Analysis of the CO2 power emission factor for indirect compensation related to the EU ETS

Executive summary

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Executive summary

Context and objectives

- **The Guidelines of the EU Emissions Trading Scheme (EU ETS), established by the European Commission (EC) in 2012, allow Member States to compensate some electro-intensive parties for part of higher electricity costs (indirect costs) related to the introduction of a carbon price. The aim of such compensation is to avoid carbon leakage.**
- **The compensation level is based on an emission factor (tCO2/MWh) that estimates the increase in power prices associated with an increase in carbon prices.**
- **The future of the compensation mechanism in the context of the revised EU-ETS scheme (phase IV: 2021-2030) is yet to be determined and the CO2 emission factor could be revised by the European Commission.**
- **In this context, Compass Lexecon was mandated by UNIDEN to perform an independent analysis of the emission factor evolution. This report describes the analysis conducted:**
  - Review of the different possible approaches for emission factor calculation as well as the relevant geographic market for France;
  - Empirical analysis of the past level of the CO2 emission factor (2013-18); and
  - Prospective analysis of the future level of the CO2 emission factor (2019-25).
- **The temporal scope of the analysis is voluntary restrained to 2019-25 as beyond this period there are many uncertainties regarding the evolution of European power markets that make it difficult to project the evolution of the emission factor.**

The two possible approaches for estimating the emission factor

The counterfactual analysis

- The indirect costs paid by the industrials are directly linked to the increase of power prices related to the implementation of the ETS market. We define the **counterfactual analysis** as the methodology deriving the impact on the power price of a 1€/tCO2 increase in the carbon price.

- To perform this analysis, we use our dispatch model that replicates the day-ahead power markets across Europe*. We run two scenarios :
  - A real scenario with the ETS market (with carbon price); and
  - A counterfactual scenario without the ETS market and so without carbon price.

- The emission factor (t/MWh) is determined as follows :

$$\frac{(Power\ price_{\ Real}\ -Power\ price_{\ Counterfactual})}{Carbon\ price}$$

- This factor represents the increase in power prices in €/MWh that will result from a 1€/tCO2 rise in carbon prices.

* Our power price model is presented in annexe.

The existing method

- The Guidelines 2012 set the **existing method** to calculate the emission factor as follows:

$$\frac{Emissions\ from\ the\ energy\ industry}{Gross\ thermal\ generation}$$

- The reasons for using this simplified method are presented in the EC impact assessment (2012):
  - No EU wide electricity market model was available in 2012 to run a counterfactual scenario ; and
  - The existing approach tends to replicate a counterfactual analysis by focusing only on the thermal generation (mostly the marginal units in power markets).
- The 2012 Guidelines pooled countries per zone based on the electricity market integration**. The relevant geographical area for assessing the French coefficient is the CWE zone** (Central-West Europe : Austria, Belgium, Luxembourg, France, Germany and Netherlands) **and the emission factor is currently set at 0.76 tCO2/MWh.**
- The existing method does not mention the reference year used for the determination of the current emission factor. Historical data shows that the year 2005 might have been used especially for the CWE zone.

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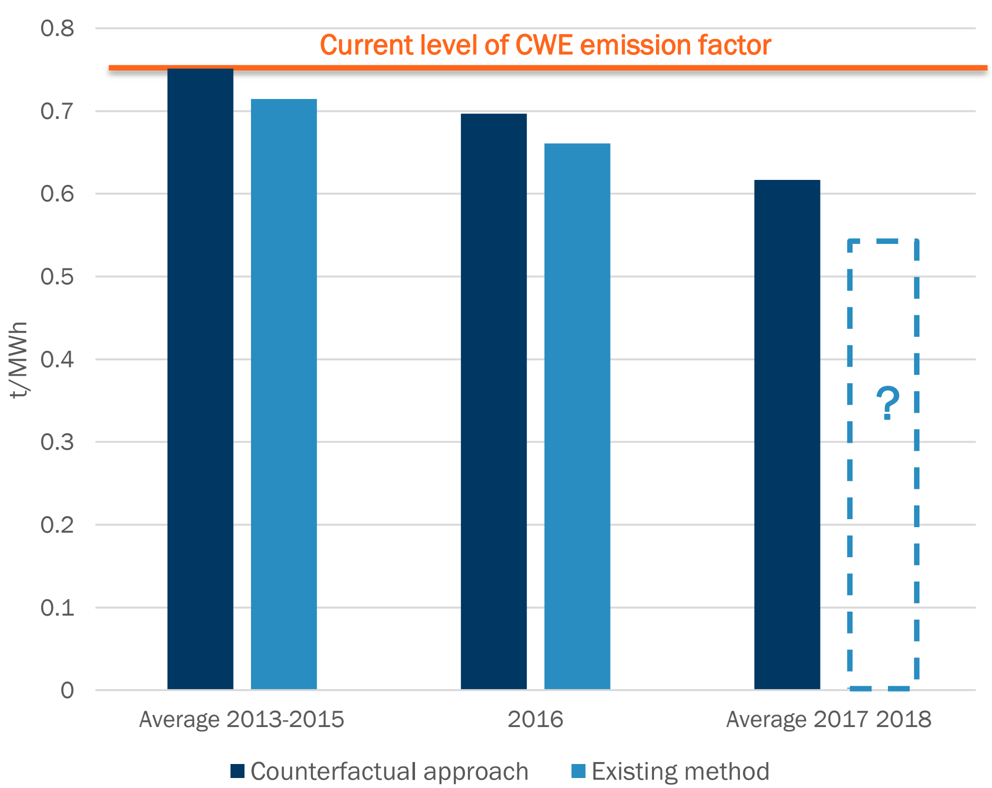
Comparison of the two approaches over the period 2013-2018: existing proxy versus counterfactual approach

Emission coefficients in the CWE region



Source: FTI-CL Energy modelling results, FTI-CL Energy analysis based on Eurostat data

Notes: Historical data for years 2017-2018 was not available on Eurostat website when this analysis was released.In the counterfactual approach, the CWE coefficient is calculated as a simple average of national coefficients.

- To perform a comparison of the two approaches:
  - We run a **counterfactual analysis** with our dispatch model; and
  - We use historical verified data to assess the emission factors with the **existing method**
- Our analysis shows that :
  - **The counterfactual approach gives an emission factor at 0.75t/MWh, aligned with the EC's existing coefficient (0.76) for the period 2013-15.**
  - **The existing method results in lower coefficients compared to the counterfactual approach for the CWE zone**. The countries with significant gas generation have a lower emission coefficient with the existing method / a higher coefficient with the counterfactual approach as their power prices are often set by neighbouring markets with coal capacity*.
  - **With the counterfactual approach, the coefficient decreases after 2016**. However, this estimate cannot be compared with the existing method as verified data was not published when this report was released.
  - **Despite these small differences, the two methods therefore show similar results.**

*Notes: *the emission factor varies from around 0.4t/MWh for gas assets to more than 1t/MWh for lignite plants .*

The counterfactual approach shows a consistent level of the emission factor with EC's existing coefficient (0.76). Despite small differences, the existing method is consistent with the counterfactual analysis over the period 2013-2016.

To validate the previous results, we replicate the dynamics of spot & forward electricity prices using econometric models

- **We validate the coefficients presented previously with two econometric models :**
  - One model replicates spot power prices over the period 2015-2018; and
  - One model focuses on the forward prices and provides a coefficient for each period defined by structural breaks in electricity and carbon markets.

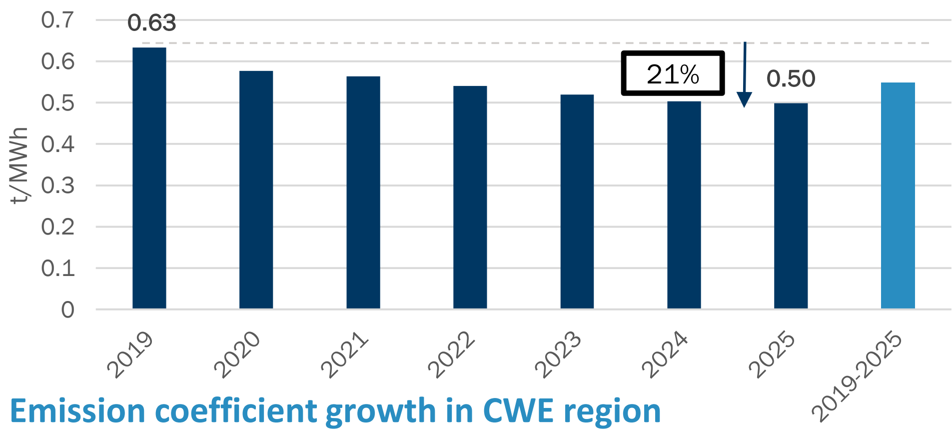
- **Our work on the econometric model focussing on spot prices suggests that :**
  - The specificities of French power spot market need to be taken into account in the regression, therefore we use residual load as a control factor;
  - The results indicates a coefficient at 0.591t/MWh for the period 2015-18. This coefficient ranges between 0.45 and 0.73t/MWh at 95% confidence level.

- **Our analysis on the econometric model focussing on forward prices shows that :**
  - The period 2011-18 can be split into seven sub-periods with identified structural breaks;
  - The regression provides one coefficient for each structural break: emissions factors vary between 0.53 and 1.23 depending on the period considered;
  - For the year 2018, the regression provides 0.76 as emission factor. In periods characterised by a strong increase in carbon prices, the econometric model leads to similar results to the other two approaches. This outcome is particularly interesting because these periods result in high compensation levels from the Member States to the industrials.

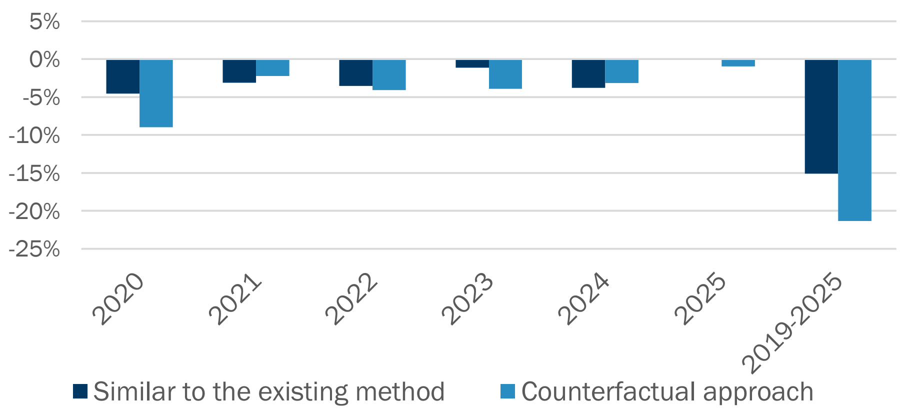
Both econometric models confirm that the results from previous approaches (existing and counterfactual) are aligned with historical trends, especially during periods with growing carbon prices.

Projected evolution of emission factors over the period 2019-25

Emission coefficients in CWE region – Counterfactual analysis



Emission coefficient growth in CWE region



Source: FTI-CL Energy modelling results

Notes: In the counterfactual approach, the CWE coefficient is calculated as a simple average of national coefficients.

- **We use our dispatch model under the base case scenario to assess the evolution of the emission factor until 2025 in CWE.** Our assumptions for the base case scenario are based on recognized third parties such as IEA, ENTSOE, RTE.
- As it is complicated to project the verified data used in the existing method (cogeneration, net to gross ratio for thermal units, total emissions…), **we elaborate a simplified version of the existing method to be able to perform a comparison of the future coefficients**. This proxy is based on the net generations and emissions from the thermal units in the CWE zone from our power model.
- The results show that :
  - **With both methods, the coefficient is expected to decrease over the period 2019-2025; and**
  - **The counterfactual analysis shows the most important decrease of the emission factor (21%) from 0.63t/MWh in 2019 to 0.50t/MWh in 2025, driven by coal closures partially replaced by less emitting technologies.**
- Sensitivities around the base case scenario lead to factors in the range 0.48-0.52 for the year 2025, showing that the base case results are robust.

The counterfactual analysis indicates an emission factor at 0.63t/MWh for year 2019. Both approaches project a decrease in the CWE emission factors. The counterfactual coefficient is projected to reduce to 0.50t/MWh in 2025.

Conclusions

- **The EC impact assessment (2012) and Guidelines (2012/C 158/04) explain the choice of the existing method for deriving the emission factor:**
  - No EU wide power market model was available to run a counterfactual analysis; and
  - The aim of the simplified method was to replicate a counterfactual analysis.

- **The results of our empirical analysis of historical emission factors indicate:**
  - An emission factor around 0.75t/MWh for the CWE region in 2013-15 with the counterfactual method. This result is consistent with the historical emission factor used by the EC over the period 2013-2015.
  - Similar levels for the emission factors within the CWE zone confirming that CWE is the relevant geographic scope for France.
  - When comparing the existing and counterfactual approaches, we find that the two methods show consistent results.
  - The counterfactual analysis tends to provide higher coefficients in the short term but is also more sensitive to power market changes.

- **Our projections of the emission factor rely on a set of recognised third party assumptions for the evolution of the power sector and suggest the following:**
  - The counterfactual analysis indicates that the emission coefficient will vary in the range [0.48;0.63]t/MWh over the period 2019-25 as a result of the changes in the generation mix.
  - Both approaches lead to similar decrease in the emission factor over the next years.

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