Carbon2Chem®

The Carbon2Chem® Communities

Regulatory Framework Renewable Fuels from SMG and Flue Gases

Carbon2Chem® Regulatory Framework represented by
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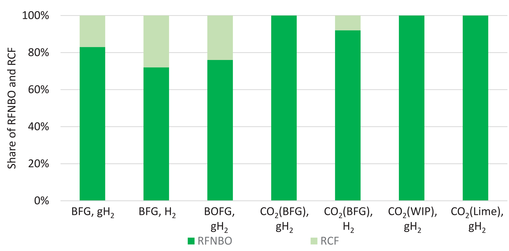
The production of renewable fuels (e. g. methanol) must be in line with the EU's regulatory framework [RED II and the relevant Delegated Acts to Article 25(2), 28(5) and 27(3)] for the use of renewable energy in the transport sector. The utilization of steel mill gases (SMG) and alternative CO_2 sources (waste incineration plant, lime industry) to produce RFNBOs and RCFs present attractive options as a high share of RFNBOs can be achieved while slashing greenhouse (GHG) emissions ≥70% compared to fossil fuels.

Production of RFNBOs and RCFs from SMG and flue gases

RFNBO are defined as fuels whose energy content is derived from renewable sources, such as green H_2. RCFs are defined as fuels that are produced from waste processing gases and flue gases of non-renewable origin.

Within Carbon2Chem®, process gases such as SMG and CO_2 from exhaust gases - both are potential sources for RCFs - are converted to methanol using green H_2 (the simplest RFNBO). The share of RFNBOs in the output fuel is determined by dividing the relevant renewable energy input (mainly green H_2) into the process by the total relevant energy input into the process. The share of RCFs is determined by dividing the relevant energy input qualifying as a source to produce RCFs (mainly CO from BFG or BOFG and/or H_2 from COG) into the process by the total relevant energy input into the process. The results show that the production of methanol by means of various Carbon2Chem® processes leads to a mix of RFNBOs and RCFs and mainly to the preferred production of RFNBOs. A higher share of fossil feedstocks (CO from BFG or BOFG, H_2 from COG) results in a higher share of RCFs.

Carbon2Chem® methanol production: Share of RFNBO and RCF



Green H_2 (gH_2) is used as the H_2 source for all process concepts except BFG, H_2 and CO_2(BFG), H_2. BFG, H_2 and CO_2(BFG), H_2 were calculated assuming a share of 80% gH_2 and 20% H_2 from COG (availability of H_2 from COG for Carbon2Chem®) to show the influence of different H_2 sources.

GHG savings in the production of RFNBOs/RCFs from SMG and flue gases with green H_2

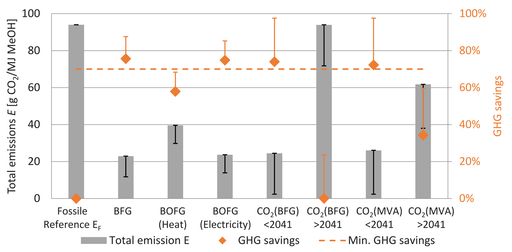
Given the need to substantially reduce GHG emissions in the transport sector, a minimum GHG emission saving threshold of 70% is required for all types of RFNBO and RCF compared to fossil fuels before they can be recognized as being either an RFNBO or RCF by the EU. The Delegated Act to Article 25(2), 28(5) RED II determines the total emissions E from the use of RFNBOs and RCFs as well as the GHG savings using the following two formulas:

$$GHG\ Savings = \frac{(E_F - E)}{E_F}$$

$$E = e_{i\,elastic} + e_{i\,rigid} - e_{ex-use} + e_p + e_{td} + e_u - e_{ccs}$$

For Carbon2Chem®, E and the GHG savings are mainly dependent on the previous or alternative use of the carbon source (CO_2, BFG, BOFG) and the process energy source used. Credits for the previous use ($e_{ex\text{-}use}$) of captured CO_2 from flue gases will only be granted until 2041. This will make the production of RFNBOs and RCFs from these gases unattractive under current regulations because the required 70% reduction in GHG emissions will be almost impossible to achieve without these credits.

Carbon2Chem® methanol production: Total emissions and GHG savings



Green H_2 (0 g CO_2/MJ Fuel) is used as the H_2 source for all process concepts. The results of the sensitivity analysis regarding the CO_2 intensity of the process energy used (fossil or renewable energy) on E and GHG are shown by means of the respective bars. For BOFG, E and GHG savings depend on the previous use and on the substitution of the heat generation [BOFG (Heat): substitution by natural gas] or power generation [BOFG (Electricity): substitution by power from the grid] that is lost, and should be considered in more detail.

Abbreviations and Symbols used

BFG = blast furnace gas; BOFG = basic oxygen furnace gas; COG = coke oven gas; GHG = greenhouse gas emissions; RCF = recycled carbon fuels; RFNBO = renewable fuels of non-biological origin; SMG = steel mill gases; WIP = waste incineration plant.

E = total emissions from the use of RFNBO or RCF; E_F = total emissions from the fossil fuel comparator (94 g CO_{2eq}/MJ); $e_{i\,elastic}$ = emissions from elastic inputs; $e_{i\,rigid}$ = emissions from rigid inputs; $e_{ex\text{-}use}$ = emissions from inputs' existing use or fate; e_p = emissions from processing; e_{td} = emissions from transport and distribution; e_u = emissions from combusting the fuel in its end-use; e_{ccs} = emission savings from carbon capture and storage.

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A KEY BUILDING BLOCK FOR THE CLIMATE PROTECTION

CO_2 reduction by cooperation of process industrial sectors