



The impact of auctioning on European wholesale electricity prices post-2012

A report for WWF

By

New Carbon Finance

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New Carbon Finance
2nd Floor, New Penderel House
283-288 High Holborn

London WC1V 5HP
+44 20 7092 8800
info@newcarbonfinance.com

www.newcarbonfinance.com
www.newenergyfinance.com

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Executive Summary

This report has been prepared by New Carbon Finance for WWF to investigate how the introduction of auctioning in the EU ETS post 2012 is likely to affect power prices in four key European countries, Germany, Poland, Czech Republic and Hungary. Overall we conclude that the auctioning of allowances in the EU ETS market in 2013 and beyond is unlikely to have a material impact on power prices.

In liberalised wholesale electricity markets such as Germany and the Czech Republic electricity prices reflect the short run marginal costs of generation which include the cost of consuming emission allowances. Irrespective of how the generator acquires its emission allowances, allowances are still consumed and therefore charged for whenever the generator produces electricity.

In regulated wholesale electricity markets, as found in Poland and Hungary, only out of pocket costs plus a regulated return may be recouped. This means that free allocation allows generators to avoid passing through the full cost of CO₂ allowances, effectively shielding end users from the full opportunity cost of carbon allowances. Today therefore the introduction of full auctioning of emission allowances would be expected to increase electricity prices in these countries.

Both these countries however are currently in transition from regulated to fully liberalized wholesale electricity markets (partially as a consequence of the European Commission's drive for greater liberalization in European energy markets). This is evidenced by the trend towards short run marginal cost pricing. For example long term Power Price Agreements in both Hungary and Poland have been annulled following investigations by European competition authorities in the last two years. Market data also suggests that there is growing convergence between German, Polish, Hungarian and Czech wholesale electricity prices, suggesting that more of the costs of carbon are already being incorporated into whole prices in all four countries.

Our view is that the trend towards further liberalisation is likely to continue to the extent that the Polish, Hungarian and Czech markets are likely to be sufficiently competitive by 2013 to allow wholesale electricity prices to be determined on a short run marginal cost basis incorporating the full cost of carbon allowances. Certainly the European Commission is intent on progressing energy market liberalization across Europe. For this reason a change from free allocation to full auctioning in Phase III of the EU ETS should have little impact on wholesale electricity prices in these countries.

Even in a scenario where existing, partly liberalised regulatory and pricing frameworks are maintained to 2013 a switch from free allocation of allowances to full auctioning would have a small impact. Our analysis suggests that assuming no change in regulatory structure in 2013 the introduction of full auctioning would increase Polish electricity prices by 28 percent and Czech electricity prices by 12 percent – this is significantly less than the price increases predicted by some industry and government studies.

This conclusion does not suggest that there will be no increase in the price of electricity either before or after 2012. Although market liberalisation will deliver a more efficient power generation industry with lower costs and prices in the long run, in the short run prices do become more influenced by the real cost of generating power, including the cost of the fuel and the consumption of emission allowances. In a liberalized market power prices will be higher (other things being equal) with the EU ETS than without the EU ETS. This research simply shows that these increases should not be attributed to the methodology chosen to distribute the allowances. Our analysis of the change in electricity prices brought about by the EU ETS in 2013 under different allocation assumptions is summarized in Table 1.

In terms of economic impacts, the auctioning of allowances to the power sector should not result any adverse effects. Indeed, where marginal cost pricing is present auctioning provides a valuable means of compensating electricity consumers for increases in electricity prices brought about by the EU ETS. Our analysis also indicates that meeting EU ETS targets should be broadly affordable for Poland, the Czech Republic and Hungary, both in absolute terms as a proportion of GDP, and in the context of other monetary flows from wealthier Member States. In particular, the mechanism proposed by the European Commission for redistributing allowances from the wealthiest to the poorer Member States

through the auction process, alone should compensate Poland, the Czech Republic and Hungary for a large part, if not all of the additional costs of the EU ETS. In addition, EU Structural funds should see monetary flows of five to ten times the cost of EU ETS compliance to these countries.

Table 1: Summary of wholesale electricity price projections

Price Scenario	Poland		Germany		Czech Republic	
	Price €/MWh	Indexed (100)	Price €/MWh	Indexed (100)	Price €/MWh	Indexed (100)
2008	57	63	66	80	68	72
2013 no EU ETS	37	42	54	65	32	32
2013 + EU ETS, existing regulatory structure, free allocation	71	78	83	100	85	89
2013 + EU ETS, expected regulatory structure, free allocation. (base case)	91	100	83	100	95	100
2013 + EU ETS, expected regulatory structure, full auctioning	91	100	83	100	95	100

Source: New Carbon Finance

1. Introduction

This report has been prepared by New Carbon Finance for WWF to assess how the introduction of auctioning in the EU ETS post 2012 is likely to affect power prices in four key European countries, Germany, Poland, Czech Republic and Hungary. It follows previous report released by WWF in March 2008 on the extent of windfall profits in the European power sector.¹

1.1 Background

In January 2008 the European Commission (EC) published a wide-ranging proposal to amend the 2003 EU ETS Directive, designed to extend the scheme beyond 2012. A key part of this amendment is the increased use of auctioning of EUAs, rather than the extensive free allocation of EUAs used in Phases I and II. For the electricity generation sector the Commission is proposing that all allowances should be auctioned from 2013 onwards.

It has been suggested that full auctioning of EUAs to the power sector will result in two or threefold increases in electricity prices in some Member States (MS), notably in the Central Eastern European Region (CEE) with damaging economic consequences. The purpose of this report is to assess these claims by examining the likely impact of the new auctioning proposals on power prices in Germany, Poland, Hungary and the Czech Republic.

Experience from Phases I and II of the EU ETS has shown that free allocation of allowances produces four undesirable outcomes:

- **Windfall profits.** Electricity utilities that are able to pass through the cost of carbon emissions to consumers have made substantial windfall profits under the existing arrangements, resulting in widespread calls for a change in the allocation process and the imposition of windfall taxes.²
- **Politicised allocations.** Significant time and effort is invested in lobbying for free allocations, and in a number of instances this has even led to legal challenges between business and government.
- **Lack of abatement incentive.** The free allocation of EUAs to many industrial installations means that they have no need to purchase allowances for compliance and those they receive are not valued at their true economic cost, reducing the incentive to investment in abatement.
- **Administrative complexity.** The process of governments making allocation decisions is undoubtedly time-consuming and costly. There is also a significant risk that the level of allocation may be just plain wrong, as evidenced by the over allocation in Phase I of the ETS.

Auctioning removes many of these problems. Windfall profits are eliminated where there is cost pass-through. Companies which had previously not fully valued the opportunity cost of allowances will have to pay for them directly. The allocation process will also be fairer, more transparent and much less subject to minority group influence and the process should be cheaper and easier to administer.

In principle therefore auctioning has a number of advantages over free allocation. It does however have one draw back, namely the additional costs imposed on installations and particularly those that may be exposed to international competition. However in contrast to the industrial sectors which in some cases face international competition and hence are less able to pass through the costs of EUAs, virtually all power consumed in Europe is generated in Europe. As such power generators in liberalised markets have been able to pass-through a large proportion (70-90 percent) of CO₂ opportunity costs to end consumers, despite receiving the majority of their compliance requirements free.

¹ WWF, March 2008, EU ETS Phase II – The potential and scale of windfall profits in the power sector. A report by Point Carbon.

² For more on this topic see “EU ETS Phase II – The potential and scale of windfall profits in the power sector” published by the WWF.

The Commission has not yet specified the precise auctioning model that should be used, and different auctioning techniques can produce variable outcomes for different participants. The design of auctions matters because if they are not efficient, fair, transparent and predictable (in terms of their timing frequency and volumes) then this could cause volatility in the secondary market or systematically disadvantage some participants. The likelihood of significant problems related to auctioning methodology is however small as there is extensive experience available from other markets. A detailed assessment of auctioning methodology is beyond the scope of this report (as what matters here is that participants must pay for their allowances) and detailed discussions of the topic exist elsewhere.

Another question yet to be addressed in detail in the Commission's proposal is what will happen to the revenues that auctioning will generate. Under the current proposals national governments will be responsible for organising auctions and there is considerable debate about whether or not they will be able to retain full control of the revenues they generate. It has been suggested that member states will be required to hypothecate some of the revenues back to EU level bodies or designated green funds. The current shape of the political debate however implies hypothecation is unlikely. In the debate on the aviation amendments to the EU ETS, national governments forcefully resisted calls for revenues to be hypothecated. The UK for example has stated that it does not plan to hypothecate any revenues flowing from the EU ETS. The July aviation decision gives Member States control of revenues generated from auctioning to that sector, offering only guidance on what should be done with the monies raised. Consequently we believe that it is most likely that the same approach will be taken for the rest of the EU ETS.

It is therefore likely that member states will be able to retain revenues from EU ETS auctions post-2012. Conceivably these could be used to finance general government expenditures, to compensate consumers of carbon-intensive products for the higher prices of these products due to the passing through of the CO₂ allowance costs or to compensate producers who cannot pass on the full cost of carbon. Moreover were the presence of a carbon price to sufficiently weaken the economy of member states such as Poland, they could seek further access to resources from the European structural funds post-2013. However, such a scenario would seem unlikely since 77 percent of Poland's exports go to the European Union..

1.2 Opposition to full auctioning for the electricity sector post-2012

Some Member States, notably Poland, Hungary and the Czech Republic have argued that the EC's 100 percent auctioning proposals will have a damaging impact on their economies, as full auctioning will translate into much higher electricity prices. This in turn will have a knock-on effect on the rest of their economy over Phase III and beyond. In their view this problem is exacerbated by their carbon intensive energy mix. Generally Central European states have a much higher proportion of coal and lignite fired generation, which produces greater carbon emissions than other generation technologies, than their Western European counterparts.

Poland (which obtains 95% of its electricity from coal and lignite fired plant) has been particularly vocal. In recent months Polish Ministers have claimed that full auctioning of allowances to generators will increase power prices markedly from 2013, costing much as €5 billion per year.³ Moreover a recent report published by the Polish Electricity Association suggested that auctioning could negatively impact GDP by up to 16 percent.

The Czech Republic has raised similar concerns, arguing that immediate 100 percent auctioning from 2013 would mean increases in Czech electricity prices of the magnitude of "several dozen...percent".⁴ Hungary has not explicitly come out against 100 percent auctioning for the electricity generation sector for Phase III. It has however challenged other parts of the proposal including the basis on which climate targets are determined for each Member State.

³See "Poland Fights to Keep Free Emission Permits for Power Industry" (03/03/2008) Bloomberg News and "Poland's Economic Growth May Drop 15% on Emission Permit Costs" (20/08/2008) Bloomberg News

⁴ Martin Riman, the Czech Industry Minister commented in February that he would like to see auctioning phased in because of the Czech Republic's energy mix

Opposition to 100 percent auctioning is not uniform. Other Member States have argued that the allocation methodology used should make little difference to power prices. Usually this assessment is made on the basis of the economics of free allocation in competitive markets. Carbon allowances whether allocated for free or auctioned still represent the same opportunity cost to generators and therefore should be passed through to electricity prices.

1.3 This report

This report assesses the impact of full auctioning for the electricity sector post-2012 in Germany, Poland, Hungary and the Czech Republic. The remainder of this report is structured into five parts. Section two sets out the key theoretical concepts that underpin this study. Section three reviews EU electricity market reform to date and examines the prospects of further liberalisation. Section four examines the current state of electricity market liberalisation in Germany, Poland, Hungary and the Czech Republic. Section five reviews the economic impacts of auctioning and the EU ETS in general in the four countries, and section 6 draws together the conclusions.

2. Methodology

The analysis in this report assesses how wholesale power prices are formed under different market conditions. In Europe power markets are currently determined within either a competitive or regulated framework. Understanding the implications of each of these is central to understanding the impact of auctioning versus free allocation.

Against this theoretical background we then look at how some Member States and commentators can argue that auctioning could result in large increases in electricity prices post-2012. These arguments are grounded in a static view of electricity market structure in Europe. Here a more dynamic approach is taken to account for the fact that electricity markets are likely to have a different profile by 2013.

2.1 Wholesale electricity prices in competitive markets

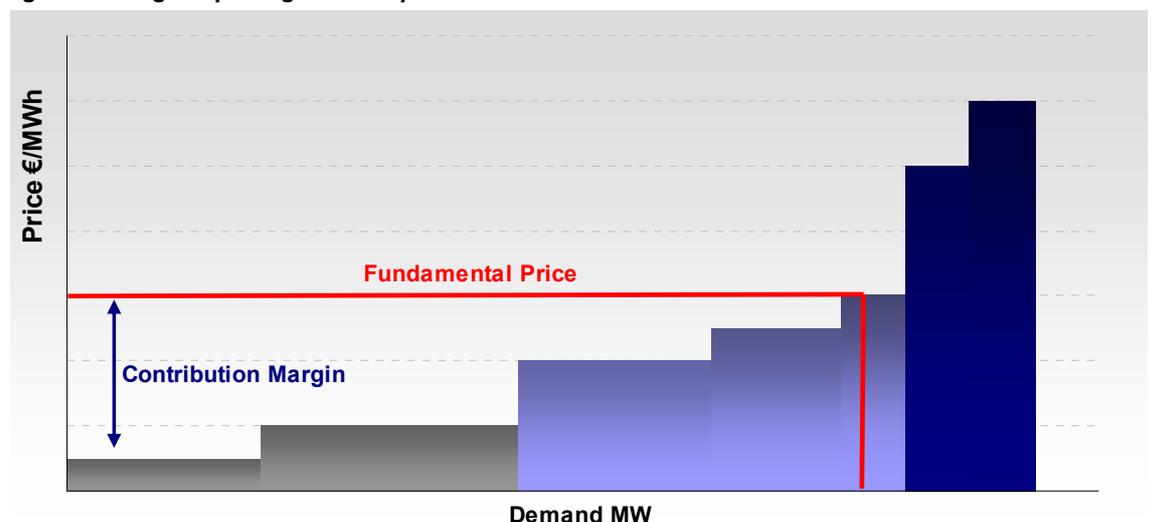
In competitive wholesale electricity markets prices should reflect the short run marginal cost (SRMC) of generation including the cost of EUAs, regardless of whether or not EUAs are auctioned or allocated for free. Companies can use EUAs to cover their emissions or sell them to third parties that require more EUAs. This means that EUAs represent an opportunity cost which remains the same regardless of how the allowance was allocated. For this reason a generator should expect to add the cost of EUAs to its other marginal costs when making choices about production or trading.

Figure 1 below shows how electricity prices are formed in a fully competitive electricity market. The x axis represents the level of system load (i.e. demand for electricity), the y axis represents the short run marginal cost of all the generators available produce electricity at a given time. For any given demand $D(t)$ at time t , the electricity price, $P(t)$ is set by the short-run marginal costs of the marginal generating unit.

In most European countries the cheapest and most efficient generators are used to generate base load usually this is nuclear, hydro, wind and the most efficient CCGTs. Mid-load is generally met by coal or gas generators and peak load may require the most expensive OCGT and oil plant. The ordering of plant in this way according short run marginal costs of generation plant is referred to as the merit order.

In a non carbon constrained environment the SRMC of each plant is a function of short-run non-fuel variable costs, the cost of fuel and the generating unit's efficiency which also determines the merit order. At any given time therefore, the price of electricity covers the SRMC of the most expensive generator. This marginal plant sets the price of electricity, so all the generators further down the merit order are able to make a contribution margin.

Figure 1: Marginal pricing in a competitive market

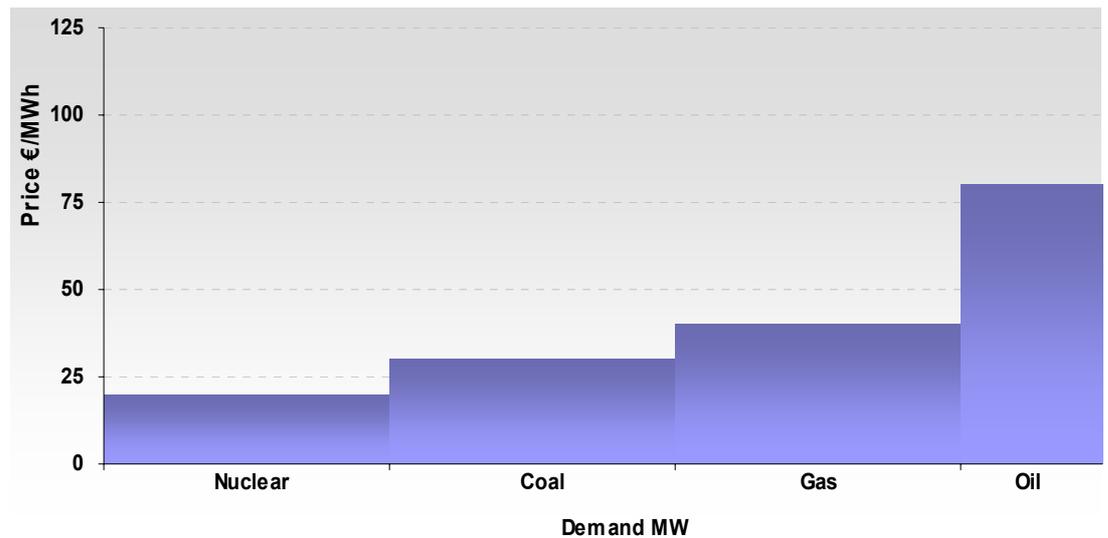


Source: New Carbon Finance

The same logic applies in a carbon-constrained environment, except that the cost of carbon is built into the cost of generation for each thermal generator. A carbon price may mean changes to the merit order as different generation technologies and fuels emit different volumes of CO₂ for each unit of electricity dispatched, for example conventional coal stations emits nearly twice as much CO₂ as combined cycle natural gas units.

Consider a generation fleet comprised of nuclear, coal, gas and oil generation. Figure 2 below shows the likely merit order without a carbon price, which is essentially reflective of fuel costs. Under these conditions, for this fleet of generators, nuclear generation plant is the cheapest, followed by coal, then gas and then oil.

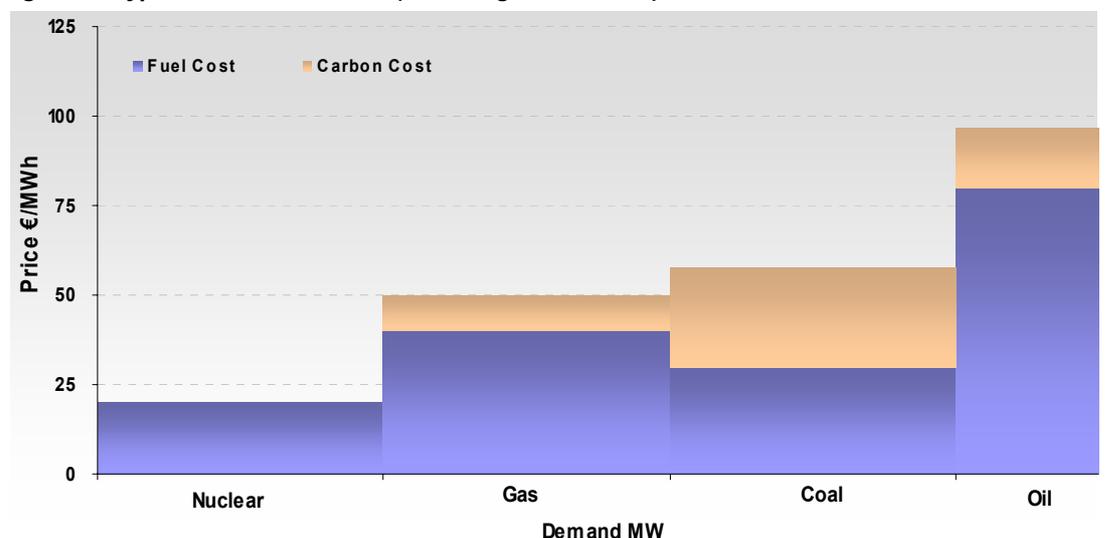
Figure 2: Hypothetical merit order (excluding carbon costs)



Source: New Carbon Finance

Figure 3 shows the merit order for the same generation fleet when a carbon price is introduced. The nuclear plant which does not emit CO₂ remains the cheapest and so is still first. Coal and gas however have switched places. This is because whilst on fuel costs alone it is cheaper to generate electricity with coal than gas, coal combustion emits proportionately more CO₂. This means that existence of a carbon price adds more to the cost of coal generation than it does to gas, making gas which burns more cleanly the cheaper generation technology. Consequently gas is now second on the merit order and coal is third. Oil generation remains the most expensive as even with the addition of a carbon price it therefore remains more expensive than coal or gas generation.

Figure 3: Hypothetical merit order (including carbon cost)



2.2 Average cost pricing in regulated energy markets

In the regulated markets power is often priced on an average cost basis. Under this arrangement power generators are paid a rate sufficient to cover their total cost of generation plus a margin to provide a return on investment in generating plant. An alternative model is where power generators have long term power purchase agreements (LT PPAs) with electricity supply business backed by long term fuel supply contracts.

When EUAs are allocated for free under this arrangement the opportunity cost does not necessarily have to be fully passed through to the end users as the price of electricity has already been set. Accordingly generators are able to shield consumers from the full opportunity cost of EUAs. Indeed the regulator responsible for pricing is likely to prohibit price increases that are not supported by increases in the “out of pocket” costs incurred by electricity generators.

If credits are fully auctioned then this means that the full cost of carbon is more likely to be passed through to the end user. This means that the price of electricity can rise as a result of a move away from partial free allocation to full auctioning.

2.3 Will power prices increase under full auctioning?

Economic theory tells us that under conditions of perfect competition the price of a product will be set at the level of the marginal cost of production. Consequently in a competitive wholesale electricity market prices will be driven to the level of the marginal cost of generation required to satisfy demand for each settlement period (typically one hour). As the marginal generation units in most European markets are primarily gas or coal fired power stations, the cost of fuel is a key component of the SRMC underpinning wholesale power prices. The introduction of the EU ETS from January 2005 effectively increased the cost of burning fossil fuels such as coal, gas and fuel oil in power stations due to the CO₂ emissions resulting from their combustion. The extent to which thermal plant generation costs increased depends on both the carbon content of the fuel and the thermal efficiency of the generation unit.

Where there is a liberalised wholesale market for electricity, EUAs and the associated fossil fuels, the marginal generator is faced with a choice between two options:

1. Run the power station incurring the cost of the fuel combusted and submit the appropriate number of EUAs required for compliance with the ETS
2. Not run the power station and then sell both the fuel and EUAs through their respective wholesale commodity markets.

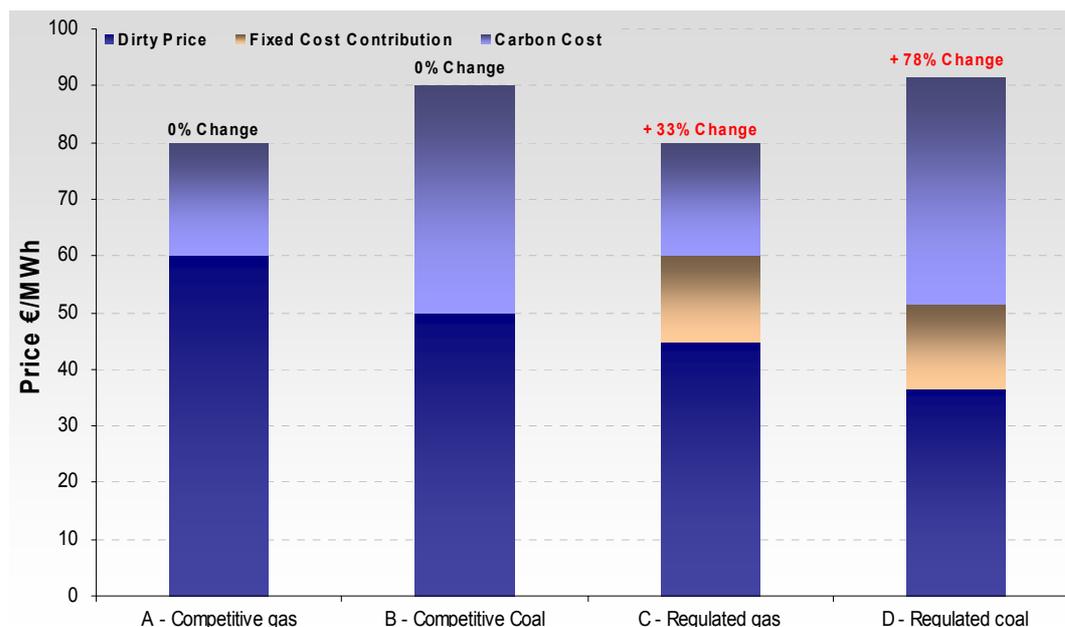
In a liberalised competitive wholesale market, these two options are available to the marginal generator irrespective of how they source their EUAs, be that from a free allocation, an auction process or from the secondary EUA wholesale commodity market. Consider an EUA with a wholesale market value of €25/t, the generator who receives a free allocation can either use it for compliance or sell it for €25. Similarly a generator who bought their EUA through an auction or from the secondary market also may either submit the EUA for compliance or sell it for €25. In either case the opportunity cost of submitting an EUA for compliance, that is the value of the alternative option of selling the EUA is €25.

Therefore in the context of a competitive liberalised energy market it is economically rational for the generator to either pass-through the opportunity cost of EUAs in the wholesale electricity price, or to sell the allowance into the marketplace. SRMC pricing is not a complete definition of a competitive electricity market but it is the defining property in this research.

Figure 4 below shows the effect of auctioning EUAs on power prices under different market structures, by comparing four hypothetical countries, A, B, C and D. Countries A and B have fully competitive markets where prices are determined on a SRMC basis. In country A gas operates at the margin and sets the electricity price, whereas in country B it is coal. In both countries switching from free allocation to full auctioning makes no difference to the price of electricity as carbon opportunity costs for both fuels are passed through regardless.

Countries C and D each have a regulated wholesale market where prices are determined by Long Term Power Purchase Agreements (LT PPA). Differences in LRAC and SRMC vary by country. In this example we have used a discount of 25%. We then add a fixed cost contribution. In country C the majority of generation is gas fired whereas in country D, coal is the dominant fuel. Under free allocation none of the cost of carbon is passed on in the wholesale electricity price. If auctioning is introduced however the cost of purchasing EUAs would be passed through in full to account for the actual out of pocket cost experienced by generators. Assuming a carbon cost of €20/MWh for gas and €40/MWh for coal (which produces twice as much CO₂ per unit of electricity generated than gas), this means that electricity prices would increase by 33 percent in state C and 78 percent in state D.

Figure 4: Theoretical impact of full auctioning under competitive and regulated market



Source: New Carbon Finance

This example highlights the point that if regulated pricing regimes are assumed then a transition from free allocation to full auctioning could imply relatively higher electricity price increases than liberalised markets although not necessarily in absolute terms.

Any assessment of the European electricity market however must be understood in the context of the European authorities' drive for greater liberalisation in the European internal electricity market (IEM). Momentum towards greater liberalisation is important because it means that the existing structure of European electricity markets is likely to be significantly altered over the next five years. The level of progress towards more competitive electricity markets will therefore be the key driver of electricity prices and determine the magnitude of any price changes resulting from the auctioning of EUAs, as this determines whether or not wholesale power prices will be formed on a SRMC or average cost basis.

2.4 Methodology used in this study

The approach taken in this research is to look at examine existing policy and market data to provide a robust view of the likely state of electricity markets in 2013. A base case is presented which assumes that the existing market structure will be maintained in 2013. The focus of this research is the determination of *wholesale* electricity prices. Centering the analysis on wholesale prices ensures a robust comparison of the effect of a carbon price on

electricity prices between countries without the distortions arising from different national policy⁵ and regulatory frameworks.

Our base electricity price projection for each state is extrapolated from the German 2012 forward baseload price, adjusted as a function of the relationship between 2008 German day-ahead baseload prices and 2008 day-ahead baseload prices in Germany, Poland, Hungary and the Czech Republic. Projections from New Carbon Finance's Carbon Balances Model are used to quantify full SRMC of wholesale electricity and a carbon free price in 2012. These prices are used to provide an indicative view of the likely impact of 100 percent auctioning on electricity prices.

This assessment is deepened using the available wholesale electricity market data. Numerous empirical studies have shown that the German wholesale power prices are set on a marginal economic cost basis. This means that they reflect the full opportunity cost of EUAs and that full auctioning should therefore make no difference to electricity costs in Germany. Consequently Germany represents a good benchmark against which to assess existing electricity price data from the other states in this study. This is because German power prices are already almost fully cost reflective and Germany's geographical proximity and similar generation mix to the other states in this study. These characteristics are useful because if German power prices reflect the SRMC of generation, then if power prices in Poland, Hungary and the Czech Republic are moving towards those in Germany this implies that electricity in these states might be increasingly being priced on a SRMC basis. Under these circumstances we could conclude that 100 percent auctioning would make little difference to wholesale electricity prices compared to free allocation.

With a view of how electricity markets in Germany, Poland, Hungary and the Czech Republic will be structured after 2012 based on existing data and policy trends, power price formation post-2012 is then analysed. Projections from New Carbon Finance's European Carbon Balances model are used to quantify the impact of 100 percent auctioning on electricity prices in each state. Prices from three scenarios are presented.

1. An electricity price with no carbon costs.
2. A free allocation under current wholesale electricity market conditions
3. Full auctioning in a competitive framework.

The prices for the first and third scenarios are estimated using availability, fuel and carbon price projections from New Carbon Finance's European Carbon Balances Model and generation plant capacity data from each country. We use this data to build dirty (i.e. prices without the cost of carbon) and clean (based on prices that reflect the full cost of carbon) merit order curves for each country in the study. We then generate a baseload price forecast for dirty and clean prices by taking an average of the electricity price at the 40 percent and 80 percent of maximum demand for each country.

The second scenario is our baseline analysis point. The electricity price calculated for each country is based on the relationship between average 2008 German baseload price and average prices in the same period for Poland, Hungary and the Czech Republic. The price presented for 2013 is a function of the 2012 German baseload forward price and the relationship between Poland, Hungarian, Czech with German prices in 2008.

These projected prices and the analysis from current data and the policy outlook form the basis of our conclusions, which are given in section five.

⁵ Electricity prices for industrial and domestic end users across Europe vary according to the cost of transmission and distribution as well as the effect of applicable taxes (most commonly VAT) and green levies in individual countries

3. EU energy market reform

3.1 Are European energy markets competitive?

Over the last ten years the European Union has been pursuing a progressive drive towards greater energy market liberalisation. The existing EU legislation might suggest that there has been a fully competitive market for industrial energy consumers since 2004 and full competition for households since July 2007. In reality different countries have made progress at different speeds.

Evidence gathered by the Commission and others has shown that the existing gas and electricity Directive from 2003 has had only limited success in creating a competitive internal electricity market for the European Union. Many Member States still maintain regulated wholesale power markets where the full pass-through of CO₂ costs cannot be automatically assumed and the wholesale power price often may not reflect the marginal cost of generation.

Indeed the EC's Competition enquiry into the electricity sector, published in January 2007, revealed some "serious malfunctions" in the market for industrial consumers. It found that European electricity markets still reflect the "old" market structure characterized by national or regional monopolies - usually dominated by vertically integrated companies - which control electricity prices in the wholesale market and that block new entrants to the market.

Because of these ongoing issues in 2007 the European Commission put forward a third package of proposals to amend the 2003 directive to provide for more effective internal electricity market for Europe. These proposals aim to:

- **Further unbundle the European transmission networks.** Vertical integration of transmission, generation and retail activities is viewed by the Commission as one of the most significant barriers to new entry in the European electricity supply market. The Commission wants to see ownership unbundling of transmission networks.
- **Enhance the powers of national regulators and develop a formal co-operation structure.** The Commission's view is that many national regulators lack sufficient independence from their national governments. There is also a lack of effective formal co-operation between national regulators. The third package aims to rectify this problem.
- **Improve co-operation between Transmission System Operators**
- **Improve the functioning of the market,** by developing transparency, third party access to transmission and storage facilities, tight control of long term supply agreements to ensure that they do not foreclose the market to competition and measures to help develop a European retail market.
- **Promote security of supply** through enhanced co-operation between member states and by monitoring transmission system operators.

Some of these goals were not welcomed by certain Member States. Germany and France for example have been vocal in their opposition to full ownership unbundling for gas and electricity networks. Nonetheless the European Commission has shown itself willing to drive forward its liberalization agenda. Indeed it has been prepared to take enforcement action against countries that have not complied with the existing directives.

In the last five years the Commission has taken action over retail electricity tariffs in France in 2006 and 2007. In January 2007 the Commission also opened an investigation into tariffs in the Spanish market for medium and large sized businesses.

The Commission has also opened investigations into EDF and Electrabel following concerns that they might be preventing access to customers in France and Belgium, through the use of long-term electricity supply contracts. It has also been active in merger control blocking

the proposed EDP/GDP/ENI merger and imposing significant conditions on EDF/EnBW and GDF/Suez mergers.

Electricity liberalization in Europe is, therefore by no means complete or uncontested. It is clear, however, that the European authorities are determined to push the development of competition in European electricity markets.

Based on the economic theory and the EC's willingness and demonstrated ability to press forward with liberalization, New Carbon Finance's view is that European electricity markets are likely to be more competitive in 2013 than they are now. This suggests that marginal pricing will be the norm in all EU member states by the start of Phase III. This significantly would mean that auctioning should have little effect on wholesale electricity prices.

In the countries that are the focus of this study, marginal pricing cannot currently be automatically assumed, though moves towards a more competitive framework are being made by the European authorities as well as the German, Polish, Hungarian and Czech governments.

It must be remembered that liberalization is a broad term. Central to the analysis here is the development of marginal cost pricing, rather than the extent to which states are "completely" liberalized as an overall goal. In Germany, for example, whilst there are serious outstanding competition issues, relating to unbundling, transparency and third party access, electricity prices are formed on a marginal cost basis. Similarly short run marginal pricing exists in Great Britain and whilst the market is often presented as one of the most competitive in Europe, there are still outstanding competition issues.

4. Electricity prices post-2012

4.1 Germany

4.1.1 Wholesale market context and policy developments

The German electricity market has been fully open since 1998 but is still not fully competitive. This is because there are still problems associated with poor transparency and a high level of horizontal and vertical integration which restrict competition, particularly for new entrants, even though Germany is compliant with existing legal unbundling requirements.

The German government has consistently opposed the dimensions of the third package that aim to extend unbundling for vertically integrated generation, transmission and supply businesses. The German authorities have argued that retaining legal unbundling would be a preferred option as this solution is more compatible with German legal norms with regard to asset expropriation.

Despite strong opposition from the German government the European Commission has made substantial progress towards further unbundling in 2008 largely through the use of its competition powers. Following an EC investigation into alleged collusive activity E.ON tabled commitments in 2008 to divest its electricity transmission assets as well as a number of power generation units in return for an end to the investigation. In July 2008 the German arm of Vattenfall unilaterally announced that it also plans will divest its German transmission network assets. Whilst vertical integration does not directly influence the formation of wholesale power prices, the Commission's success in driving unbundling in Germany does reinforce the point that the European Commission has been able to drive forward its liberalization agenda even in the largest Member States.

Despite the incomplete state of liberalization in Germany the German wholesale electricity market is both liquid and sophisticated. The German power exchange, the EEX has generally good liquidity and offers a wide range of contracts. Numerous empirical studies have shown that EUA opportunity cost pass-through rates have been as high as 80 percent for baseload and near 100 percent for peak. Prices in Germany therefore generally reflect the SRMC of generation including CO₂. This means that in Germany full auctioning of EUAs should make no material difference to electricity prices post-2012 as prices already reflect the opportunity cost of carbon.

4.1.2 Post-2012 electricity pricing

The German 2012 forward baseload contract on EEX was trading at €82.55/MWh on 1st September 2008. The NCF European Carbon Balances Model was calibrated to match this 2012 price, and was then extrapolated to derive an electricity price assessment for 2013. For Germany in 2013 we project that auctioning will have no impact on prices in 2013 as the cost of power under free allocation and auctioning is the same.

Table 2 shows that the impact of full auctioning for Germany will be zero compared to a free allocation scenario.

Table 2: German price projections

Price scenario	Projected electricity prices €/MWh	Indexed (100)
2008	66	80
2013 no EU ETS	54	65
2013 + EU ETS, existing regulatory structure, free allocation	83	100
2013 + EU ETS, expected regulatory structure, free allocation (base case)	83	100
2013 + EU ETS, expected regulatory structure, full auctioning	83	100

Source: New Carbon Finance

4.2 Poland

4.2.1 Wholesale market context and policy developments

The Polish electricity market has, in theory been fully open to competition since the 1st July 2007. In practice there have been ongoing competition issues that affect power price formation. The prevalence of long-term power contracts and the continuation of a regulated price regime are impeding the development of a liquid wholesale electricity market. A large portion of the current Polish power generation fleet has traditionally been funded through long-term PPAs, which accounted for nearly half the volume of wholesale electricity demand in 2006.

Low liquidity in the Polish wholesale electricity market coupled with an opaque balancing market and dominant vertically integrated incumbents represent significant barriers to new entrants. The electricity transmission system operator (TSO) has not, according to the European Commission, been properly unbundled further entrenching the dominant position of the domestic incumbents.

Regulatory independence is a further concern. The Polish electricity market regulator the URE is still not clearly separated from government, which the EC argue is desirable to ensure fair and impartial treatment for all current and prospective market participants.

Whilst several obstacles to a liquid competitive wholesale electricity market in Poland are yet to be overcome, the direction of policy is clearly towards this end. Since 2007 there has been increasing evidence of the growing momentum towards wholesale electricity market liberalisation in Poland. For example, following a 2007 investigation by the European Commission into state aid the Polish government developed legislation to bring about the end of LT PPAs. In August 2007 legislation was introduced in releasing electricity generators from LT PPAs initially on a voluntary basis. Participation in this scheme was subsequently made mandatory from the 1st January 2008. The full implementation of this scheme is a key step in progressing Poland towards a competitive wholesale electricity market.

Progress has also been made in the retail market. From 1st January 2009 all end consumers will be able to choose electricity supplier. The development of more vigorous retail competition should add to the forces driving the development of a liquid wholesale electricity market as retailers seek greater transparency and access to the wholesale energy markets.

4.2.2 Recent wholesale pricing trends

The policy trends described above are reflected in the wholesale market price data. Figure 5 compares German and Polish day-ahead baseload prices since April 2007 and shows increasing convergence of Polish and German day-ahead power prices since the move away from LT PPAs in Poland from January 2008. This implies that Polish wholesale power prices are increasingly being driven by short-run operating costs, similar to liberalised markets such as Germany and the UK. This trend towards marginal cost price determination in the Polish wholesale electricity market is likely to continue as LT PPAs are progressively annulled and wholesale market liquidity and maturity increases.

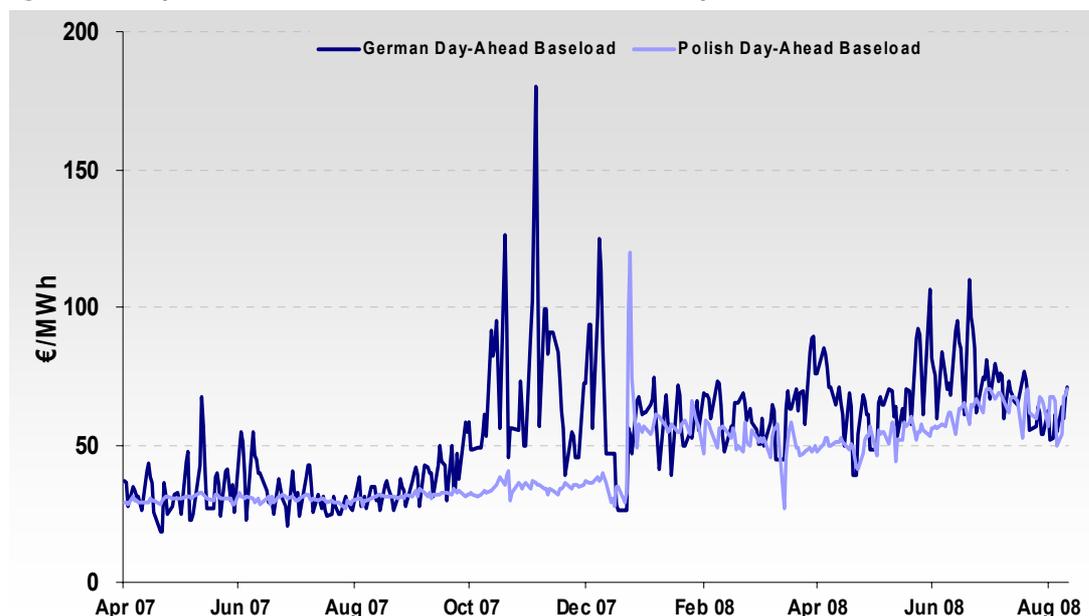
4.2.3 Post-2012 electricity pricing

On the basis of the observed relationship between the average 2008 German and Polish baseload wholesale electricity prices a baseline electricity price track consistent with the full auctioning of EUAs to power generators was derived, giving a value for Polish wholesale electricity price in 2013 of €87/MWh. An alternative approach to estimating the 2013 Polish wholesale electricity price using a marginal cost pricing approach gave an equivalent value of €71/MWh including the EUA cost, broadly in line with the German market correlation estimate. This provides further evidence that the price determination for the Polish wholesale electricity market has become more cost reflective since the LT PPA reforms were introduced.

For comparison, an estimate of 2013 Polish wholesale electricity prices under a regulated price regime with 100 percent free allocation was made. This price excludes any cost of carbon, so the implied wholesale electricity price impact of moving from 100 percent free

allocation to 100 percent auctioning under a regulated pricing regime would be to increase prices by €55/MWh (150%), the full cost of EUAs for a lignite power station.

Figure 5: Comparison of German and Polish ahead baseload prices



However, the evidence from both the current level of Polish electricity market price and recent policy changes clearly indicate that Polish wholesale electricity prices have already moved a long way towards a marginal cost basis and would be expected to continue to make substantial progress towards this structure by 2013. Consequently as the full opportunity cost of EUAs would be factored into wholesale electricity price irrespective of the method of allocation, the expected impact of full auctioning of EUAs on Polish wholesale power prices would be minimal.

Table 3: Polish price projections

Price scenario	Projected electricity prices €/MWh	Indexed (100)
2008	57	63
2013 no EU ETS	37	42
2013 + EU ETS, existing regulatory structure, free allocation	71	78
2013 + EU ETS, expected regulatory structure, free allocation. (base case)	91	100
2013 + EU ETS, expected regulatory structure, full auctioning	91	100

Therefore the Polish proposal to have 30 percent auctioning of EUAs for power generators in 2013 would result in a wholesale electricity price of €52/MWh under a regulated price regime, €39/MWh lower than full auctioning.⁶

⁶ "Poland Wants EU to Slow Down CO2-Permits Auction" (27/03/2008) Bloomberg News

4.3 Hungary

4.3.1 Wholesale market context and policy developments

Of the electricity markets in this study the Hungarian market is currently the least liberalized. One portion of the market remains fully regulated and exists in parallel with a competitive electricity market. The liberalization process for electricity sector began in 1992, and since then there have been further waves of legislation passed as part of a gradual privatization process. The latest law was passed in 2003 but Hungary is still not fully compliant with European legislation.

There are 12 generation companies in the Hungarian wholesale market 10 of which are privately-owned. Until the end of 2008 State-owned Magyar Villamos Művek will control 80 percent of power plant capacity through long-term off-take contracts.

The Hungarian electricity market does not have an organized power exchange and all electricity trades are conducted on an OTC basis. In this sense there is little transparency and long term PPAs still dominate electricity pricing. In 2004 the Hungarian government told the EC about the existence of long term PPAs between the state owned transmission operator and some generators. The agreements were on an average cost basis (described in section two) and covered nearly 80 percent of the Hungarian generation market.

The Hungarian market is, therefore only competitive in a limited sense at present. Nonetheless with a move away from long term contracts coming at the end of 2008 there are good reasons to believe that pricing should become increasingly marginal generation cost reflective before 2013.

In 2005 the EC opened an investigation into these contracts and in May 2008 declared them to be unlawful state aid. The EC has requested that Hungary terminate these contracts by the end of 2008 and recover any aid granted to generators since Hungary's accession to the EU in 2004. This ruling has already has an impact on the Hungarian market, in July, for example MVM Trade, the wholesale unit of the state-owned MVM announced that it would terminate its long-term power contract with Dunament Power Plant effective from December 31st 2008. The contract was originally signed in 1995 and when terminated will free 1,531MW of capacity.

Hungary announced plans to end the dominant position of its national electricity wholesaler MVM to spur competition and curb price rises. The state-owned wholesaler will be reorganized and new regulation for the wholesale electricity business will be drafted.

The Hungarian authorities are committed to the development of a Central European power exchange which should help to increase transparency and liquidity in wholesale electricity markets. In 2007 legislation was passed requiring that a power exchange be established either by a private undertaking or through connection with existing non-Hungarian power exchanges. In the event that no private entity chooses to establish an exchange, the Hungarian TSO MAVIR is obliged to do so.

At present there is no public market data available for Hungary, as all trades are OTC as there is currently no public power exchange. Given the trends towards liberalized wholesale electricity markets in the other countries described above, it would seem likely that Hungary will follow a similar path. Indeed there are parallels between Poland and Hungary insofar as both have agreed to remove all long-term contracts in the market.

4.4 Czech Republic

4.4.1 Wholesale market context and policy developments

The Czech wholesale electricity market was fully liberalized on the 1st January 2006 and is broadly compliant with existing EU legislation. The power generation market is partially privatised and is dominated by state-controlled ČEZ Group. Transparency is an ongoing issue and a lack of open access to transmission capacity and limited interconnection capacity with adjacent markets are further impediments to the developments of a liquid competitive wholesale electricity market.

Significant steps towards liberalization have been made as illustrated by the opening of the Czech power exchange in 2007. However, currently the vast majority of wholesale electricity trades are still OTC, rather than through the Czech power exchange.

In order to increase liquidity in the wholesale market the Czech energy regulator, the Energy Regulatory Office (ERO), established virtual power plant (VPP) auctions in 2005. These were designed to make generation capacity from the dominant generator CEZ available to other participants. Initial auctions announced in 2005 for 2006 delivery succeeded in increasing the volumes of generation available to other market participants by 10 percent.

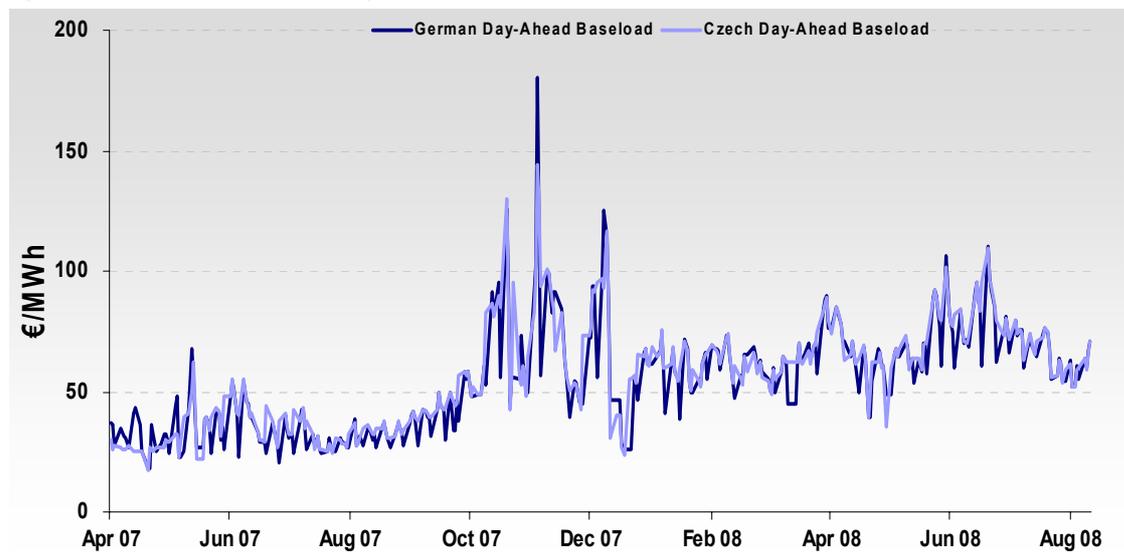
The regulator has also committed to develop a more transparent capacity auctioning mechanism for the whole central and eastern European region, whereby transmission capacity would be sold with power.

4.4.2 Recent wholesale pricing trends

Figure 6 below shows that Czech and German day-ahead base load prices have almost complete converged since the Czech exchange was established. There has been an extremely strong correlation between Czech and German prices suggesting that Czech wholesale power price determination is based on the same marginal generation cost basis as found in the German market discussed in section 4.1.

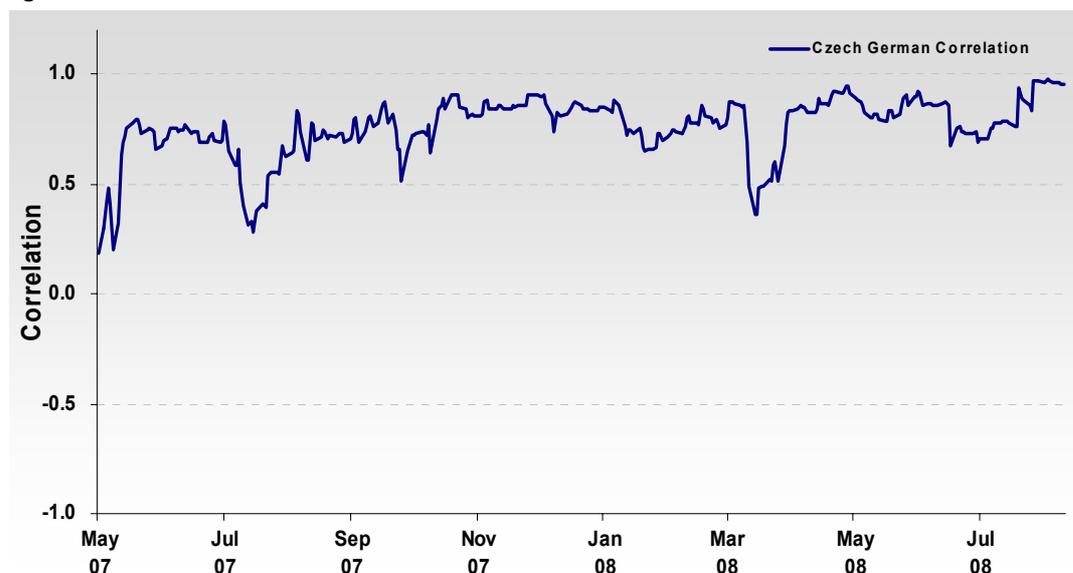
Consequently the opportunity cost of EUAs is already being fully factored into Czech wholesale electricity prices despite an estimated 100 percent free allocation for 2008.

Figure 6: German and Czech Day-Ahead Baseload Prices



Reviewing the correlations between German and Czech power price in figure 6, the increasing linkage between the two markets can be clearly seen. The extent of the correlation between these markets rose from 46 percent in 2007 to 65 percent 2008 for the year to date.

Figure 7: Correlation Between German and Czech Baseload Power Prices



4.4.3 Post-2012 electricity pricing

On the basis of the observed relationship between German and Czech wholesale electricity prices an estimate of Czech 2012 forward power prices was derived from 2012 forward German wholesale power prices. An assessment of the impact of auctioning EUAs on Czech wholesale electricity prices was made by extrapolating the synthetic Czech 2012 prices out to 2013. If no cost of carbon is incorporated into Czech power prices under a full free allocation scenario, the marginal fuel cost would give rise to a wholesale annual baseload power price of €37/MWh. However the evidence presented above clearly shows that, as expected, under a liberalised market regime, the full opportunity cost of carbon will be incorporated into the wholesale electricity price.

As with Poland two alternative approaches were used to estimate the level of Czech wholesale electricity prices with full auctioning of EUAs, firstly based on the correlation with German power prices giving a 2013 Czech annual power price of €85/MWh and secondly deriving prices from a bottom up merit curve which suggests a price level of €95/MWh. Therefore the contribution of EUAs to Czech wholesale prices in 2013 would be in the range €50-60/MWh.

Table 4: Czech price projections

Price scenario	Projected electricity prices €/MWh	Indexed (100)
2008	68	72
2013 no EU ETS	37	32
2013 + EU ETS, existing regulatory structure, free allocation	85	89
2013 + EU ETS, expected regulatory structure, free allocation (base case)	95	100
2013 + EU ETS, expected regulatory structure, full auctioning	95	100

Whilst the contribution from EUAs to Czech wholesale power prices is expected to be substantial, it is important to note that this is expected to be the case irrespective of the level of auctioning for EUAs.

5. Economic impacts

5.1 Impacts of auctioning

As well as the effect of auctioning on power prices, much attention has also focused on the potential economic costs of introducing auctioning to the EU ETS. Whilst a complete analysis of the economy wide effects of auctioning is beyond the scope of this report we do make the following two observations.

1. Assuming a liberalised electricity market with marginal cost pricing, the auctioning of allowances to the power sector has few disadvantages, and provides a fairer outcome than free allocation. Specifically, auctioning allows electricity consumers to be compensated for the higher power prices experienced as a result of electricity producers passing through the cost of carbon. Auction revenues can be recycled back to electricity consumers (although not necessarily in equal proportion) directly or through lower taxes. Under free allocation there is no in-built mechanism to recover the excess profits of the power generators.
2. Auctioning to the industrial sector has different consequences because producers covered by the scheme have to compete with producers outside Europe that, at present, do not have similar carbon constraints. This makes passing on costs in the form of higher prices more difficult. As governments have the ability to recycle some of the auction revenue back to the firms covered by the scheme some of the additional cost burden can be mitigated, but it is unlikely that total revenue neutrality could be achieved for all firms. This is why the Commission's proposals for Phase III of the EU ETS suggested a gradual phasing in of auctioning for the industrial sectors from 2012 to 2020.

5.2 Impacts of the EU ETS

Because the method of allocation mostly concerns the distribution of costs and revenues within a particular country rather than any net new expenditure, when considering economic impacts it is more relevant to look at the cost of meeting the targets under the EU ETS. Again we do not attempt here to provide a detailed economic impact analysis of the EU ETS for the four countries studied in this report, but we do highlight the following points.

1. Our analysis indicates that the maximum direct cost of meeting Phase III targets for Poland and the Czech Republic is of the order of €0.5 to €1.0bn per year based on our calculated average Phase III EUA price of €61/t. This equates to less than 0.1 percent of GDP in both countries. Hungary will likely have a surplus in this period as its allocation is greater than its projected emissions indicating zero compliance costs.
2. The cost of the EU ETS can be put in the context of other EU funding streams. For example, substantial funding is available to Poland, Hungary and the Czech Republic from the EU structural funds designed to promote convergence of their economies with those in the EU. At present Poland, Hungary and the Czech Republic are amongst the largest beneficiaries of EU structural funding. In the 2007-2013 settlement from the European Fund for Regional Development (EFRD), the European Social Fund (ESF) and the Cohesion Fund was worth €10 billion a year to Poland and €3.6 billion a year to Hungary and €3.8bn the Czech Republic. The basis on which funding will be allocated post-2013 has yet to be determined and will be subject to changing economic conditions over the next seven years. Given the current distribution of funds however it seems likely that Poland, Hungary and the Czech Republic will continue to receive substantial financial assistance from the wealthier Member States, and this could increase to cover the extra costs stemming from EU climate change policy.
3. Poland, Hungary and the Czech Republic will also benefit from the proposed redistribution of allowances to be auctioned post-2012. The Commission's January 2008 proposal states that 10% of the allowances should be redistributed to EU Member States with the lowest GDP per capita and the greatest potential for growth. Poland, Hungary and the Czech Republic are all likely to receive redistributed allowances under

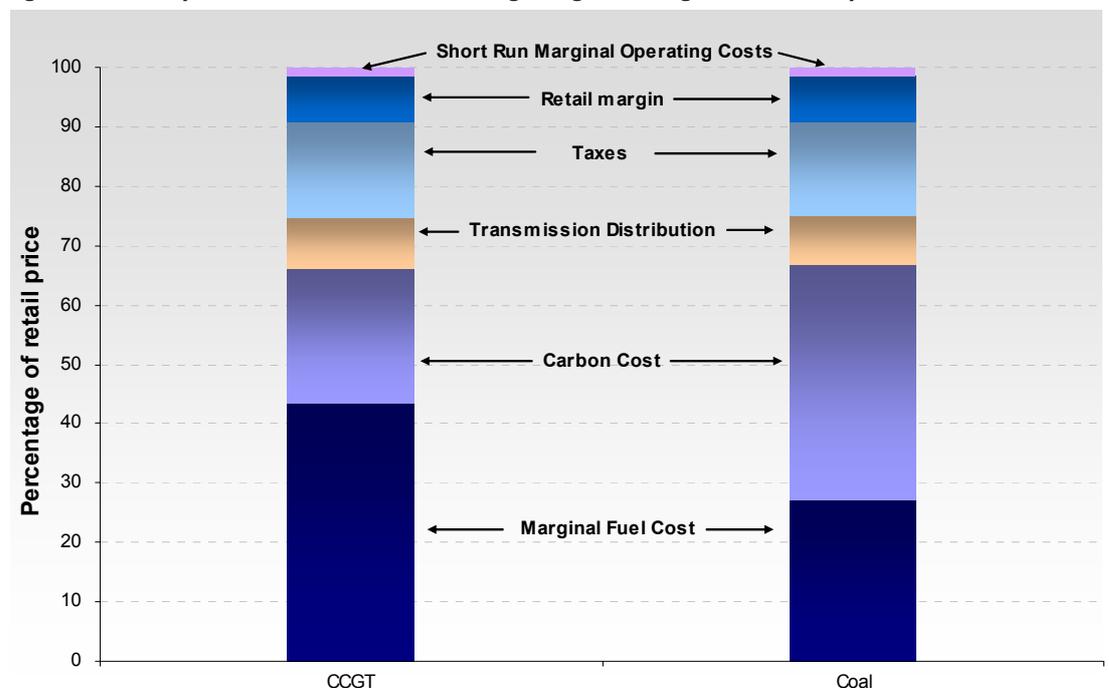
this proposal. The exact basis on which this redistribution would take place is yet to be determined but our analysis of future carbon prices, allocation projections and GDP figures suggests that Poland would receive allowances worth €0.7 - 1.4bn per year, Czech Republic €0.5 - 1.0bn per year and Hungary €0.3 - €0.7bn per year.

4. The impact of a the EU ETS on retail prices is significant but the main drivers of electricity prices going forward will be fossil fuel costs. Figure 8 shows a representative breakdown of European retail power prices for the marginal plant under a competitive market framework. Note this chart assumes a carbon cost of €61/t post 2012.

For CCGT plants, the majority of the price is the cost of fuel at around 40 percent, where as carbon costs account for 20 percent of the electricity price paid by end users. A margin for retailers is usually around 5-10 percent. The costs of transmission and distribution account for further 10 percent of the price. Taxes and green levies vary from country to country, though most include VAT, and in general this accounts for another 15 percent of the retail price. The remainder of the price is a reflection of non-fuel variable plant costs. Where coal plants are at the margin, the proportion of the final electricity price accounted for by carbon is higher because coal is a more carbon intensive fuel and is cheaper than gas. Figure 8 shows that in a competitive market where coal is at the margin carbon costs could account for 40 percent of the retail price.

It is important to note that this relatively simple analysis only shows the price breakdown for the marginal plant. Under these conditions, the price does not explicitly incorporate a fixed cost recovery element for the marginal plant. Capital costs for all plants other than the marginal plant are recovered by the difference between the SRMC of the marginal plant (ie the highest marginal cost plant in the market) which sets the price in the market and the SRMC of the more efficient plants lower down the merit order. For these non-marginal plants there is a significant additional contribution margin that goes towards capital cost recovery. For a typical high efficiency, mid merit order coal plant for example, carbon costs in 2013 (assuming a €61/t carbon price) would represent 34 percent of the retail price.

Figure 8: Retail price breakdown for the marginal generating unit in a competitive market



Source: New Carbon Finance, Ofgem, Eurostat

6. Conclusions

The argument that full auctioning of EUAs for the electricity generation sector will result in substantial electricity price rises, only holds if it is assumed that wholesale electricity pricing will still be subject to extensive regulation in 2013 and beyond. This is because in regulated pricing frameworks where only out of pocket costs plus a regulated return may be recouped, free allocation means that generators can avoid passing through the full cost of CO₂ allowances, effectively shielding end users from the full opportunity cost of carbon allowances.

A more complete assessment of the impact of auctioning post-2012 on electricity prices must account for the substantial changes that are likely to occur in European energy markets over the next five years.

Continuation of current trends suggests that regulated pricing based on long term PPAs in Poland, Hungary and the Czech Republic is unlikely to be in place in 2013. This is because of the increasing drive by the European Commission towards energy market liberalization, as well as the fundamental benefits of a more efficient power generation sectors with lower long run power prices.

Anticipating future regulatory structure matters because it affects the way in which wholesale electricity prices are determined. In liberalised competitive wholesale electricity markets prices will reflect the short run marginal costs of generation. Under competitive market conditions whether allowances are allocated for free or auctioned should make little difference because they still represent an opportunity cost to electricity generators. It should therefore be expected that opportunity costs of allowances will be passed through in full to wholesale electricity prices. This means that the impact on wholesale electricity prices of replacing free allocation with full auctioning from 2013 should effectively be minimal.

There is already good evidence to suggest that short run marginal cost pricing is developing in Poland, Hungary and the Czech Republic. For example long term PPAs in both Hungary and Poland have been annulled following investigations by the European competition authorities in the last two years. These contracts had previously accounted for more than half of the wholesale electricity markets in each of these countries. More generally Poland, Hungary and the Czech Republic have all also taken other steps to promote greater access and liquidity in their power markets.

Electricity market reforms are far from complete at present. Nonetheless the developments above, the clear commitment to further energy market liberalisation made by the European Commission through the publication of the Third Package of energy market reforms in 2007 and the EC's willingness to pursue competition cases against states and organisations that fail to comply with liberalisation legislation means there are good reasons to believe that further reform is likely.

Analysis of the available market data reinforces the evidence of increasing wholesale electricity market liberalisation. In Germany empirical studies have shown a high degree of pass-through of CO₂ opportunity costs to electricity prices. This coupled with its similar generation mix to Poland, Hungary and the Czech Republic make it a good benchmark against which to assess the level of CO₂ opportunity cost pass through in the other states.

Whilst in places the limited data gives a mixed picture, Czech day-ahead power prices show a consistently strong correlation with the equivalent German prices. Polish price data shows a weaker relationship with German prices, though in recent months there is some evidence to suggest that Polish prices are tracking German prices more closely. It is reasonable to assume therefore that by 2013 these markets are likely to be pricing broadly on the same marginal basis as in Germany.

New Carbon Finance's view is that marginal pricing will be the norm by 2013 not only in Poland, Hungary and the Czech Republic but across the EU. Therefore full auctioning of EUAs should produce the same wholesale electricity market price outcomes as full or partial free allocations.

Even in a scenario where current market structures and pricing mechanisms are maintained until 2013, a shift to full auctioning has a relatively small impact. This can be attributed to the fact that a movement towards marginal wholesale electricity pricing is already becoming apparent in Poland, Hungary and the Czech Republic.

This is not the same as arguing that there will be no increase in the price of electricity either before or after 2012. A natural result of market liberalisation is more variable short term electricity prices, with fossil fuel commodity prices being key drivers of power prices. Moreover the addition of a carbon price through the EU ETS is explicitly designed to ensure generators internalise CO₂ costs and will therefore almost certainly result in higher prices (other things being equal) as the EU ETS cap tightens in Phase III. This research demonstrates that these wholesale electricity price increases should not be attributed to the methodology chosen to distribute the EU ETS allowances.

In terms of economic impacts, the auctioning of allowances to the power sector should not result any adverse effects. Indeed, where marginal cost pricing is present auctioning provides a valuable means of compensating electricity consumers for increases in electricity prices brought about by the EU ETS. Our analysis also indicates that meeting EU ETS targets should be broadly affordable for Poland, the Czech Republic and Hungary, both in absolute terms as a proportion of GDP, and in the context of other monetary flows from wealthier Member States. In particular, the mechanism proposed by the European Commission for redistributing allowances from the wealthiest to the poorer Member States through the auction process, alone should compensate Poland, the Czech Republic and Hungary for a large part, if not all of the additional costs of the EU ETS.