Greenhouse gas impacts of rDME

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This document is a summary of a greenhouse gas assessment carried out by NNFCC for Circular Fuels Limited. Full details on data, methodology, results and limitations are reported in "*GHG calculator for DME production from RDF – Phase II analysis*"

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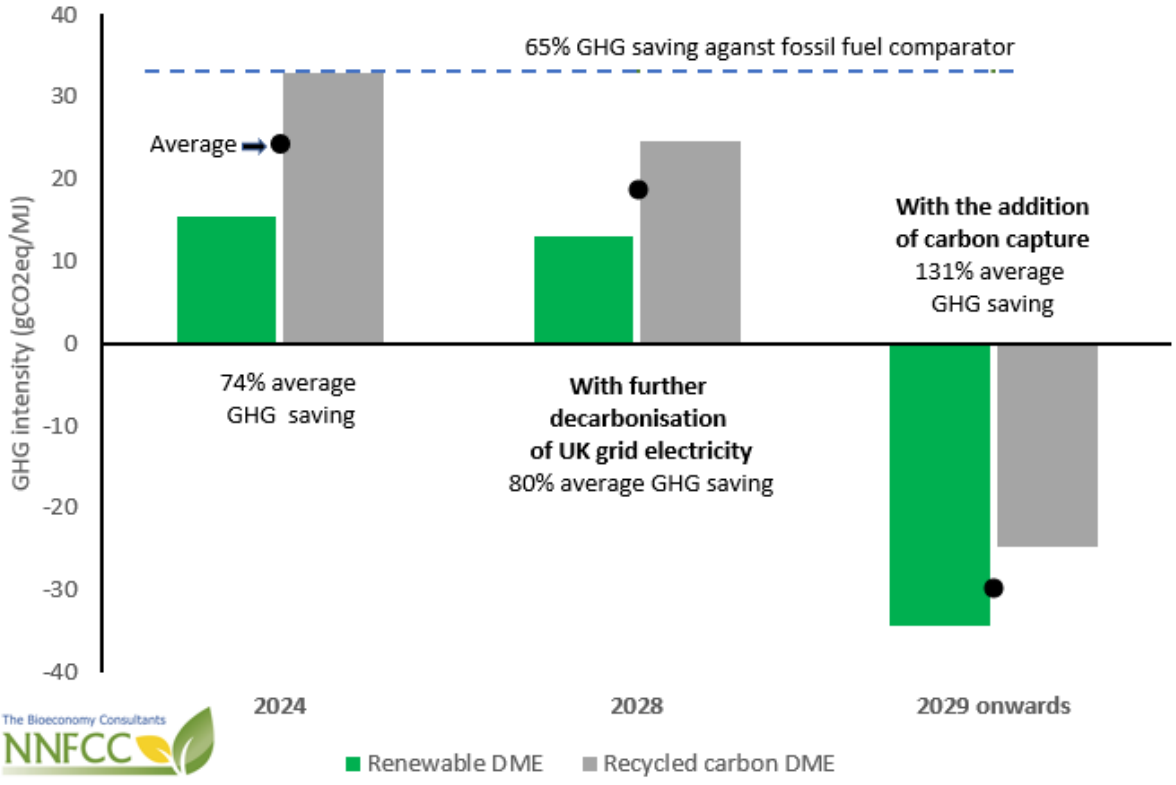
Summary

- **rDME** (dimethyl ether produced from renewable and recycled carbon) is an **important fuel molecule** used either on its own or in blends with liquid petroleum gas (LPG), with applications in **off gas grid domestic, commercial and industrial heating**, and potentially in the transport sector.
- Circular Fuels is developing a **plant in Teesside for the production of rDME**, via gasification of non-recyclable residual waste streams. The fuel, produced from mixed biogenic and non-biogenic waste, is considered to be a mixture of renewable DME, produced from the biogenic part of the waste, and recycled carbon DME, produced from the non-biogenic part of the waste.
- rDME produced in the plant will initially have an **average GHG saving of at least 74%** over fossil transport fuels, based on the GHG methodology used by the UK Department for Transport (DfT) for assessing the GHG savings of renewable and recycled carbon fuels.
- Renewable DME will readily exceed the EU's 70% GHG saving/MJ heat threshold required for support of **renewable fuels used for heating applications**
- **Over the lifetime of the plant the GHG intensity of the rDME will decrease further** as the UK electricity grid continues to decarbonise in line with UK government targets.
- Implementing carbon capture and sequestration at the plant, taking advantage of Teesside's developing carbon sequestration infrastructure, would enable the rDME produced to achieve a **net negative GHG emissions intensity**.



GHG intensity of renewable DME and recycled carbon DME derived from gasification of non-recyclable residual mixed waste under current and anticipated future situations

The production process

Circular Fuels is developing an rDME production plant in Teesside, utilising KEW's proprietary advanced gasification technology to convert non-recyclable residual household and industrial solid waste into rDME. The plant is expected to start production in 2024, then increase to full production capacity of 50kt / year. The plant location will enable Circular Fuels to capitalise on the Net Zero Teesside project that aims to develop a UK-leading carbon capture, utilisation, and storage cluster in the region. Production of rDME from non-recyclable residual waste diverts waste away from combustion applications, allowing less GHG intensive forms of renewable power to address any gap in power generation while delivering GHG reductions in more difficult to decarbonise sectors of the economy.

Fuel outputs

Non-recyclable residual waste is a mix of biogenic (wood, card etc) and non-biogenic components (mainly non-recyclable waste plastic), so the fuels produced from it are a mix of what are defined by DfT as 'renewable' and 'recycled carbon' fuels (RCF) respectively. The method proposed by DfT for assessing the GHG emissions of recycled carbon fuels considers GHG emissions of diverting waste from its existing use, such as power production[1]. As a result, the GHG intensity of the biogenic (renewable) and non-biogenic (recycled carbon) fraction of the rDME differs. However, in practice for many uses, especially for heating, the biogenic and non-biogenic portions would not be separated and so the average GHG intensity for a renewable and recycled carbon rDME mix is also shown, based on a typical 50% biogenic waste fraction.

GHG impacts

Using DfT's approach to GHG accounting, NNFCC modelled the GHG impacts of renewable and recycled carbon DME production in Circular Fuels' proposed Teesside plant.

At the project outset, renewable DME is expected to be produced with a GHG saving of around 84% and 74% on average across both fuels against DfT's fossil fuel comparator[2]. By 2028, with grid decarbonisation, the GHG saving is expected to increase to 86% and 80% respectively. These values take account of feedstock logistics and typical fuel distribution emissions.

The plant will generate a clean separated CO_2 stream from start-up, and once infrastructure is established to sequester the captured CO_2, the process would be a net CO_2 sink resulting in rDME with a net negative carbon intensity. Full capture and sequestration of carbon generated in the plant would deliver GHG savings of 137% for renewable DME and 131% on average for both fuels.

Looking at uses beyond transport, renewable DME will readily exceed the EU's 70% GHG saving/MJ heat threshold required for support of renewable fuels used for heating applications, and 80% for plants starting from January 2026.

[1] Based on DfT established methodology for assessing the GHG emissions for fuels produced from biogenic waste, and the proposed methodology for Recycled Carbon fuels defined in "Targeting net zero – next steps for the Renewable Transport Fuels Obligation (DfT publication).

[2] 94 gCO2/MJ fuel