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Renewable methane from biogas and hydrogen – Environmental assessment from different perspectives

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INTRODUCTION

Renewable methane as a transport fuel can contribute to emission reductions in different sectors, e.g. heavy duty or maritime transport. The project PilotSBG (Pilot plant Synthesized BioGas) supports the development of innovative and sustainable value chains for producing renewable methane, based on biogenic waste and residues streams and hydrogen as well within a circular economy. The core processes of the plant are anaerobic digestion with subsequent catalytic methanation. An assessment of GHG emissions shall help to flag opportunities and risks for further optimization of the value chains. The product stream contains (i) biogas-based methane and (ii) methane from the methanation of the CO_2 in the biogas stream using hydrogen (Fig.1). There are differences in the calculation method between (i) biofuels and (ii) renewable fuels of non-biogenic origin (RFNBO) according to the Renewable Energy Directive (REDII).

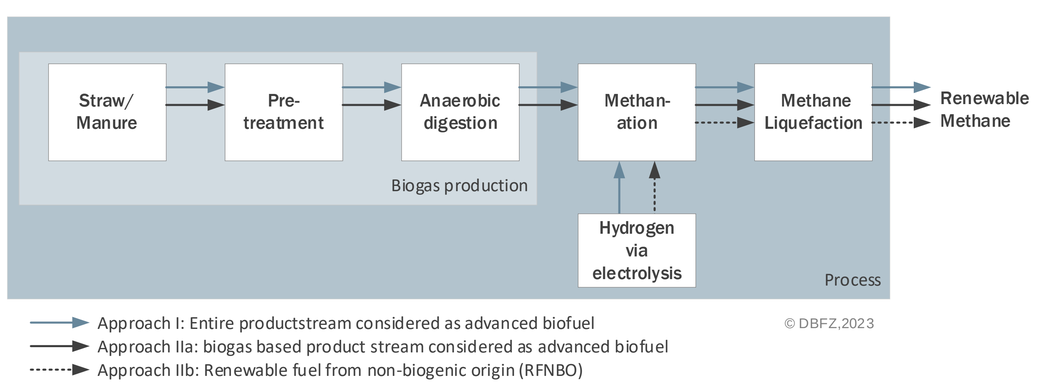

Fig. 1: Value chain and assessment approaches

RESULTS

A fuel specific analysis approach results in higher GHG emissions associated with the production of advanced biofuel, and significantly lower emissions from the RFNBO production (Fig. 2) compared to the assessment of the entire product stream (Approach I). This is caused by methodological differences: (i) the assessment and allocation of the upstream emissions and (ii) the assessment of renewable electricity (RE) purchased via the electricity grid. While RFNBOs can declare the used electricity as renewable per power purchase agreement (PPA) without a direct connection to RE plants, biofuels have to calculate the GHG emissions using the regional energy mix if the plant is not direct linked to a RE plant. .

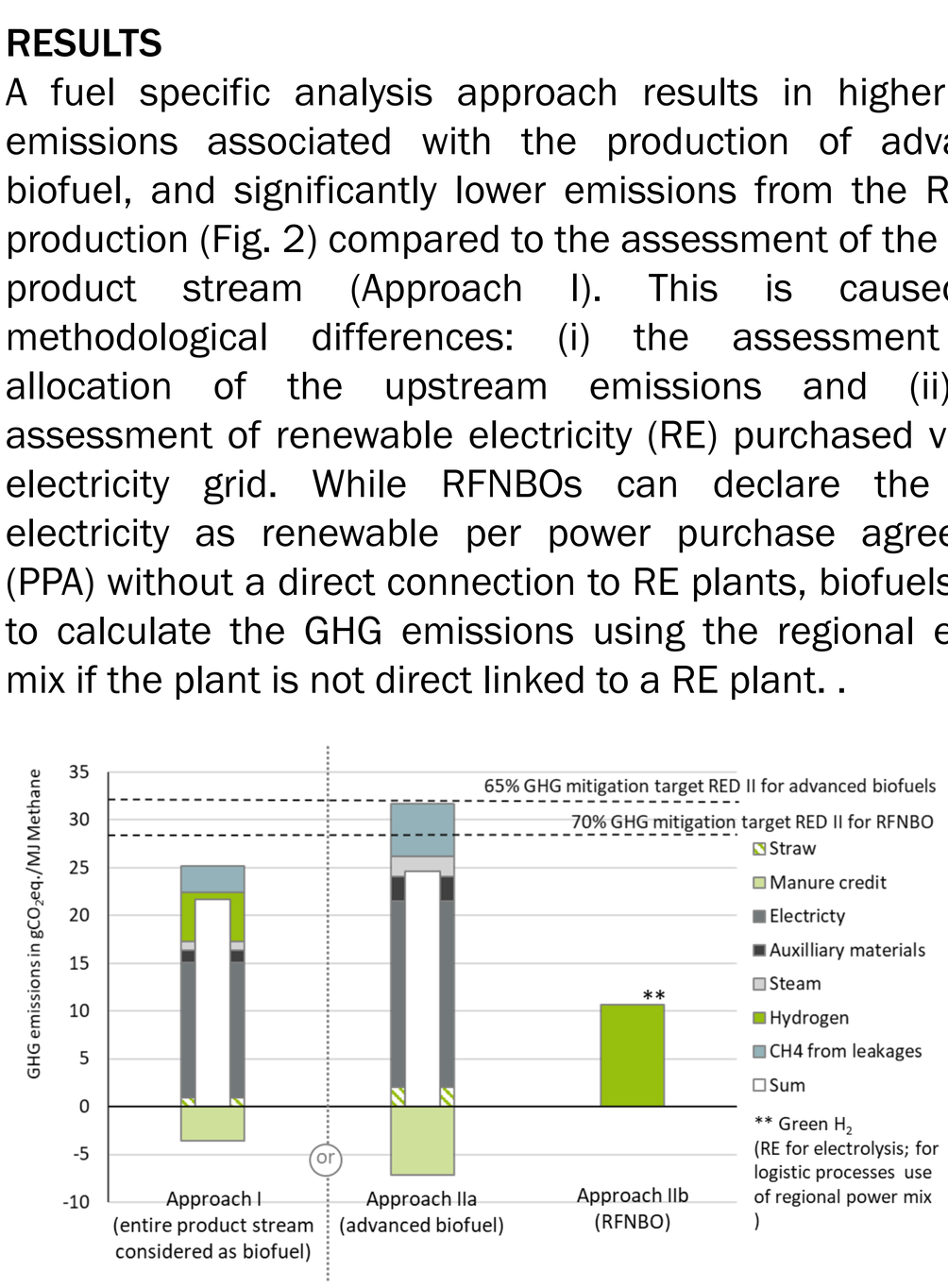

Fig. 2: Specific GHG emissions from the prodcution of liquefied renewable methane under differntent approaches for product declaration

In case that biorefinery plants operate with a PPA, the expenditures for the processes methanation and liquefaction that has been allocated between the biofuel and the RFNBO, would be assessed completely different. For RFNBO assessment emissions from this processes would be assumed as zero, meanwhile GHG calculation for biofuels has to use emission factor for the regional power mix. This leads to significant differences (Fig. 2), because the demand of electricity for the operation of the biorefinery concept is the main driver for the emissions associated with the production of advanced biofuel (Approach IIa) (Fig. 3).

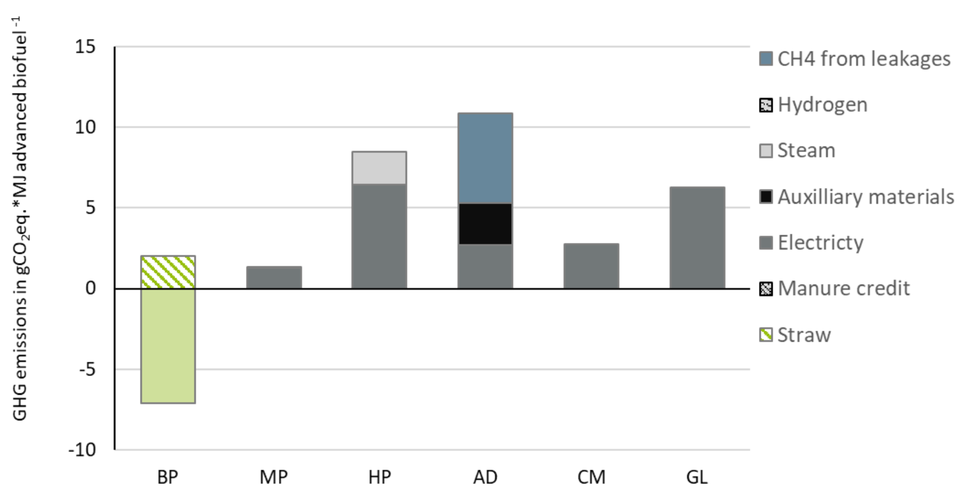

Fig. 3: Specific GHG emissions of the different processes of advanced biofuel (Approach IIa) (BP: biomass provision, MP: mechanical preparation, HP: hydrothermal pre-treatment, AD: anaerobic digestion, CM: catalytic methanation, GL: gas liquefaction)

DISCUSSION

The assessed liquefied renewable methane will achieve the specific GHG reduction target regardless of the approach chosen. But the different methodologies lead to disadvantages on the part of the produced advanced biofuels. Additionally, from the perspective of conventional Life Cycle Assessment, additional elements should be considered in order to complete the assessment: (i) the consideration of infrastructure, (ii) GWP of methane (leakage) according to the latest findings, (iii) allocation of upstream emissions from CO_2-provision. These will need to be considered in future sensitivity analyses.

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