Supplementary Information

Coal-to-Gas Bridge Incompatible with Paris Agreement Goals

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1. Regional Model of Investment and Development (REMIND) Integrated Assessment Model

The scenarios in the paper are generated using the multi-regional integrated assessment model REMIND v1.7 [1,2]. REMIND represents the European Union (including the United Kingdom), four individual countries (China, India, Japan and the United States of America), and seven aggregate regions (CAZ – Canada, Australia, New Zealand; LAM – Latin America; MEA – Middle East and Africa; NEU – Non-EU Europe; OAS – Other Asia, REF – Russia and other reforming economies; SSA – Sub-Saharan Africa).

Each region is modelled as a hybrid energy-economy system and is able to interact with the other regions by means of trade. Tradeable goods are the exhaustible primary energy carriers, coal, oil, gas and uranium, and emission permits. The economy is modelled by a Ramsey-type growth model which maximized utility, a function of consumption. Labor, capital and end-use energy generate the macroeconomic output, i.e., GDP. The energy sector is described with high technological detail. It uses exhaustible and renewable primary energy carriers and converts them to final energy as electricity, heat and fuels. REMIND is solved for the 2005 – 2150 timespan to avoid end-effects but results are interpreted only until 2100. Emission factors for CO_2, CH_4, N_2O, SO_2, black carbon, organic carbon, CO, NOx and VOC are assigned on a technology level to calculate emissions arising from the energy system.

2. Effect of near-term policy (carbon prices) on natural gas generation in 2030

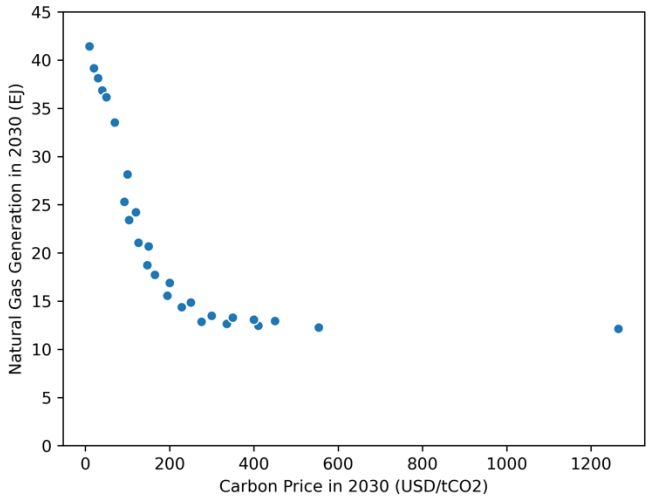

Figure SI1: *Effect of carbon price in 2030 on natural gas generation in 2030*

In this section we present the effect of near-term policy (represented by the carbon prices in 2030) on natural gas generation in 2030. To achieve a temperature target of 1.5°C with low overshoot the minimum carbon price in our scenario set is 250 USD/tCO_2. A key observation we can make from this additional figure is that beyond a carbon price of 300 USD/tCO_2, each additional unit of increase does not have a significant effect on the level of natural gas generation.

3. Harmonized Emission Trajectories

In this paper we harmonize the emissions to the historic emissions from the SSP database[3] using an automated harmonization routine, aneris[4]. We first infill missing gas species using the corresponding trajectories from RCP2.6, and then allow aneris to select the appropriate harmonization routine based on an algorithmic selection. A detailed overview of the algorithm and decision tree implementation can be found at: https://aneris.readthedocs.io/en/latest/. In *Figure SI2* we demonstrate the effect of harmonization for one of the scenarios underlying this study.

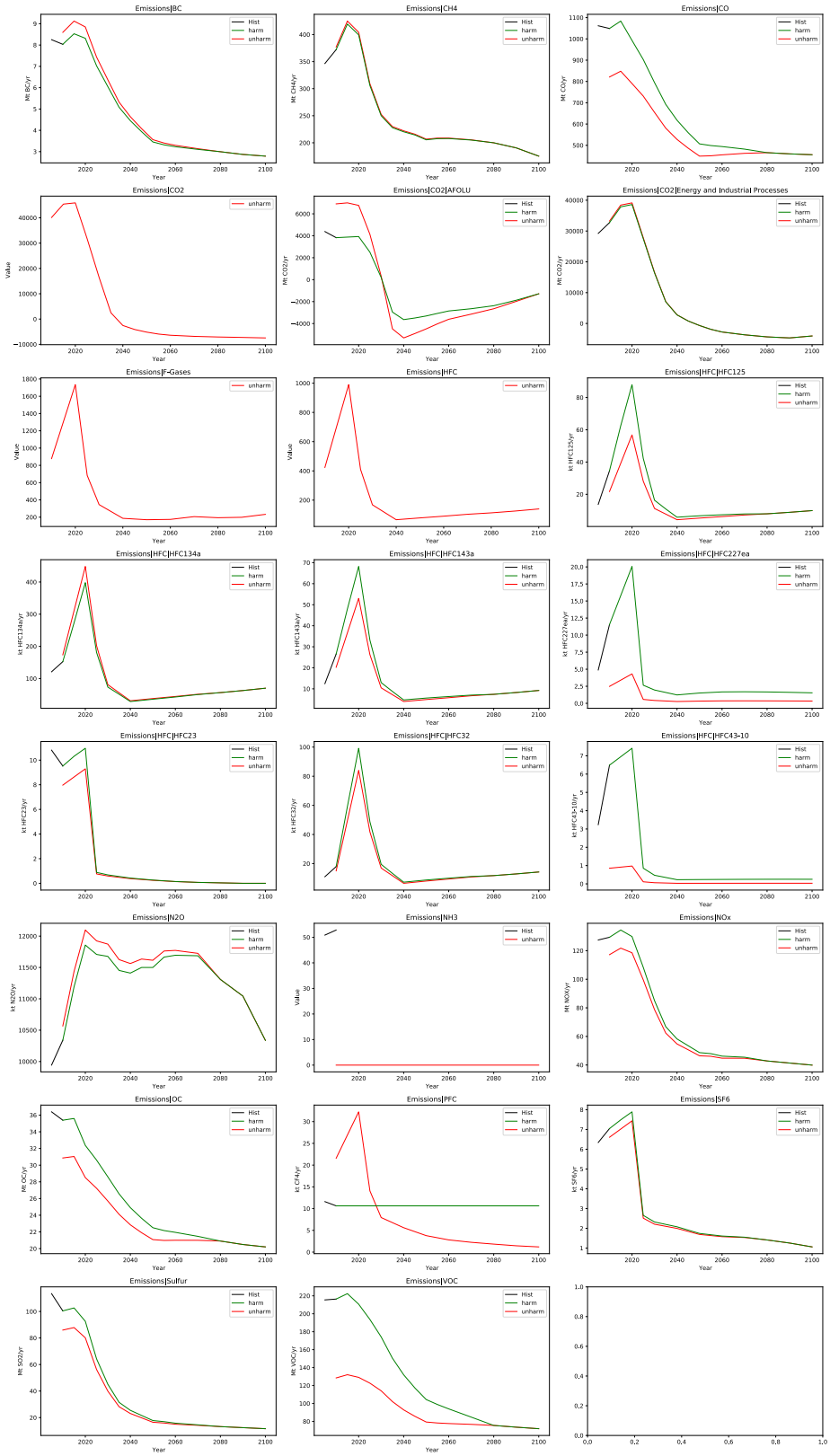

Figure SI2: *Example of harmonized trajectories for one of the scenarios underlying this study.*

References

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