

September 22, 2022 – Task 64



Technology Collaboration Programme on
Advanced Motor Fuels

E-fuels - overview on current status and technology assessments



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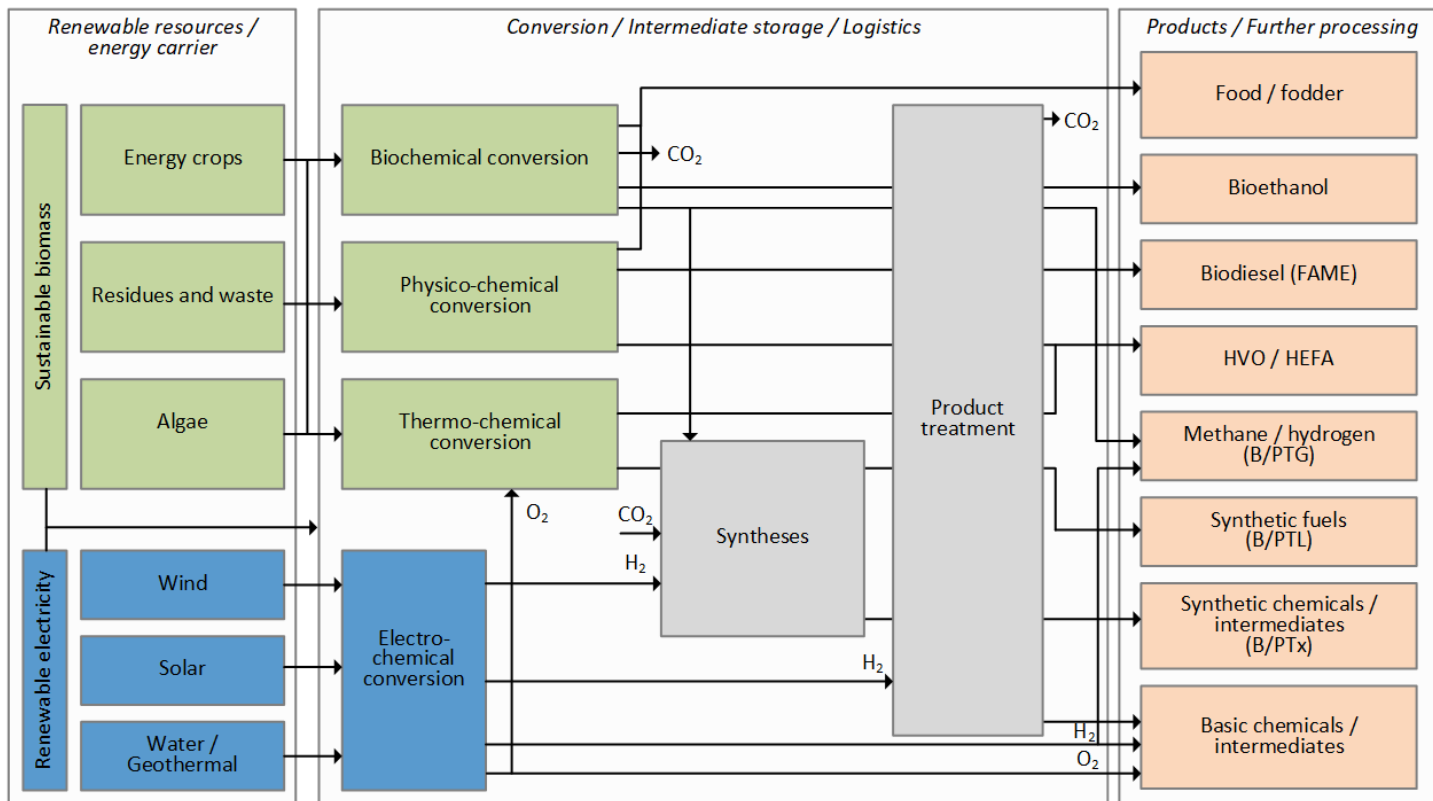
Technology Collaboration Programme on
Advanced Motor Fuels

Technical overview



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Different technology options and synergies



Further information



Resources for the production of renewable fuels

	Biomass rich in oil and fat	Biomass rich in sugar and starch	Lignocellulosic biomass	Mixed resource
Biogene Main products	Oilseeds	Sugarbeet and sugarcane	Logwood	
	Palm oil	Cereals, corn	Grass Farmed wood	
	Algae		Landscape maintenance material	
	Cover and intercrops		Other non-food material containing cellulose Other lignocellulosic material	
Biogenic By-products	Animal fats (cat. 1 and 2)		Straw, bagasse Wald- und Industrieholz	Crude glycerin
	Tall oil		Covers, husks	Raw methanol
	Other fats and oils			Animal fats (cat. 2 and 3)
Biogenic waste and residual materials	Used cooking oils and fats		Leaves, green cuttings Waste wood	Biowaste, organic municipal waste
	Animal fats (Cat. 3)	Waste from food and feed production		Sewage sludge, slurry, manure
		Biomass share of industrial waste		POME
	Residues from food and feed production			Wastewater and derivatives

Note: without claim to completeness, Cat. corresponds to category, potentially advanced resources according to [E4tech (2020)]

Resources for the production of renewable fuels

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Biogenic By-products	<ul style="list-style-type: none"> Animal fats (cat. 1 and 2) Tall oil Other fats and oils 			<ul style="list-style-type: none"> Crude glycerin Raw methanol Animal fats (cat. 2 and 3) Bio-based CO₂
Biogenic waste and residual materials	<ul style="list-style-type: none"> Used cooking oils and fats Animal fats (Cat. 3) Residues from food and feed production 	<ul style="list-style-type: none"> Waste from food and feed production Biomass share of industrial waste 	<ul style="list-style-type: none"> Leaves, green cuttings Waste wood 	<ul style="list-style-type: none"> Biowaste, organic municipal waste Sewage sludge, slurry, manure POME Wastewater and derivatives
PTX-Resources	<ul style="list-style-type: none"> Renewable electricity <ul style="list-style-type: none"> Wind Sun Hydropower 		<ul style="list-style-type: none"> Water <ul style="list-style-type: none"> Freshwater Saline water 	<ul style="list-style-type: none"> Carbon <ul style="list-style-type: none"> Point sources (recycled CO₂) Diffuse sources (atmospheric CO₂)

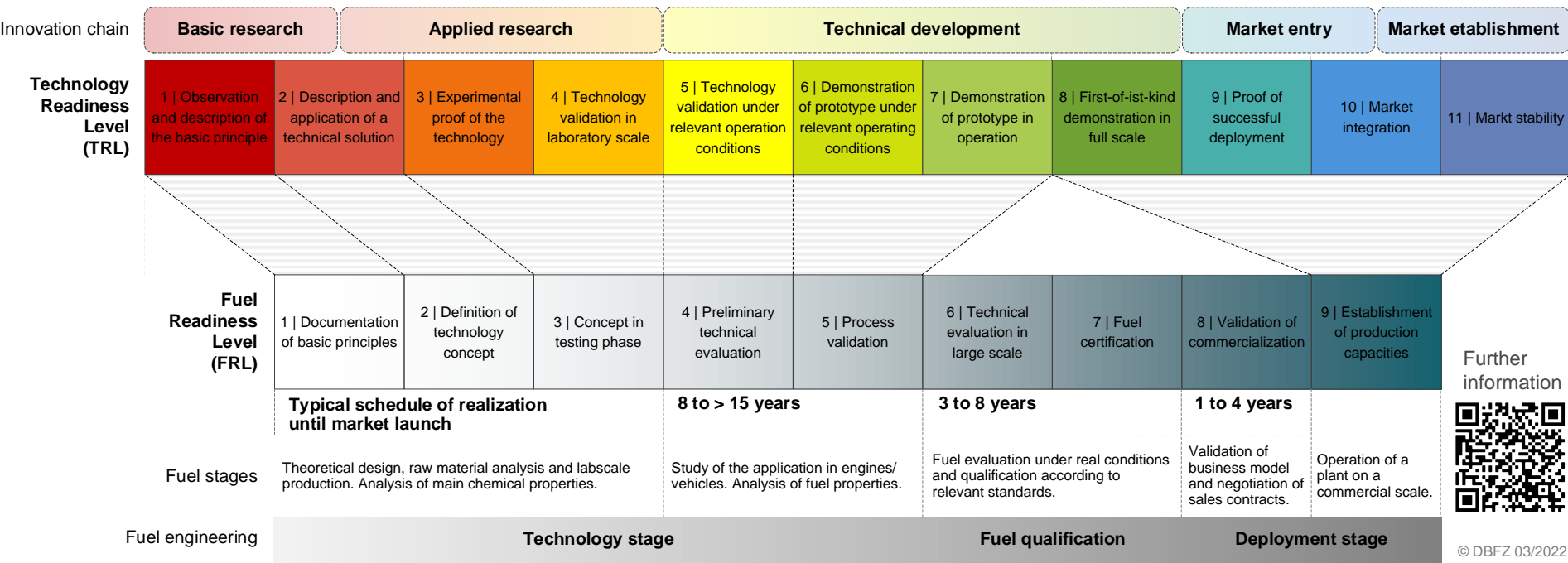
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- Conventional resource
- Advanced resource (RED II, Anhang IX A)
- Used cooking oils and animal fats (RED II, Anhang IX B)
- Potentially advanced resource
- Resource with high iLUC risk
- Electricity from renewable sources and resources for RFNBOs

Note: without claim to completeness, Cat. corresponds to category, potentially advanced resources according to [E4tech (2020)]

References and further information in [Schröder 2022]

State of development along the innovation chain



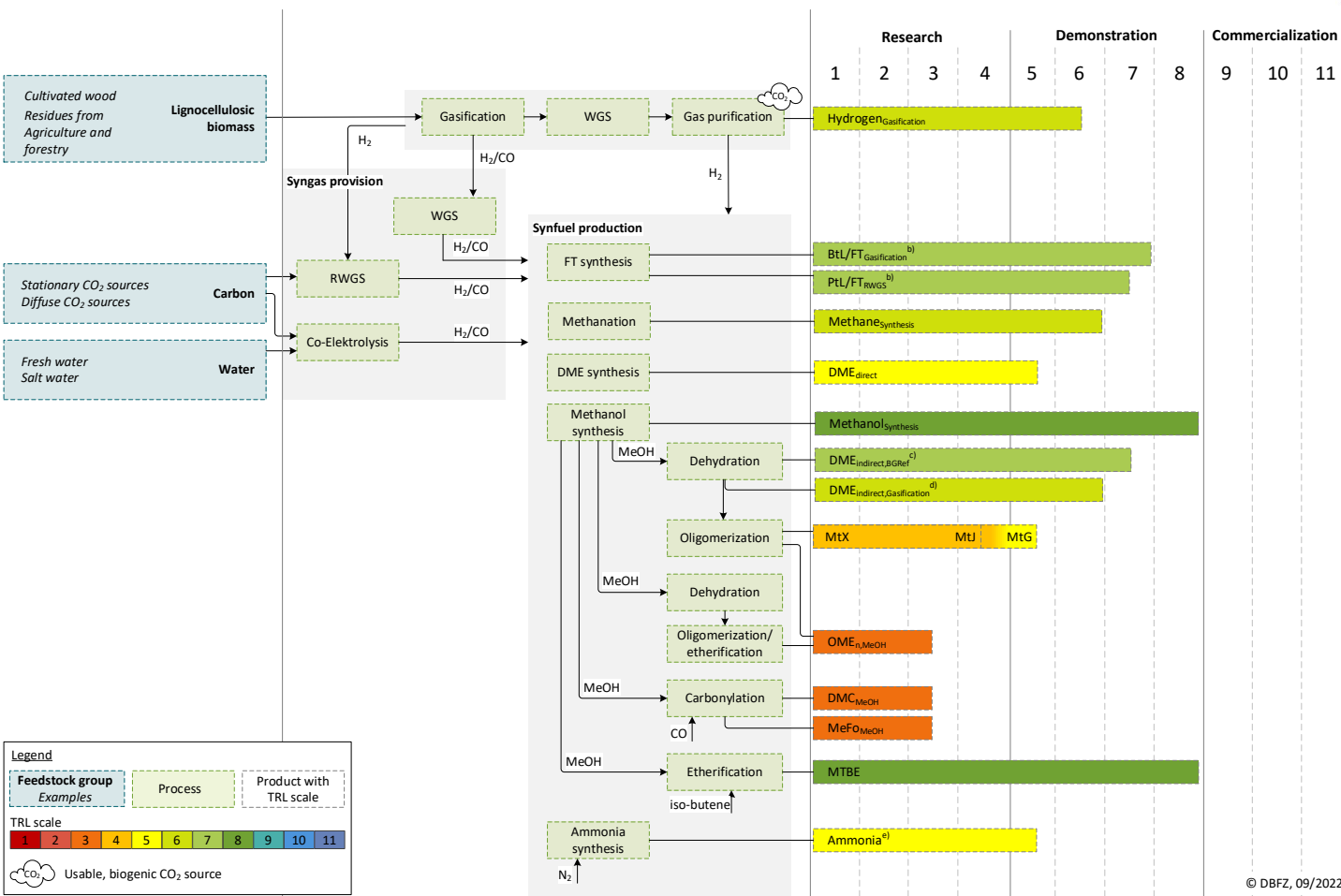
Further information



Ressources

Processes

Technology readiness level (TRL)



Many technical routes for synthetic / e-fuels

Further information



Legend

Feedstock group Examples	Process	Product with TRL scale
TRL scale		
Usable, biogenic CO ₂ source		

State of development

Option	Technology Readiness (TRL)	Capacity	Research and development (examples)
Vegetable oil	11	DE: 168 PJ	Use as fuel in agriculture and forestry sector as well as for off-road applications
Biodiesel (FAME)	11	EU: 759 PJ	Diversifying of resources (used cooking oils and animal fats)
HVO/HEFA	11 8 (biocrudes)	EU: 289 PJ	Diversifying of resources (like FAME and additional biocrude like pyrolysis oil); Flexibilization of product portfolio (diesel, jet fuel, naphtha and gases); SynBioPTX: use of green hydrogen for hydrotreating
Ethanol	11 (sugar, starch) 8 (lignocellulosic, residues)	EU: 227 PJ EU: 27 PJ	Diversifying of resources (lignocelluloses, industrial residues) Downstream processing to synthetic aviation fuels; SynBioPTX: CO ₂ recovery for syntheses with green hydrogen
Biomethane	11 (anaerobic)	EU: 68 PJ	Diversifying of resources (unused resources according RED II Annex IX A); Liquefaction to renewable LNG; SynBioPTX: CO ₂ recovery for syntheses with green hydrogen
Hydrogen	9 (electrolysis) 5 to 8 (others)	EU: < 1 PJ	BECCU/S: methane pyrolysis; Seawater treatment; Product synthesis of follow-up products
Synthetic fuels (BTX, PTX)	3 to 8	EU: 1 PJ	Fuel synthesis (e.g. methane, methanol, paraffinic fuels, oxygenates, alcohols-to-fuels); SynBioPTX: biomass as renewable carbon source