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Carbon Price Floor in Ireland

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1. Introduction

The Council are concerned that the best way of decarbonising heat and transport may involve extensive electrification. Research for the Department of Communications, Climate Action and Environment shows that pathways to decarbonisation in the non-Emissions Trading System sector rely to a significant degree on electrification of heat and transport services.[1] While electrification can bring with it some improved carbon efficiency, decarbonisation of the electricity sector is required to make this a viable long-term national decarbonisation strategy.

The Annual Review 2018 found that carbon intensity in the electricity sector has increased in the last two years with broader implications for decarbonisation nationally. Planned electrification in the heat and transport sectors requires low- to zero-carbon electricity. Unless electricity also decarbonises we could lock-in substantial carbon emissions in the long term.

The Council is concerned that the EU Emissions Trading System (ETS) will not deliver an appropriate rate of decarbonisation. Ireland will need a strategy to ensure that the suite of policies across the ETS and non-ETS sectors will deliver the low-carbon transition we want by 2050. Therefore the Council commissioned analysis of measures that could supplement the carbon price signal in the electricity sector to achieve significant decarbonisation. This paper describes the implications for Ireland of that analysis, drawing on [Deane et al, 2018].

2. CCAC requested analysis on carbon price floor

The Irish electricity sector still includes some high carbon electricity generators in its portfolio; coal at Moneypoint and peat fired generators. In 2018, as part of the National Development Plan, the government committed to ending the role of peat and coal in electricity generation in Ireland by 2030. Moreover, the Irish Government joined the Powering Past Coal Alliance, committing to closing Moneypoint by 2025. More recently Bord Na Móna have also indicated that they plan to close much of the peat-fired generators of electricity earlier than originally planned.

The Council is interested in how the closure of coal and peat fired generation in Ireland might be achieved most cost-effectively. As part of its 2018 work programme, the Climate Change Advisory Council requested analysis of the implications of a carbon price floor for the electricity sector in Ireland and other EU Member States. Dr. Paul Deane, University College Cork, undertook this analysis with colleagues. An academic paper has been prepared, based on the results of the analysis for all countries in the EU. This briefing paper builds on that paper to summarise the results, in particular the implications for Ireland.

[1] Department of Communications, Climate Action and Environment (2013), Technical Support on Developing Low Carbon Sector Roadmaps for Ireland. Low Carbon Energy Roadmap for Ireland [online] https://www.dccae.gov.ie/documents/Low%20Carbon%20Energy%20Roadmap.pdf [accessed 13 June 2018].

3. Importance of carbon price in the electricity sector

The term 'carbon pricing' is short-hand for putting a value on greenhouse gas emissions that aims to reflect, to some degree, the costs to society of climate change from those emissions. The Periodic Review Report 2017 described how carbon pricing ensures that some of the costs of climate change from greenhouse gas emissions are taken into account in the decisions of producers and consumers.[i] Typically, in response to increased costs, polluters decide to reduce costs by reducing overall emissions in the cheapest way. In this manner, the overall environmental goal can be achieved in the most flexible and least-cost way to society. In addition, by providing a clear price signal new investment in technology and infrastructure that does not emit greenhouse gases is incentivised. In its First Report the Council emphasised the importance of an effective price signal for carbon emissions.[ii]

Energy Industries, dominated by the electricity sector, emitted 20.4% of GHG emissions in Ireland in 2016. Currently a carbon price signal is delivered to the electricity sector and other large emitting industries in Ireland via the EU Emissions Trading System.[2] A carbon price sets a 'real-world' price reflecting, the adverse environmental impact of greenhouse gas emissions, by imposing a unit cost on greenhouse gas emissions or, more commonly, on the carbon content of fossil fuels. With the existence of a carbon price via the EU ETS:

- Individuals and households are incentivised through an increased electricity price to reduce their carbon emissions through reduced consumption of electricity or through switching to lower carbon energy suppliers. Investment in energy efficiency, alternative low-carbon heating systems or other emissions-saving strategies are therefore encouraged.
- Business and industry are incentivised to reduce their own demand for fossil fuel based electricity and to provide low- and zero-carbon options to consumers. Research and innovation are therefore encouraged and costs of low-carbon options reduced.
- The electricity industry is incentivised to invest in: increased efficiency of generation; fuel switching from high to low carbon fuels; necessary grid infrastructure to support decarbonisation; and increasing capacity in renewable energy systems.

The prevailing carbon price in the EU Emissions Trading System has been commonly accepted as offering a carbon price too low to incentivise significant emissions reductions or low-carbon transition. In 2008, prices were as high as €30 / tonne but then fell during the recession and

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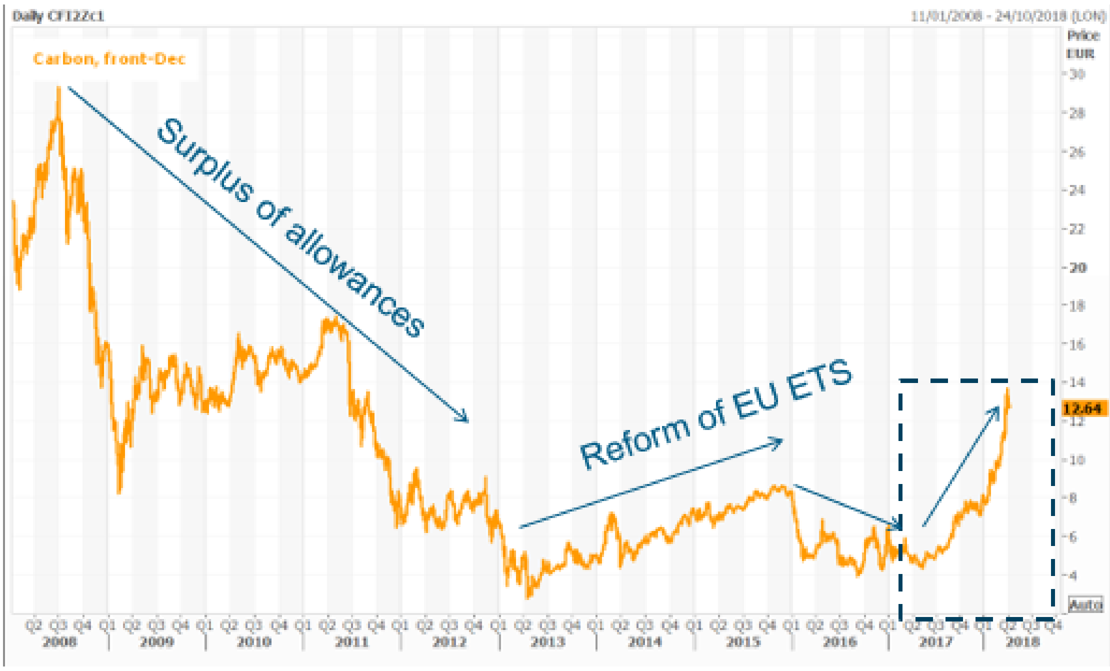
[2] The functioning of an emissions trading system and how it delivers a carbon price and emissions reductions is explained in an annex of the 2017 Periodic Review Report.

languished in the range of €4-6 / tonne for most of 2011 to 2017. Recent reforms to the EU ETS that came into force in April 2018, as described in [AR2018 chapter 8] and [Deane 2018], saw a significant increase with the price reaching €20 in August 2018[3]. However, this price level still is not at the level recommended for carbon pricing in the international literature. Moreover, there are concerns among analysts that this price increase is temporary [BNEF[4], other papers].



Source: Deane, 2018

Due to the low carbon price, public financial support, collected via the Public Service Obligation charge on electricity bills and most recently delivered via the REFiT price support mechanism, has been required to underpin the expansion of the renewable electricity sector in Ireland.

4. Why a carbon price floor?

A volatile and low carbon price does not offer sufficient signal to the electricity industry to change investment patterns towards lower carbon options. Decarbonisation of the electricity sector is a key plank in the National Policy Position to achieve transition to a low carbon economy and society by 2050. Decarbonisation of the transport and built environment sectors will depend in part on switching to electricity as a low carbon energy source. It is therefore crucial for the low carbon transition that appropriate investment choices are made in the electricity sector for long-term decarbonisation.

To rapidly phase out coal and peat from their current role in electricity generation in Ireland, either a regulatory, fiscal or a market approach can be used. Compared to a regulatory approach, a fiscal-market based approach may have an advantage in creating revenues for government,

[3] https://sandbag.org.uk/carbon-price-viewer/
[4] http://carbon-pulse.com/59231/

while at the same time providing signals to other actors in the sector. The Council undertook to explore the comparative impacts of a carbon price floor versus a regulatory approach.

5. Analysis of a Carbon Price Floor - Assumptions

When considering introduction of policies in such a vital sector for the economy it is important to consider the broader impacts, what the competitiveness effects might be, what the impacts on producers and consumers might be, and what the emissions outcome in Ireland and at an EU level might be. Examining the impact of a carbon price floor or regulatory closure of coal on the electricity sector, and on the wholesale electricity price in Ireland and in other EU Member States, will determine a large part of the economic and competitiveness impacts for Ireland.

UCC (Deane, 2018) undertook to model the impact of a carbon price floor on the electricity market in Ireland and Europe using the Plexos model. PLEXOS is a tool used for electricity and gas market modelling and planning across Europe. It contains details of all generation equipment across the EU, as well as details of the interconnection of the different systems.

In this analysis, the focus is limited to the electricity system, i.e. gas infrastructure and delivery is not considered here. In brief, the model optimises the dispatch of conventional thermal generated electricity, renewable electricity and pumped hydro storage to meet the assumed level of demand for electricity across Europe.[5] The model seeks to minimise the overall generation cost across the EU to meet demand subject to the assumed portfolio of installed generators and networks, and their technical characteristics such as interconnection, ramp rates, start costs, minimum up-times etc. Operational costs, consisting of fuel costs, carbon costs and start-up costs are represented[6]. A perfect market is assumed across the EU (i.e. no market power or bidding behaviour by power stations).

It is assumed that the portfolio of generation equipment remains at specified levels for 2020 and 2030 and does not change in response to the Carbon Price Floor. In reality, such a policy change would see greater investment in low-carbon or renewable technologies. Such investment would reduce the cost of the CPF and increase any savings in emissions. However, to analyse the full impact of such changes would require a more complex modelling process.

Given the assumed infrastructure, assumptions about the hourly demand for electricity across the EU, and assumptions about energy and carbon costs, the model can then simulate the dispatch of the electricity system in each country. The resulting simulation shows the cost of electricity in each country, the national demand, national output of electricity and national emissions.

[5] The methodology used to develop this European model is as presented in [Deane 2018] and Collins et al. (2015).

[6] Fuel price assumptions are described in [Deane 2018]

To look at the effects of the implementation of a regulatory or carbon price floor approach, we modelled the EU reference scenario – the European Commission's assessment of business as usual – as the base case.

Table 1: Carbon prices and carbon floor prices examined

	REF Carbon Price (€/tonne)	S1 & S2 Carbon Price Floor (€/tonne)
2020	18	35
2030	35	50

The EU Reference Scenario is a projection of economic activity and energy, transport and emissions trends in the EU and its Member States, assuming current policies and trends. Because the Reference Scenario assumes current policies are continued, it can be used as a benchmark to assess the impacts of policy changes. The EU Reference Scenario assumes an EU ETS carbon market price of €18 in 2020 and €35 in 2030 (Table 1). This price applies across all ETS countries and sectors. This, together with other policies and measures already in place, leads to emissions reductions of 26% below 1990 levels in 2020, 35% below by 2030 and 48% by 2050 in the EU reference scenario.

Table 2: Assumed Energy Prices

Fuel	2020	2030
Coal Price (€/GJ)	2.0	3.1
Natural Gas (€/GJ)	8.1	9.7
Nuclear (€/GJ)	1.9	1.9
Oil (€/GJ)	11.5	15.8

The assumptions used in Deane, 2018, about energy prices for electricity generators are shown in Table 2. These prices are assumed to hold in all scenarios.

In all scenarios no account is taken of the cost of supporting renewable electricity. Where the wholesale electricity price is higher, for example because of a carbon price floor, the support cost will be reduced. Also, if it is assumed that the ETS permits, which would have been used by closing coal and peat generating stations are cancelled, then the market for permits will tighten if demand from non-participating countries rises. However, the market for permits is not modelled in Deane and no account is taken of any such rise in the ETS permit price as a result of a partial introduction of a carbon price floor.

A rise in the underlying ETS price would further reduce emissions for the EU as a whole. It would also increase prices in those countries that don't participate in the CPF strategy, while probably only having a small additional effect on prices in the participating countries. Government revenue from the CPF would also be reduced because of a higher ETS price.

Three scenarios were developed and modelled by Deane, 2018; S1, S2 and PPCA. These scenarios take the assumptions regarding fuel prices, carbon prices and the network and generation capacity portfolio except for the following changes:

- Scenario 1 (S1) assumes a higher carbon price (a carbon price floor, CPF, as set out in Table 1); it is assumed that this CPF is applied to the following countries Ireland, Belgium, Denmark, Finland, France, Luxembourg, Netherlands, Norway, Sweden and the United Kingdom while the remaining countries continue to apply the EU reference scenario carbon price.
- Scenario 2 (S2), similar to S1, assumes the CPF is applied to all S1 countries and Germany.
- A final scenario, Power Past Coal Alliance[7] (PPCA) assumes the EU reference scenario carbon price across all countries but also assumes a complete shutdown of coal fired plant in all S1 countries to approximate the effects of regulatory shut-down of coal in PPCA countries. This amounts to shutting down 26GW of coal fired generation out of a total of 144GW coal fired plant in the EU 2020 system and 13GW out of a total of 100GW in 2030. Scenario 1 and PPCA countries capture 45% of Total EU electricity demand, 19% of total EU CO2 Emissions and 46% of EU GDP. Scenario 2 countries capture 62% of Total EU electricity demand, 43% of total EU CO2 Emissions and 66% of EU GDP.

6. Results: EU

The results for the EU of the three scenarios are summarised in Table 3 for 2030.

One unexpected result of the simulations was that because of the relatively high price of gas, even with a carbon price floor of €50 a tonne, coal generation did not close in a number of countries. It would have taken a price of €60 a tonne to produce this result. An alternative explanation may be that without new investment in more sustainable technologies it would not have been possible to operate the electricity system without the coal-fired plant.

In Ireland, France, the UK and Belgium coal-fired generation effectively closes in the CPF floor scenarios. However, for Denmark, Finland and the Netherlands there is only a limited reduction in coal-fired generation. Where Germany participates in the CPF in scenario 2, there is some

[7] https://unfccc.int/news/more-than-20-countries-launch-global-alliance-to-phase-out-coal

reduction in German coal-fired generation, but it still remains a crucial part of the generation system.

In spite of the fact that the CPF scenarios still see some coal-fired generation continuing, the results show a substantial reduction in emissions of carbon dioxide from the countries participating in the CPF. In Scenario 1, where Germany is not participating, the reduction amounts to 21% of emissions from the electricity sector in the participating countries. If Germany participates, Scenario 2, the reduction is much larger in absolute terms, though the percentage decrease is lower at 14%. The decrease in emissions is even larger where all of coal-fired plant is closed in the participating countries. In that case emissions in these countries falls by almost 30%.

However, the results also show a significant "water-bed" effect with emissions in non-participating countries rising substantially as they export more electricity generated by coal-fired plant to those countries implementing a CPF. The effect of this trade is to leave EU-wide emissions only slightly lower in Scenario 1. In Scenario 2 and the third scenario (PPCA), where all of coal-fired plant closes in participating countries, there is a reduction in EU-wide emissions. This reduction partly arises from factors such as capacity and transmission constraints, which prevent a full substitution of electricity generation from non-participating countries to participating countries.

These scenarios assume that the ETS price would remain unchanged as a result of the CPF. However, if unused permits were cancelled there would be some increase in the ETS price. In turn, this would ensure that EU-wide emissions fell, possibly by the full amount of the cancelled permits.

Table 3: Results for the EU, 2030, change compared to baseline

	Scenario 1			Scenario 2			PPCA		
	CPF Group	Non CPF Group	EU Wide	CPF Group	Non CPF Group	EU Wide	CPF Group	Non CPF Group	EU Wide
Change in Emissions (Mt)	-37.6	33.2	-4.4	-66.5	46.8	-19.8	-50.5	19.1	-31.4
Government Revenue (m€)	2093	0	2093	6084	0	6084	0	0	0
Consumers: (m€)	10824	982	11806	16753	625	17378	7195	6201	13397
Producers Net Profits (m€)	5586	1602	7188	3155	1260	4415	5120	6418	11538
Fuel, start-up and emissions costs (m€)	-2672	4986	2314	729	6175	6904	-1123	2175	1051
Trade (m€)	5816	-5605	211	6787	-6811	-24	3198	-2391	807
2030 (Relative Values) Environment: Change in Emissions/relative to REF (%)	-21%	5%	0%	-14%	11%	-2%	-29%	-7%	-6%
Consumer Prices	3.7			3.4			2.2		

In the participating countries the price of electricity for households would rise on average by between 3% and 4%, depending on whether Germany participated in the CPF. The price rise would be somewhat lower where coal is closed by regulation.

Under the first scenario, the cost of electricity bought by consumers would rise by just under €11 billion. Of this increase just over €2 billion would go to governments with electricity generators, including generators of renewable electricity, making €5.5 billion more in profits. Energy costs would fall by €2.7 billion while imports of electricity from non CPF countries would cost almost €6 billion.

To the extent that the increased profitability of renewable generators reduced the cost of the subsidy to them, the price increase for consumers would be reduced. Also, if the government returned the revenue to consumers through more general tax cuts this would offset some of the rise in prices.

The difference between scenario 1 and 2 is German participation in the CPF. In the case where they do not participate, the price of electricity for consumers would still rise by around 0.5%, with the bulk of the additional revenue going as increased profit to German coal-fired generation.

In Scenario 2, with German participation, the average rise in price for households in participating countries is 3.4%, with the increase in price in Germany being just over 2%. A much higher share of the increase in electricity costs goes as government revenue in this scenario.

Where coal is closed by regulatory action the rise in price is only 2%, but of course there is no government revenue to offset it. Also, other fossil-fuel generators benefit in the same was a renewable generators from the higher electricity price. This contrasts with the other two scenarios, where more of the benefits of the higher prices would accrue to renewable generators. In turn this would change the incentives for future investment.

7. Results: Ireland

The results for Ireland are shown in Table 4 for each of the three scenarios.

Table 4: Results for Ireland, 2030, change compared to baseline

	Scenario 1	Scenario 2	Scenario 3
Change in Emissions (Mt)	-3.9	-3.8	-3.6
Government Revenue (m€)	60	61	0
Consumers: (m€)	318	334	104
Producers Net Profits (m€)	70	84	53
Fuel, start-up and emissions costs (m€)	-129	-100	-102
Implied Trade (m€)	318	289	153
2030 (Relative Values)			
Environment: Change in Emissions/relative to REF (%)	-49%	-48%	-45%
Consumer Prices %	4.4	4.6	1.5

Under all three scenarios coal effectively closes in Ireland. In the reference scenario it is already assumed that peat-fired generation has closed by 2030. Under the three scenarios the emissions from electricity would be halved compared to the reference scenario. (In turn, because of the closure of peat, the reference scenario emissions for 2030 are well below current emissions.)

The rise in consumer prices is around 4.5% under the first two scenarios and only 1.5% in the final scenario where Moneypoint Coal-fired plant is closed by regulatory action. The revenue raised for government in the first two scenarios is around a fifth of the increase in costs for consumers. There is a limited increase in profits for generators in the first two scenarios, many of whom will be producers of renewable electricity. In the case of the PPCA, some of the limited increase in generators' profits would go to gas-fired generators. This would lessen the incentive to invest in renewable generation.

Given the nature of the support for renewable electricity in Ireland, a significant part of these higher profits would be recouped as a lower subsidy. In turn this would mean a lower public service obligation (PSO) charge for consumers. As a result, the final increase in price for households could be substantially less than shown in Table 4. In addition, if the revenue earned by the government were fed back to consumers in some other form (e.g. a cut in taxes), this would further mitigate the impact on household's finances.

For the scenarios to work best and maximise the impact on EU emissions it would be important that the ETS permits for Moneypoint should be cancelled on closure. While this would represent a lost opportunity to sell the permits, the long-term benefits for Europe from a tightening in the ETS price would be significant.

8. Conclusions

The analysis outlined in this paper and Deane, 2018, shows that a substantial reduction in Irish emissions could be achieved by the implementation of a carbon price floor strategy or the closure of Moneypoint by regulatory action. If this action is taken on a co-ordinated basis in North-Western Europe it will minimise any negative competitiveness effects from the policy action.

In any event the effects on consumer prices would be strictly limited – a cumulative rise of 4.5% in Ireland over the period to 2030 or an average of around 3.5% across those countries participating. This would represent a smaller addition to consumer prices than that imposed over the last year in Ireland by the Public Service Obligation. In addition, under the CPF scenarios, the government would receive some additional revenue which could be used to offset the marginal increase in prices for those least able to carry them.

Because of the increased profitability of renewable generators, the need for a subsidy, financed out of the PSO, would be substantially reduced or even eliminated. This saving could offset much of the increase in prices for households.

While the price increase under a regulatory closure of coal looks to be lower that for the CPF, this result needs further analysis. Under this scenario gas-fired generators would receive a bigger share of the increased profits of generators while the renewables generators would, as a result, receive a smaller share. This would send out the wrong signal for future investment. It would also mean that the reduction in the PSO needed to fund renewables could be significantly lower.

When these factors are combined it could turn out that the long-term cost for consumers of the CPF scenarios would be lower than for the PPCA scenario.

Further work is needed to understand: how the implementation of a CPF would incentivise investment in new generation; the impact of a CPF on the cost of support for renewables; the impact of cancellation of unused permits in CPF countries on the price of permits; on the effect of the PPCA scenario on the profits of renewable and fossil-fuel generators; simulate a slightly higher CPF price (or lower gas price) such that coal closes in all participating countries.

In the light of the evidence presented in this paper, the Council has recommended that Ireland support the introduction of a carbon price floor by as many countries as possible in Europe. The wider the coverage of the CPF the smaller will be the competiveness effect, and the bigger the incentive to develop newer and better renewable generation. The cost of joining a coalition to introduce a CPF would be relatively small, especially spread over the period to 2030. It would provide direct support for the further development and deployment of renewable electricity while, at the same time, reducing the subsidy to such generators.

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[i] Climate Change Advisory Council (2017), *Periodic Review Report*, Dublin, [online] http://www.climatecouncil.ie/media/CCAC_PERIODICREVIEWREPORT2017_Final.pdf [accessed 14 June 2018].

[ii] Climate Change Advisory Council (2016), *First Report 2016* [online] *http://www.climatecouncil.ie/media/CCAC_FIRSTREPORT.pdf* [accessed: 25 November 2017]; see also *www.climatecouncil.ie*