

RP1.2-01: Future Fuel Production Technology Status and Prospects

The purpose of this project was to prepare a 'state-of-play' assessment of future fuels production technologies to inform the work undertaken in Research Program 1 by Future Fuels CRC.

A comprehensive report was released in December 2019 summarising the current technology for, and the commercial status of, a wide range of future fuel production technologies (as at December 2019) with a view to informing decision-making on potential production technology-focussed research projects. The report reviews current and emerging technologies in eight categories (see *Table 1* below):

Table 1: Future fuels options and production technologies addressed in the report

Category	Technology / technological sub-category and their technology readiness level (TRL)
Direct Gas Pipeline Substitutes	• Biomethane from Anaerobic Digestion (TRL 9) • Bio-Syngas from Biomass Gasification (TRL 9) • Synthetic Methane from Hydrogen – Power to Gas (TRL 9)
Hydrogen from Hydrocarbons	• Coal Gasification (TRL 9) • Steam Methane Reforming (TRL 9) ◦ Autothermal Reforming (TRL 9) • Emerging methods: ◦ Partial Oxidation (TRL 6) ◦ Direct Thermal Cracking (TRL 5) ◦ Dry Methane Reforming (TRL 3) ◦ Pyrolysis (TRL 3) • Carbon Capture, Storage, and Utilisation: ◦ Carbon Capture and Separations (TRL 6 – 9) ◦ Geological Storage and Utilisation (TRL 9) ◦ Carbon Utilisation (TRL 9) ◦ Biological Utilisation (TRL 4)
Hydrogen Produced from Water	• Electrolysis (TRL 6-9) ◦ Alkaline Electrolysis (TRL 9) ◦ Proton Exchange Membrane Electrolysis (TRL 9) ◦ Solid Oxide Electrolysis (TRL 7) • Photocatalysis (TRL 3) • Thermocatalysis (TRL 2)
Hydrogen Produced from Biological Systems	• Photolysis (TRL 2) • Fermentation (TRL 2)
Downstream Hydrogen Processing	• Water Gas Shift (TRL 9) • Pressure Swing Adsorption (TRL 9) • Membranes (TRL 2-9)
Hydrogen Storage – Physical	• Compression (TRL 7) • Liquefaction (TRL 9) • Solid State Hydrogen Storage (TRL 1-3)
Hydrogen Storage – Chemical	• Ammonia (TRL 9) • Liquid Organic Hydrogen Carriers (TRL 8)
Synthetic Fuels	• Methanol (TRL 9) • Dimethyl Ether (TRL 7-9) • Fischer-Tropsch SynFuels (TRL 9)

Additionally, summary sheets were developed for the following future fuel technologies:

- Biogas from anaerobic digestion
- Syngas from biomass gasification
- Synthetic methane
- Coal gasification
- Steam methane reforming
- Pyrolysis
- PEM electrolysis
- Solid oxide electrolysis (SOE)
- Photocatalysis
- Green ammonia
- Liquid organic hydrogen carriers
- Green methanol
- Dimethyl Ether

Finally, the project developed a list of future fuels recommended for priority development through Future Fuels CRC projects. The CRC subsequently funded research in several areas that were identified including methane pyrolysis, photocatalysis and novel methanol production methods.

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