1. INTRODUCTION

1.1 This note is based on the work carried out for CER by ILEX in July 2003 and contained in the report – "The price and dispatch impact of a centralised wholesale electricity market in Ireland", which is available on the CER website[1].

1.2 CER have requested that ILEX analyse the impact of the EU emissions trading scheme (ETS) on potential prices in the Ireland wholesale electricity market[2]. We have investigated the impact of a number of different scenarios in regards to the cost of carbon and the percentage of emission permits allocated to the market participants.

1.3 In the next section we present a background to the EU ETS. In Section 3 we present the assumptions behind this analysis and the results are presented in Section 4.

[1] www.cer.ie/cerdocs/cer03100.pdf

[2] The impact of the EU ETS is to be in reference to the price projections contained in the original ILEX report.

2. THE EUROPEAN UNION EMISSIONS TRADING SCHEME (EU ETS)

2.1 The EU ETS is the European Union's principal policy instrument aimed at meeting the EU's collective target agreed under the Kyoto Protocol. Under the terms of the scheme, national governments must award CO_2 allowances to CO_2 emitting installations above 20MW thermal input capacity specifying the amount of CO_2 they can emit each year.

2.2 At the heart of the scheme is the ability of companies to trade CO_2 allowances. Thus, a company for whom it would be extremely costly to reduce emissions can purchase allowances from companies that can achieve emissions reductions at little or no cost. Through this mechanism, emissions reductions can be achieved at least cost to Europe overall. This trade will be EU-wide and has the potential to be fairly liquid given that thousands of installations across Europe will be seeking to trade with each other.

2.3 There are two initial phases of the scheme (2005-7 and 2008-12), after which it is intended that there will be ongoing 5-year phases in line with the intended 5-year phases of the post-Kyoto international commitments to greenhouse gas reduction. The amount of allowances national governments allocate must be consistent with their commitments under the Kyoto protocol. Governments must decide how many allowances to issue for the first phase of the scheme by 31 March 2004, at which point they must submit their allocations to the European Commission for approval in order to meet the start date of 1 January 2005.

2.4 The operation of the scheme could have fundamental implications for carbon-intensive sectors of the economy. The most significant impact in terms of the cost of manufacturing goods, and the method and location of their manufacturer, will arise from the cost of CO_2 that will 'emerge' from the scheme. All manufacturing processes that emit CO_2 will need to factor the cost of CO_2 into their production just like any other raw material such as fuel.

2.5 The consequence of this will be to raise the cost of goods in line with the carbon-intensity of the marginal producer. It could also result in carbon-intensive production processes being displaced by carbon-efficient processes. In the case of electricity, wholesale prices will rise in line with the marginal generator. If the generator is gas-fired the price rise will be less than if it is coal-fired. It may also result in changes in relative positions in the merit order. For example, in-merit coal-fired plant may get pushed down the merit order to be displaced by more carbon-efficient gas-fired plant. The extent of this displacement will obviously depend on the level of CO_2 price that emerges from the scheme – and whether generators choose to pass this additional cost through to the electricity price[3].

[3] For example, the threat of regulatory action may influence generators behaviour.

2.6 The second major impact on the profitability of carbon-intensive generators will stem from the methodology that national governments choose for allocating the CO_2 allowances to installations.

2.7 Under the EU ETS, governments have a wide choice of methodologies to choose from ranging from allocating allowances based on historic emissions (often called 'grandfathering'), to allocating allowances based on projected future emissions. Governments can also choose to share allowances within a sector (e.g. steel, electricity, aluminium etc.) based on product output (e.g. kWh in the case of electricity) rather than emissions. In addition, governments have to decide whether to hold back allowances from existing plant in order to award some to potential new entrants.

2.8 Due to the extreme variability of production method, and projected major changes between past and future output, the different methodologies result in radically different divisions of allowances for the electricity sector in particular. Methodologies that award allowances based on historic emissions will be most beneficial to existing carbon-intensive generators such as coal-fired plant, potentially resulting in windfall profits. However, at the other extreme, methodologies that award allowances based on projected output could result in such coal-fired plant being faced with major additional costs.

3. ASSUMPTIONS

Market assumptions

3.1 Following discussions with CER, we have chosen to project the impact of the EU ETS on wholesale electricity prices in two years:

- 2006 – this was the reference year for our original work for the CER and is the first year after the introduction of the scheme in 2005; and
- 2008 – this year is the first year of phase 2 of the EU ETS.

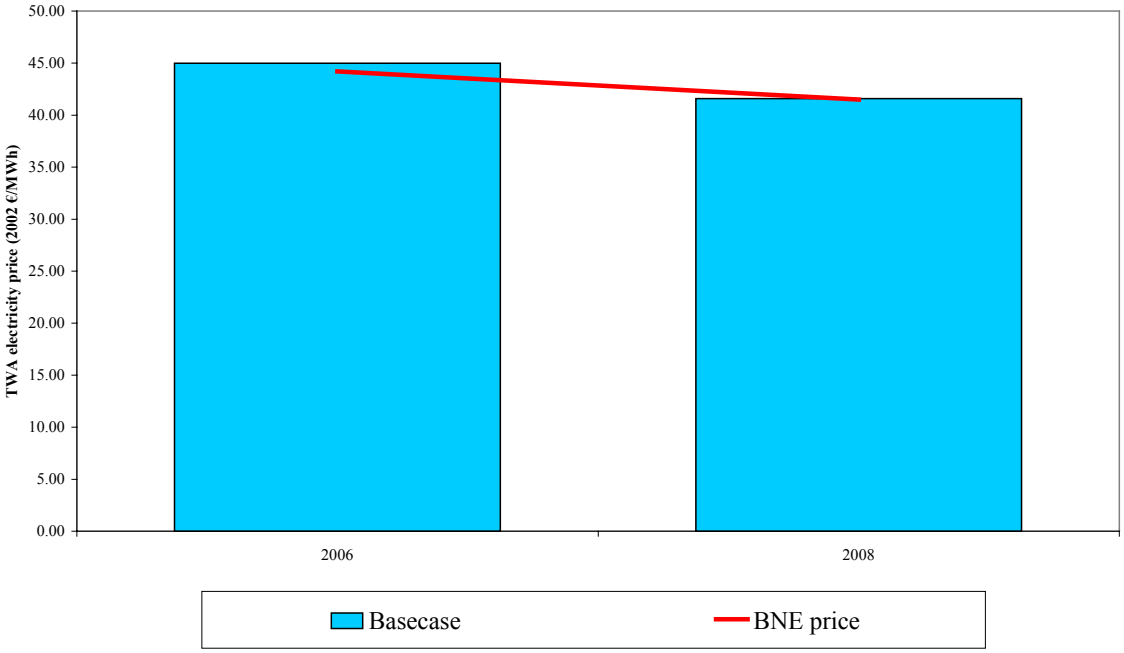
3.2 In our original work, we presented a number of scenarios of the annual time-weighted average (TWA) electricity price in 2006, these were as follows:

- €45/MWh which is the Best New Entrant (BNE) price[4] that underpins the present transitional regime for top-up power. It also corresponds to our own view of the base-load price, which would be required by a generic new-entrant CCGT (combined-cycle gas turbine) in 2006. A TWA price of €45/MWh would therefore be consistent with a competitive market in equilibrium with new entry by CCGTs;
- A TWA of €51/MWh which corresponds to the revenue which is effectively allowed to ESB PG at present, through the wholesale component in the price control on supply to the franchise market; and
- €55/MWh which was chosen so that, together with the €45/MWh, it brackets the current €51/MWh.

3.3 In this piece of work we have only considered the BNE price scenario. In the original work, we assumed that ESB bid plant up, such that annual average prices are at the BNE level. The annual average price projections are shown in Figure 1. The fall in prices from 2006 – 2008 is due to the projected fall in gas prices under the ILEX central scenario.

[4] When calculated from our central view for gas prices in the year 2006.

Figure 1 – Basecase price projections



3.4 In this analysis we investigate the impact of the EU ETS on this reference level of wholesale electricity prices in Ireland. We have considered two options in regards to ESB's bidding behaviour and the BNE:

- ESB's bidding behaviour is the same as was the case in our original work (i.e. the absolute level of ESB's bid up is the same), but prices may be higher to reflect the impact of the value of carbon[5]; and
- ESB's bidding behaviour is driven by a revised BNE price, which includes a component for the value of carbon, assuming that a new entrant must purchase 100% of its permits[6].

3.5 We assume one new 400MW CCGT comes on-line before 2006, and no further CCGTs are commissioned before 2008. It may be that higher electricity prices, due to the impact of carbon, could encourage further new entry before 2008 (depending on the allocation methodology) but we have ignored this in our analysis.

3.6 All assumptions behind this scenario can be found in the original ILEX report.

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5 This case effectively allows us to compare the difference between electricity price with and without a value of carbon by keeping all the variables the same except for the carbon value.

6 In this case we assume that the impact of the value of carbon on electricity prices will be capped by the impact on of carbon on a new entrant CCGT.

3.7 We agreed with CER that we would only consider the impact of the EU ETS against the annual time-weighted average electricity price. This would be on a non-locational basis only, i.e. we have not considered the impact under the location marginal pricing (LMP) scheme proposed for the Irish market.

EU ETS assumptions

3.8 Under the EU ETS, in phase 1 and 2, generators will be allocated a number of emission permits, which will not necessarily cover all their emissions. Generators can purchase additional permits to meet their requirements.

3.9 In this analysis, under CER guidance, we have considered four scenarios in regards to the allocation of permits against requirements:

- no allowances for free[7];
- 70% allocation;
- 80% allocation; and
- 90% allocation.

3.10 We have modelled two different methodologies for determining the allocation of allowances:

- the allocation is made based on the projected generation (and the new entrants will be allocated permits) and generators will purchase the additional permits required and pass this cost through to the wholesale electricity price; and
- the allocation is based on historical emissions, but new entrants have to purchase all their permits[8]. We have used the historical emissions supplied by the CER[9].

3.11 In this analysis, we assume that the generators do not pass through the opportunity cost of permits they have been allocated for free[10]. Again based on CER guidance, we have modelled the following scenarios for the cost of CO_2:

- €10/tonne;
- €20/tonne; and
- €30/tonne.

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7 This scenario is also equivalent to a scenario (as final prices are concerned) in which generators are allocated permits but pass the full opportunity cost of these permits through to the electricity price.

8 We assume that the new peat units coming on-line in 2005 are eligible to use the allowances for the old units they have replaced on the same site.

9 In reality the historical emission limits is likely to be based on the same reference year, rather than the estimated limits presented here for some plant.

10 We were requested by CER to make this assumption.

3.12 Table 1, below, sets out the emissions factors used in determining the level of emissions from burning different types of fuel. These are based on the Ireland National Inventory Report[11]. All emissions factors are in tCO_2/TJ.

Table 1 – Assumed emissions factors (tCO_2/TJ)

Fuel	Emission Factors
Coal	94.99
Oil	80.06
Gas	56.64
Peat	111.58

11 "Ireland National Inventory Report 2003: Greenhouse Gas Emissions 1990 – 2001 Reported to the United Nations Framework Convention on Climate Change", available on http://unfccc.int/program/mis/ghg/submis2003.html

4. RESULTS

4.1 We have examined three separate cases in relation to the allocation methodology and the allowed level of prices in the Irish market:

- ESB bidding behaviour is limited such that TWA electricity market prices are consistent with those of a BNE, but including a further component to cover the cost of carbon assuming a new entrant must purchase all their allowances;
- Allocation based on projected output and ESB bidding behaviour is normalised based on the scenario, with no value of carbon, where TWA prices are consistent with the BNE price; and
- Allocation based on historical emissions and ESB bidding behaviour is normalised based on the scenario, with no value of carbon, where TWA pprices are consistent with the BNE price.

4.2 In total we have projected twelve scenarios of the impact of the EU ETS, for each case, on wholesale electricity prices in 2006 & 2008, based on the allocation and cost of carbon assumptions given in Section 3. We have also presented the basecase price projections, with no cost of carbon, as a reference point.

ESB bidding behaviour limited by revised BNE price

4.3 Here we present the results under the methodology of allocating emission permits based on either projected output or historical emissions, but where ESB's bidding behaviour is driven by the requirement that annual TWA electricity prices are consistent with the BNE price, but including a component to cover the cost of new entrants purchasing all of their emission allowances.

4.4 The projections for the wholesale electricity price are shown in Figure 2 and Table 2. The table also shows the percentage increase of prices over the level of prices with no value of carbon.

Figure 2 – Impact of EU ETS on wholesale electricity price projections (case a)

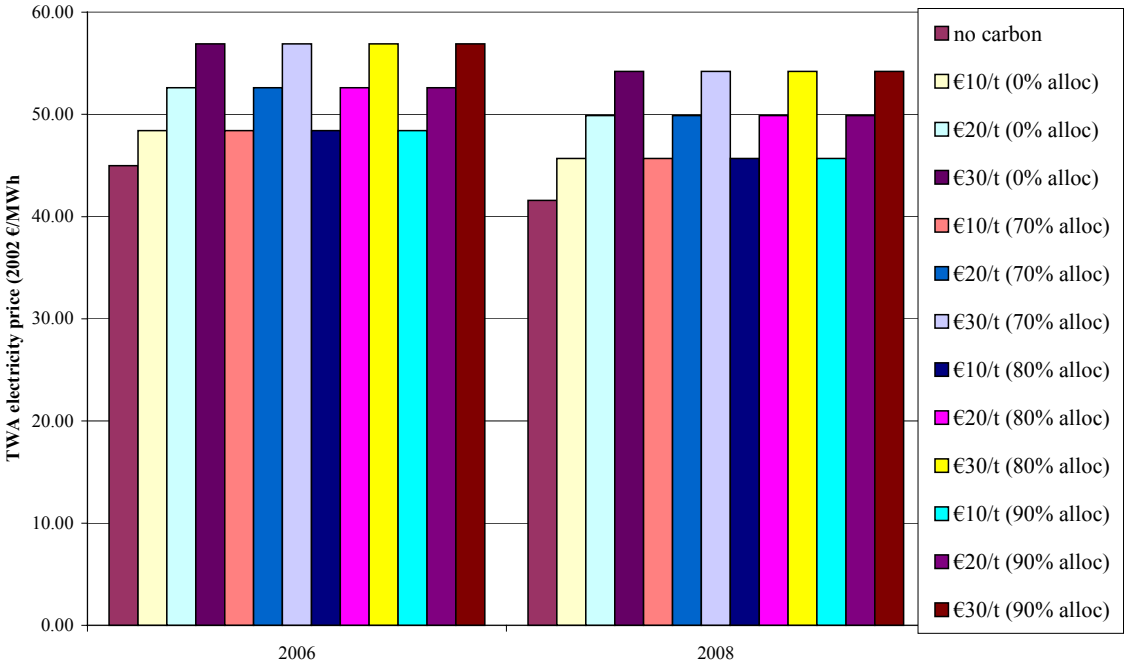


Table 2 – Impact of EU ETS on wholesale electricity price projections (case a) (2002 €/MWh)

Scenario	2006		2008	
No value of carbon	45.0		41.6	
€10/tonne (0% allocation)	48.4	(7.6%)	45.7	(9.9%)
€20/tonne (0% allocation)	52.6	(16.9%)	49.9	(20.0%)
€30/tonne (0% allocation)	56.9	(26.5%)	54.2	(30.3%)
€10/tonne (70% allocation)	48.4	(7.6%)	45.7	(9.9%)
€20/tonne (70% allocation)	52.6	(16.9%)	49.9	(20.0%)
€30/tonne (70% allocation)	56.9	(26.5%)	54.2	(30.3%)
€10/tonne (80% allocation)	48.4	(7.6%)	45.7	(9.9%)
€20/tonne (80% allocation)	52.6	(16.9%)	49.9	(20.0%)
€30/tonne (80% allocation)	56.9	(26.5%)	54.2	(30.3%)
€10/tonne (90% allocation)	48.4	(7.6%)	45.7	(9.9%)
€20/tonne (90% allocation)	52.6	(16.9%)	49.9	(20.0%)
€30/tonne (90% allocation)	56.9	(26.5%)	54.2	(30.3%)

4.5 Under this scenario the level of prices is always driven by the BNE price rather than the allocation methodology for existing plant.

Allocation based on projected output

4.6 In this case we assume that ESB's bidding behaviour is the same with or without the value of carbon, i.e. the absolute bid-up by ESB (in terms of €/MWh) is the same under both scenarios. The difference in prices between the two scenarios will be entirely due to the impact of the value of carbon.

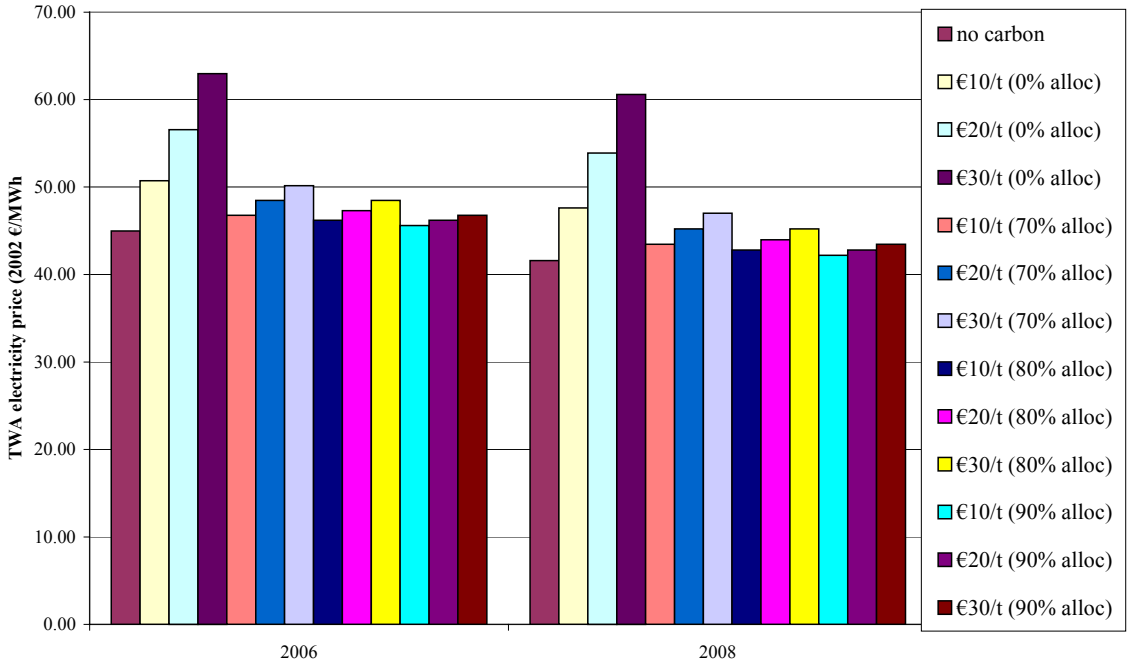
4.7 In basing the emission allocations on projected output we have assumed perfect foresight, i.e. the generation we project for each plant will be consistent with the outturn generation. For the Irish market, this is an acceptable assumption since there is not a large number of competing mid-merit plant.

4.8 For those scenarios in which we assume that a percentage of permits have been allocated to a plant we adjust the bid price for the plant to ensure that they cover

the cost of purchasing the additional permits[12]. For the purposes of this analysis we assume that in any given hour plant will despatch based on this lower bid price, rather than on a marginal carbon bid price, which includes the full cost of carbon.

4.9 The projections for the wholesale electricity price, under the methodology of allocating emission permits based on projected output, are shown in Figure 3 and Table 3.

Figure 3 – Impact of EU ETS on wholesale electricity price projections (case b)



12 We model the additional marginal cost for each plant as equivalent to the carbon price multiplied by the percentage of permits not allocated for free.

Table 3 – Impact of EU ETS on wholesale electricity price projections (case b) (2002 €/MWh)

Scenario	2006		2008	
No value of carbon	45.0		41.6	
€10/tonne (0% allocation)	50.7	(12.8%)	47.6	(14.5%)
€20/tonne (0% allocation)	56.6	(25.8%)	53.9	(29.6%)
€30/tonne (0% allocation)	63.0	(40.0%)	60.6	(45.7%)
€10/tonne (70% allocation)	46.8	(4.0%)	43.5	(4.5%)
€20/tonne (70% allocation)	48.5	(7.8%)	45.2	(8.7%)
€30/tonne (70% allocation)	50.1	(11.5%)	47.0	(13.0%)
€10/tonne (80% allocation)	46.2	(2.7%)	42.8	(2.9%)
€20/tonne (80% allocation)	47.3	(5.2%)	44.0	(5.8%)
€30/tonne (80% allocation)	48.5	(7.8%)	45.2	(8.7%)
€10/tonne (90% allocation)	45.6	(1.4%)	42.2	(1.5%)
€20/tonne (90% allocation)	46.2	(2.7%)	42.8	(2.9%)
€30/tonne (90% allocation)	46.8	(4.0%)	43.5	(4.5%)

4.10 Since we have normalised the bidding strategy for ESB, the absolute difference in price between each case and the basecase (with no value of carbon) is the impact of the EU ETS under the scenario in question.

Allocation based on historical emissions

4.11 This case is equivalent to the previous case except that emissions allowances are based on historical emissions.

4.12 The projections for the wholesale electricity price are shown in Figure 4 and Table 4.

Figure 4 – Impact of EU ETS on wholesale electricity price projections (case c)

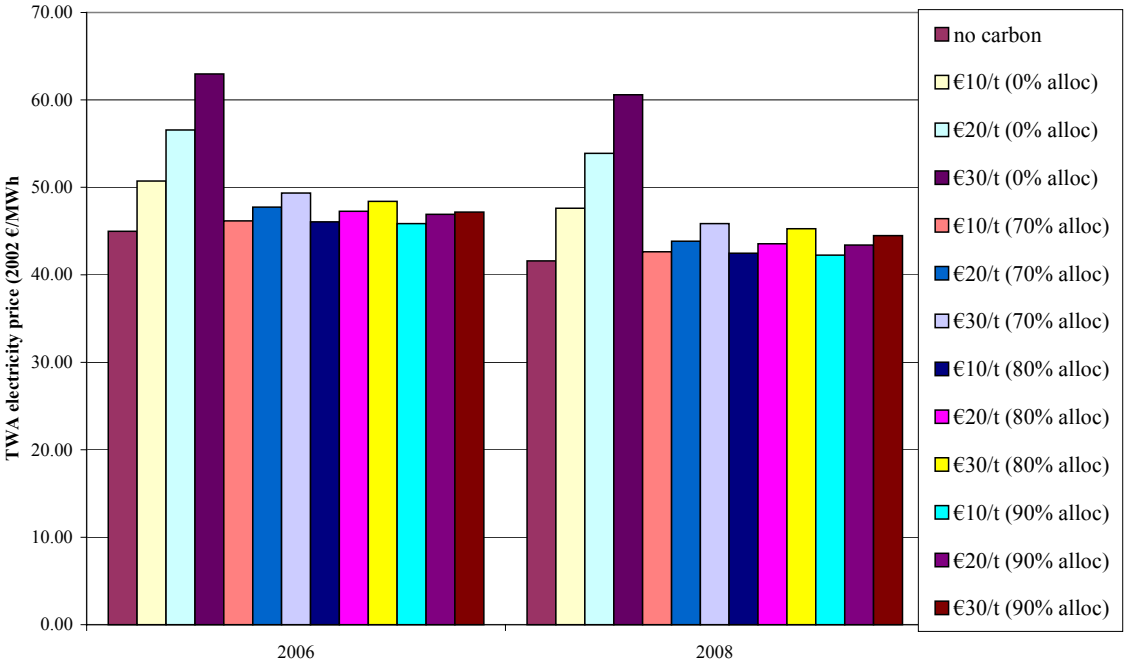


Table 4 – Impact of EU ETS on wholesale electricity price projections (case c) (2002 €/MWh)

Scenario	2006		2008	
No value of carbon	45.0		41.6	
€10/tonne (0% allocation)	50.7	(12.8%)	47.6	(14.5%)
€20/tonne (0% allocation)	56.6	(25.8%)	53.9	(29.6%)
€30/tonne (0% allocation)	63.0	(40.0%)	60.6	(45.7%)
€10/tonne (70% allocation)	46.2	(2.6%)	42.6	(2.5%)
€20/tonne (70% allocation)	47.7	(6.1%)	43.9	(5.5%)
€30/tonne (70% allocation)	49.4	(9.7%)	45.9	(10.3%)
€10/tonne (80% allocation)	46.0	(2.4%)	42.5	(2.1%)
€20/tonne (80% allocation)	47.3	(5.1%)	43.6	(4.7%)
€30/tonne (80% allocation)	48.4	(7.6%)	45.3	(8.9%)
€10/tonne (90% allocation)	45.9	(2.0%)	42.3	(1.6%)
€20/tonne (90% allocation)	46.9	(4.3%)	43.4	(4.4%)
€30/tonne (90% allocation)	47.2	(4.9%)	44.5	(6.9%)

Conclusion

4.13 In conclusion, the impact of the EU ETS on the Ireland wholesale electricity market would result in a maximum rise of €5/MWh in prices (on a annual average basis) if at least 70% of the required permits were allocated for free (and generators did not pass the opportunity cost of these permits through to consumers) and the BNE price is unaffected by the allocation methodology. If the new entrants have to purchase all of their allowances and this can be reflected in the BNE price then the impact of the EU ETS is potentially much higher – up to €12/MWh. This maximum rise in prices is based on an extreme cost of CO_2 – obviously the lower the CO2 cost the lower the impact on wholesale electricity prices.

4.14 However, if generators could pass the entire cost of carbon through to electricity prices, there would be a potential rise of €19/MWh under the worst-case scenario.

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