allowances (EUAs) is still done on the OTC-market, but several exchanges also offer trade and the trade is growing rapidly. The most surprising development has probably been in the prices of emission allowances.

This report aims at analysing the factors that may explain why observed EUA prices are much higher than the estimates made by most analysts *ex ante*. In very general terms there are a few possible explanations:

- Cuts in the National Allocation Plans contributed to a higher net demand,
- Larger than expected business-as-usual emissions, again contributing to a higher net demand,
- Higher abatement costs than expected, or
- Changes in abatement costs could due to changes in fuel prices, etc.

Each of these potential explanations is analyzed in the report. In addition, changes (possible and known) for the second trading period are described and the implications of these changes are discussed.

Recently, the Swedish Energy Agency published a report on the price development for electricity, emission allowances and the international fuel markets.¹ That study concludes that the development in the oil market has affected other fuel markets and indirectly also the price on emission allowances and electricity; the emissions market is still in a developing phase with few active participants; the electricity price is determined by the marginal costs, including the opportunity cost for emission allowances independently on the initial allocation; and that it seems like the EU ETS is fulfilling the goal of creating incentives for cost efficient emission reductions within EU.

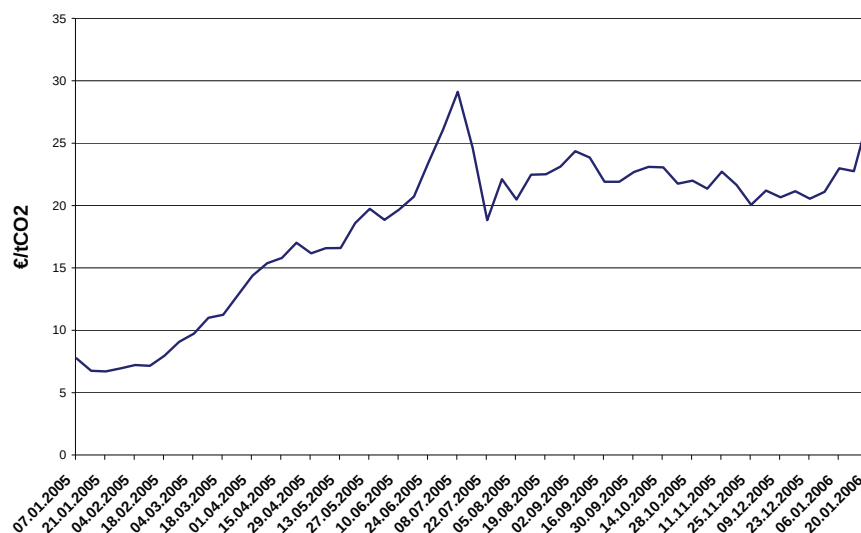
¹ STEM ER 2005:35, "Prisutvecklingen på el och utsläppsrätter, satm de internationella bränslemarknaderna", October 2005

1.1 Background

Figure 1.1 shows the development in the EUA price from the beginning of 2005 to January 20, 2006.² The prices increased from a low level of €6 in January to around €30 in the first week of July.³ The spring was characterized by increasing gas prices and NAP rulings implying rather large cuts for some countries. The peak around €30 in the first week of July coincided with a peak in gas prices in the UK. After the peak in July, prices fell back and throughout the autumn and winter of 2005 they seemed to have stabilized in the range €20-25. During January 2006 prices have again started to climb and on January 20, 2006 prices were above €27.

In line with the higher prices for emission allowances, power prices in Europe have also increased.

Figure 1.1 Price development for EUAs during 2005



Source: Point Carbon

There were naturally varying prognosis on the prices of emission allowances before trade started, but in general most analysts expected lower prices than what has been observed. During 2004 the Nordic Council of Ministers (NCM) financed the project “EU Emissions Trading Scheme and The Effect on the Price of Electricity” (ECON, 2004). That project was followed up with the development during the first two months of 2005 (ECON, 2005). In those reports the expectations were that the prices of EUAs would not exceed €5/ton CO₂ during the first trading period (2005-2007) and €8 was considered as a high price scenario for that pe-

² Data collected every Friday.

³ This graph shows a price just below €30 in July, but trade took place at prices above €30.

riod. For the second trading period (2008-2012) the likely price range was estimated at €8-13/ton CO₂.

These prices referred to the market balance for the each full trading period (2005-07 and 2008-12 respectively). No analysis was made of the price pattern until the final market clearing in the beginning of 2008 (for the first trading period). Since the EUAs for the coming year (e.g. 2006) are allocated before the sufficient amount of EUAs for the emissions in the previous year (e.g. 2005) it is possible for the installations that are included in the EU ETS to borrow EUAs from the coming year to cover for the preceding year, if it is short. This means that no real shortage will arise until EUAs for 2007 years emissions have to be surrendered in the spring of 2008. In that sense the final market clearing will be made in the spring of 2008 and the price will depend on the balance seen over the entire trading period. It was this market equilibrium that was estimated in the two previous studies. As was pointed out in these studies, the price pattern until then may, for various reasons, diverge from this final market clearing price, which can still turn out to be significantly lower than what has been observed this far. The discrepancies between the prognosis and the observed prices still warrant a study of potential explanations.

Several other studies also indicated low prices. The KPI Technical Report from May 2003 analysed the effect of linking under different assumption based on model simulations. With linking (i.e. EU ETS opened to JI and CDM credits) the price of allowances were estimated to be in the range €4.8-12/ton CO₂ in the second trading period. A report from Credit Suisse First Boston (CSFB, 2003) from October 2003 indicated a value of emission allowances of € 9.2/ton CO₂ for EU-15 in 2010. Within the enlarged EU the value of carbon would drop to € 6.9/ton CO₂, and with the addition of JI and CDM credits the value would drop further to € 3.2/ton CO₂.

2. Demand for EUAs during the first trading period

In ECON's two previous reports to the NCM our best guess estimates of net demand for EUAs were 6 (first report) and 10 (second report) million ton CO₂ per year. However, we pointed at large uncertainties. In the first report we had a minimum demand with a net surplus of about 75 million ton and a maximum net demand of 84 million ton CO₂ per year. In the second report the best guess had changed slightly due to new information regarding NAPs, but most of the uncertainty still remained.

2.1 Changes in national Allocation Plans

For the first trading period (2005-2007) emission allowances corresponding to approximately 6.6 billion ton CO₂ have been allocated. The power sector is the largest sector with approximately 50 % of ETS sector emissions.⁴

When the two previous ECON reports were written was considerable less information about the allocations. The most important changes have been considerable reductions in the allocations due to the Commission's decision on the NAPs. The timeline for these decisions is shown in Figure 2.1.

ECON (2004) was based on information available in June 2004 and there was only information from 12 NAPs.⁵ Adding the allocations in the remaining NAPs, which had not been submitted then, the total allocation for EU-25 would approximately have been 6 830 Mt CO₂ for the three year period. Our assumptions on the emissions from the remaining countries were however at a somewhat lower level, but that was also partly due to lower assumptions on business-as-usual emissions.

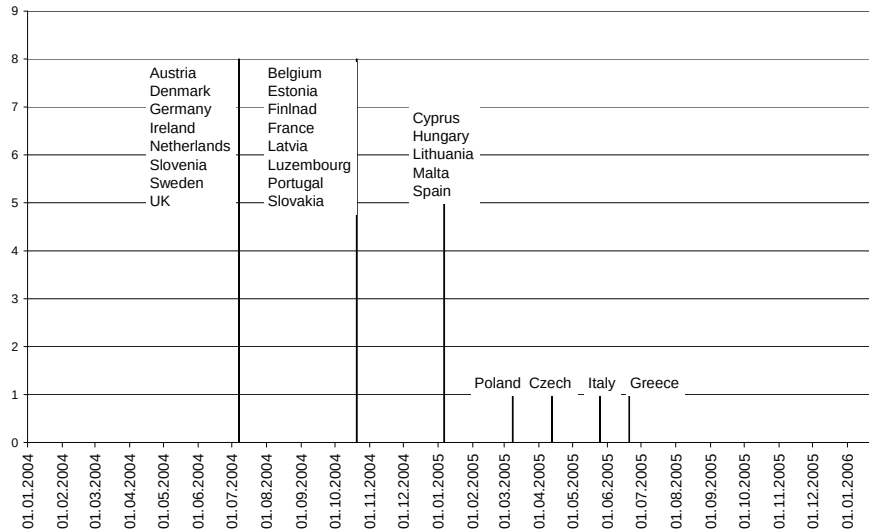
ECON (2005) was based on information available in the beginning of March 2004 and included data from 21 countries. According to these NAPs the total allocation in these 21 countries would have been 6 575 Mt CO₂. If the allocation in the NAPs of the remaining four countries is added, the total allocation according to the information available then would have amounted to 6 637 Mt. The reduction in total allocation between June 2004 and March 2005 was thus close to 200 Mt. In addition, France had increased there total allocation by approximately 100 Mt after

⁴ The CO₂ emissions from the ETS sectors constitute about 45 % of total CO₂ emissions within the EU.

⁵ In the case of Italy the assessment was based on a first draft used for national consultation.

the conditional approval of the French NAP in October 2004 due to the inclusion of more facilities.

Figure 2.1 Timeline for EU Commission decision on NAPs



Source: EU Commission press releases

As shown in Table 2.1 the total allocation according to the NAPs finally approved by the Commission is 6 569,7 Mt, and thus a further cut by about 65 Mt over the three year period compared with the information available in March 2005.

ECON (2005) reported cuts corresponding to 192 Mt CO₂ made during the review of the NAPs and we assumed further cuts of 60 Mt. The Czech Republic and Italy subsequently got a cut of 31 Mt and 69 Mt respectively, i.e. in total 100 Mt.

Not all allowances are allocated to allocations up front. New entrant reserves (NERs) amount to about 175 Mt, while other reserves are slightly above 20 Mt, giving a total of about 200 Mt in reserves. The uses of leftovers in these reserves are defined in the NAPs. 11 countries have stated that they intend to auction off surplus allowances, while the remaining countries will cancel any surplus. This means that allowances for up to 100 Mt may be cancelled. In addition closure of plants could add to the NERs.

In addition to what is reported here Bulgaria and Romania will enter the EU ETS in 2007. Very limited information is yet available for these countries. Both countries have current emissions far below their Kyoto targets. It is thus highly unlikely that any of them will add to the net demand. However, judging from the decisions the Commission previously has made regarding NAPs, very generous NAPs can not be expected for these countries either.

Table 2.1 Allocation of emission allowances 2005-2007, Mt

	Final allocation (incl. reserves)	Allocation to energy sector	Reserves	Cuts com- pared to notified NAP	Emission projections 2005-2007 ^{****}
Austria	99.0	37.2	1.0	0.3	104.0
Belgium	188.8	57.8	7.6	2.1	214.7
Cyprus ^{*,***}	17.0	11.6	0.1	-	17.2
Czech Rep.	292.2	186.7	23.5	30.84	311.0
Denmark	101.1	74.0	3.0	-	117.9
Estonia	56.9	52.7	0.6	8.1	42.0
Finland	136.5	103.4	2.5	-	139.8
France	469.5	194.9	17.1	4.5	491.4
Germany	1 494.2	1 243.6	9.0	-	1494.2 ^{****}
Greece	223.3	170.0	9.5	-	228.0
Hungary	93.7	69.1	2.0	-	93.9
Ireland	67.0	53.0	1.5	0.5	69.0
Italy	697.5	495.1	38.9	69	733.5
Latvia	13.7	9.2	1.6	5.6	13.2
Lithuania	36.8	28.3	1.8	3.9	42.0
Luxembourg ^{**}	10.1	3.8	0.7	0.5	11.1
Malta ^{*,***}	8.8	6.5	2.3	-	8.7
Netherlands	285.6	178.4	7.5	9	305.1
Poland	717.3	619.4	2.5	141.3	789.0
Portugal	114.5	76.9	9.1	2.1	116.7
Slovak rep	91.5	43.1	0.5	14.9	108.6
Slovenia ^{**}	26.3	18.4	0.2	-	28.5
Spain	523.3	347.6	5.8	-	544.8
Sweden	68.9	21.1	2.4	-	79.8
UK [*]	736.4	507.3	46.7	-	801.9
Total	6 569.9	4 609.3	197.3	293.7	6905.9 ^{*****}

Source: NAPs, COM decisions and press releases, Umweltbundesamt (Nov. 2005)

^{*} There is an ongoing process in which the UK demands a small increase.

^{**} Not included in ECON (2005)

^{***} Cyprus and Malta do not have separate commitments as parties to the Kyoto Protocol.

^{*****} The German NAP lacks information about BAU emissions. Here we have included the allocation in Germany (1494 Mt)

2.2 Business-as-usual emissions

In our previous studies we have primarily based the estimates of business-as-usual emissions on the projections provided by the countries in their national communications and national allocation plans. For some countries the projections differed substantially between the national communications to the UNFCCC⁶ and the national allocation plans, which highlight the uncertainty in these estimates.

Our estimates of business-as-usual emissions for 2006 for the ETS sectors for the 21 included countries in ECON (2004) based on the information contained in the national communications to the UNFCCC was 1 810 million ton CO₂. Assuming that the 2006 levels can be used as the average for the 2005-2007 period the total emissions over the three year period would be 5 430 million ton CO₂. The emission projections in the NAPs are, especially for the new member states, generally higher than the ones provided in the national communications.

Most NAPs include projections for CO₂ emissions in 2005-07 (see Umweltbundesamt, 2005 for a summary). For some countries⁷ projec-

⁶ United Nations Framework Convention on Climate Change

⁷ Belgium, Estonia and Latvia

tions based on their⁸ own calculations are reported, while information is lacking for Germany. Using these numbers and adding the allocated amount for Germany, the total projected emissions are about 6 900 Mt CO₂, i.e., substantially above the levels reported in the national communications to the UNFCCC.⁹

The discrepancies between the numbers submitted to the UNFCCC and the numbers in the NAPs may of course reflect actual changes and the fact that the emissions projections for one year cannot automatically be extended to the entire period, but it cannot be ruled out that it also reflect political considerations. In the NAPs the countries generally have an incentive to claim high projected emissions in order to get acceptance for more generous allocations. On the other hand, countries may also submit more optimistic plans in order to promote the policy measures taken. The latter behaviour is likely to be stronger in the national communications, since those do not have the same direct impact on the country (in terms of approved allocation) as the allocation plans have. Over time it is of course not credible to report different projections.

Below we present model simulation results, which yield separate estimates for the BAU emissions. These estimates are considerably lower than what is presented by the countries in the NAPs.¹⁰

2.2.1 Some factors affecting the emissions during 2005

Economic Conditions

The economic conditions will naturally always vary, and it is not the purpose of this report to go into depth regarding the economic developments during 2005 and expectations for the coming year. We can however note that the European steel industry has reduced output with 4%. Based on the average emissions from the steel industry this would reduce emissions by 8-10 Mt CO₂.¹¹

In Finland the labour market conflict within the pulp and paper industry reduced the demand for electricity and reduced emission of CO₂. Electricity consumption was reduced by 2.5% over the year.¹² According to calculations by the Finnish energy industries these developments led to reductions in CO₂ emission by about 10 Mt compared with 2004.¹³

⁸ Umweltbundesamt

⁹ The projected emissions of the four countries that were omitted in the earlier study are only 65.5 Mt and can thus not explain the large difference.

¹⁰ In the final version we will present an analysis by country on the differences in our BAU estimates from the simulations and what is provided in the NAPs. This analysis will however be limited by data constraints (different definitions of sectors, lack of data etc).

¹¹ In addition reduced industry production leads to reductions in the electricity demand, and thus lower emissions from the electricity sector.

¹² Mild weather also contributed to the reduction.

¹³ <http://www.energia.fi/page.asp?Section=3219&Item=15596>

Weather

Weather conditions affect electricity and heat markets. Warmer and wetter conditions than normal implies reduced electricity and heat demand (although electricity demand may increase in hot summers), and hence reduced demand for allowances.

During 2005 there are in particular two weather related events that have affected emissions. 2005 was quite wet in the Nordic area, resulting in precipitation of 35 TWh above normal. This increase in hydro power generation will replace electricity generated in coal fired plants, and thus reduce emissions with approximately 30-35 Mt CO₂.

On the other hand Spain has experience a dry year. During the first 8 months of 2005 hydro inflow was reduced by 14 TWh and nuclear production was reduced by 7 TWh. In addition a hot summer increased the demand during the summer. All in all the increased emissions in Spain are however probably less than the decrease in the Nordic area.

2.3 Effects on net demand

Net demand for allowances was estimated at around 10 Mt CO₂ annually in the previous ECON reports (ECON, 2004 and 2005). However, this would result in a price close to zero and transaction costs would then probably prevent all allowances from entering into the market. In addition unused reserves for new entrants could push the actual net demand on the market upwards. These behavioural aspects were not captured in the main estimates of net demand, and a plausible net demand for allowances of 30-60 Mt (ECON, 2004) and 40-60 Mt (ECON, 2005) was estimated, i.e., in the range of 90-180 Mt over the three year period.

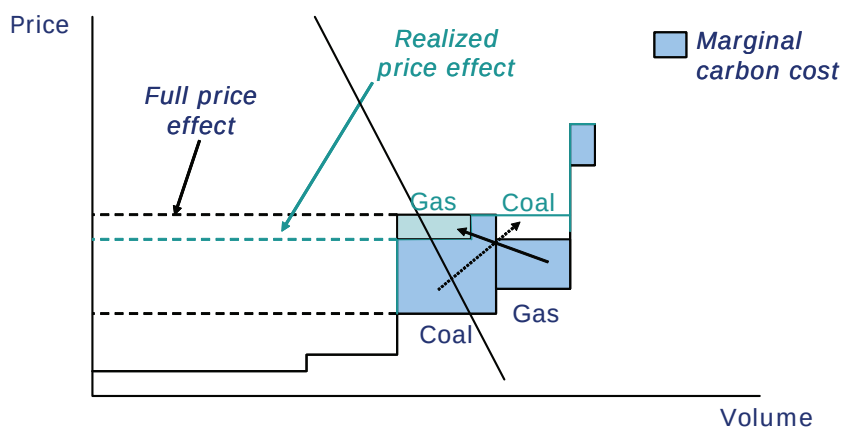
The projected total emissions from the ETS sectors in Europe amounts to 6 900 Mt (according to the NAPs), while emission allowances have been allocated for 6 569 Mt, leaving a gap of more than 300 Mt CO₂ over the three year period. This may however be exaggerated due to the above-mentioned incentives to claim high emissions in order to get acceptance for more generous plans.

The estimated net demand is primarily increased by cuts in allocation, but to some extent also by higher business-as-usual estimates. Specific events such as industry production and weather does however seem to have contributed to reduced emissions and do not seem to provide a strong explanation for increased net demand or higher than expected EUA prices.

2.4 Abatement costs

It is generally believed that the most important short term abatement opportunity is fuel switching (in power production) from coal to gas. The CO₂ emissions from gas-fired power plants are considerably lower than the emissions from coal-fired plants. This does of course mean that the total emissions are reduced when gas is burned instead of coal, but also that the profitability of burning gas is improved as the price of emission allowances increases for given fuel prices. Fuel switching does not (usually) mean that one particular power plant switch fuel, but rather that the merit order curve, i.e., the order in which power plants are taken into operation as the price increase, is affected so that gas-fired plants are used for generation before coal-fired plants instead of the opposite (see Figure 2.2).

Figure 2.2 Fuel switching - a principle sketch



The extent of such fuel switching depends crucially on two factors. Firstly, the actual physical possibilities are important; there needs to be power plants of both types in order for switching to occur and some of this capacity must be unused at least during some hours. Hence, the fuel switching potential is primarily found in the UK, but there are also possibilities in some continental countries (Benelux/Germany area). The possibility for fuel switching is further analysed in the simulations presented below.

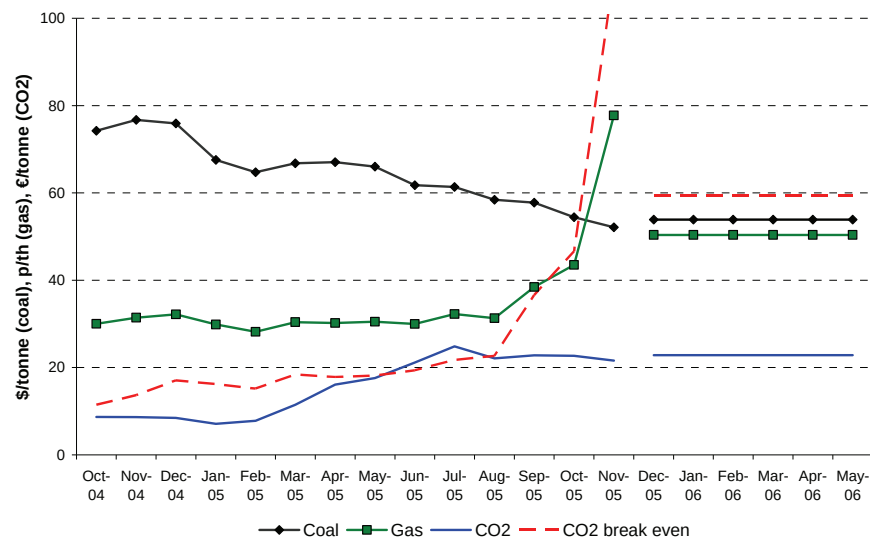
Secondly, fuel switching must be profitable. This profitability depends on the fuel prices and the price of emission allowances. Fuel switching is encouraged when coal prices increase or gas prices decrease, and when the price of emission allowances increase. For given fuel prices it is possible to calculate the necessary price of emission allowances for fuel switching to happen for particular plant types.

Figure 2.3 shows the price development for coal, gas and EUAs from October 2004 until the end of 2005 and forward prices for 2006. The graph shows that the coal price has decreased, more or less, continuously during the year, while the gas price has increased considerably. The graph also shows a calculated break even price for EUAs, i.e., the price of al-

allowances necessary for fuel switching between a typical coal and gas plant to be profitable given the fuel prices. This calculated break even price does naturally not give a complete picture of the possibility for fuel switching. First of all there is a considerable seasonal pattern in gas prices, with much higher prices during the winter than the summer. Secondly, the market prices may not at all time be the relevant price for the actors in the market, since their contracts may not necessarily follow the market prices directly. Thirdly, there are large regional differences in the gas market in Europe. The graph does however indicate that given the current forward prices fuel switching does not seem to be a profitable option.

From the spring 2005 until the end of the summer there was a clear relationship between the price of EUAs and the calculated break even price for fuel switching. From September and onwards this link seems to have been broken as the break even price has increased considerable due to higher gas prices, the EUA price as not increased to the same extent. The calculated break-even price for 2006 is around €60/ton CO₂. It should be emphasized that this is only a rough approximation and more detailed analysis is needed to assess both the potential for fuel switching and the equilibrium price for EUAs. Later in the report we present simulations using ECON's newly developed carbon market model.

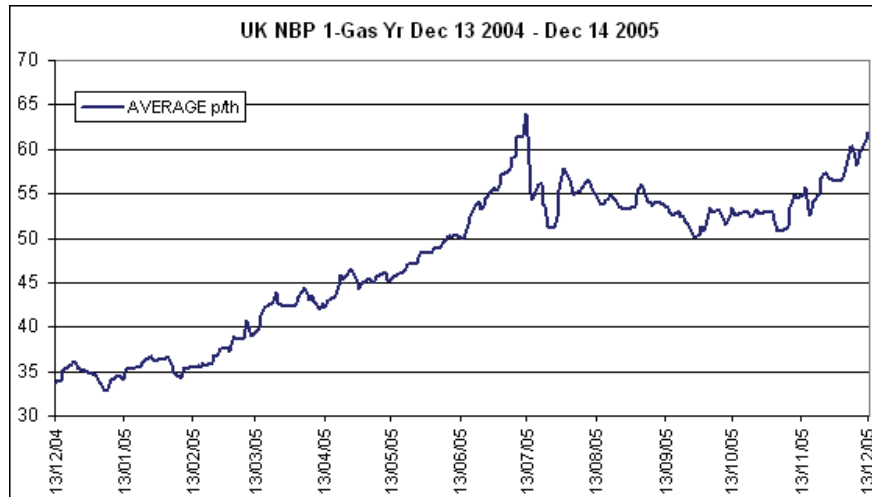
Figure 2.3 Fuel price developments during 2005.



The regional differences in gas prices are highlighted in Figure 2.4 and Figure 2.5 which show the price development for gas prices in the UK (NBP) and in Germany (Bunde). In the beginning of 2005 UK gas prices were at levels around 35 p/th, which is rather high by historical standards. During the spring and summer the UK gas prices increased to a peak of around 65 p/th in July, before falling back to €50-55 p/th. During the last two months of 2005 the price again rose and in December it was back above 60 p/th again. The UK gas market has been characterised by a con-

cern for shortages during the winter season which is one potential explanation for the high prices.

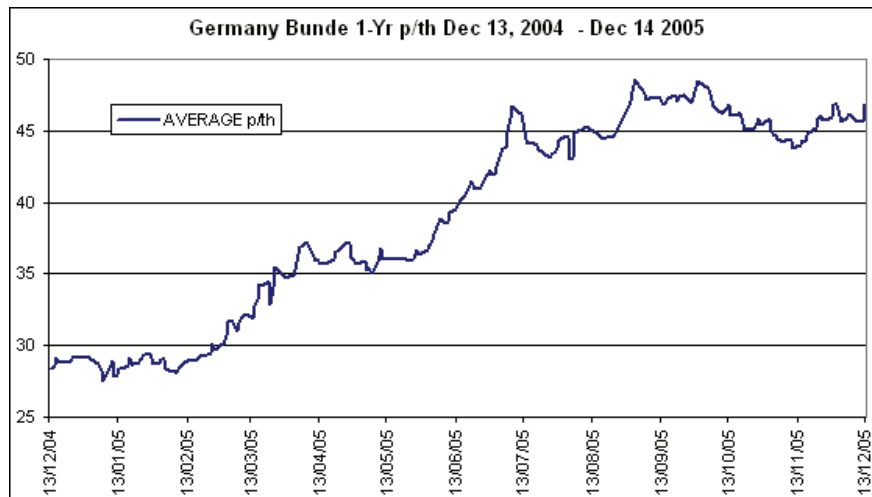
Figure 2.4 UK Gas price development 2005



Source: Platts

Also in Germany the gas price has increased considerably from levels below 30 p/th in the end of 2004 and beginning of 2005 to levels around and above 45 p/th during the summer and autumn.

Figure 2.5 German gas price development 2005



Source: Platts

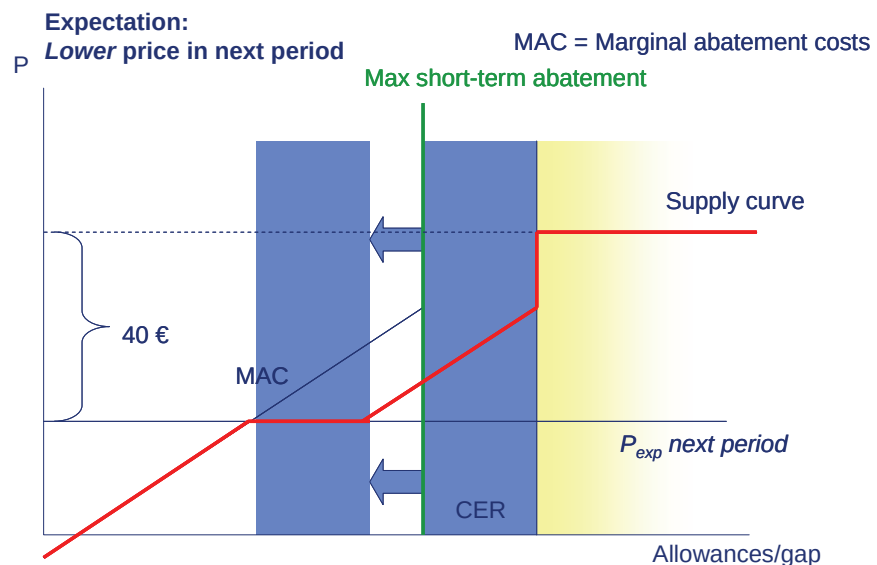
The fuel price development has clearly been dramatic during 2005 and this has affected the costs of fuel switching, and thus the marginal abatement costs. The impact on the total market is analysed in the numerical simulations presented below.

2.5 Links to the second trading period

The uncertainty as to what happens when the market meets “the wall” in 2008 (end of the first trading period) and the cost of being short, may be a powerful price driver, and more so as the uncertainty of the market balance in the next trading period eases. The EUAs, i.e. the permits allocated in the first trading period, cannot be transferred to the second trading period. However, credits from CDM¹⁴ projects (Certified Emission Reductions, CERs) may be used both in the first and second periods. This creates a relationship between prices in the first trading period and the price expectations for the second period.

Figure 2.6 illustrates the supply curve for CO₂ allowances in 2005-2007. The marginal abatement cost (MAC) increases by the amount of abatement needed. Disregarding any imports from credits the equilibrium price of allowances will be determined by the marginal abatement cost for the required level of abatement. This level is however uncertain. For a high level of abatement the equilibrium price in the first period may be above the expected price in the second period. That would mean that CERs will be shifted from the second to the first period, which would alter the shape of the MAC curve, shifting the upper part of that curve outwards. To which extent that this is possible depends on a number of factors. First of all it, the necessary infrastructure need to be in place, and secondly the CERs must have been produced, i.e., enough projects have to have started producing CERs. This is further developed in the next section.

Figure 2.6 Carbon supply 2005-2007



¹⁴ Somewhat simplified Clean Development Mechanism (CDM) are projects leading to emission reductions in countries that do not have commitments under the Kyoto Protocol (developing countries).

Installations that are short by the end of the first trading period must pay the penalty and purchase allowances to cover their emissions. If the market fails to comply with the cap, these allowances can only come from CERs or from allowances issued for the second trading period. However, if eligible installations are penalized for covering their emissions in the first period with second period allowances, and the penalty in the first period is €40 per ton, the end price of the first trading period may be up to €40 above the price expectation for the second period. The €40 penalty will however also put a cap on the price difference between the first and second trading period.

If on the other hand the market is long at the end of the first trading period there is no possibility to bank surplus EUAs to the second period. Prices may thus drop significantly (possibly close to zero), especially if unexpected events (weather, industry production) occur towards the end of 2007.

As mentioned above, CERs can be banked from the first to the second period. Market participants can thus use CERs to cover for the uncertainty and if there are enough CERs these can be used to decrease price differences, or potentially even equalize prices, between the first period and the second period. The availability of CDM credits may play a crucial role in mitigating hockey stick prices as the wall approaches. The possibilities for import of CERs are discussed in the following section.

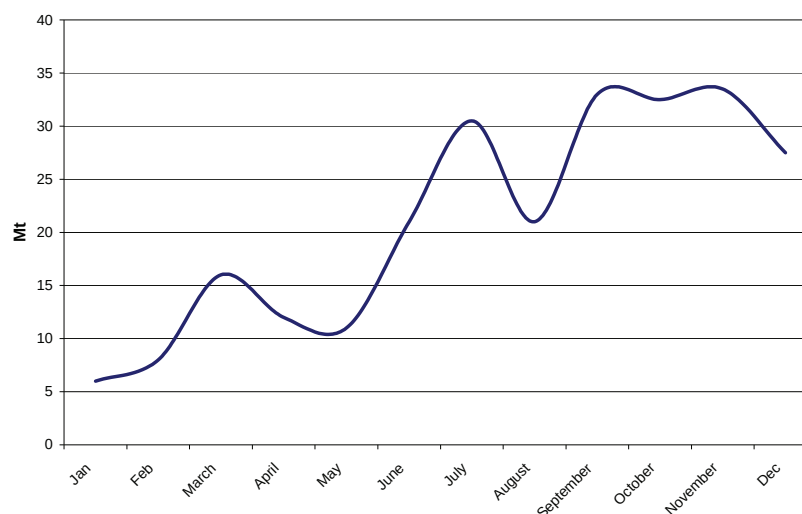
2.6 Development of the market

The trade on the European emission market has developed rapidly throughout the year. In the beginning of the year the market was thin. The volumes traded varied between days. In January and February the weekly volumes ranged from 0.6 million ton to more than 3 million. By the end of the year the volumes were at levels around 10 million ton per week. Figure 2.7 show the approximate traded volumes per month during 2005.¹⁵ It is furthermore estimated that the total volume traded on OTC and exchanges during 2005 was about 250 million ton.¹⁶

One central part of the emission trading is the establishment of the national registries. These are needed in order for the participants to receive and be able to transfer their emission allowances. The national registries interlink with the Community transaction log operated by the Commission. According to the current information the national registries are still not operational in seven member states, while the remaining are classified as partially operational. Italy and Poland are the large countries that yet have to get their registries online.

¹⁵ Source: Point Carbon

¹⁶ Source: Total

Figure 2.7 Approximate volumes traded in 2005

Source: Point Carbon

Figure 2.8 Status for national registries

Registry	Public Site URL	Registry Status	Online by
Austria	http://www.emissionshandelsregister.at	Partially Operational	< Sept -05
Belgium	http://www.climateregistry.be	Partially Operational	< Sept -05
Cyprus		Not Operating	
Czech Rep.	http://www.ote-cr.cz	Partially Operational	Oct -05
Denmark	http://www.kvoteregister.dk	Partially Operational	< Sept -05
Estonia	http://khgregister.envir.ee	Partially Operational	Oct -05
Finland	http://www.paastokaupparekisteri.fi	Partially Operational	< Sept -05
France	https://www.seringas.caissedesdepots.fr	Partially Operational	< Sept -05
Germany	https://www.register.dehst.de/	Partially Operational	< Sept -05
Greece		Not Operating	
Hungary		Not Operating	
Ireland	http://www.etr.ie/	Partially Operational	< Sept -05
Italy		Not Operating	
Latvia	http://etrlv.lv.gma.gov.lv/	Partially Operational	Oct -05
Lithuania	http://etr.am.lt	Partially Operational	Oct -05
Luxembourg		Not Operating	
Malta		Not Operating	
Netherlands	http://www.nederlandse-emissieautoriteit.nl	Partially Operational	< Sept -05
Poland		Not Operating	
Portugal	https://rple.ambiente.pt	Partially Operational	Dec -05
Slovakia	http://co2.dexia.sk	Partially Operational	Dec -05
Slovenia	http://rte.arso.gov.si	Partially Operational	Dec -05
Spain	http://www.renade.es	Partially Operational	< Sept -05
Sweden	http://www.utslappshandel.se/	Partially Operational	< Sept -05
United Kingdom	http://emissionsregistry.gov.uk	Partially Operational	< Sept -05

Source: EU Commission web pages (<http://europa.eu.int/comm/environment/ets/>), downloaded 27 January, 2006 and Total

2.7 Import of Credits

The Kyoto Protocol contains two schemes for project-based emission trading (Clean Development Mechanism, JI, and Joint Implementation, JI) and one cap-and-trade scheme (International Emissions trading, IET). The latter is restricted to Parties who has a cap under the Protocol, which is also the case for JI. CDM allows for emission reductions generated by projects in developing countries (without a cap under the Protocol).

The Protocol creates a framework for emissions trading, but the implementation depends primarily on domestic emission trading schemes. The EU ETS (and the Norwegian scheme) are not regulated by the Protocol, but linked to the mechanisms under the Protocol through national legislation and EU directives.

During the first phase of the EU ETS only CERs are allowed, while in the second phase Emission Reduction Units (ERUs)¹⁷ can also be used. Physical delivery of CERs has only recently started and the volumes are small. There is however a steady growth in commercial contracts and financial transactions. Countries and multilateral development banks also have ongoing discussions that could be preparations for trade in AAUs¹⁸ under IET.¹⁹ The latter kind of credits can however not be directly imported into EU ETS.

How imports of credits will affect price formation in the carbon market depends on two crucial factors: firstly, the development of projects and commercial contracts, and secondly, the implementation of the necessary infrastructure for trading.

Figure 2.9 shows the timeline for the supply of CERs. CDM began operating in December 2001. Since then experience have been gained and most importantly, methodologies for baseline setting have been developed. As of 15 November, 2005, 35 CDM projects were registered, representing about 7.8 million CERs over the projects lifetime. As of October 31, 2005 approximately 400 projects were at the validation stage, 20 were awaiting registration and about 57 000 CERs had been issued into the CDM registry. Given the projects that are in the system it is not unlikely that credits corresponding to more than 500 Mt CO₂e will have been generated by 2012.

Many governments have established aggressive purchasing programmes and governments are also major purchasers of CER credits so far. It is thus likely that the majority of the funds committed prior to the start of the Kyoto period will belong to governments. Many of the government programmes have also committed to only purchase credits for

¹⁷ ERUs are credits from Joint Implementation projects, i.e., projects leading to emission reductions in countries that have reduction commitments under the Kyoto Protocol.

¹⁸ Assigned Amount Units

¹⁹ For instance in the form of Memoranda of Understanding between governments to help ensure that optimal conditions for trading and project development are created and discussions of criteria for Green Investment Schemes. The latter could help justifying trade in AAUs.

compliance purposes and will not resell them in a secondary market, i.e., the credits will not become available for participants within EU ETS. However, the amount of CERs and ERUs used for compliance in non-ETS sectors may affect the allocation to the ETS sectors.

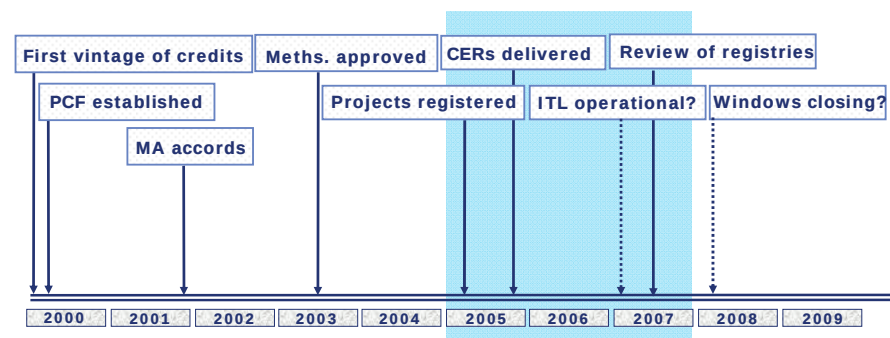
Before any CERs can be transferred out of the CDM registry the parties must develop national registries, the registries must be reviewed and the International Transaction Log (ITL) must be up and running. The countries within the EU ETS will (most likely) have their registries fully functional in time to make it possible to import CERs in the first trading period, but the review process and the ITL must be completed as well. This may create difficulties in using CERs in the first trading period.

During the COP11/MOP1 meeting in Montreal in November/December 2005 some additional clarifications regarding the establishment of the ITL were made. A schedule for implementing the ITL in 2006 was decided, with a view to allow registry systems to connect to the ITL by April 2007.²⁰

Credits from JI projects, ERUs, can only be traded (physically) from 2008 and these credits can not be used within the EU ETS during the first trading period. JI projects may however begin generating credits already from January 2000.

CERs and ERUs are linked to EU ETS through the Linking Directive. According the Directive AAUs can not be acquired by ETS participants and ERUs can first be used in the second trading period (2008-2012) as mentioned above. As the Linking Directive is transposed into national law some further restrictions may arise. The deadline for implementing the Directive into national law was November 15, 2005, but currently only six or seven member states have completed the process.²¹ The amount of CERs and ERUs that can be used will normally be specified in the NAPs for the second period.

Figure 2.9 Timeline for supply of CDM



²⁰ <http://unfccc.int/resource/docs/2005/cmp1/eng/05.pdf>

²¹ Denmark (1 juni, 2005), France (28 October, 2005), Germany (30 September, 2005), UK (13 November, 2005), Spain (10 March, 2005) and Ireland (11 November, 2005). The Netherlands has also sent a draft amendment on the Environmental Control Act to the Parliament (20 September, 2005). Source: <http://www.ieta.org/ieta/www/pages/index.php?IdSiteTree=1345>

3. Model results for 2005-2007

ECON's newly developed European carbon market model was used for the simulations presented in this chapter.

We simulate the outcome of the EU ETS in the first trading period (2005-2007) in three cases:

- Base case, with normal weather and actual fuel prices (observed spot prices in 2005, forward prices for 2006-2007)
- Sensitivity with low gas prices in 2006 and 2007 in order to quantify the impact of the present high gas prices
- Sensitivity with actual events in 2005 in order to quantify the impact of deviation from normal conditions. In particular, we model the wet year in the Nordic countries, dry year in Spain and reduced production level in European metal industries.

3.1 About the model

ECON's Carbon market model includes emissions from all ETS sectors: the power sector, the heat sector and other industrial sectors that are contained in the ETS. Geographically, the model covers EU-25 plus Norway and Switzerland.

The model is a bottom-up model capturing the fundamental supply and demand functions in the market. It is an extension of ECON's power market model, ECON Classic. The model finds an equilibrium between supply and demand of allowances in the EU ETS market for the whole trading period (2005-2007), and equilibrium between supply and demand of power in each country. Figure 3.1 shows the structure of the model.

The allowance market

In the model, emissions from power generation, heat generation and production in ETS industries are "matched" with the cap, i.e. total emissions from these sectors must be lower than or equal to the total amount of allowances.

The resulting carbon price is determined in the model by requiring supply to equal demand for allowances, via endogenous abatements in the ETS sectors. Total supply is given by the amount of allowances allocated to the participants. The gap between baseline emissions (i.e. without restrictions) and the cap given by the total amount of allowances deter-

mines the required abatements. Which abatements are actually carried out depends on the costs of reducing emissions in the different ETS sectors.

As a result of this optimization, the model finds one equilibrium price for the whole three-year-period. Since allowances can in practice be borrowed from the next year, it is the total emissions and the total amount of allowances during the three-year-period that determine the price. High emissions in one year cause many allowances to be used in that year, leaving fewer allowances available for the next year, thus implicitly raising the price of allowances in the future. This mechanism equalizes the price in all three years. With perfect information and no uncertainty (as in the model), there is no fluctuation in allowance price.

The power market

The power market module includes demand functions for up to five demand segments in each country, described by income and price elasticities and initial demand levels. Supply is represented by generation capacities and corresponding marginal costs, i.e. the merit order curves for each country. In the short term, investments are exogenous, but the model can also handle endogenous investments. Cross-border trade takes place according to price differences and transmission capacities. Diurnal and seasonal price structures are captured through the representation of four seasons, each consisting of five load blocks (the number of seasons may be increased). Power prices, production, consumption, trade and emissions in each period and each country are calculated.

The heat market

Heat demand is determined by temperatures and economic growth. Supply comes from CHP units (that produce both power and heat) and district heating units and is specified by capacities and costs in these units.

Industrial sectors in ETS

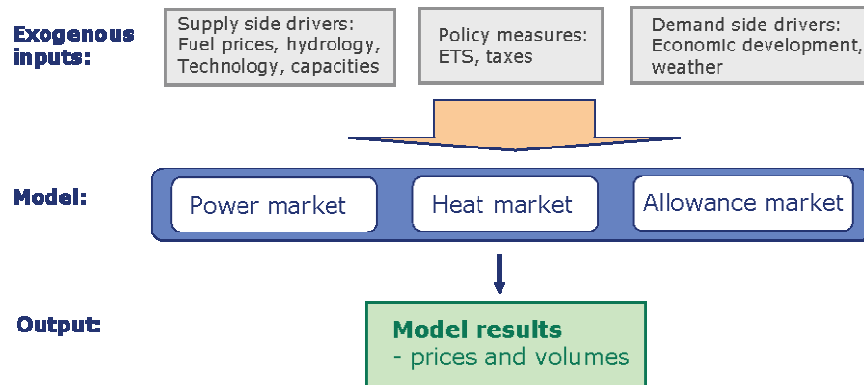
In addition to the energy industry, other (emission-intensive) industries are participants in the ETS market. Some of them (iron and steel, pulp and paper, and chemical industry) are also power intensive, and as such important for the outcome of power market. Others (e.g., minerals) are not power intensive.

Emissions from industries depend on the activity level, which is in turn a function of global economic growth and domestic conditions. Emissions are reduced according to marginal abatement costs and the abatement potential in different industries. Abatement costs and potentials in these industries are based on the PRIMES model (Blok et al,

2001), but adjusted to take account of potentials in the new EU member countries.

Figure 3.1

ECON Carbon market model



3.2 Model assumptions

In chapter 2, the most important price drivers in the carbon market were identified and discussed. In the following we present the assumptions made about these drivers in the model simulations.

Allocation of allowances

The NAPs determine the number of total allowances available to the market (the cap), and thereby also the total emissions. The total allocation is shown in Table 2.1.

Norway, although not being part of the ETS, has also allocated tradable emission allowances to industries. We assume that it will be possible also for these agents to trade in the ETS market during the first period (2005-2007). Hence, the Norwegian allowances (20.5 M ton in total) are added to the total quota.

There is, however, considerable uncertainty about the size of the gap. We will return to this issue when discussing the model results below.

Import of CERs

Possibilities for imports of CERs were discussed in chapter 0. With high prices for allowances in the ETS market, some import of CERs is likely. This will probably not have a significant impact in the first trading period, but high allowance prices in the first period create a strong incentive to import CERs to this period.

The effect of import of credits in the first trading period is similar to the effect of increasing the cap on emissions, i.e., the gap between the allowed emissions and the business-as-usual emissions decreases. As

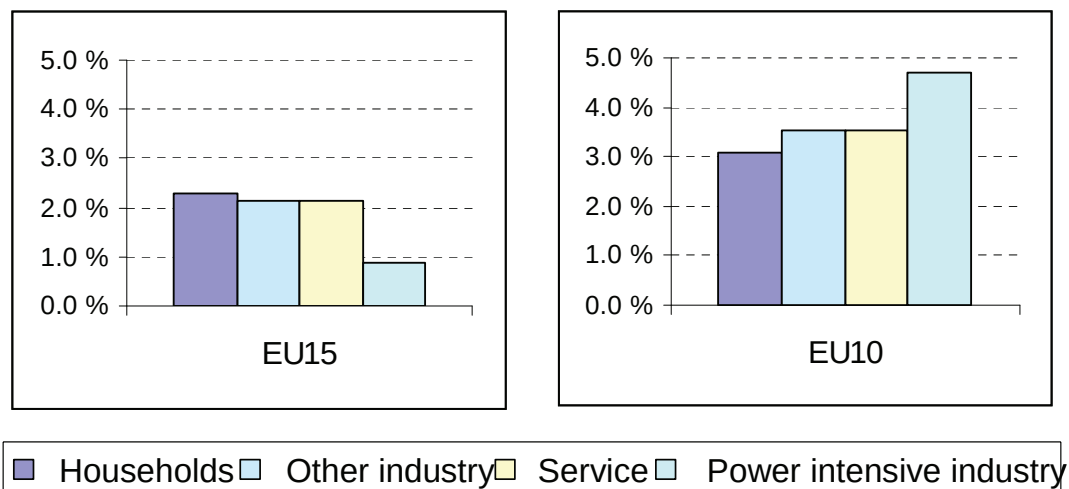
there is still much uncertainty pertaining to the size of the gap, and imports of CERs affect the size of the gap, we have not analysed the effects of CER imports separately from the analysis of varying sizes of the gap.

Economic growth

Economic growth is an important determinant of the economic activity level, and as such affects both power demand and emissions.

Figure 3.2 shows the assumed average growth rates for the period (separate assumptions are made for each country). The assumptions are based on ECON's analysis of the macroeconomic situation in the countries and Deutsche Bank's newest forecast.

Figure 3.2 Assumptions on economic growth



Weather

Weather is an important determinant of demand for electricity and heating. Warm winters reduce the need for heating, bringing about reduced demand for heating in countries that have district heating facilities (e.g., Germany, Central European countries) and reduced demand for electricity in countries that have a large share of electrical heating (e.g., Norway and Sweden). Hot summers, on the other hand, increase the demand for electricity for air conditioning purposes, especially in Southern Europe.

Due to large variations in precipitation, electricity supply can vary a lot from year to year in countries with hydropower production.

In the present analysis, we have not modelled demand variations due to weather. Variation in production is analysed in the sensitivity analysis that analyses the effect of actual event in 2005 (see section 3.3.3 below).

Abatement costs and fuel prices

In the short term, i.e. in the next couple of years, the largest part of emission abatements must occur in the power sector. In power generation it is

possible to switch from an emission-intensive fuel (coal) to a less emission-intensive fuel (natural gas), assuming that the alternative capacity is available. For the industrial sectors, abatement often involves investments and is therefore not a feasible option in the short term (unless the plant is closed altogether). Therefore, the relationship between fuel prices, especially coal and natural gas prices, is the most important determinant of marginal abatement costs and allowance price in the short term (2005-2007).

Natural gas prices

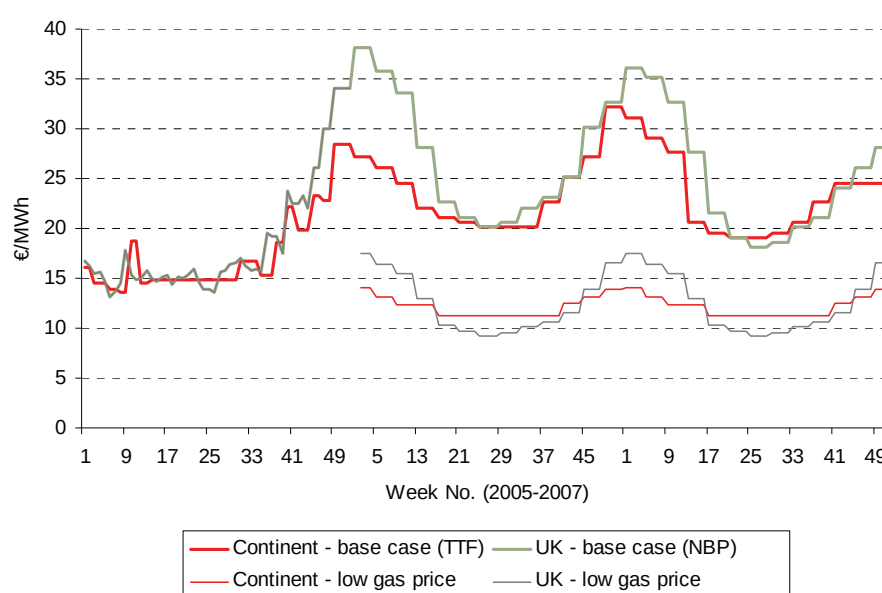
In the base case calculations we have used observed spot prices in 2005 and forward prices for 2006 and 2007. For Continental Europe we have used TTF (Dutch Title Transfer Facility) quotations, while for UK we have used NBP (National Balancing Point) quotations. The annual averages of these gas prices are shown in Table 3.1.

Table 3.1 Natural gas prices (annual average), €/MWh

	Base case		Low gas price	
	Continental Europe	UK	Continental Europe	UK
2005	17	19	17	19
2006	24	27	12	12
2007	23	25	12	12

Source: Financial Times, Total, Heren

Figure 3.3 Seasonal variation in gas price



Source: Financial Times, Total, Heren, own calculations for 2006-2007

There is, however, considerable seasonal variation in gas prices, and the variation is more pronounced in the UK than on the Continent. Figure 3.3 shows the seasonal profiles we have applied in the simulations.

In addition to the base case, we have made calculations for a case with low gas price. Here average annual prices are as observed in 2005, but fall to 12 €/MWh in 2006 and 2007.

Since gas prices in 2005 have been at a relatively high level, compared to the historical level, a scenario with even higher gas prices seems unlikely.

Coal prices

Also for coal prices the actual spot price was used for 2005, giving an annual average price of 61 USD/ton. For 2006 and 2007, the price level of 55 USD/ton was assumed (about the same level as in the end of 2005).

Fuel oil prices

There are also power plants using heavy fuel oil (HFO) and light fuel oil (LFO) in the model. While the LFO price follows the crude oil price quite closely, the HFO price is usually much more stable than the crude oil price. For both fuels, the actual spot price was used for 2005 (in average 226 USD/ton for HFO and 514 USD/ton for LFO). For 2006 and 2007 forward prices were used (226 USD/ton for HFO and 546 USD/ton for LFO).

Other assumptions

Generation and transmission capacities are as the actual capacities in 2005, and adjusted for known investments and closures in 2006 and 2007 (e.g., Estlink is assumed to start operation from 2007). There are no endogenous investments in that short time horizon.

There is considerable uncertainty about how much and how quickly consumers respond to changes in power prices, especially in the short term. We believe that the demand response is limited in this time frame.

To reflect this, we reduce the price elasticity of power demand, compared to what we assume in the long run.²²

²²

As an approximation in order to reduce the *total* demand elasticity, we assume that power demand is price inelastic in households and power intensive industry, while other industry and services have price elastic demand. The values for elasticity vary between -0.2 to -0.4 in different countries.

3.3 Model results

3.3.1 Base case – normal year

Emissions – business as usual

With assumptions as discussed in the previous section, emissions in the business-as-usual (BAU) case are estimated at 6 534 M ton CO₂ over the three-year period (assuming precipitation as in a normal year). This is considerably lower than in the countries' own estimates of BAU emissions, which is about 6 905 M ton CO₂, excluding Norway (see Table 2.1).

There are several reasons for this discrepancy: first, the model is in some respect 'too perfect': there is perfect competition and no uncertainty (for instance about weather in the three-year period). Secondly, there are no start-up costs in power production, meaning that thermal power producers can adjust production immediately. This may underestimate emissions from thermal power plants.

Furthermore, there is considerable uncertainty about the actual size of the gap. As mentioned in chapter 2.2, the BAU estimates have changed considerably over time for some countries, and it is uncertain to what extent this reflects real changes in expected emissions. It cannot be ruled out that many countries have exaggerated their BAU emission projections due to strategic reasons, hoping to get less binding caps and thus giving more favourable conditions to domestic industries.

Also, the projections have been prepared under different fuel price assumptions than those that were prevalent in 2005 (as we have assumed). Even though the present high gas prices induce more coal to be used, the resulting high allowance prices and power price suppress demand somewhat, reducing the production in coal power plants. Notably, the discrepancy between sector allocations (that are presumably based on BAU projections) and our modelling result are largest for the power sector in Poland and Germany – both countries with large coal power production capacities. In both cases our model simulation gives much lower emissions.

There is inherent uncertainty about how much of the New Entrant Reserve (NER) will enter into market. Cancellation of unused reserves may reduce the total allocation by up to 100 Mt (but most likely much less). However, it is probable that the amount of unused reserves is linked to the BAU emissions. Reserves will remain unused if there is less entry (or possibly more exit) than expected. This means that an important driving force behind the amount of unused reserves will be the activity level in the relevant sectors. Also, the NAPs do not always contain detailed information about expected new entry; therefore, it is possible that there is a discrepancy between assumed growth figures in the model and allowances to new entrants.

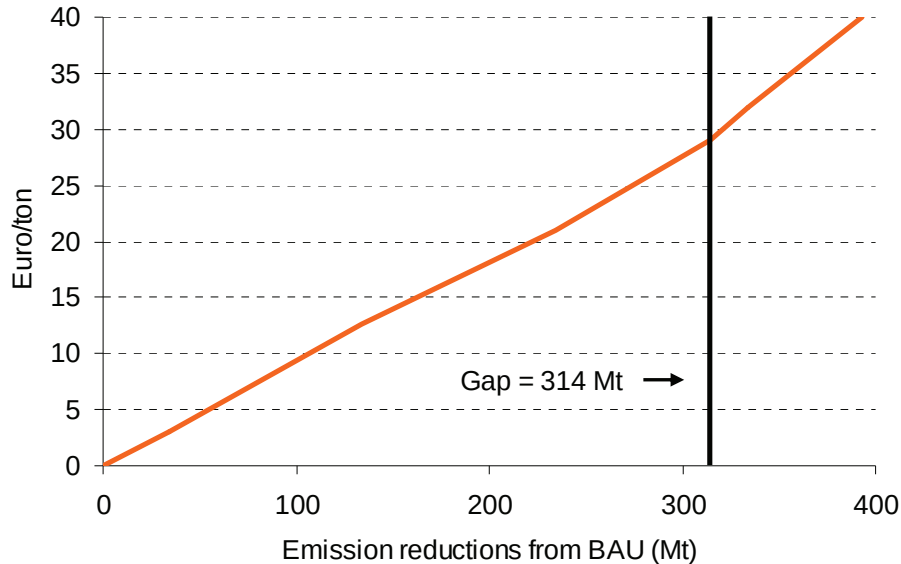
These issues reflect the challenges that any modelling attempt will encounter. We have chosen to use the estimated gap from the NAPs as a starting point for the analysis, i.e. we assume that the gap is 314 Mt CO₂ and adjust the cap correspondingly. This gives us the cap of 6 220 Mt CO₂ and a gap of 314 M ton.

Allowance prices

Figure 3.4 shows the CO₂ allowance price as a function of the size of the gap. The allowance price is higher, the larger the gap, i.e. the tighter the market. A gap of 314 Mt yields an allowance price of 29 €/MWh in the base case. The allowance price reaches the penalty level of 40 €/MWh when the gap is 393 Mt. At this level of allowance price, it is more profitable to pay the penalty than to carry out any additional abatement activities.²³

Note that at the estimated price level, most of the abatements occur in the power sector. Emissions in other industries are reduced only by 33 Mt, about half of which in the metal industry (which is the largest industrial sector initially).

Figure 3.4 EUA price as a function of the size of the gap



Power prices

The cost of emissions translates into higher power prices also in the Nordic market. Assuming the gap of 314 M ton, the allowance price of 29 €/ton CO₂ increases the power price in Sweden by 13.7 öre/kWh (Swed-

²³ According to the EU ETS rules, installations that are short by the end of the first trading period must pay the penalty *and* purchase allowances to cover their emissions (as discussed in chapter 0). Since the allowance price in this case is very uncertain, we have disregarded it in this modeling exercise in order to make a clear point. Including this restriction simply increases the cap on price.

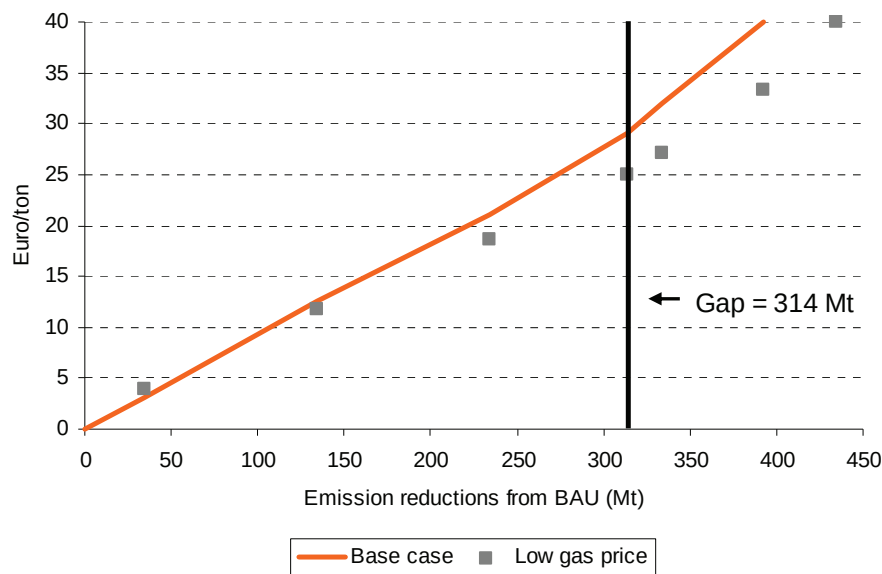
ish öre), to 44 öre/kWh. The allowance price of 40 €/ton CO₂ corresponds to a power price of 51.9 öre/kWh. The impact is similar in all Nordic countries and there are small differences between prices in the different regions, except in Jutland, where the power price is consistently lower. The detailed results for all Nordic regions are shown in Table 3.2.

Table 3.2 Power prices in the Nordic market in 2005, as function of allowance prices (normal year). Swedish öre/kWh

CO ₂ price (€/ton)	Finland			Jutland			Norway		
	2005	2006	2007	2005	2006	2007	2005	2006	2007
0	29.4	29.3	28.2	23.7	23.7	24.3	31.2	31.2	31.2
3	29.7	29.5	28.7	24.9	24.9	25.2	31.4	31.4	31.4
13	31.7	31.4	31.4	27.9	29.1	29.4	32.9	32.9	32.9
21	37.2	37.0	36.9	31.8	34.4	35.2	38.3	38.3	38.3
29	44.2	44.0	44.0	37.4	37.4	41.9	45.3	45.3	45.3
32	46.1	46.0	46.0	39.4	39.0	42.9	47.4	47.4	47.4
40	52.3	52.4	52.4	44.4	44.5	45.7	52.9	52.9	52.9
	Sweden			Zealand					
	2005	2006	2005	2006	2005	2006			
0	30.6	30.6	30.6	30.6	30.6	30.6			
3	30.8	30.7	30.8	30.7	30.8	30.7			
13	32.3	32.3	32.3	32.3	32.3	32.3			
21	37.5	37.5	37.5	37.5	37.5	37.5			
29	44.4	44.4	44.4	44.4	44.4	44.4			
32	46.5	46.5	46.5	46.5	46.5	46.5			
40	51.9	51.8	51.9	51.8	51.9	51.8			

Nevertheless, the allowance price does not increase as rapidly when the gap gets greater for low gas prices as for high gas prices. Also, the allowance price hits the penalty level of 40 €/ton at a higher level, when the gap is 434 Mt. With a gap of 314 M ton and low gas price, the allowance price is 25 €/ton CO₂ (compared to 29 €/ton in the base case).

Figure 3.5 Allowance price as a function of the gap – base case and sensitivity with low gas price



The relationship between power prices and allowance prices with low gas price is shown in Figure 3.6, together with the base case results.²⁴ Power prices are only slightly lower (less than 2 öre/kWh) with low gas prices when the gap is small and allowance price low (up to 10-15 €/MWh). For higher levels of allowance prices, there is virtually no difference at all. In Jutland the difference is even less than in other regions: less than 1 öre/kWh for low allowance prices (but power prices are lower than in other Nordic areas, see Figure 3.7).

The reason for this small effect is that natural gas-fired power plants are not price setting in the Nordic area.²⁵ Changes in gas prices do not change the merit order in the Nordic market. In other words, the cost of CO₂ allowances is added to the marginal cost of the same (coal-fired) plant as before, and for the same level of CO₂ price, the add-on is the same. Gas prices primarily affect the CO₂-price, which in turn affects the power prices. Increased gas prices do however have little direct effect on the power prices, especially in the Nordic region.

²⁴ Sweden is used as an example here. Since power prices in the Nordic regions, except Jutland, are almost equal, which region is picked as an example is insignificant.

²⁵ Gas power is generally not price setting on the Continent either, but in addition limitations on the transmission lines limit the import of Continental prices.

Figure 3.6 Power price (annual average in Sweden in 2005) and allowance price – base case and sensitivity with low gas price

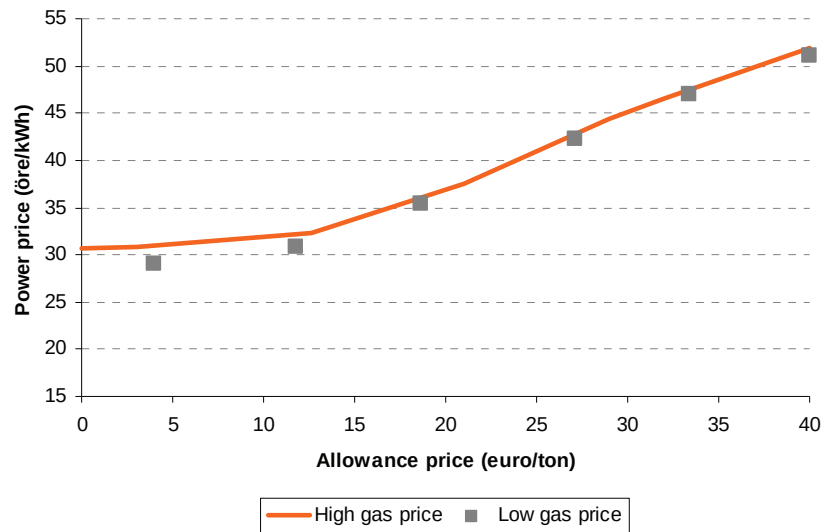
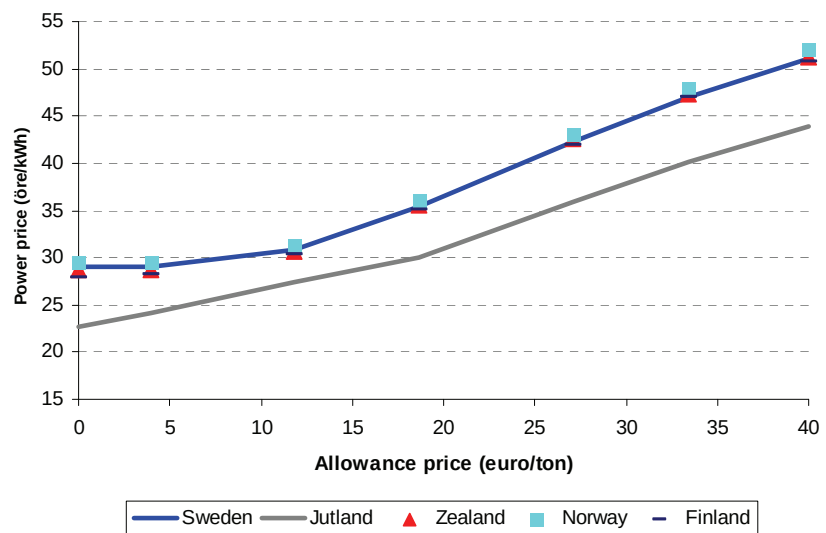


Figure 3.7 Power price (annual average in 2005) and allowance price in the Nordic countries – low gas price scenario



3.3.3 Sensitivity: Events in 2005

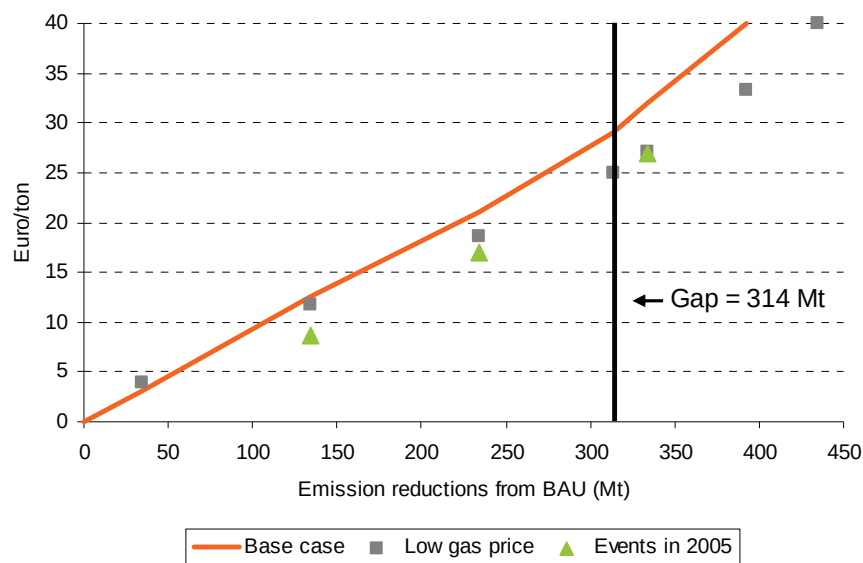
We have also analysed the importance of actual events in 2005. The most important events, related to the allowance market and power market, were:

- Wet year in the Nordic countries: there was about 30 TWh more precipitation than in a normal year in the Nordic countries combined (mostly in Norway and Sweden).

- Dry year in Spain: about 14 TWh less precipitation than in a normal year. In addition to lower hydropower production, this also caused reduction in nuclear power production. In total, electricity production in Spain was about 20 TWh lower than in a normal year.
- Iron and steel production in Europe fell 4% compared to 2003 (there are large differences between countries, however, and in some countries production increased). Lower production in iron and steel industries has two effects on the allowance market: firstly, their own demand for allowances is reduced. Secondly, their demand for power is reduced, leading to lower demand for allowances from the power sector (all else equal).

The total effect of all these events is to reduce the equilibrium allowance price (over the three-year period) by 4-5 €/ton CO₂ (depending on the size of the gap), see Figure 3.8. If the gap is 230 M ton, the allowance price is 17 €/ton CO₂; if the gap is 330 M ton, the allowance price is 27 €/ton.

Figure 3.8 Allowance price as a function of the gap – all cases



The effect on electricity prices in Sweden is also shown in Figure 3.9, while Figure 3.10 shows the prices in all Nordic countries. In the business-as-usual case (without any cap on the emissions), the power price is 21.6 öre/kWh (9 öre/kWh lower than in a normal year) in Sweden. The level is about the same, between 21 and 22 öre/kWh, in other Nordic countries, except in Jutland where the price is 18.7 öre/kWh (where also the reduction is less, only 5 öre/kWh).

Even when the emission cap is binding, power prices in the Nordic region are 3-7 öre/kWh lower than in the normal year scenario. Thus, circumstances that influence the Nordic power market directly (hydropower

conditions) still have a significant impact on Nordic power prices, and a much larger impact than gas prices (although gas prices impact through the allowance prices).

Figure 3.9 Power price (annual average in Sweden in 2005) and allowance price – all cases

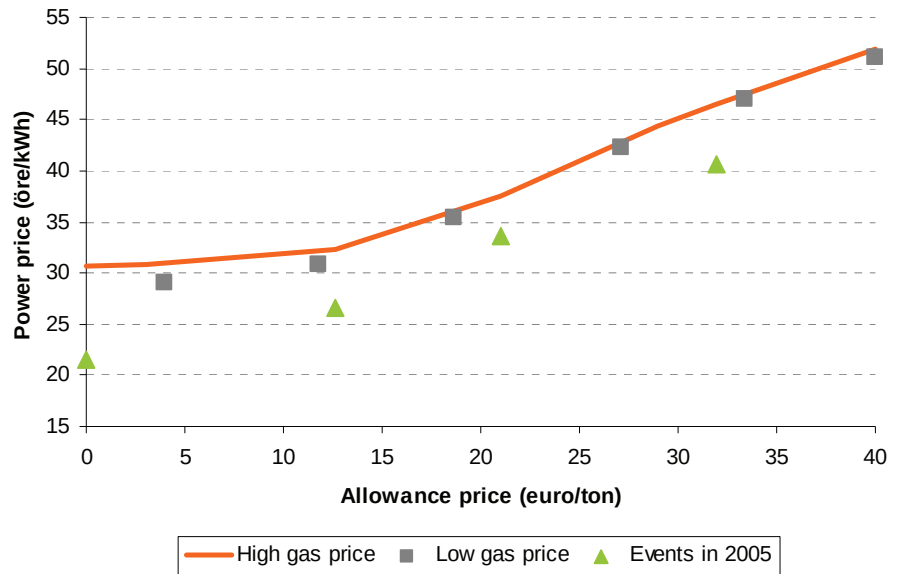
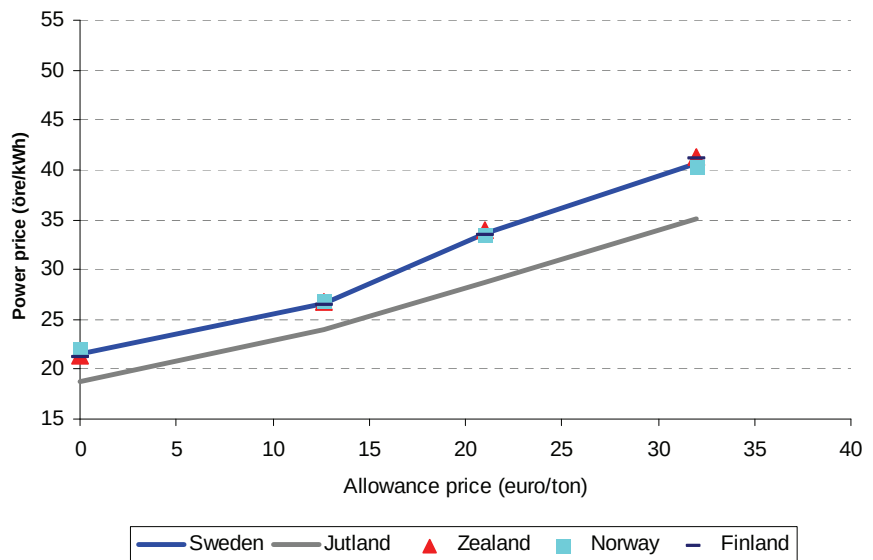


Figure 3.10 Power price (annual average in 2005) and allowance price in the Nordic countries – events in 2005



4. The Kyoto period

Compared with the first trading period, a number of changes will occur in the second period 2008-2012 (the Kyoto commitment period).

First of all there are several new markets emerging. Today EU ETS is linked to CDM and it is possible to import credits from CDM projects. In the second period this will also be the case for JI projects. From 2008 physical trade of Assigned Amount Units (AAUs) can begin given that the eligibility criteria are met.

Secondly, it seems likely that within the next few years regional or national markets outside Europe will develop. Canada plans to have an intensity based trading system, New Zealand has developed a project based scheme using tradable units for reductions in the 2008-2012 period, Switzerland has legislation in place that allows emissions trading by 2008 and Japan (both government and industries) are large purchasers of CDM and JI credits, although Japan has not yet decided whether to establish a national emissions trading scheme. In the US and Australia there are plans of regional markets. To what extent it will be possible to link any of these markets to the EU ETS is uncertain, and it will require bilateral negotiations. The emergence of additional markets and sources of demand will however most likely increase the competition for CDM and JI credits.

Thirdly, there are some changes within the EU ETS compared with the first trading period. Opting-out²⁶ will no longer be possible, the penalty for non-compliance rises to €100/t CO₂, auctioning of up to 10% will be allowed and other sectors or gases may be included. As mentioned above, import of JI credits will also become possible. These are changes that are already contained in the Directive. It is not likely that the Directive will be changed before the second trading period, but some changes may be made in the annexes. For instance new sectors may be included. Aviation is currently the most likely candidate.

The EU Commission recently published guidelines for the national allocation plans for 2008-2012. In these guidelines the Commission states that the plans need to be more transparent and easier to implement than the first period NAPs. Furthermore the Commission signals that it will look very closely at the overall policy mix, since this period coincides with the Kyoto commitment period, in which the EU collectively, as well as the individual member states, have an obligation to fulfil that commitment. The Commission has thus signalled that it will not accept NAPs

²⁶ The possibility to exclude certain sector, given that equivalent measures are taken to reduce emissions.

that do not present a credible plan for how the obligations will be met. Finally there are some clarifications in scope and definitions.

In the guidelines the Commission points at the fact that a number of member states²⁷ are not sufficiently on track towards meeting their Kyoto targets and that more needs to be done in these states. The Commission also states that it is unlikely that the gaps can be closed only by reductions in the non-trading sectors and by import of credits. Some member states will thus have to reduce their allocations to the ETS sectors, while others have to maintain the first phase caps resulting in an overall reduction.²⁸ According to the Commission, if the ETS sectors were to contribute their proportionate share of the reduction in the Member States that have a gap to close, total allocations to the ETS sectors in the second phase would be 6% below the allocation in the first phase. The annual average allocation would then be 2 063 Mt (about 130 Mt lower than the annual average allocation in the first period).

The total gap is however uncertain, and the guidelines from the Commission are not binding and do not provide the final answer on the allocation. The annual gap for EU-15 in all sectors between emission projections (with existing policies and measures) and the target is estimated at 291 Mt. The new Member States (EU-10) has an estimated surplus of 63 Mt, so the total gap for EU-25 would be 228 Mt. Bulgaria and Romania, which will become members, have an estimated surplus of 116 Mt and EU-27 would thus have a gap of only 112 Mt. The ETS sectors cover about 45 percent of total emissions, and if they would be responsible for a proportionate share of the reductions the ETS gap would be 130 Mt/year for EU-15, 100 Mt for EU-25 and only 50 Mt for EU-27.²⁹

If a proportionate share of all the surplus were to be used in the ETS the gap could thus in the extreme case be only 50 Mt per year. If instead the calculations done in the Commission guidelines are representative of the final allocations, the annual ETS gap in 2008-12 would be 130 Mt above the gap in the first period. The projected annual gap in the first trading period is slightly above 130 Mt (see 2.1), and in the extreme case the gap could thus be doubled to 260 Mt. This would reflect a scenario in which the ETS sectors takes its share of the emission reductions in the countries that are short, but do not get any of the surplus in the countries that are long.

The gap will also be affected by the possible imports of CERs from developing countries and ERUs and AAUs from primarily Ukraine and Russia. Even though AAUs can not be directly imported to the ETS there will most likely be links between the markets, with possibilities to “con-

²⁷ Austria, Belgium, Denmark, Finland, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Slovenia and Spain are mentioned.

²⁸ It is said that for the member states that have a gap to close this gap is 296.5 Mt (annual) compared with 2003 year levels. The estimated Kyoto gap for EU is however only about half of this (145 Mt).

²⁹ Source for the numbers in this section is EEA (2005).

vert" AAUs to ERUs. There will be competition for such credits from primarily Japan, Canada and New Zealand and the strategies of these countries will thus affect the supply available for the EU. Imports of CERs above 50 Mt/year during the Kyoto period seem reasonable, but as already mentioned it is unclear how large part of this will go to the EU. If other markets (Japan, Canada and New Zealand) cover their shortage with AAUs from Ukraine and Russia, more CER credits will be available for the EU.

The gap is thus highly uncertain, both linked to the second period NAPs and to the competition for and availability of CERs, EAUs and AAUs. What effect will changes in the gap have on the price of EUAs? The results from the model analysis for the first trading period indicate that a change in the gap of 1 Mt changed the carbon price with approximately 0.1 €/t CO₂ for the three year period (see Figure 3.5 for the base case). The range for the annual gaps (disregarding imports) for the 2008-12 period would for a three year period correspond to 150-690 Mt, which based on the model simulations for the first trading period than would imply a price range for EUAs of about 15-70 €/t CO₂.

The marginal abatement costs will, however, most likely be lower in the second trading period. First of all, with a longer time frame more abatement possibilities are available and investments can also be affected. Secondly, as already described, there will be better possibilities to import credits, which may both shift the marginal abatement curve downwards but also change the slope of the curve.

Consequently, the marginal abatement curve will be lower for the second period than for the first period, but how much lower it will be, is not possible to say without a more detailed analysis. One important investment possibility is investment in gas fired power plants, since more gas fired capacity has the potential of reducing the marginal abatement costs. The amount of new such investments that are profitable depends of course on fuel price developments, but also on the initial allocations. With high share of free allowance to new gas fired power plants, more such capacity will become available.

To summarize, the size of the gap for the ETS sector is highly uncertain especially since:

- The allocation to the ETS sector, and the share of the reductions that have to be carried by these sectors are not known,
- The level of import of credits is not known, and
- Business-as-usual emissions are uncertain.

Furthermore, the marginal abatement costs will most likely be reduced, i.e., the marginal abatement cost curve will shift downward and/or the slope will decrease since there is more flexibility with a longer time fra-

me. This both relates to possibilities for investments and flexibility on the demand side.

4.1 Post-Kyoto

The expectations for a post-Kyoto agreement are vital for the development of the market. If an agreement is reached there will be a value on carbon (and hence, credits) also after 2012.³⁰ This means that credits may be banked if prices are expected to be higher in the future, which will contribute to an increased price during the 2008-2012 period. Certainty of a continuation of the market will however also mean that CDM and JI projects can generate revenues from emission reductions beyond 2012 and thus contribute to the interest in carrying through such projects. That will add to the total supply of credits.

In the Montreal meeting (COP11/MOP1) some important steps forward were taken, although the results should not be exaggerated. Agreement was reached that the Parties to the Protocol will start discussions on a post-Kyoto agreement, although the role of developing countries is still unsolved. The parties to the UNFCCC (including US, Australia, and OPEC) agreed to launch a dialogue although without any binding commitments.

The positions of different countries vary considerably. EU is committed to quantitative and binding targets, while countries such as USA are opposing this. Last summer the US together with Australia, China, India, Japan and South Korea launched the Asia-Pacific Partnership on Clean Development which had their first meeting in January 2006. The purpose of the Partnership is said to be to "Create a voluntary, non-legally binding framework for international cooperation to facilitate the development, diffusion, deployment, and transfer of existing, emerging and longer term cost-effective, cleaner, more efficient technologies and practices among the Partners through concrete and substantial cooperation so as to achieve practical results."³¹ This fundamental difference in views was not altered in the Montreal meeting. In any case, negotiations on a post-Kyoto agreement will take several years and no agreement will be reached until well into the Kyoto period. So even if an agreement was reached in Montreal to continue with the negotiations, the details of a new agreement will not be known for quite some time. In addition there will always be uncertainty whether an agreement will be reached until it is actually in place.

³⁰

EU ETS can of course continue even if no post-Kyoto agreement is reached
³¹ <http://www.dfat.gov.au/environment/climate/ap6/>

5. Conclusions

The prices of emission allowances have turned out to be much higher than what was expected *ex ante*. In broad terms there may be several possible explanations for this, such as a stricter allocation, higher business-as-usual emissions, errors in the estimate of the marginal abatement costs, or changes in the underlying fundamentals that have increased the abatement costs.

The allocations have clearly been much stricter than what was originally expected. The reductions made from the first NAP to the final decision by the Commission are about 300 Mt over the three year period. The gap, according to the business-as-usual estimates made in the NAPs, is of the same size. Accordingly, if no reductions had been made, it is questionable whether there had been any shortage, and hence, whether the carbon price would have been significantly higher than zero.

Secondly, estimates of business-as-usual emissions have been increased by many countries. Whether this reflects real changes or not is uncertain. The countries may have had incentives to provide high estimates for strategic purposes. Changes in these estimates will however not affect the market equilibrium (given that the underlying reality has not changed). The individual market participants are not primarily interested in the aggregated balance, but on the difference between their own abatement cost and the price of EUAs. The changes in estimates do however affect the assessments made by market observers and analysts, and may therefore affect market expectations. Since the price level depends on the balance over the whole three-year period, expectations are crucial for price formation in the market.

There were, and still are, uncertainties regarding the marginal abatement costs. In this report we present model simulations based on the newly developed ECON's carbon market model. This model builds on ECON's European power market model and extends it to the other ETS sectors. The model provides us with a new and more sophisticated tool to assess the marginal abatement costs.

The marginal abatement costs have however also changed, primarily due to a sharp increase in gas prices while coal prices have decreased. This reduces the profitability of fuel switching from coal to gas within the power sector. Such fuel switching is the most important short term abatement possibility.

The model simulations also show that the increase in gas prices have had an effect. The estimated equilibrium allowance price, given an assumed gap of about 300 Mt and gas prices as observed, is about €29, while our low gas price scenario yields an allowance price of €25. There

is a clear impact of the gas prices, although perhaps much less than one would expect.

The limited effect on the EUA price is to some extent related to demand responses in the power sector. Higher gas prices increase the power price, which reduces equilibrium demand. This effect may have been underestimated in the initial assessments. On the other hand, the model may also overestimate the short-term electricity demand response.

The model simulations also show that emissions trading have a significant impact on power prices. Given the actual precipitation levels during 2005, prices would have been around 22 (Swedish) öre/kWh³² without emissions trading (or with an EUA price of 0). An EUA price of € 20, yields a power price that is approximately 10 öre/kWh higher, and an EUA price of € 30 adds an additional 10 öre/kWh. 2005 was a year with high precipitation. In a normal year the price levels would have been some 3-7 öre/kWh higher depending on market area.

Several others have analysed the development in the allowance market, how it has been affected by fuel price developments and its impact on electricity prices. In the introduction an analysis made by the Swedish Energy Agency (2005) was mentioned. Their overall analysis and conclusions are in line with the findings in this report. Prices on oil and gas have increased rapidly during the last year. Coal prices have decreased, although from a fairly high level. This has affected the prices of emission allowances. Our analysis does however indicate that the effect of the high gas prices is smaller than what perhaps could be expected. The general findings of the effect on the electricity price of emissions trading are also in line with the views in this report. Our modelling approach implies that the power producers take the opportunity cost of emission allowances into account in its bidding behaviour on the electricity market. This is also economic efficient and a rational profit maximizing behaviour.

For the second trading period there are large uncertainties regarding the allocations. The EU Commission has published guidelines which states that if the ETS sectors are to cover their proportionate share of the shortage in the countries that are short, while no increases in allocations are allowed in the remaining countries, the annual gap for 2008-12 would increase with about 130 Mt, i.e., approximately doubling the gap to 260 Mt. On the other hand if the ETS sectors can take part of their proportionate share of the surplus in EU-27 (including Bulgaria and Romania) the annual gap could be as small as 50 Mt. Imports of credits can also contribute to reducing the gap. The modelling results for the first trading period indicate that a increase of the gap with 1 Mt (over the three year period) increase the price of EUAs with about 0.1 €/t CO₂ (for the three year period). This is however most likely an overestimate of the marginal abatement costs in the second trading period, primarily due to larger

³² Finland, Norway, Sweden and Zealand. Jutland has a lower price in the simulations. Note that the simulations are made under the assumption of perfect competition.

flexibility with a longer time horizon. To quantify the effect model simulations for the second trading period are however needed.

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Svensk sammanfattning

Priserna på utsläppsrätter inom EU:s system för handel med utsläppsrätter har visat sig bli mycket högre än de flesta förväntade sig innan systemet kom igång. Det finns flera förklaringar till detta. Betydande nedskärningar i allokeringen av utsläppsrätter gjordes under EU Kommissionens översyn av de nationella allokeringsplanerna. Högre gas priser har ökat kostnaden för bränslebyte från kol till gas inom kraftsektorn och därmed ökat den marginella reduktionskostnaden. Detta är de två viktigaste förklaringarna. Med hjälp av ECON's modell för utsläppsrättsmarknaden estimeras den kvantitativa effekten som detta har haft på priset på utsläppsrätter. De högre utsläppsrättspriser har också bidragit till ett högre elpris. Modellsimuleringar indikerar att med ett utsläppsrättspris på €20 ökar elpriset i Norden med omkring 10 öre/kWh, jämfört med en situation utan utsläppshandel. Om priset på utsläppsrätter stiger till €30 höjs elpriset med ytterligare ca 10 öre/kWh.

Bakgrund

Den 1:a januari 2005 infördes EU:s system för handel med utsläppsrätter (EU ETS). Trots förseningar i inlämnande och godkännande av de nationella allokeringsplanerna (NAP) och i att få de administrativa systemen i funktion har marknaden fungerat. Större delen av handeln med utsläppsrätter (EUA) görs via OTC-marknaden, men börshandeln växer också snabbt. Den mest överraskande utvecklingen har sannolikt gällt priserna på utsläppsrätter.

Innan systemet kom igång presenterades ett antal prisprognoser. De flesta indikerade låga priser; i vart fall under €10 per ton CO₂ och i många fall klart lägre än så.

Priset på utsläppsrätter har stigit betydligt under 2005. I januari 2005 låg priset först på nivåer kring €5, men började sedan stiga under våren och toppade runt €30 under den första veckan i juli. Efter den toppen föll priserna och var under en kort tid under €20 för att sedan stabiliseras på nivån €20-25. Under januari 2006 steg priset återigen över €27.

Ett antal förklaringar för denna ökning i utsläppsrättspriset har presenterats. De två viktigaste är sannolikt tilldelningen av utsläppsrätter och bränsleprisutvecklingen. Tilldelningen av utsläppsrätter har blivit mycket striktare än de flesta förväntade sig, eftersom EU Kommissionen har gjort betydande nedskärningar i tilldelningen. Detta leder självklart till en mycket högre nettoefterfrågan, vilket påverkar priserna uppåt. Vidare har gaspriset stigit betydligt under 2005. Bränslebyte från kol till gas inom kraftsektorn ses generellt som en av de viktigaste möjligheterna för att

minska utsläppen. Med ett högre gaspris krävs ett högre pris på utsläppsrätter för att göra bränslebyte lönsamt för ett givet kolpris.

Problem och metod

Priset på utsläppsrätter har blivit mycket högre än vad som indikerades i prisprognoser som gjordes innan starten av EU ETS. Denna rapport analyserar de potentiella förklaringarna för denna utveckling. I allmänna termer finns det några möjliga förklaringar:

- Minskningar i de nationella allokeringsplanerna,
- Högre business-as-usual utsläpp än förväntat,
- Högre reduktionskostnader, eller
- Förändringar i reduktionskostnader till följd av bränslepriser, etc.

Dessa möjliga förklaringar analyseras i rapporten. Utvecklingen under 2005 beskrivs och modellsimuleringar har gjorts för att bedöma den kvantitativa betydelsen av de olika förändringarna.

Vidare har utsläppshandeln bidragit till ett högre elpris. Effekten av utsläppshandeln på elpriset analyseras och simuleras också.

Slutsatser och rekommendationer

Betydande nedskärningar gjordes i tilldelningen av utsläppsrätter från det att de ursprungliga nationella allokeringsplanerna lämnades in, tills det att de slutgiltigt godkändes av Kommissionen. Totalt motsvarar nedskärningarna omkring 300 miljoner ton CO₂ för perioden 2005-2007. Gapet, dvs. skillnaden mellan de framskrivna business-as-usual utsläppen och utsläppstaket, är ungefär av den storleken. Det innebär att utan nedskärningarna är det tveksamt om det hade uppstått någon brist på utsläppsrätter överhuvudtaget och därmed om priset skulle ha varit väsentligt över noll.

Vidare har business-as-usual estimaten för flera länder ökat i de nationella allokeringsplanerna jämfört med tidigare estimat. Förändringar i dessa estimats påverkar dock inte marknadsjämvikten givet att inga reella förändringar har skett. Enskilda deltagare är inte i första hand intresserade av den aggregerade balansen, utan av deras egna kostnader för utsläppsminskningar i förhållande till priset på utsläppsrätter. Förändringar i estimaten kan dock påverka bedömningar som görs av marknadsanalytiker och kan därmed påverka förväntningar. Eftersom prisnivån beror på balansen över hela perioden är förväntningar av avgörande betydelse för prisbildningen.

Specifika händelser under 2005 som har haft en direkt effekt på utsläppen förefaller dock inte ha bidragit till en högre nettoefterfrågan. I Spanien har reducerad vattenkraft- och kärnkraftproduktion ökat utsläp-

pen, men samtidigt har Norden haft hög tillrinning vilket har minskat utsläppen. I tillägg finns det tecken som tyder på att vissa branscher har minskat sina utsläpp till följd av en lägre produktionsnivå.

Det finns fortfarande osäkerheter kring de marginella reduktionskostnaderna. I denna rapport presenteras modellsimuleringar baserade på ECONs nyutvecklade modell för den europeiska utsläppsrättsmarknaden. Modellen ger oss ett nytt och mer sofistikerat verktyg för att bedöma de marginella reduktionskostnaderna.

De marginella reduktionskostnaderna har helt klart ökat till följd av förändringar i bränslepriser. Effekten på jämviktspriset för utsläppsrätter är dock relativt liten. Enligt modellsimuleringarna är det estimerade jämviktspriset, givet ett antagande på ett gap på omkring 200 miljoner ton och observerade gaspriser (under 2005 och forward priser för 2006 och 2007). Omkring €29 per ton CO₂. I vårt scenario med låga gaspriser faller priset på utsläppsrätter till €25, vilket dock fortfarande är klart över de estimat som gjordes innan handelssystemet kom igång.

Den begränsade effekten på utsläppsrättspriset beror i viss utsträckning på efterfrågesrespons i kraftsektorn. Högre gaspriser höjer elpriset, vilket reducerar efterfrågan. Möjligen kan modellen överskatta den kortsiktiga efterfrågeresponsen för el.

Osäkerheten kring nettoefterfrågan är fortfarande stor. Baserat på tilldelningarna och EU-ländernas egna business-as-usual estimat är det en brist på ca 300 miljoner ton CO₂. De business-as-usual utsläpps som ges av modellen, dvs. utsläppen vid ett pris på utsläppsrätter på €0, är dock väsentligt lägre än de estimat som ges av medlemsstaterna.

Modellsimuleringarna visar också att utsläppshandeln har en betydande effekt på elpriset. Givet de faktiska tillrinningsnivåerna under 2005, skulle de nordiska elpriserna ha varit runt 22 svenska öre per kWh utan utsläppshandeln. Med ett utsläppsrättspris på €20 skulle elpriset vara omkring 10 öre/kWh högre, om ett utsläppsrättspris på €30 ökar elpriset med ytterligare ca 10 öre/kWh. Med normala tillrinningsnivåer skulle elpriset ha varit 3-7 öre/kWh högre beroende på marknadsområde.