Hydrogen from Biomass

UKCCSRC Web Event with IMechE: Hydrogen Production with Carbon Capture and Storage

04 November 2021

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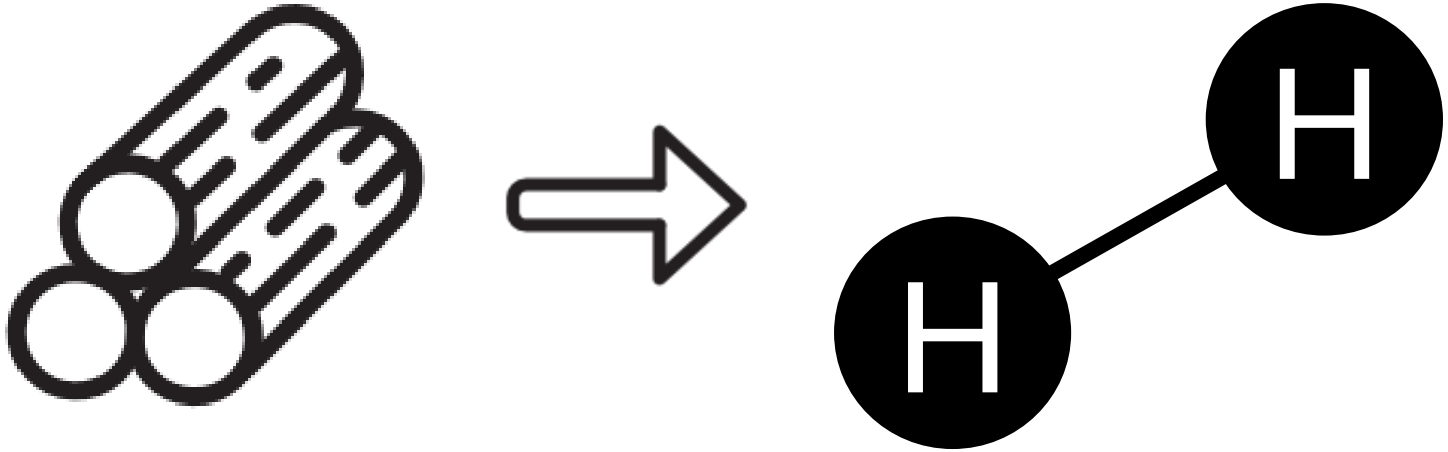
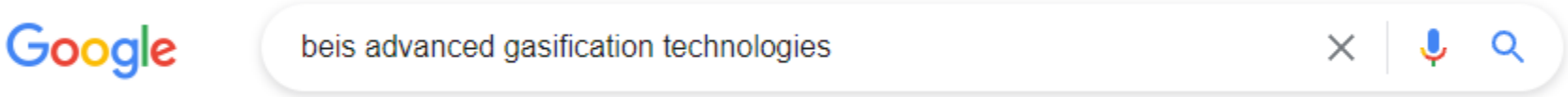
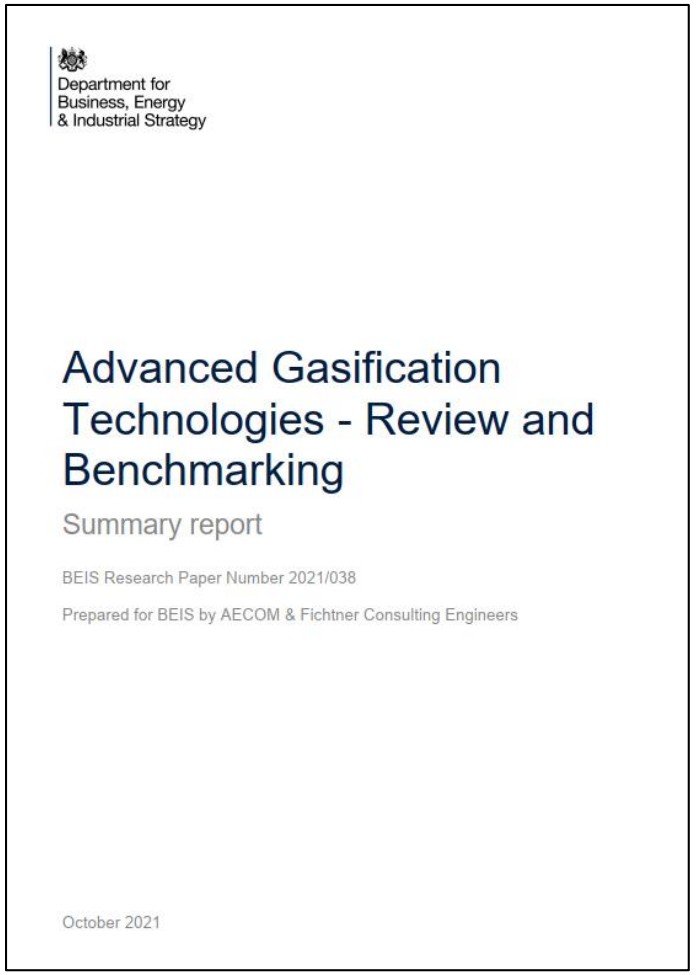


Advanced Gasification Technologies Study



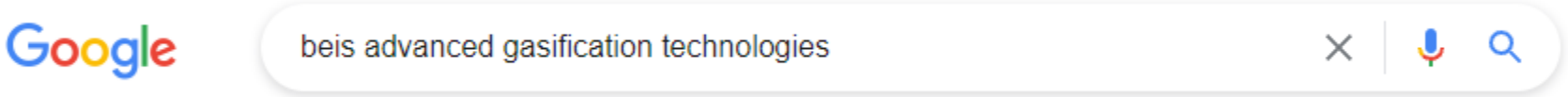
– AGT Study

- Advanced Gasification Technologies converting biomass and municipal solid waste to a range of fuel products: Hydrogen, Methane, Methanol, Fischer-Tropsch fuels
- Review of Current Status of AGT
- Review of Next Generation AGT
- Techno-Economic Analysis
- Focus on Opportunities and Barriers



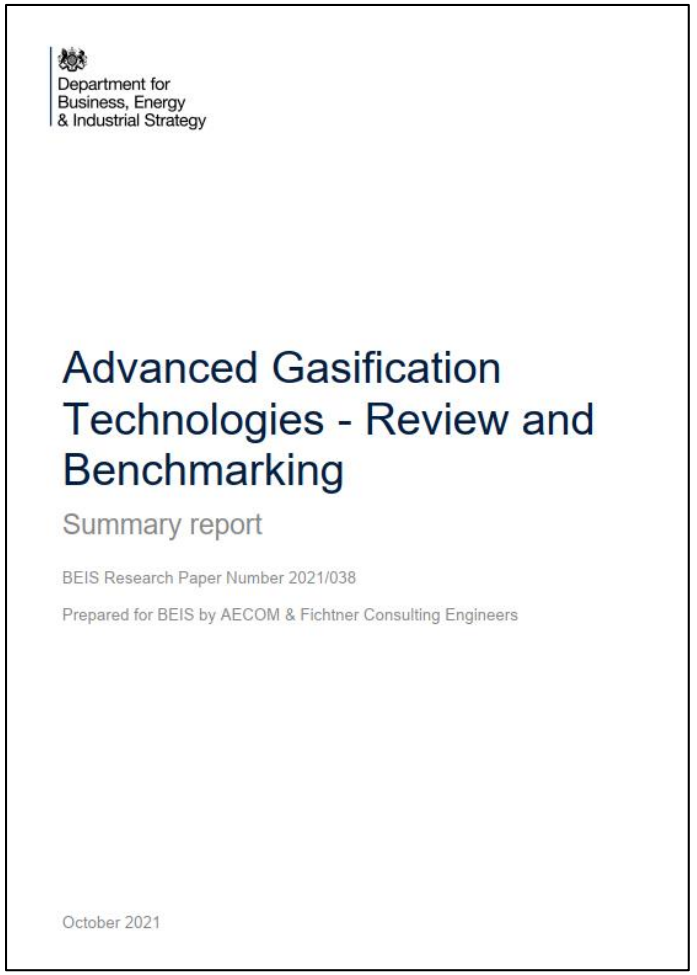
https://www.gov.uk/government/publications/advanced-gasification-technologies-review-and-benchmarking

Advanced Gasification Technology Study



– Key Messages

- CO_2 balance should be studied further
- Realistic approach to feedstock availability and utilisation is required
- Technology is still at developmental stage



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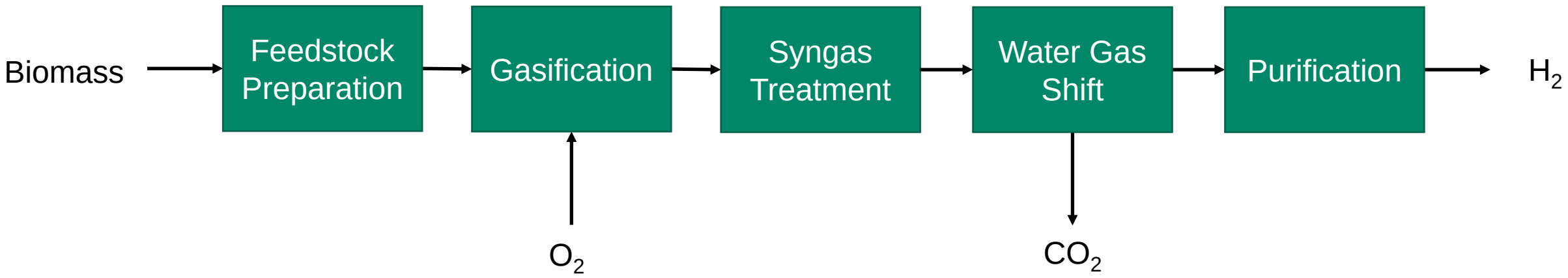
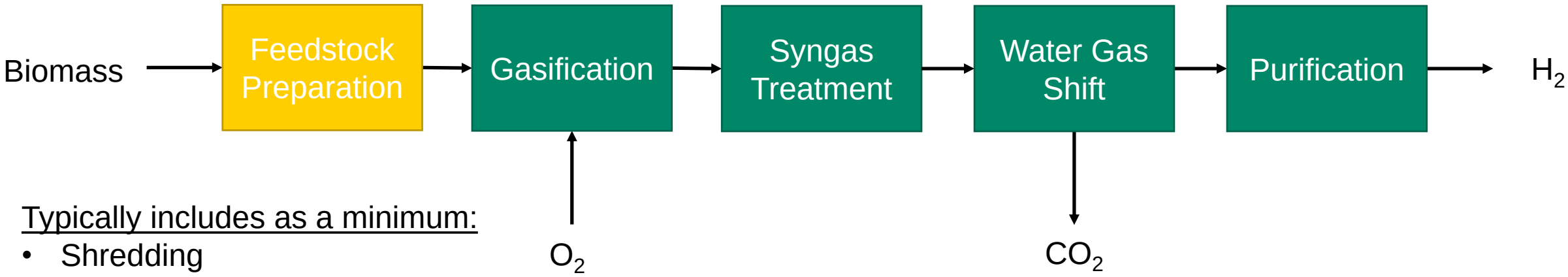
Biomass to Hydrogen Process Overview



Biomass to Hydrogen Process Overview

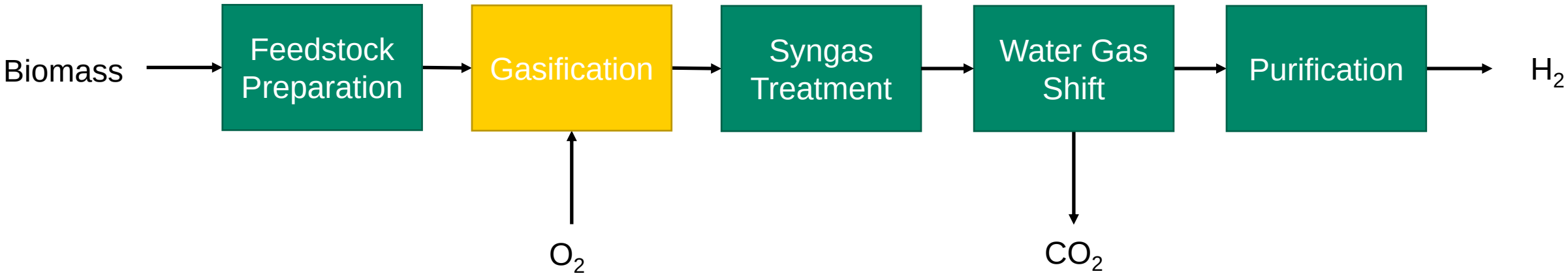


Typically includes as a minimum:

- Shredding
- Metals Separation
- Inerts Separation
- Drying

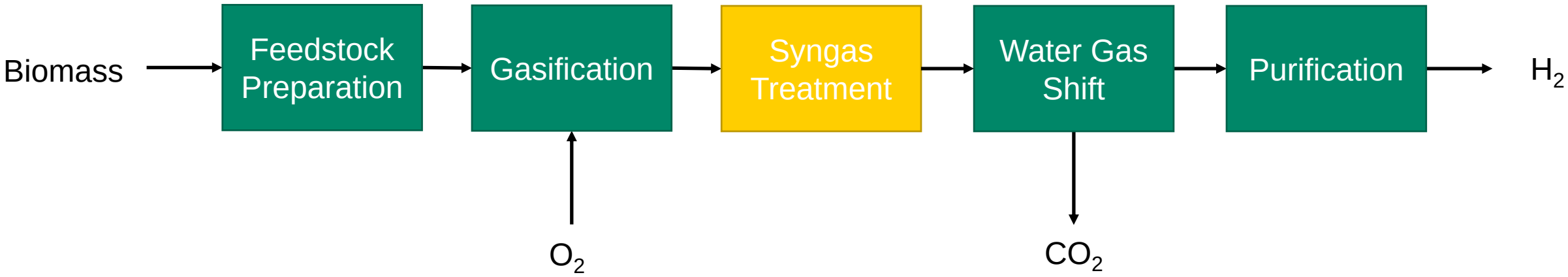
Cheaper Feedstock ⇨ Increased Contamination ⇨ Increased Complexity ⇨ Increased Risk

Biomass to Hydrogen Process Overview



$$C_nH_m + O_2 + \text{Steam} \longrightarrow CO + H_2 + \text{Steam}$$

Biomass to Hydrogen Process Overview

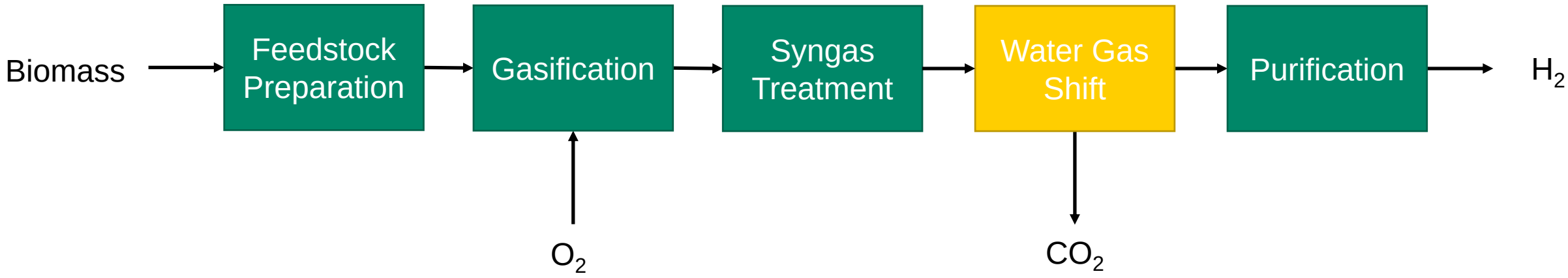


Treatment systems can include:

1. plasma conversion;
2. high efficiency cyclones for collection of entrained particulates and droplets of hydrocarbons;
3. wet scrubbing for the removal of entrained particulate matter, tars and NH_3;
4. activated carbon beds for adsorption of metals;
5. hydrolysis reactors for the reduction of COS, HCN and unsaturated hydrocarbons; and
6. amine scrubber for the removal of CO_2 and some acid gases.

Cheaper Feedstock ⇨ Increased Contamination ⇨ Increased Complexity ⇨ Increased Risk

Biomass to Hydrogen Process Overview

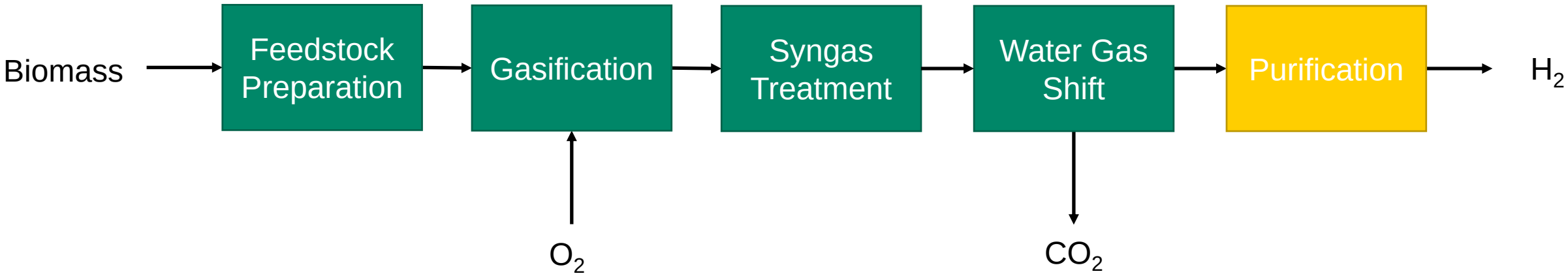


$$CO + H_2O \longrightarrow CO_2 + H_2$$

Low Temperature (200°C) - cobalt-molybdenum catalysts
High Temperature (500°C) - chromium or copper promoted iron oxide catalysts

CO_2 removal from shifted syngas by solvent based process, produces concentrated >90% stream

Biomass to Hydrogen Process Overview



- Pressure Swing Adsorption
- Further purification as required

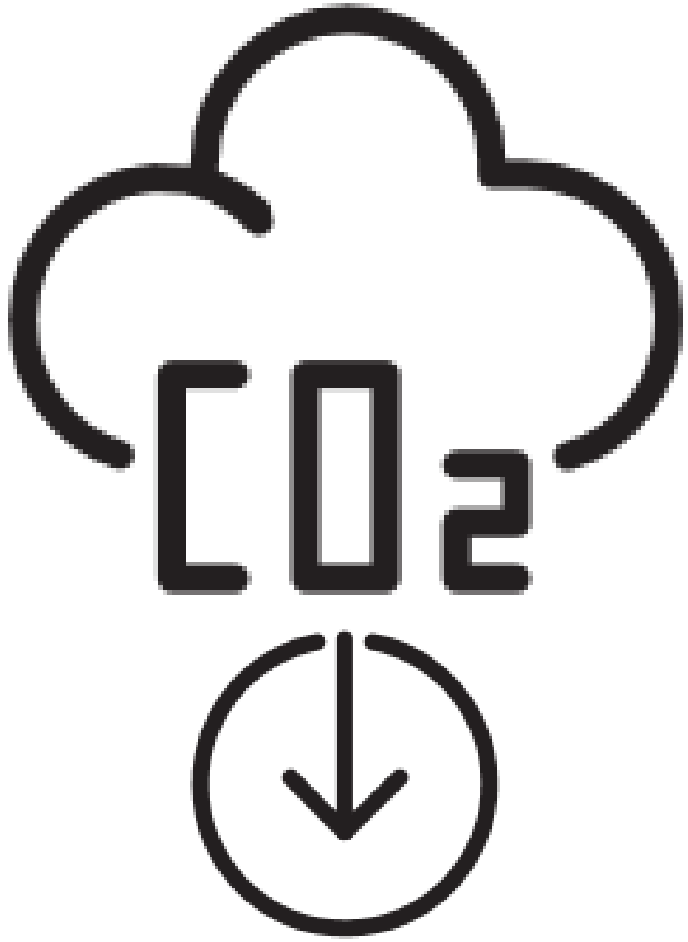
Biomass to Hydrogen AGT Developers

- Kew Technology
  - Feedstock – Densified RDF
  - Gasifier – Fluidised Bed
  - Product – Hydrogen, Electricity & Liquid Fuel
  - TRL - 6
- PowerHouse Energy Group
  - Feedstock – RDF, SRF & Mixed Plastics
  - Gasifier – Rotary Kiln
  - Product – Hydrogen & Electricity
  - TRL - 6

Opportunities

- Production of Low Carbon Hydrogen

- Carbon Negative Technology



Barriers

- Supply of sustainable biomass
- Conversion efficiency
- Product purity
- Product certification
- Value of CO_2
- Availability of technology
- Economics

Techno-Economic Analysis: Levelised Cost of Hydrogen

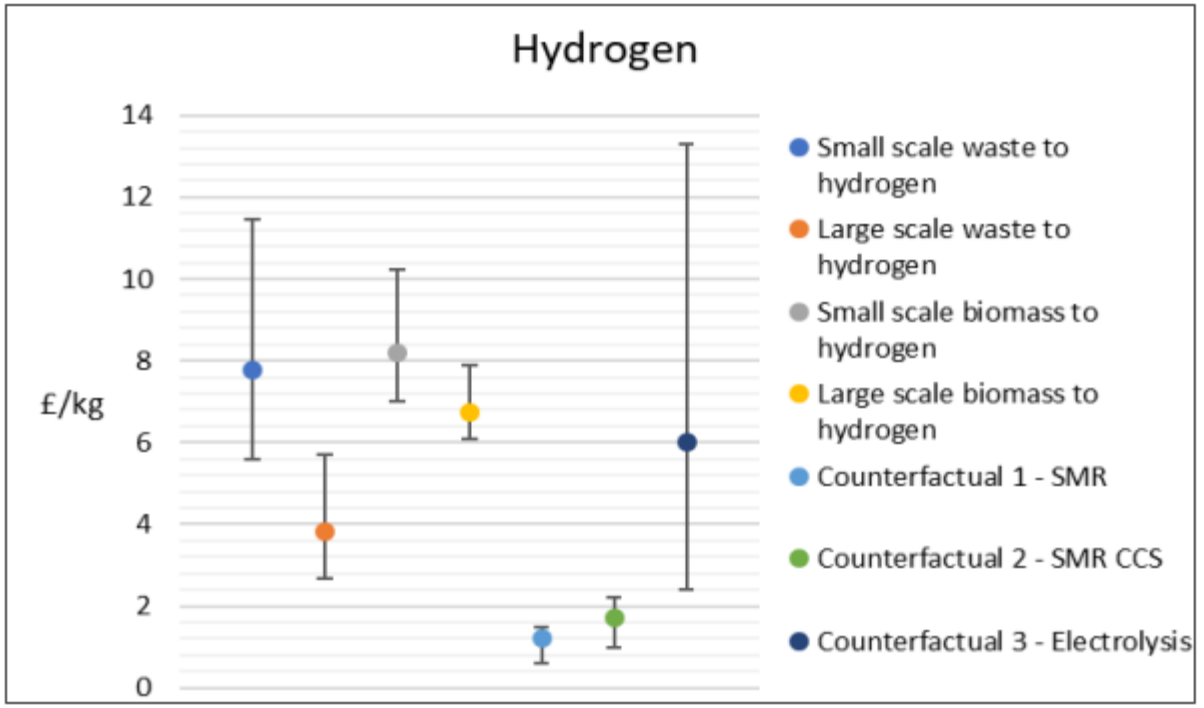


Figure 7: LCOH for biomass and waste with capture of the rich CO_2 stream

Conclusions

- Does this technology have potential to be part of the future energy system?

Yes

- Will it solve all our problems?

No, sustainable feedstock supply is limited and has other uses

- What is the technology for?

Low Carbon Hydrogen? CO_2 Capture from atmosphere? Which will be the main revenue is unclear.

Any Questions?

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