Future Fuels & Gasification Groups thoughts on Life Cycle Strategies for Recycled Carbon Fuels

INTRODUCTION

The revised Renewable Energy Directive (REDII) defines Recycled Carbon Fuels (RCFs) and gives Member States the option to include these fuels in their fulfilment of the RE-T target of 14 % in 2030. REDII also mandates the Commission via delegated acts to establish methodologies for the calculation of GHG emissions reductions achieved by RCFs, and to establish any threshold for GHG emissions reductions to qualify as an RCF, by 2021.

To advance broader EU climate objectives, strategies for assessing impacts of Recycled Carbon Fuels (RCFs) should consider the principles and anticipated impacts of other policy goals, including decarbonization of electricity generation, electrification of road transport, and preference for material re-use and recycling over energy recovery from wastes. The transition to a fully decarbonized grid combined with zero emission vehicles is underway but low carbon fuels will continue to be required. A successful energy transition may entail a period in which waste fossil carbon is prioritized for hard to decarbonize transport sectors and away from power supporting

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grid decarbonization. This will allow the most appropriate low-carbon solutions to be deployed across all sectors as technologies and production capacities continue to develop.

This paper suggests strategies to support the transition to a decarbonized grid and decarbonized transport with recycled carbon fuels. The key is adopting a methodology for calculating the life cycle emissions of recycled carbon fuels that aligns with the future context for their deployment, based on forward-looking policy objectives and commitments. Careful methodological choices will encourage investment in projects today that promote the most efficient and high priority uses of carbon-rich waste gases and solid wastes.

RCFs FROM GASEOUS WASTE STREAMS

In one approach, recycled carbon fuels capture and reuse emissions that typically still hold some energy in the form of H2 and/or CO, which is toxic and cannot be released without combustion. These gases are typically burned for power at low efficiency (< 40%) or flared. RCFs avoid combustion at the source and at facilities where power is produced, potentially diverting carbon-based power from the electricity grid and creating additional demand for electricity from other sources that are increasingly renewable. Approximately 85% of new EU power generation capacity came from renewable sources in 2017[1]. As a result, diverting emissions to RCFs reduces transport emissions with a modest increase in electricity generation emissions, which will drop over time as the electricity grid is decarbonized in line with policy targets.

- First, for RCFs from emissions, it is essential to ensure that the CO2 emissions burden of waste gas inputs are allocated to the products, not to wastes such as gaseous waste streams or (fossil) solid waste streams, similar to the way bio- wastes and residues are treated in the *Renewable Energy Directive II*[2] (REDII).
- Second, 'displacement' or 'indirect' emissions require careful consideration, which begins by determining the project baseline. If gases are currently flared or if continuing a current use requires investment that cannot be economically justified, the baseline is flaring and there is no displacement. If, instead, the Directive was to assess current Best Available Technologies (BAT) and use this as a baseline, it could potentially encourage a less efficient use of the gases. For example: Combustion with energy recovery may be less efficient than conversion of waste gases to fuels yet with inclusion of RCFs in REDII, new opportunities and technologies are available and the BATs for the steel industry should be revised with a view to supporting the most efficient use of the gases and approaches that support the overall climate and energy goals of the EU, including promotion of renewable electricity.

[1] https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2017.pdf
[2] Renewable Energy Directive II (RED II), directive 2018/2001/EU

RCFs FROM SOLID WASTE STREAMS

In a second approach, Recycled Carbon Fuels can be produced via e.g. thermal treatment in solid waste streams, including mixed biogenic and fossil post-recycling wastes[3], or fossil residual waste fractions that remain after conventional recycling operations, e.g. plastic rejects. Post-recycling wastes observe the requirement of REDII to consciously consider the waste hierarchy (avoid, re-use or recycle, recover, dispose) which is laid down in the Waste Framework Directive (WFD)[4].

Moreover, technologies such as gasification allow the complete conversion of the combustible part of all solid waste streams into a syngas that can be converted to chemicals and fuels that substitute for their fresh fossil equivalents. Gasification enables material recovery, producing chemicals[5] as an alternative to disposal[6] by e.g. landfilling or incineration with energy recovery[7]. When producing chemicals, this promotes R3 material recovery as an alternative to incineration with energy recovery, R1. Gasification of mixed (biogenic and fossil) post-recycling wastes produces both a fuel in the "advanced" category for any biogenic feedstock and a fuel in the "recycled carbon fuel" category for the recycled carbon portion.

Member States must require fuel suppliers to supply a minimum of 14% of the energy consumed in road and rail transport by 2030 with renewable energy. Advanced biofuels, such as fuels from the biogenic portion of mixed waste feedstocks, can contribute at least 3.5 % in 2030. This separate 3.5% target combined with double counting of advanced biofuels, complements other supportive measures at the Member State level. However, when implementing RED II, it is for the Member States to decide on whether recycled carbon fuels shall be included or not in the 14 % target.

- First, including recycled carbon fuels into the 14% target increases the feasibility of advanced biofuel projects based on post-recycling wastes, as otherwise full value is only derived from a fraction of the product. This stimulates the production of advanced biofuels and recycled carbon fuels from these waste streams and increases the market value of the recycled carbon fuels.
- Second, the drivers for material recovery to chemicals and fuels from post-recycling wastes are strengthened in relation to diversion from incineration with or without energy recovery, or disposal by landfilling.

The Commission's delegated regulation will define the GHG emissions calculation methodology and the reduction threshold for recycled carbon fuels. Using a methodology that explicitly includes indirect emissions in the form of displacement justifies the adoption of a less stringent threshold than for fuels where indirect emissions are not included.

[3] *typically containing 40-60 % biogenic carbon*

[4] *Waste Framework Directive (WFD),* Directive (EU) 2018/851. Its annexes define recovery, R, and disposal, D, methods respectively.

[5] *R3 in the WFD terminology*

[6] Disposal operations provided in Annex I of the WFD terminology

[7] Recovery operation (R 1) in Annex II of the WFD terminology

RCFs BY LIQUEFACTION

Another technology pathway to RCFs is liquefaction of fossil waste material and co-processing the liquid in a refinery. A typical example is liquefying waste plastic which is not suitable for mechanical recycling and would otherwise be incinerated (with or without energy recovery) or sent to landfill. Co-processing produces typical refinery products with a recycled carbon content, including RCFs.

Ensuring the regulatory certainty of this pathway requires that production of RCFs by co-processing of fossil wastes is recognised by the delegated act on co-processing.

RECOMMENDATIONS FOR TREATMENT OF RCFs

- It is essential to ensure that the products which are the aim of the production process are accountable for all GHG emissions. Similar to the way bio-wastes and residues are treated in the *Renewable Energy Directive II*[8] (REDII), no emissions should be allocated to wastes such as gaseous waste streams or (fossil) solid waste streams .
- Explicit inclusion of indirect emissions in the form of displacement should be taken into account when considering a possible GHG emissions saving threshold for RCFs. Although biofuels are expected in many cases to have significant indirect emissions, indirect emissions are not assigned to biofuels in the REDII lifecycle analysis. The omission of displacement (e.g. indirect emissions) for biofuels is an argument for setting a high GHG emissions savings threshold for these fuels. In contrast, once displacement emissions for fuels from recycled carbon have been appropriately assessed, no other significant indirect emissions are expected.
- Regarding the methodology for calculation of displacement emissions from an alternative use, such as power production, the alternative should be evaluated against multiple criteria: (1) is it currently in use; (2) will that use require significant capital expenditure now (e.g. to go from flaring or landfilling, respectively to CHP) or in the future to continue (e.g. to maintain or upgrade existing generators, retrofit CCS, add efficiency improvements to meet the WID efficiency criterion, to meet revised BAT in a permit review) and (3) is its continuation consistent with a transition to desired policy outcomes. In the case of electricity as the alternate use, one approach to such an evaluation is to first identify the time before investments will be required. This marks the end of the economic life of the alternative use and the operator may freely choose without penalty whether to continue the alternative use or change to a new use (such as fuel production). A "displacement period" is then defined as the interval between the start of production and the end of the alternative's economic life. The alternative use, e.g. electricity production, forms the baseline for calculating displacement emissions during the displacement period. After the displacement period, the baseline becomes the current use at that time, e.g. fuel production and there is no displacement. To provide a uniform displacement impact through a project lifetime, an average over the project lifetime could be calculated instead.

[8] Renewable Energy Directive II (RED II), directive 2018/2001/EU

RECOMMENDATIONS FOR TREATMENT OF RCFs

We have identified four options for assessing displacement emissions during the displacement period, using electricity production as the example: 1) average carbon intensity of the most recent documented electricity generation; 2) average expected carbon intensity of generation during project lifetime; 3) average carbon intensity of current additions to electricity generation; 4) carbon intensity of expected future additions to electricity generation during project lifetime. Of these, we recommend Option 3 as an approach to estimate true impacts without the burden of detailed modeling for which data may not be available.

In case of displacement emissions from an alternative use, such as landfilling, incineration with or without energy recovery, the following principles should be taken account when assigning emissions to final RCF made from MSW:

- Portion of biodegradable waste usually landfilled which would be converted to methane in the landfill
- In case of landfilling, use option 4 mentioned for power production modified for this case, i.e. to take into account the most probable future way of MSW handling in the specific country, because of landfilling avoidance required by EU legislation (e.g incineration with or without energy recovery)
- Emission factor for heat production in the specific country in case of MSW incineration with energy recovery using the option 3 (also recommended in case of power production).

CONCLUSION:

To advance broader EU climate objectives, strategies for assessing impacts of Recycled Carbon Fuels should consider the principles and anticipated impacts of other policy goals. The key is adopting a methodology for calculating the life cycle emissions of recycled carbon fuels that aligns with the future context for their deployment, based on forward-looking policy objectives and commitments.

The AFF recommends:

- CO_2 emissions of waste gas inputs are allocated to the primary product, not to RCFs.
- Project baselines must be accurate and reflect the anticipated external environment over the entire life of the project.
- Explicit inclusion of indirect emissions in the form of displacement should be considered when considering a possible GHG emissions saving threshold.
- Approach for calculating displacement emissions should use the average carbon intensity of current additions to electricity generation.

The AFF encourages EU co-legislators to: Ensure the development of a calculation methodology that considers the expected reduction of the grid's carbon intensity, as well as avoids potential

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negative or unintended consequences from the inclusion of a displacement or alternative use penalty for recycled carbon fuels.

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