Triggering decarbonisation in the industry: Analysing the sectoral interactions within the EU ETS and the role of the MSR

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Overview

The implementation of the objectives agreed in the Paris Climate Agreement and particularly, achieving the EU emission targets requires simultaneous decarbonisation of the industry, electricity and heating sectors. Given the structure of the EU ETS, informing the interplay among its sectors is of paramount importance to assess the temporal and spatial impacts of any potential policy at the national- (e.g., the coal phase-out), sectoral- (e.g. a carbon tax for the electricity sector), or the EU-level (e.g., a reform to the EU ETS). In this paper we focus on analysing the interaction between the electricity and the industry sectors, more precisely on how these either complement or stress each other, and the role played by the market stability reserve (MSR).

The three sectors compete for certificates within the EU ETS (in 2015 EU ETS verified emissions were split as follows: electricity, 52%; industry, 32%, heating, 12%, and other combustion activities 4%). Furthermore, their emissions are deeply intertwined because of the potential electrification of the heating and industry sectors. The need to decarbonise the industry is illustrated by the fact that its current emissions (2017) account for more than 140% of the 2050-cap if emissions are to be reduced by 80%, and by more than 560% if emissions are to be reduced by 95%. As the certificates surplus (currently ~1.7 GtCO2) might threaten reaching the targets and prevent carbon price to rise (Cullenward and Coghlan, 2016), the EU ETS has implemented the MSR[1].

While the work analysing the effect of national- and EU-wide policies on the electricity sector (e.g., Osorio et al., 2018) is broad, the main research focus regarding mitigation in industries has been on how the EU ETS affects their competitiveness and the potential resulting carbon leakage. Although most of these studies estimate the potential abatement under certain carbon prices (e.g., Thema et al., 2013), there is little attention to the interaction among sectors and it is thus unclear if the required prices will be reached within the EU ETS.

In this paper we assess to what extent the industry can be decarbonised, which ultimately relates to the policy relevant question of at which price mitigation will happen in the industry in the presence of a common cap-and-trade system (the EU ETS). We use the Long-term Investment Model for the Electricity Sector of Europe (LIMES), in which we include the industry demand for certificates through the implementation of a marginal abatement cost curve (MACC).

Methods

We use LIMES, a partial equilibrium model that computes electricity dispatch and calculates generation and transmission capacity expansion on 5-year steps from 2010 to 2050 for each country in Europe. It considers technical constraints as well as EU-wide and selected national (Germany) climate and energy policies[2]. Through an iterative process, we simulate the MSR. The industry covered by the EU ETS is modelled through a MACC. This is derived from a study by the Federation of German Industries (BDI) (Gerbert et al., 2018) and upscaled to the entire EU ETS based on current national energy use and emission intensity. The total abatement potential for the industry is estimated at 701 $MtCO_2$ in 2050 (i.e., the baseline emissions), with costs ranging between 0 and 650 €/tCO_2. We run four scenarios: two default scenarios (with and without MSR), and two assuming a renewables target of 70% for the EU ETS in 2030 (in default scenarios renewables share equals to ~65%) to test the impact of decarbonising the electricity sector on the industry (with and without MSR + 70% RES).

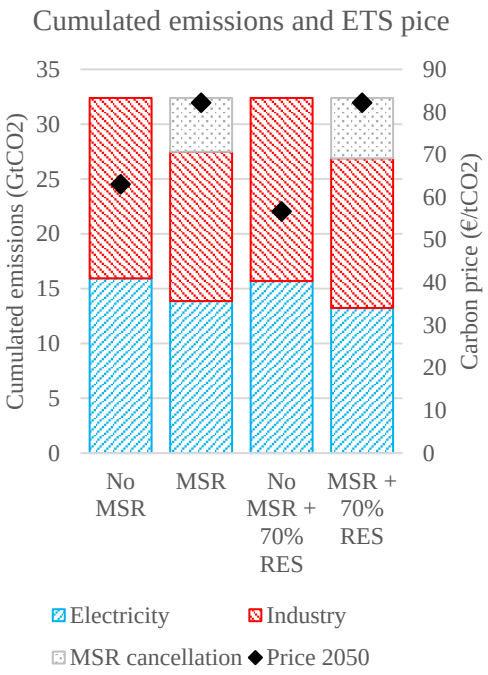
Results

Our results show that certificates are transferred to the MSR from 2019 to 2042, the largest portion occurring before 2030 (75% of all certificates sent to the MSR). From the total intake (6.6 $GtCO_2$), only 0.1 $GtCO_2$ (2%) are taken back to the market around 2050 via certificates auction. This is explained by the fact that the prolonged

[1] The recent revision establishes banking thresholds to determine the amount of certificates to be withheld from (intake of the MSR) or to be backloaded to (outtake of the MSR) the market. The MSR will start operating in 2019 and about 1.6 GtCO2 will be transferred directly to the MSR before 2020. On top, from 2023 on the number of allowances in the MSR exceeding the number of allowances auctioned the previous year will be cancelled.

[2] A more detailed description of the model can be found in https://www.pik-potsdam.de/research/sustainable-solutions/models/limes.

intake increases cancellation and reduces certificates to be auctioned, and when the surplus level (in later years) is low enough to trigger outtake from the MSR (bank lower than 400 $MtCO_2$), the low level in the MSR only allows little outtake. Therefore, 6.5 $GtCO_2$ are cancelled in total from the MSR until 2052 (i.e., 17% of all certificates available), 4.2 $GtCO_2$ of which before 2030. Such cancellation triggers EUA prices up: these are 30% higher than without MSR. At the sectoral level, emissions in the electricity and industry sectors are respectively 2.1 $GtCO_2$ and 2.8 $GtCO_2$ lower than without MSR (recall that 1.6 $GtCO_2$ that are cancelled by the MSR, are not currently in the market).



Our results are nonetheless very dependent on the surplus during until 2030, where most intake and thus cancellation occur. We evaluate the effect of a higher share of RES (70%) in 2030. Our results show that cancellation increases 9%, due to the higher certificate surplus resulting from displacing fossil-based generation. EUA prices nonetheless remain unchanged because, although there are less certificates available, the demand for certificates from the electricity sector decreases. Consequently, the higher cancellation barely affects emission abatement from industry (<1%), i.e., the entire increase in cancellation is being abated by the electricity sector. However, when there is no MSR, the abatement in industry does decrease by 4%.

To test the robustness of our results, we perform a sensitivity analysis on the share of heating within the EU ETS (affecting the supply of certificates) and the abatement costs for industry (affecting the demand for certificates), and compare these results with the default MSR scenario. When the share of heating doubles by 2050 (1.9 $GtCO_2$ certificates less available), cancellation decreases by 0.2 $GtCO_2$ (5%), but still EUA prices are 8% higher. As a consequence, industry abatement increases 1 $GtCO_2$ (10%), this accounting for the 55% of the total abatement increase. When marginal abatement costs for industry are 20% higher, cancellation decreases by 0.3 $GtCO_2$ because of the higher demand from industry, and EUA prices are 6% higher. Still, industry abatement decreases by 0.9 $GtCO_2$ (10%), and thus the electricity sector is obliged to decarbonise further (0.6 $GtCO_2$, i.e., 4%).

Conclusion

The current industry emission levels are considerably higher than the expected level of emissions in 2050. Our results show that the MSR increases EUA prices, and thus decarbonisation in the industry, whose abatement is indeed larger than that in the electricity sector. When the electricity sector is further decarbonised, cancellation of certificates is absorbed mainly by this sector, instead of affecting the industry. However, the MSR keeps prices up, preventing an increase of industry emissions due to lower demand of certificates from the electricity sector. Our results are robust to changes in abatement costs and in the share of the heating-related emissions.

The MSR plays thus a key role in enhancing the decarbonisation of the sectors covered by the EU ETS. The risk of waterbed effect has been in the centre of debate regarding enhancing national policies, as the additional efforts from some countries might be offset. Our results show that the MSR is able to prevent inter-sectoral waterbed effect, i.e., the MSR provides the tools to the sectors (and ultimately to the countries) that are willing to do more, to make sure their efforts are not offset. This has important implications for national and sectoral policies, as the risk of waterbed effect within the EU ETS due to differentiated taxation is decreased by the MSR.

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