Advanced Biofuels

The technology nexus

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Biomass, bioenergy, and low carbon fuels

Low Carbon Biofuels Forum

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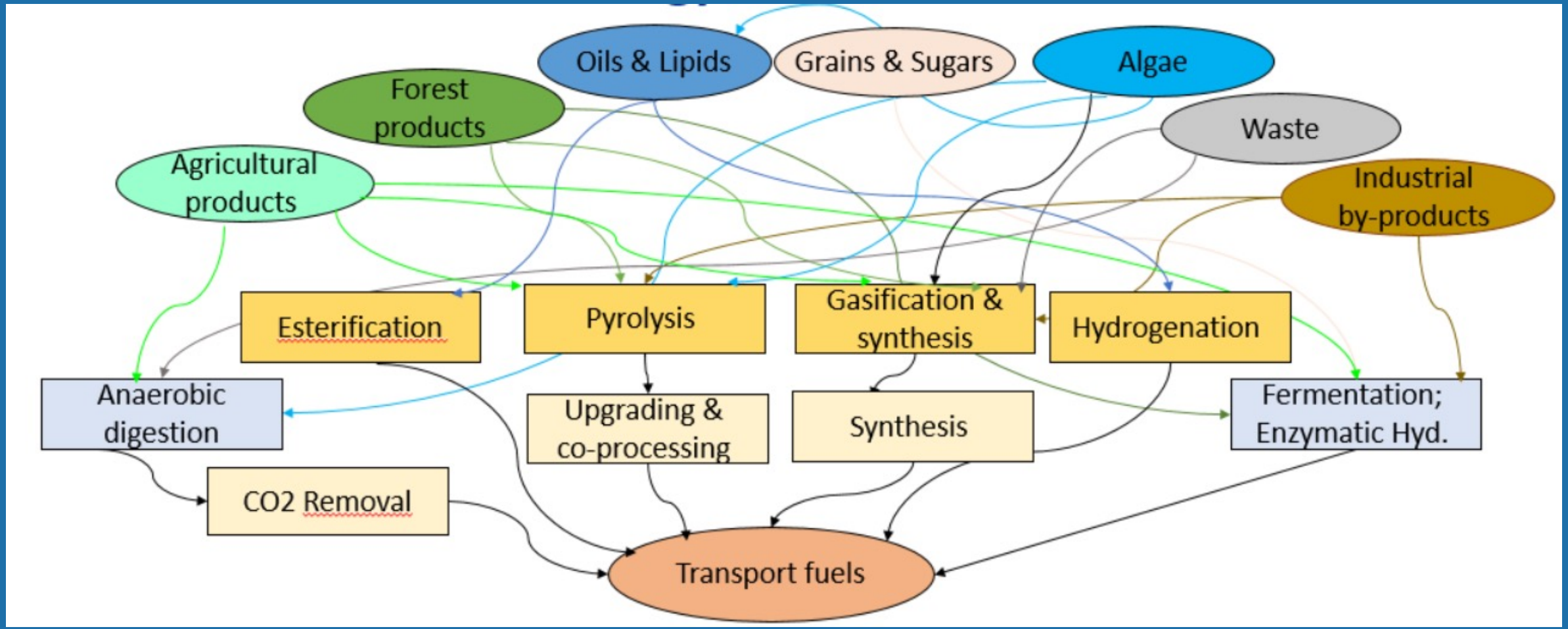
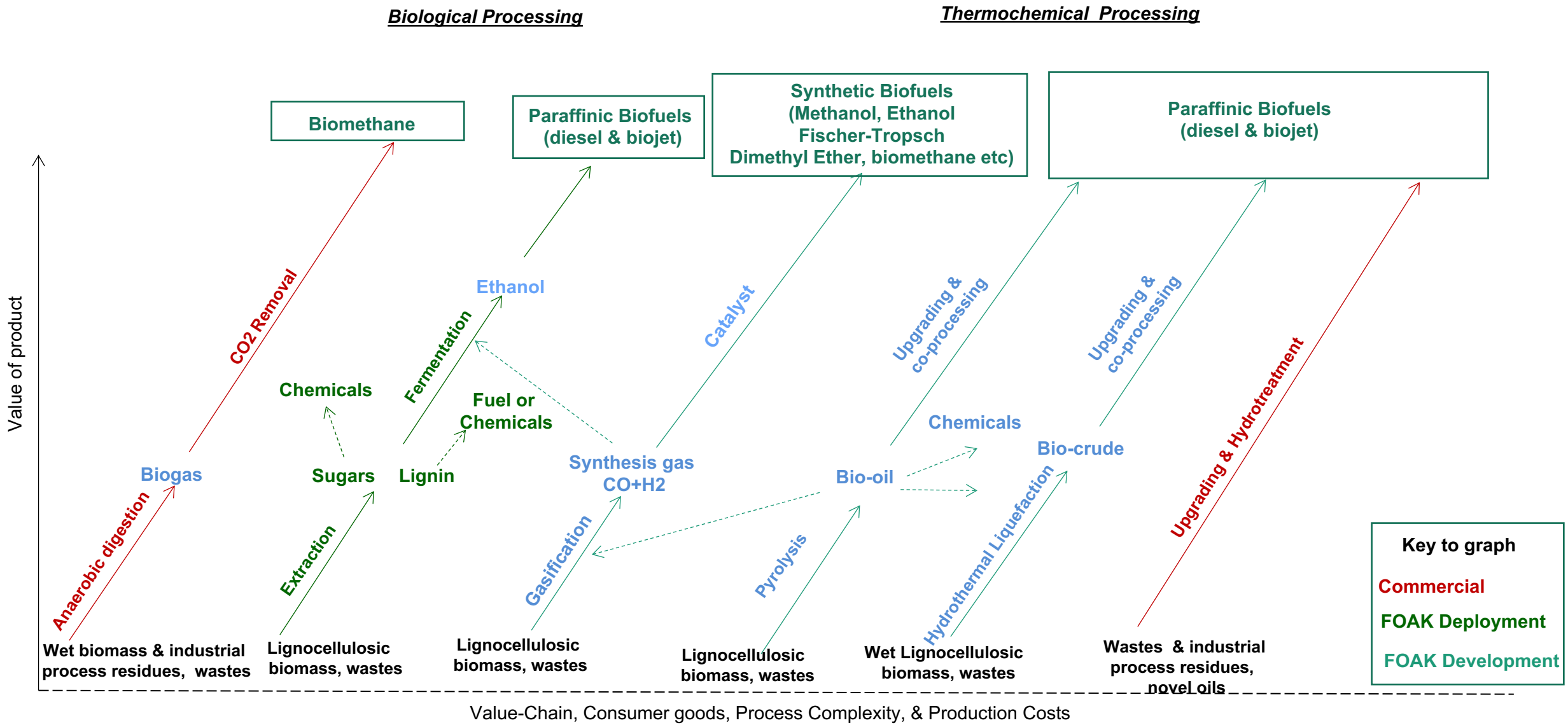
Biomass to transport fuels - Complexity and opportunity

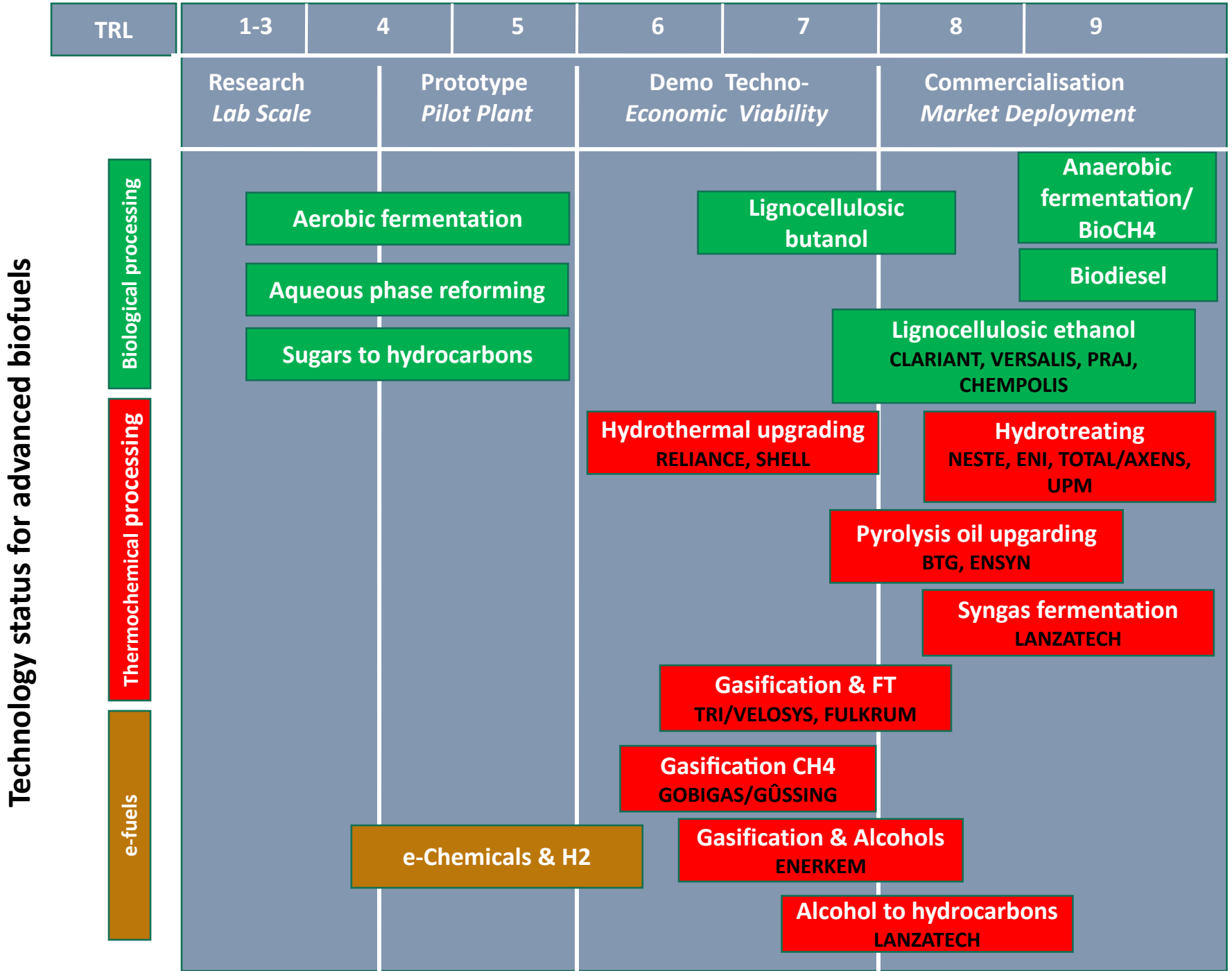


Available technologies for advanced biofuels



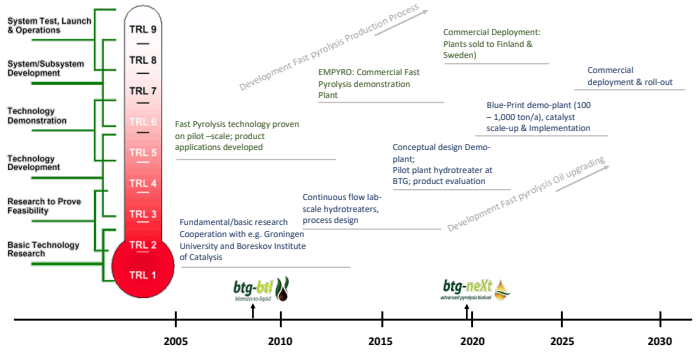
Adding value to biomass by processing to advanced biofuels and to biochemicals

Status of advanced biomass conversion technologies based on their TRL level

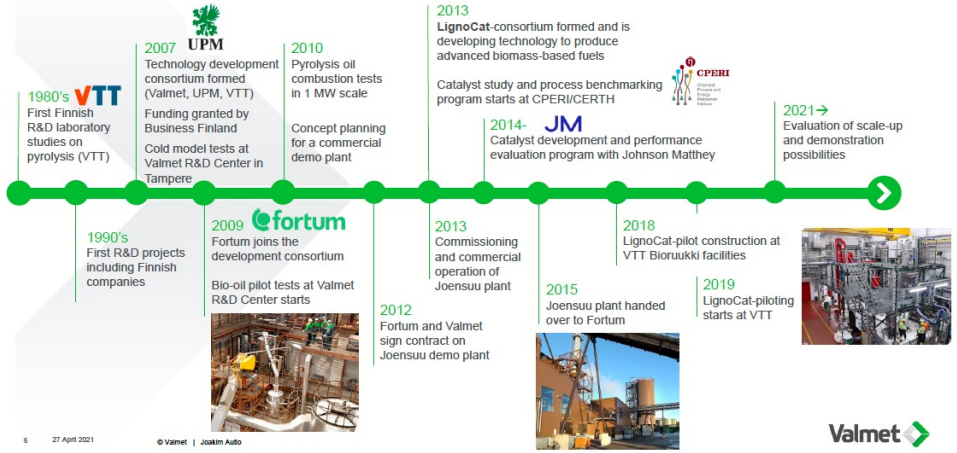


It takes a long time to bring a technology from lab scale to First-of-a-Kind and market deployment

BTG Fast pyrolysis

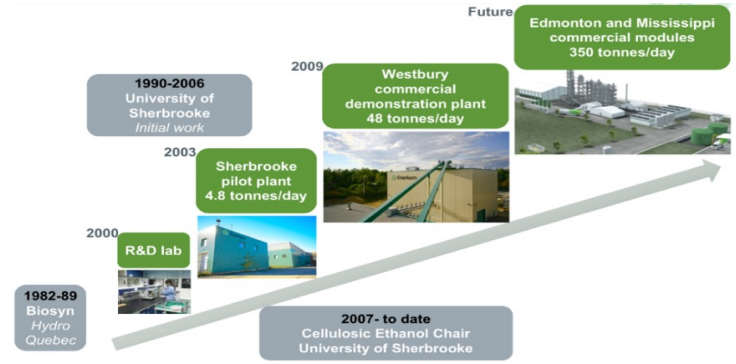


Valmet's Pyrolysis R&D, in co-operation with partners

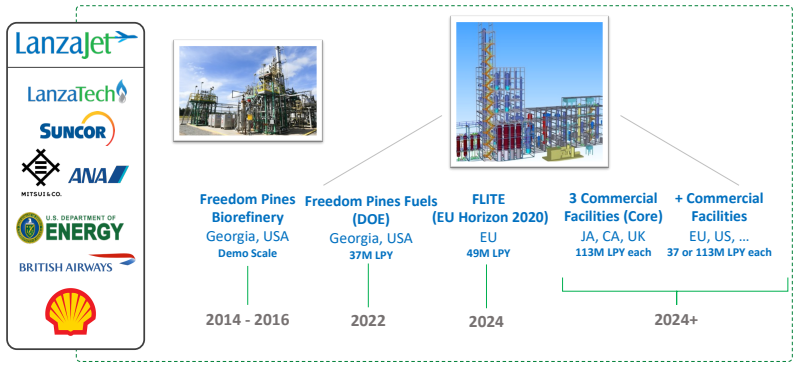


Valmet

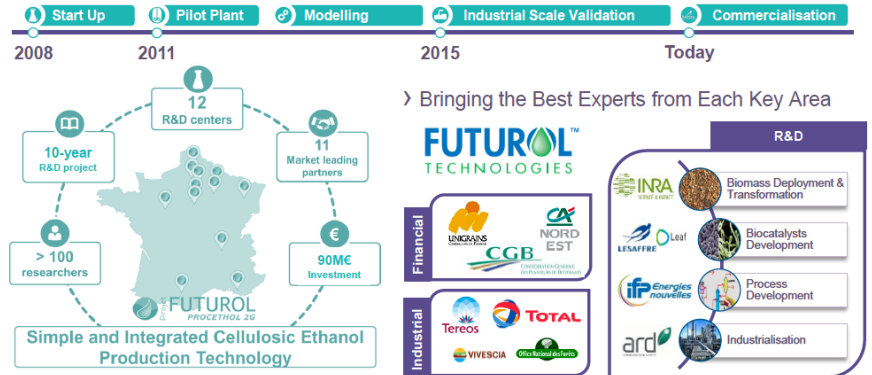
ENERKEM Gasification to ethanol/methanol



Commercial Scale-up of Sustainable Aviation Fuel



Development & Commercialisation of Futurol™



It takes on the average 2-3 years to build such a commercial facility

Available technologies for advanced biofuels: Hydrotreated oils

NESTE's HVO biorefinery, Poorvo, Finland

NESTE's HVO plant, Rotterdam

NESTE is global leader
(2,700,000 t/y)

ENI's Green Refinery Project, Venice

ENI: 375,000 t/y

UPM's Lappeenranta Biorefinery plant

UPM tall oil, works on
Brassica carinata oil
(100,000 t/y)

TOTAL's La Mède Biorefinery

TOTAL: 500,000 t/y

The Manali Refinery (India)

Indian Oil Corporation Ltd has developed a technology for co-processing of non-edible oils in Diesel Hydrodesulfurization/ Diesel Hydrotreating (DHDS/DHDT) units of the refinery. In this process de-gummed and de-metalled non-edible oil is mixed with diesel feed and fed into the DHDS/DHDT reactor along with recycled hydrogen.

Diamond Green Diesel, Louisiana (USA)

The plant utilizes the Ecofining™ process from UOP to convert feedstocks like vegetable oils, animal fats and greases to “drop in” hydrocarbon fuels viadeoxygenation, isomerization and product separation.

The AltAir Renewable Jet Fuel Project, Los Angeles, USA

The plant utilizes UOP Renewable Jet Fuel Process to convert feedstocks like vegetable oils, animal fats and greases to “drop in” hydrocarbon fuels via deoxygenation, isomerization, hydrocracking and product separation.

The commercialisation is global with several plants operational at commercial scale while new ones are being announced.

Key problem is the availability of non-edible oil resources and process residues

Available technologies for advanced biofuels: Cellulosic ethanol

Biochemtex/VERSALIS
Cresentino plant, Italy

Clariant's development plant, Germany

Clariant's cellulosic ethanol plant Craiova, Romania

ST1 Kajaani sawdust plant, Finland

The SEKAB plant Sweden

The AXENS FUTUROL pilot plant at Pomacle, France

The BORREGAARD demonstration plant at Sarpsborg, Østfold county, Norway

Borregaard has been engaged in pulp and paper processing. Borregaard's core business is based on the concept of a biorefinery that produces chemical products based on different types of lignocellulosic feedstock. The bioethanol that is produced in Borregaard's biorefinery is based on extracting sugar from wood (spruce), which is then fermented to make lignocellulosic ethanol. The production started already in 1938. The bio-ethanol process in the commercial operation is technically almost the same as it was from the start in 1938. Borregaard supplies bio-ethanol to Statoil, but most of volumes are sold for use in chemical products or as solvents.

GranBio's Bioflex 1 Plant, Alagoas, Brazil.

The Bioflex 1 plant is owned by GranBio and is utilizing the PROESA two-stage pretreatment steam explosion technology from BetaRenewables, enzymes from Novozymes in Denmark, and yeast from DSM in Holland. The Bioflex plant is co-located with an existing first-generation ethanol plant from sugarcane. Both facilities only share a common CHP unit integrated in the same site that uses both sugarcane bagasse (1G plant) and lignin (from 2G plant). The integrated power unit coproduce 70 MWel, having a surplus of 50 MWel sold to the grid.

The Amyris plant in Brazil

The Amyris industrial production plant in Brotas, Brazil converts sugarcane syrup into farnesene and other tailored molecules for a range of renewable products including a biocomponent for the diesel and jet-fuel.

LanzaTech's Plant at ArcelorMittal, Ghent, Belgium

Steelanol & Torero projects: Bioethanol from torrefied wood gasification and waste gases produced during steelmaking via gas fermentation using steel process gases. The investment cost is 185 M€ using 90 000 Nm^3 waste gas/h from blast and basic oxygen furnace to produce 64,000 ton/year ethanol. The project, aimed to produce ethanol from steel waste gas, will be sufficient to fuel half a million cars with ethanol blended gasoline.

This project is co-funded by the European Union

Views of the Praj Industries demonstration plant in Daund, in Pune district 12 TPD of feedstock

Indian Oil colocation plant at Panipat, Haryana, India

The Institute of Chemical Technology (ICT) has developed commercial technology which has been demonstrated at India Glycol Ltd (IGL), Kashipur246 on continuous processing pilot plant. The process is based on a novel two step continuous enzyme process with rapid reaction rates and reduction in enzyme dosage and reaction time resulting in more than 90 % yield of sugars from biomass. The ethanol yield is > 300 L/Ton biomass.

The demonstration plant at India Glycol Ltd, Kashipur India

The development is global; several FOAK plants are operational while new ones at commercial scale are being announced.

Key problem is the availability of adequate financial support

Available technologies for advanced biofuels: Gasification

Enerkem Plant in Edmonton, Canada

BioTfueL pilot plant in Dunkerque

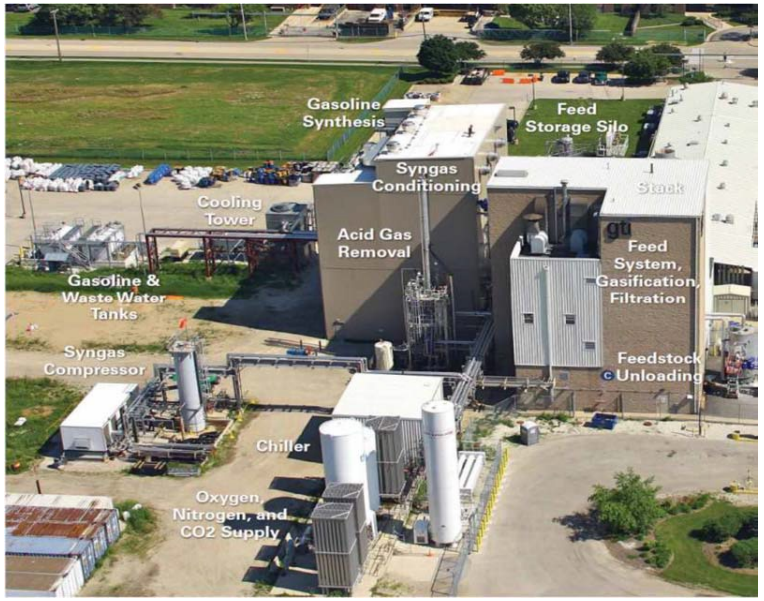
Torrified biomass to BTL

KIT's bioliq plant

LTU Green Fuels' plant in Piteå

Black liquor to bioDME

The GTI gasification plant , Des Plaines, USA



Biomass CHP Güssing, Austria

The “Gogreengas” Pilot Plant, Swindon, UK

The Gogreengas pilot plant is a development facility for proving and optimizing the process for manufacturing Bio-SNG from Refuse Derived Fuel (RDF) and biomass feedstocks. The project is a partnership between National Grid Gas Distribution, Advanced Plasma Power (APP), Progressive Energy and Carbotech (a subsidiary of Viessmann).

Only ENERKEM at present is active in commercial deployment.
Little commercial activity for the demo plants.
Fischer-Tropsch production still in progress

Available technologies for advanced biofuels: Pyrolysis

BTG's Empyro plant, Nettherlands

Sawdust to oil for CHP application

Fortum‘s plant in Finland

Biomass to oil for boiler applications

Fraunhofer's TCR300 plant in, Germany

Sewage sludge to biofuels

The Karlsruhe Institute of Technology Bioliq plant

ENSYN plant in Renfrew, Canada

ENSYN has formed a joint venture with Honeywell UOP called Envergent.

Pyrolysis oils for boiler and CHP applications is commercial.

Serious efforts in co-processing pyrolysis oils in refineries and upgrading.

BTG/Green Fuel Nordic, Joensuu, Finland

BTG/Preem-Setra in Gävle, Sweden
Coprocessing

CRI/SHELL demonstration plant in Bangalore, India

Biomass liquefaction technology to produce Biogas/Biomethane. It is a hybrid patented technology based on Catalytic Thermo-Liquefaction (CTL) of biomass or MSW

Available technologies for Algal biofuels - Biomethane

All-gas

"Industrial scale demonstration of sustainable algae cultures for biofuel production"

European Commission – co-funded by EC
SEVENTH FRAMEWORK PROGRAM
ENERGY.2010.3.4-1
Biofuels from algae
Project Number: 268208

aqualia Southampton HYGEAR BDI Fraunhofer

Available technologies for eFuels

Power to Hydrogen: Falkenhagen Hydrogen production and grid injection, Germany

E.ON's power-to-gas pilot unit in Falkenhagen, Germany has injected more than 2GWh of hydrogen into the gas transmission system in its first year. The Falkenhagen unit uses renewable-sourced electricity to power electrolysis equipment that transforms water into hydrogen, which is then injected into the natural gas transmission system. With an electrolyzer capacity of 2MW, it can produce 360Nm3/h of H2.

Power to Gas: Audi/ Solar Fuels e-gas, Germany

The largest PtG demonstration plant has been developed by Solar Fuel GmbH, for Audi and built in Werlte in Germany. This plant has an electrical capacity of 6.3MWel, producing 360Nm3/h methane, which will be injected in the local gas distribution grid, and ultimately can be certified for use in Audi's Natural Gas Vehicles (NGV) range. The CO2 source for the methanation process is the stripped CO2 from a waste treatment biogas plant nearby.

CRI’s Power to Methanol: The George Olah plant, Iceland

Carbon Recycling International Renewable Methanol Plant, Grindavik, Iceland.
Photo by Carbon Recycling International

The largest Power-to-Methanol facility has been operating in Iceland for the last 5 years. CRI’s ‘George Olah’ Renewable Methanol Plant in Svartsengi, near Grindavik, Iceland began production in late 2011 and was completed in 2012. In 2015 CRI expanded the plant from a capacity of 1,300 tonnes per year to 4,000 tonnes per year. The plant now recycles 5,600 tonnes of carbon dioxide a year which would otherwise be released into the atmosphere.

Related technologies for fuels – “non bio” according to EU legislation

Lanzatech 46 kMTA steel mill emissions - 2018

Lanzatech Refinery gas to ethanol using CO2 as feedstock, India

Lanzatech Shougang group, steel producer, Hebei province, China

Abandoned large scale plants

Abandoned plants - cellulosic ethanol

Abengoa's demonstration plant at Babilafuente Salamanca, Spain

ABENGOA's Hugoton plant, USA

The Inbicon/Dong demonstration plant at Kalundborg, Denmark

POET-DSM Liberty plant in Emmetsburg USA

DuPont's Nevada Plant, Iowa, USA

On a yearly basis the plant will use 350,000 dry tonnes of corn stover to produce 90,000 tonnes of ethanol. Key areas of concern which may affect ability to attract many licensees of the DuPont Cellulosic Ethanol Technology are clarity and stability of biofuel regulation, biomass collection and supply, capital requirement and cost of operation.

Abandoned plants – synthetic biofuels

The CHOREN Fischer-Tropsh pilot plant

OPTFUEL project, Consortium led by VW,

GoBiGas plant in Gothenburg

The INEOS Indian River facility in the US

The plant was built to manufacture cellulosic ethanol via gasification and fermentation technology; (8 million gallons of bioethanol per annum and 6 megawatts of power from local yard, vegetative and household wastes); 2013-2015.

Thank you for your attention

https://www.lcb-forum.com/

"Post COVID-19 Recovery and 2050 Climate Change Targets: Changing the Emphasis from Promotion of Renewables to Mandated Curtailment of Fossil Fuels in the EU Policies"
https://www.mdpi.com/1996-1073/14/5/1347/pdf