# Comparative techno-economic and life cycle analyses of synthetic 'drop-in' fuel production from UK wet biomass

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## 1. Background

- Transportation contributes a third of the global $CO_2$ emissions in 2020.
- Current vehicle policies favour electric vehicle rollout by 2035 [1].
- **Harder-to-decarbonise sectors, such as heavy-duty trucks, marine, and aviation**, **may continue to rely on liquid fuels beyond 2035.**
- **Biomass-derived synthetic fuel** is a promising option especially for the **harder-to-decarbonise sectors.**
- **Synthetic drop-in biofuels can be used neat (i.e., 100%)** without the need for blending **unlike conventional bioethanol and biodiesel.**

## 2. How are these drop-in fuels produced?

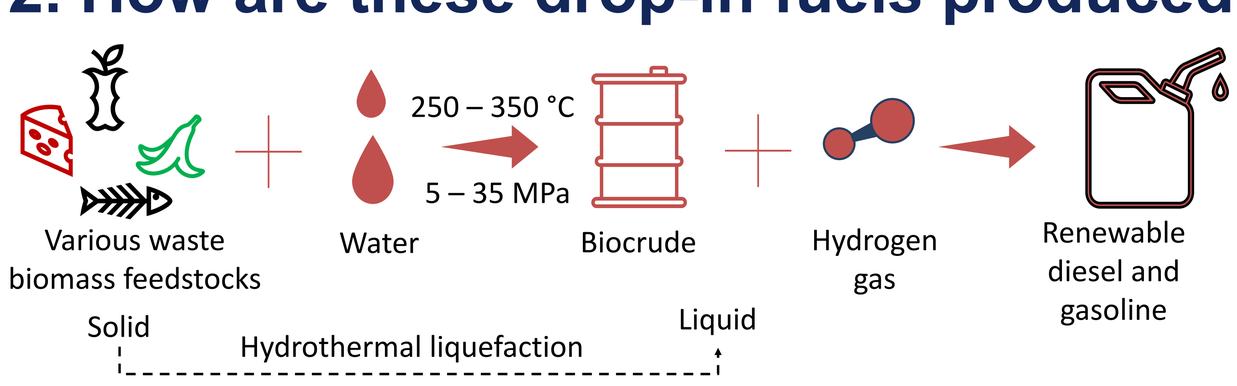
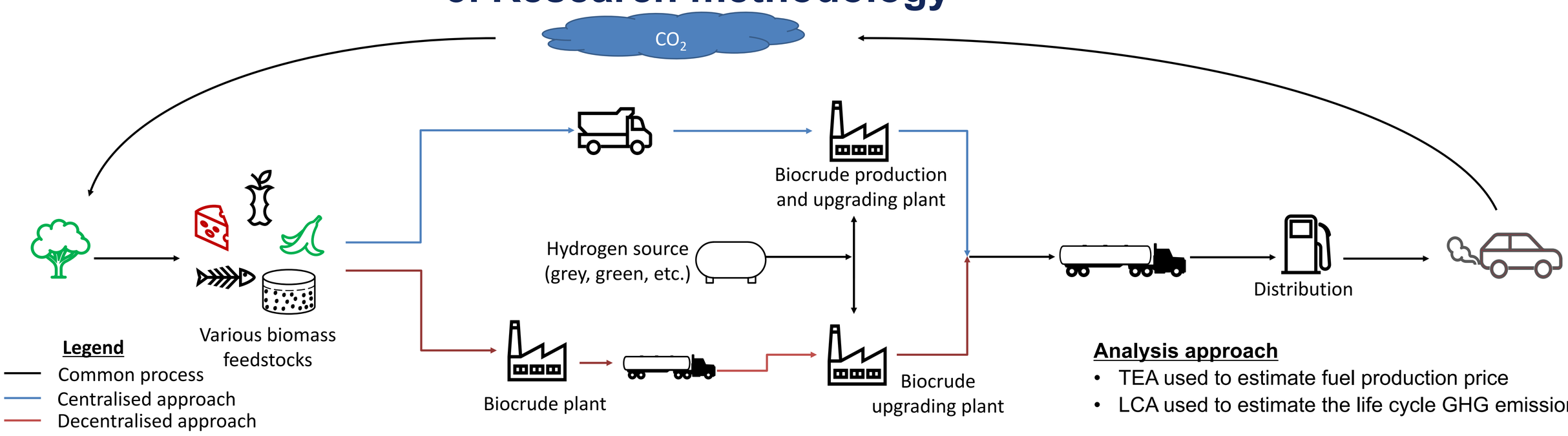



*Figure 1: Drop-in fuel production using hydrothermal liquefaction of wet wastes feedstocks at subcritical water conditions*

## 3. Research methodology




**Analysis approach**

- TEA used to estimate fuel production price
- LCA used to estimate the life cycle GHG emissions

*Figure 2: Drop-in fuel production centralised and decentralised production approaches*

## 4. How affordable and sustainable are these drop-in fuels?

### (a) Economics

- Fuel production price ranged from £14.76 to £27.11 per GJ (£0.47–0.86 per GLE), over different feedstocks and production approaches
- **Up to 2,830 ML per year**, which is **6.8% of the UK 2021 gasoline and diesel fuel demand can be supplied by wet biomass wastes**

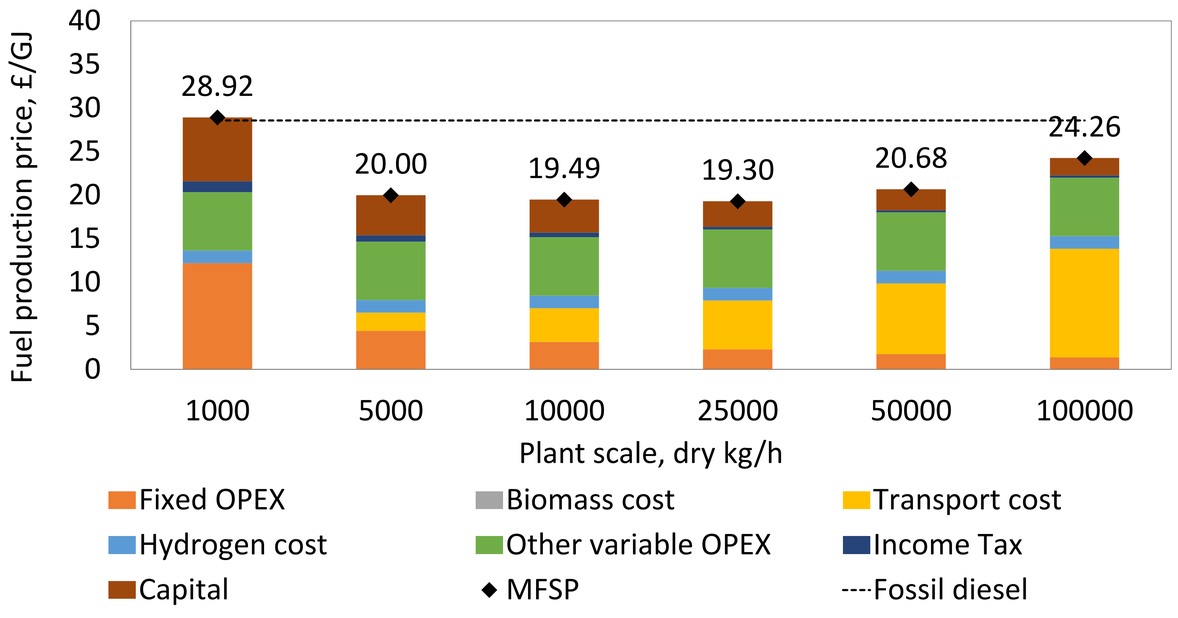



*Figure 3: Effects of plant scale on fuel production from food waste over England, based on Centralised, Grey H2 scenario*

### (b) Life cycle emissions

- GHG emissions of fuels ranged from -82.0 to 59.7 kg $CO_2$eq per GJ.
- Direct emissions only ranged from 20.3–36.1 kg $CO_2$eq per GJ
- Up to 8.4–9.8 Mt $CO_2$eq per year (**7.3% of the UK 2021 transport emissions)** emissions savings **can be achieved by using key wet wastes**

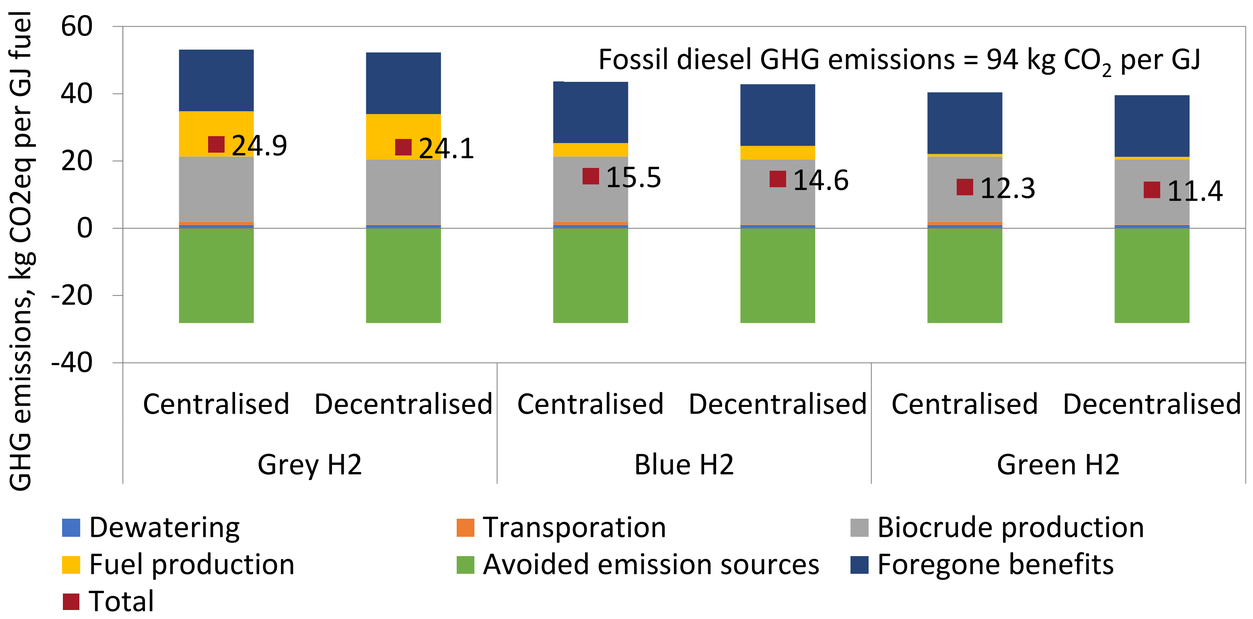



*Figure 4: GHG emissions results for drop-in fuels (gasoline and diesel) from various production approaches for food waste, in comparison to fossil diesel*

## 5. Conclusions

- Drop-in fuel prices at plant gate can be competitive with 2021 conventional diesel prices
- GHG emissions from drop-in fuels are significantly lower than conventional diesel
- Production approach significantly impacts fuel production price and GHG emissions
- Other complementary drop-in fuel options required to close the supply gap towards achieving the UK's net zero target.

## 6. Abbreviations

- $CO_2$: Carbon dioxide
- TEA: Techno-economic assessment
- LCA: Life cycle assessment
- GHG: Greenhouse gas
- GLE: Gasoline litre equivalent

**References:** [1] HM Government, "Transitioning to zero emission cars and vans: 2035 delivery plan," 2021. Accessed: Dec. 09, 2022. Available on gov.uk

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