

# The Impact of a Carbon Tax on Cross-Border Electricity Trading

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Market coupling ensures the efficient use of interconnectors so that the higher-price market always imports electricity from the lower-price market. Introducing a carbon tax in one of the connected markets distorts trade if the increased cost of electricity on one side of the interconnector changes flows, resulting in deadweight losses. In all cases, carbon taxes transfer revenue abroad at a cost to the domestic economy.

This paper investigates the impact of the British Carbon Price Support (CPS, an additional carbon tax on generation fuel) on cross-border trading of electricity, both theoretically and empirically. We provide a social cost-benefit framework showing how a unilateral carbon tax distorts cross-border trade. Empirically, taking the GB CPS as a case study, we use econometrics to estimate the influence of the CPS and interconnector capacity on the price differentials between GB and its Continental neighbours, France through IFA and the Netherlands through BritNed. The econometrics identifies the price differentials without the CPS, allowing a counterfactual estimate of interconnector flows without the CPS. A comparison of the observed flows and prices (with the CPS) with this counterfactual (without the CPS) provides a quantitative estimate of the impact of the British CPS on net imports, congestion income (the flow over the interconnector times the price differential), deadweight loss, and the amount of British carbon tax passed through to the cross-border market for both interconnectors.

## Results

Over the three electric years (1 April-31 March) 2015-2018, the CPS was set at £18/tonne CO<sub>2</sub> (on top of an EUA price that rose from less than £5/t CO<sub>2</sub> in 2013 to nearly £20/t CO<sub>2</sub> at the end of 2018 after the introduction of the EU Market Stability Reserve). About 60% of the carbon tax was immediately passed through to the GB day-ahead market (DAM) price, but allowing for lagged responses of market traders to the effect of the CPS, we cannot reject the hypothesis that 100% of the CPS was passed through in higher prices, consistent with a competitive GB wholesale market.

In the presence of market power we might expect prices to be marked up on marginal costs, and there is some (weak) evidence that the CPS was marked up above 100%. When considering major policy changes such as the introducing a CPS, the long-run impact is the relevant measure. Over 2015-2018 the CPS would have raised the GB day-ahead price by an average of about €10/MWh in the absence of compensating adjustments through increased imports. However, the higher GB prices increased imports (by 8.9 TWh/yr from France and 3.6 TWh/yr from the Netherlands, or in total by nearly 13 TWh/yr) and this displaced some now higher cost GB electricity. The final impact of the CPS was to raise the price differential with the Continent in the day-ahead market (DAM) by about €8/MWh.

Increased GB imports raised wholesale prices in France and the Netherlands, as about 18% of the increase in the GB DAM price was passed through to the French price and 29% to the Dutch price. The CPS increased IFA congestion income by €81 million/yr and BritNed congestion income by €52 million/yr, in total €133 million/yr, half of which accrues to the foreign co-owners. The deadweight loss due to CPS was €18.5 million/yr for IFA and €9.4 million/yr for BritNed, or €28 million/yr in total.

The results confirm that the British CPS raised the GB day-ahead market (DAM) price, reduced the convergence of cross-border electricity prices and increased GB imports of electricity. While the increase in congestion income (mostly) comes from the GB electricity consumers, half is retained as profits of National Grid Ventures as a co-owner of both interconnectors, but half is transferred to the Continental co-owners. This increased congestion income could over-incentivise investment in additional interconnectors, at least to fossil-based systems lacking a comparable carbon tax. The objective of the British CPS is to reduce British CO<sub>2</sub> emissions and incentivise low-carbon investment, which may be partly offset by increased imports of more carbon-intensive electricity. Finally, asymmetric carbon prices in two connected countries incur deadweight losses, resulting in less efficient cross-border trading.

Despite the fact that the CPS has distorted the cross-border electricity trading, it has significantly reduced GB GHG emissions from electricity generation. From 2015 to 2018, the share of GB coal-fired generation fell from 41% to 7%. On 21 April 2017, GB generation achieved the first ever coal-free day. When the UK introduced the CPF, the hope was that other EU countries would follow suit to correct the failures of the Emissions Trading System, at least in the electricity sector. The case for such an EU-wide carbon price floor is further strengthened by the desirability of correcting trade distortions.