our future through science

Biofuels Technology: A Look Forward

William H.L. Stafford and George A. Lotter
Natural Resources and Environment Unit
Council for Scientific and Industrial Research, South Africa
www.csir.co.za
WStafford@csir.co.za

Transport fuels are currently dominated by oil; a non-renewable resource with global proven reserves that are unlikely to last another fifty years. The widespread adoption of **renewable biofuels** is considered essential to increase the **sustainability of transport and reduce global carbon emissions.**

Biofuels are **energy carriers** and their production encompasses **a range of feedstocks and conversion processes, that are at various stages of development and commercialisation**. This study assesses the technology maturity and commercialisation of various biofuels to provide insight into the future of biofuels for transportation (Figure 1).

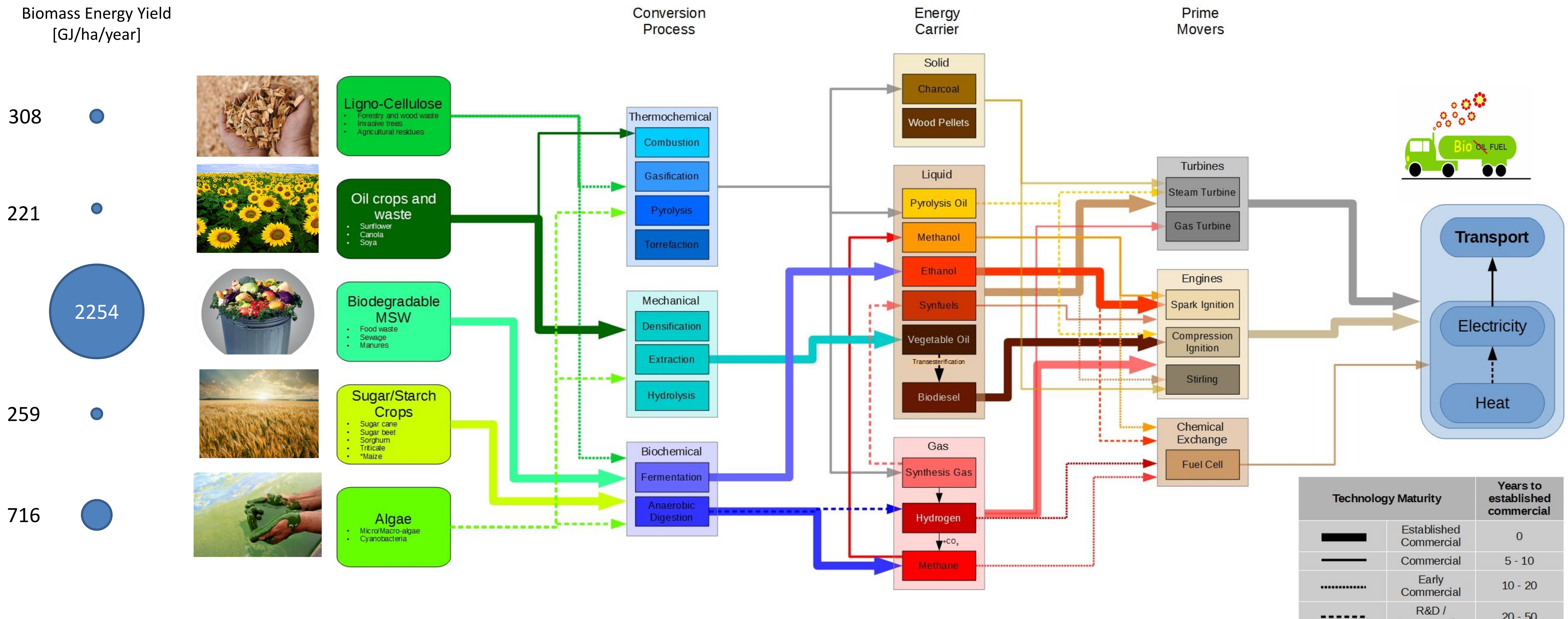

Figure 1 and Table 1. Biofuel pathways with conversion technologies showing degree of development and commercialisation

	Conventional	Advanced	Alternative
Description	First generation biofuels such as bioethanol, biodiesel and biogas are produced sugary/starchy biomass. Can replace or blend with fossil fuels. Currently commercially established.	Second generation biofuels are produced from ligno-cellulosic biomass .Third generation biofuels are from algae. At various stages of commercialization ranging from R&D to early commercial.	Non-carbon fuels such as hydrogen (combustion or fuel cell) and battery storage for electric vehicles. Require renewable energy resources to achieve carbon-emission reductions benefits. At demo- and early commercial stage mainly as a result of energy storage constraints.
Feedstock	Food crops, food waste and sewage	Forestry and Agriculture residues and wastes; Non-food crops (grasses, shrubs and trees).	Hydrogen from synthesis gas and anaerobic digestion. Electricity charge from solar, wind or other renewables ideally or municipal electricity alternatively
Energy carrier	Bioethanol, Biodiesel, Biogas	Bioethanol, Biodiesel, Biogas Synfuels (methanol, DME) and Bio-SNG Algal fuels	Hydrogen and Electricity storage (batteries)

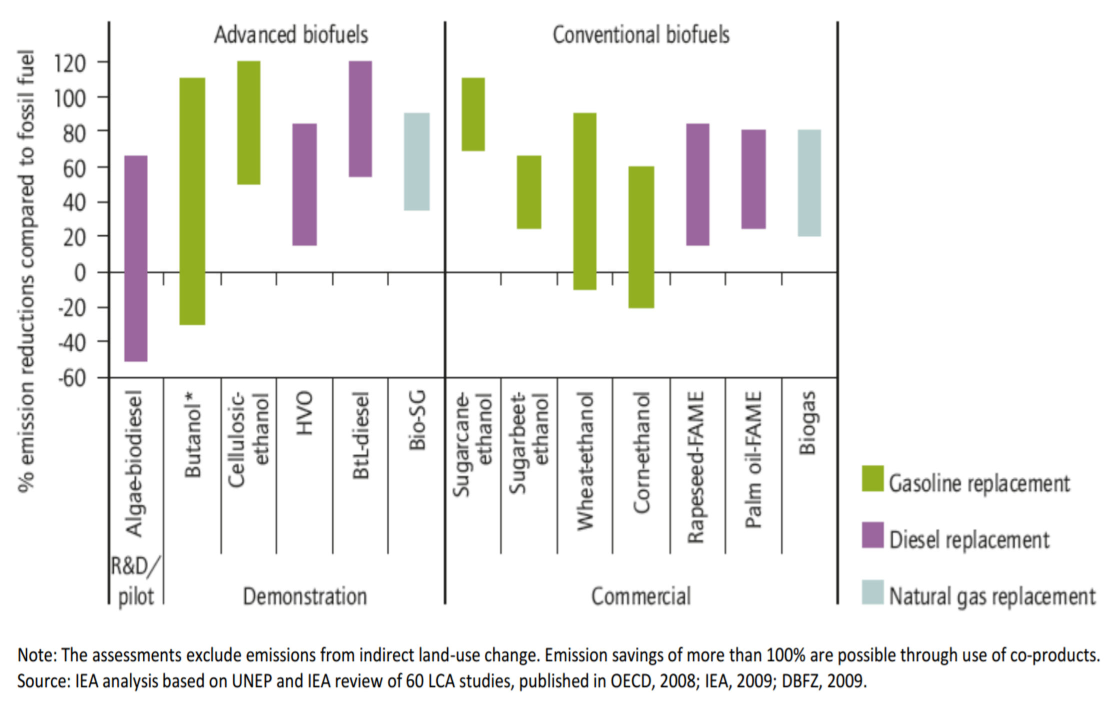

Figure 2. Carbon emission reduction of Conventional and Advanced biofuels

The use of plant biomass for **biofuels** aims to **de-carbonise** our **energy systems**, and **move away from finite fossil fuel resources**.

However, the carbon benefits will depend on the chosen technology pathway (Figure 2), and the various other factors in the **biofuels life cycle-** from biomass feedstock production, conversion to biofuels, distribution and end-use (Figure 3).

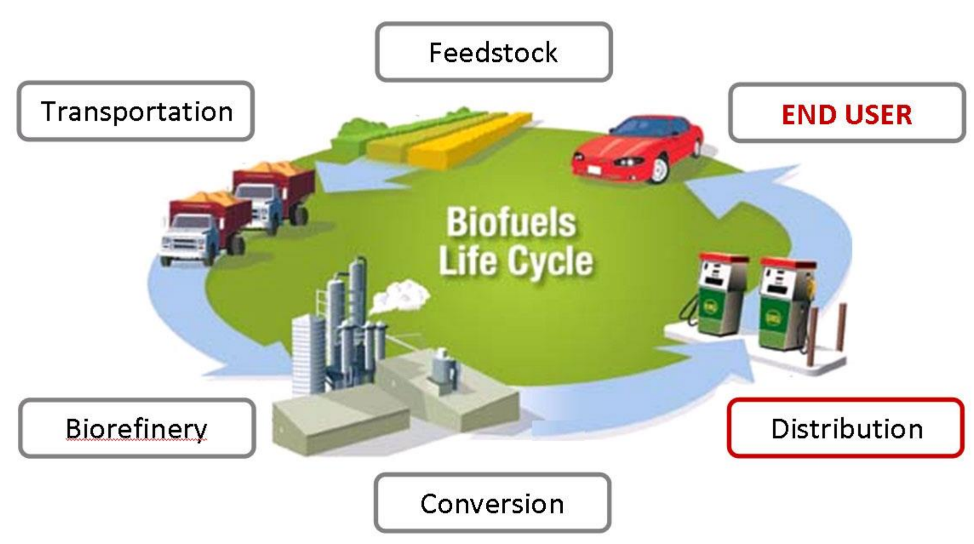

Figure 3. Life cycle of biofuels

- **Conventional biofuels** are commercially established and can replace petrol, diesel and natural gas with little additional infrastructure and vehicle modification. They can be blended with existing fuels to facilitate gradual uptake and adoption.
- **Advanced biofuels are at various stages of commercialisation** aim to access a wider range of biomass resources, while facilitating a convergence in technology pathways to deliver energy services of heat, power and electricity.
- The **environmental benefits of biofuels**, such as the **reduction in carbon emissions and other pollutants**, requires assessment across the **biofuels life cycle**
- A range of other criteria will determine market uptake of biofuels. Key issues are **cost-competitiveness with current fossil fuels** and **avoiding competition** for land and biomass to produce food, feed, fibre and fine chemicals in the developing **bio-economy**. **Biorefinery** developments offer an improved integration of these product streams.