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Corrigendum

# Corrigendum to “Long-term model-based projections of energy use and $CO_2$ emissions from the global steel and cement industries” [Resour. Conserv. Recycl. 112 (2016) 15–36]

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The authors regret that, as a reader informed us, the presented historic data for steel production from scrap did not match the available data sources for the USA and Western Europe. A close inspection of the model code revealed that for the historic period 1971–2010, the market share for scrap was erroneously allocated twice (once forced by the scrap availability and a second time as part of the historic data on production shares). As a result, our model indicated a too high production share of steel from scrap in the year 2010, which also influenced the results for 2020 due to slow turnover of the production stock. The results for 2050 were not influenced by this error because there is a full capital stock turnover between 2010 and 2050. Since this error only influenced the market allocation of steel production technologies, and not the total level of steel production, correcting this error only lead to minor changes in the composition of final energy use and $CO_2$ emissions. The regions with the largest adjustments are those with high shares of steel recycling, such as Western Europe and the USA.

We have corrected this error, reran all scenarios with the updated model, and present below a corrected version of the text and figures that were influenced by this error.

The main changes are related to Section 4.1.1 in the original paper. Instead of electric arc furnace (EAF) accounting for 75% and 66% of steel production in 2010 in respectively the USA and Western Europe, this now only represents around 50% and 42%. Future projections for EAF to account for 60% and 50% by 2050 are similar, but indicate an increase of scrap share rather than a decrease (as mentioned in the original paper). For India and China the share of EAF in total steel production now increases respectively from 10% to 30% and 10% to 50% between 2010 and 2050 (originally the 2010 values were 13% and 18%, respectively). Globally, the share of scrap-EAF increases from 23% in 2010 to over 40% by 2050 (instead of remaining stable around 40% in the entire period).

There are only minor changes in the results for energy intensity per tonne steel, carbon intensity per tonne steel and final energy for steel production. These changes do not influence any trends and numbers discussed in the text, but we have included the updated figures in this addendum.

The emissions of carbon dioxide ($CO_2$) from steel production have changed slightly as result of correcting the error with scrap EAF. Global $CO_2$ emissions are now 3215 megatonnes (Mt) $CO_2$ per year (yr) in 2010 (was 3250 $MtCO_2$/yr) and 3525 $MtCO_2$/yr by 2020 (was 3350 $MtCO_2$/yr) but remain around 2500 $MtCO_2$/yr in 2050. Emissions in the USA and Western Europe are still decreasing from 110 Mt (was 150 Mt) to around 100 $MtCO_2$/yr by 2050 and from 170 Mt (was 180 Mt)[1] to around 140 $MtCO_2$/yr, respectively. Chinese emissions still peak and decline, but start from a higher level at present-day and near future. Steel production emissions in China are now 1940 (was 1660 Mt) $MtCO_2$/yr in 2010 and develop to 2030 $MtCO_2$/yr (was 1920) in 2020 and 700 $MtCO_2$/yr in 2050. Changes for India are negligible. Only its 2010 emissions increased to 185 (was 160 Mt) $MtCO_2$/yr.

Below are the revised figures that were influenced by correcting the error. Figure numbers refer to those in the original paper.

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[1] The original text contained a typo for European $CO_2$ emissions in 2010, it stated 300 Mt instead of 180 Mt.

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Apart from this discussed error in the model, we found one typo in the paper. In Table 4, the Specific Energy Consumption (SEC) in 2010 (GJ/tonne) for Coal BF + BOF should be 25.5 and not 20.4. This was correct in the model itself, but a typo in the paper.

The authors would like to apologise for any inconvenience caused.

Fig. 1 Production of steel, globally and in four major world regions under different carbon tax scenarios with and without the availability of CCS technologies.

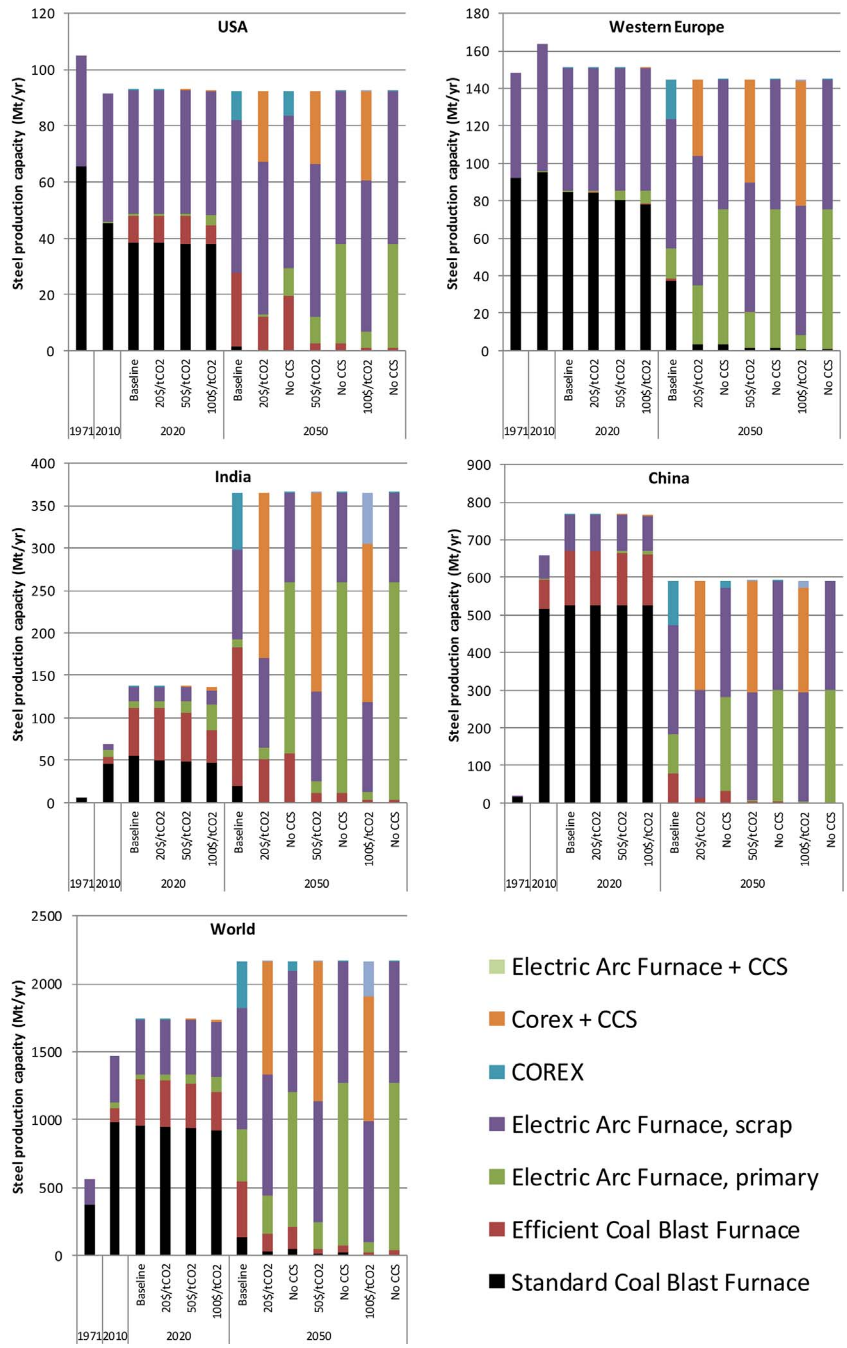

Fig. 2 Final energy use for steel production in four major world regions under different carbon tax scenarios

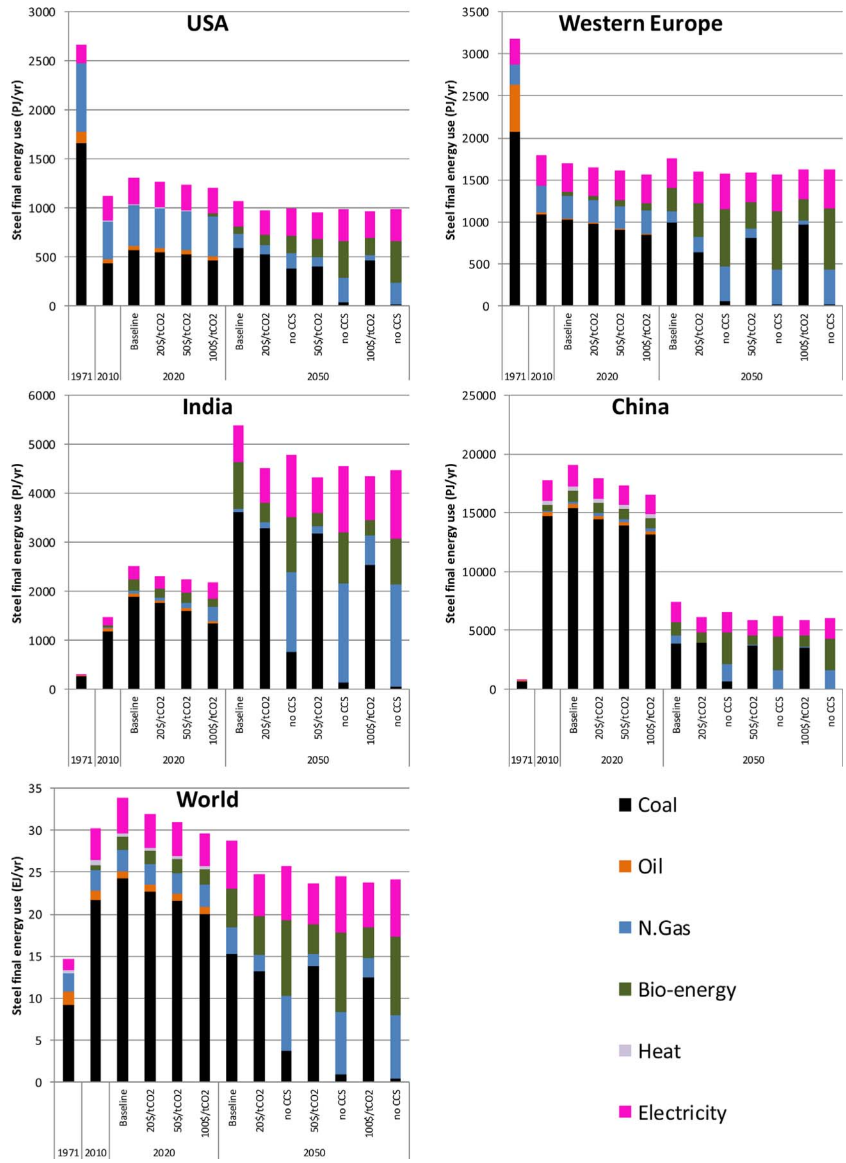

Fig. 3 $CO_2$ emissions from steel and cement production energy use, and cement process emissions under different carbon tax scenarios.

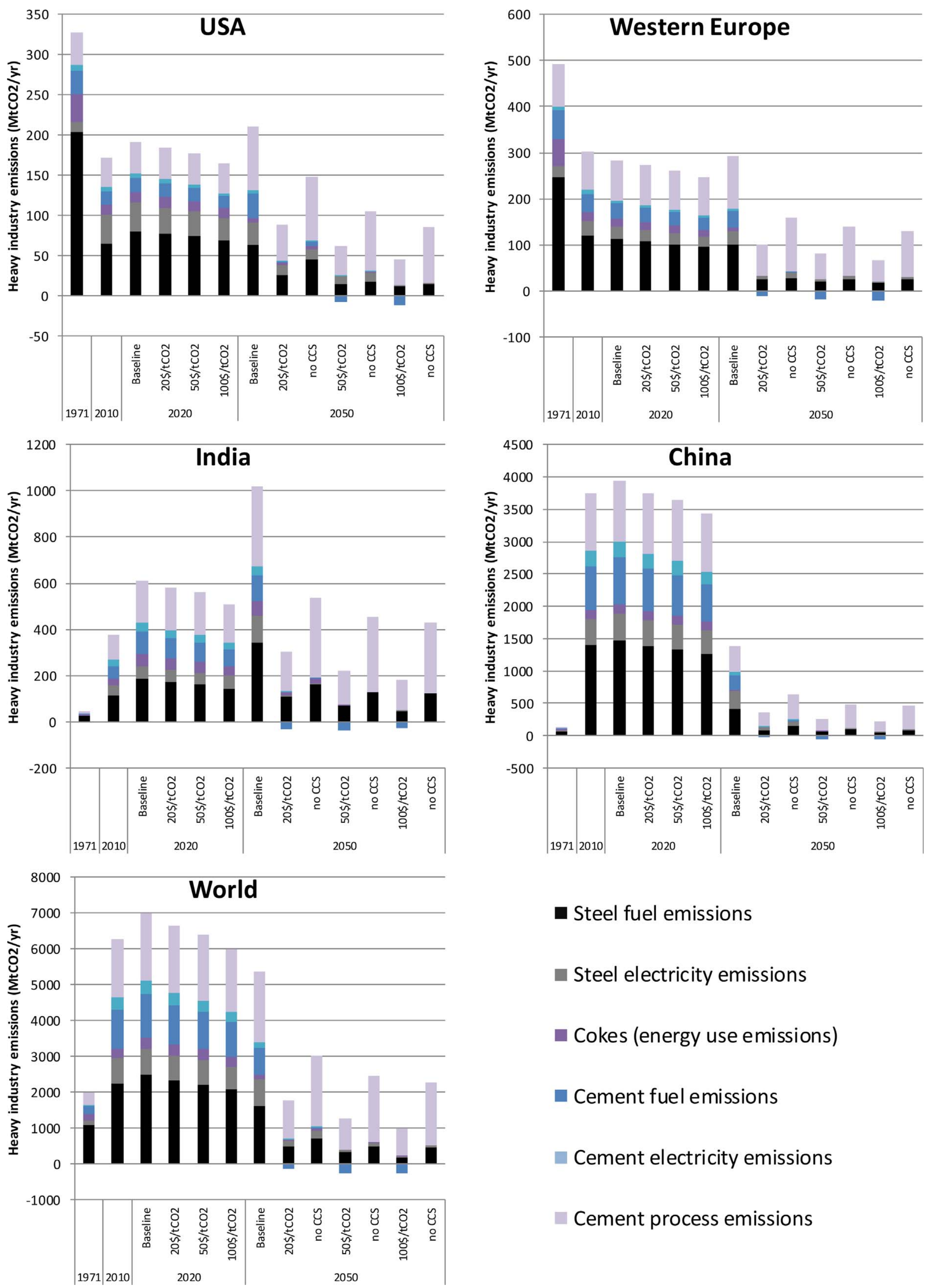

Fig. 4 Development of energy intensity and carbon intensity per tonne steel produced in several world regions in 2010, 2020 and 2050 at carbon tax levels of 100 \$/tCO2 + 4%pa with and without CCS available. We only show the high carbon tax scenario to avoid too many overlapping lines and indicate the maximum range of change in our model.

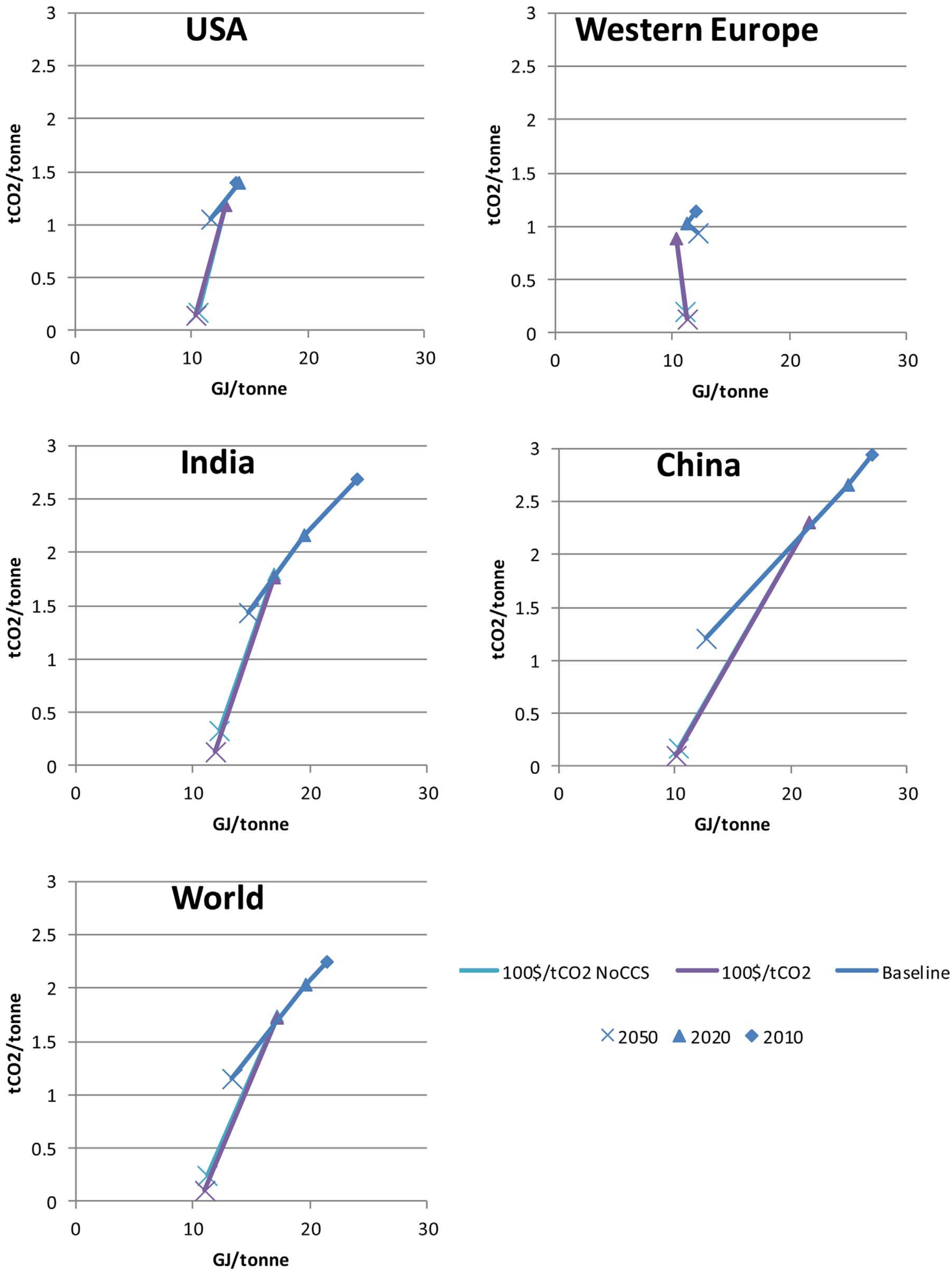

Fig. 5 Comparison of global steel production, final energy use and $CO_2$ emissions for this study and major other studies in literature.