Any Role for Advanced Biofuels in Decarbonising Transport? Do we have the Right Policies?

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Biomass, advanced biofuels and low carbon fuels

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To answer the question we need to ask two questions:

Do we have sufficient sustainable biomass quantities to be used as feedstock in the various value chains?,

and,

Do we have the available technologies needed to convert the biomass into Advanced biofuels?

To answer these questions the presentation will discuss the results from a recent study carried out by Imperial College commissioned by Concawe.

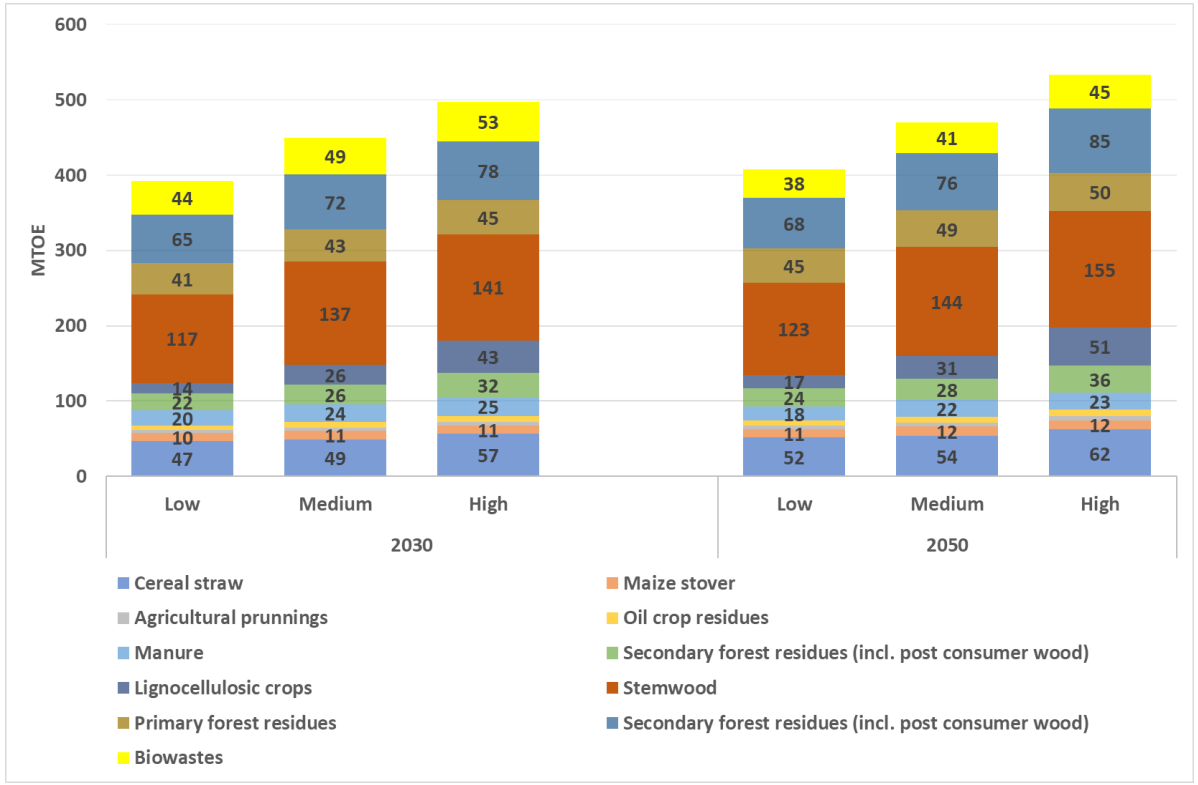
Biomass availability study in a nutshell

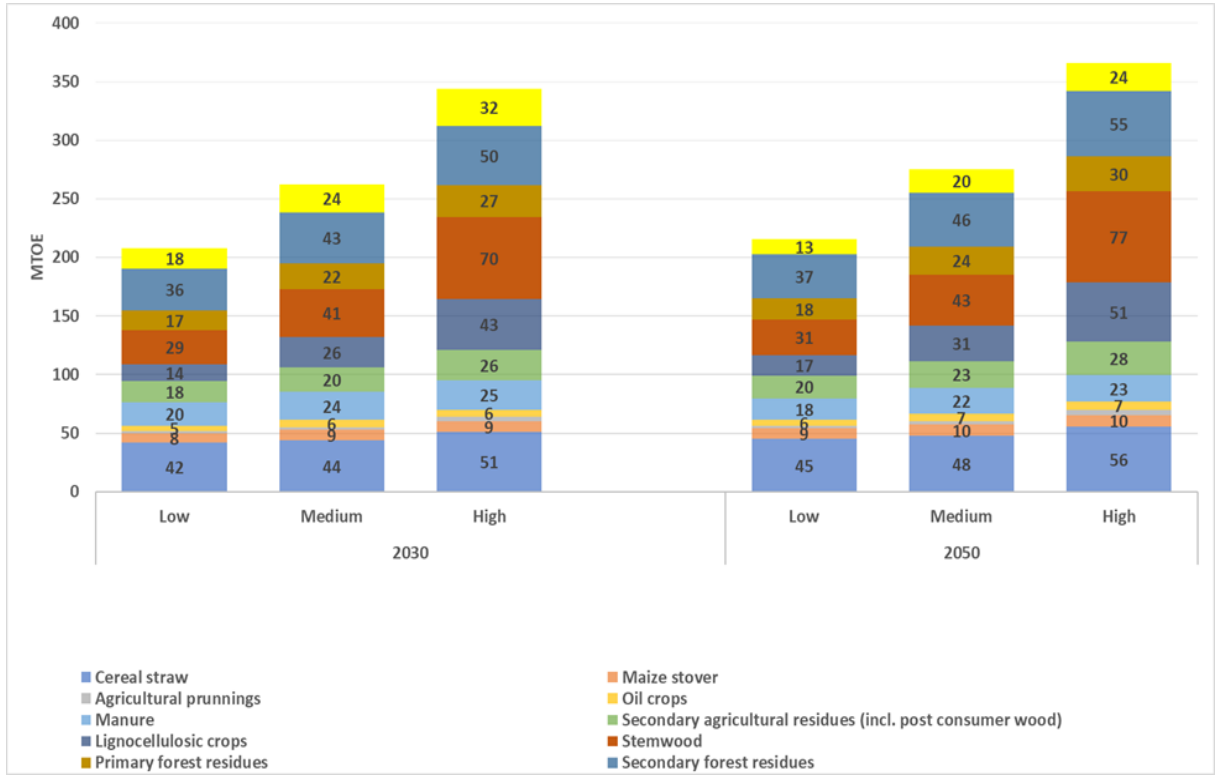
- Timeline: October 2020- June 2021
- Overview of the sustainable biomass availability in the European Union and the UK by 2030 and 2050.
- Food and feed crops are not included in this study.
- Only domestic (EU27 & UK) feedstocks of agricultural, forest and waste origin included in Annex IX of RED II (Part A and B).
- A short overview, but not detailed estimates of the potential for imports and algae.
- Up-to-date assumptions, that are in line with the European Green Deal, for the sustainable increase of available biomass acknowledging the biophysical restrictions of land resources and feedstocks as well as the adverse effects of climate change.

Estimated total sustainable biomass (Mtoe)

Subtracting allocation to biobased products

All markets → Bioenergy





- ✓ **Concawe's scenarios forecast a total EU potential biomass for all sectors of 392-533 Mtoe/y by 2030/2050.**
- ✓ **Allocation to bioenergy sector of 208-366 Mtoe/y by 2030/2050**

Important considerations

What is the sustainable biomass availability (2030/2050) with no impact on biodiversity?

The potential is there- It is important to highlight that the biomass potential availability estimated in this study are based on very conservative assumptions.

Furthermore, **additional potential to the one estimated by this study can be expected** the potentials from algal biofuels plus other sustainable biomass feedstocks not included in RED II Annex IX that have not been taken into consideration at all in the above calculations.

Therefore, it can be concluded that the **biomass potentials in 2030 and 2050 would most probably be higher than those estimated by this study**.

However, to realise this potential, **additional R&D would be required as well as the implementation of improved management strategies**. Even if the potential is there, the supply chain would need to be developed to mobilise all these resources.

This means that an enormous effort must be done in all Member States, as the maturity and reliability of several key biomass conversion technologies is still an issue and their progress towards market deployment is an important concern.

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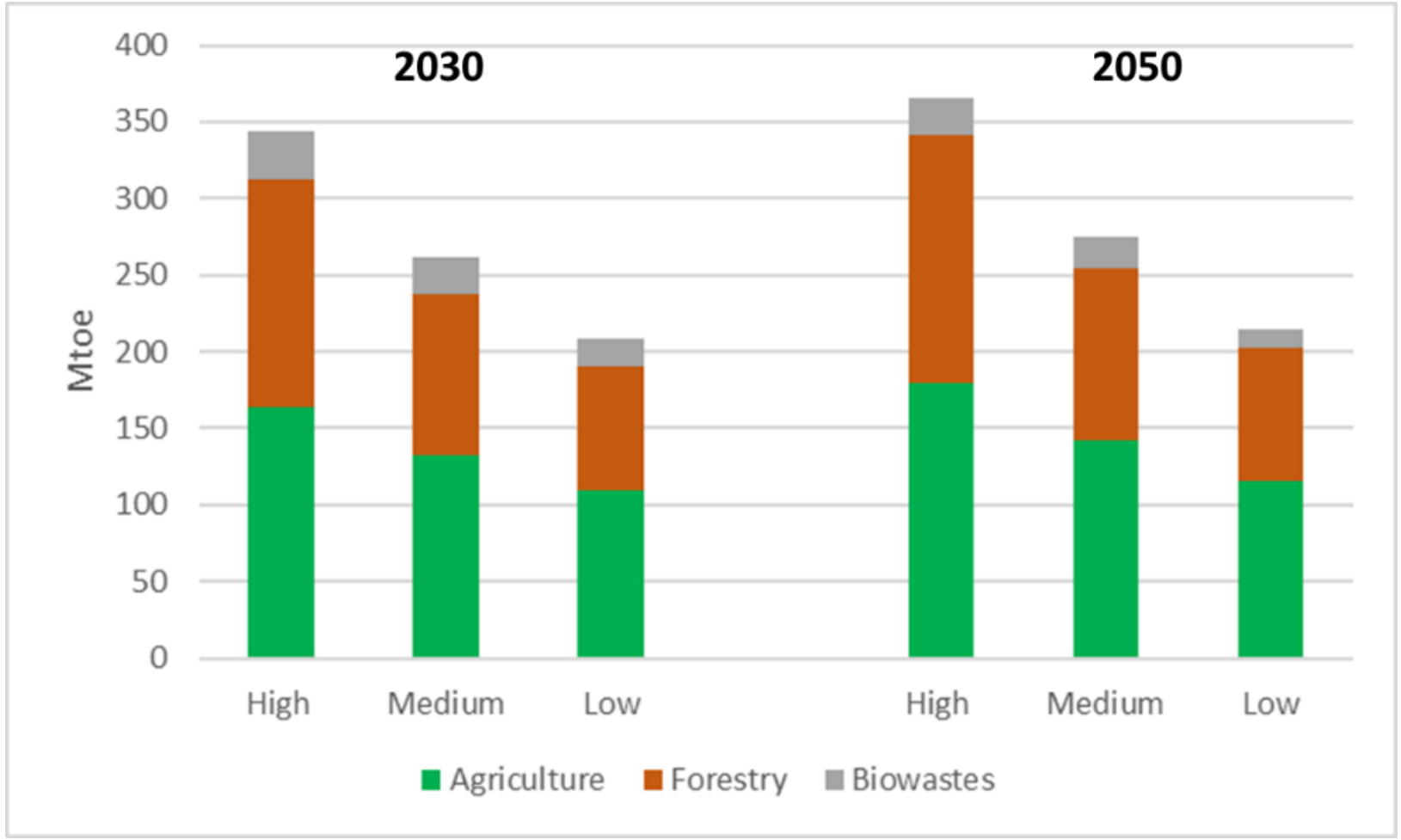
Biomass availability for bioenergy in the EU (Annex IX Part A & B)



Three scenarios have been analysed:

i) Low biomass mobilisation,

ii) Improved mobilisation in selected countries due to improvements in cropping and forest management practices, and,

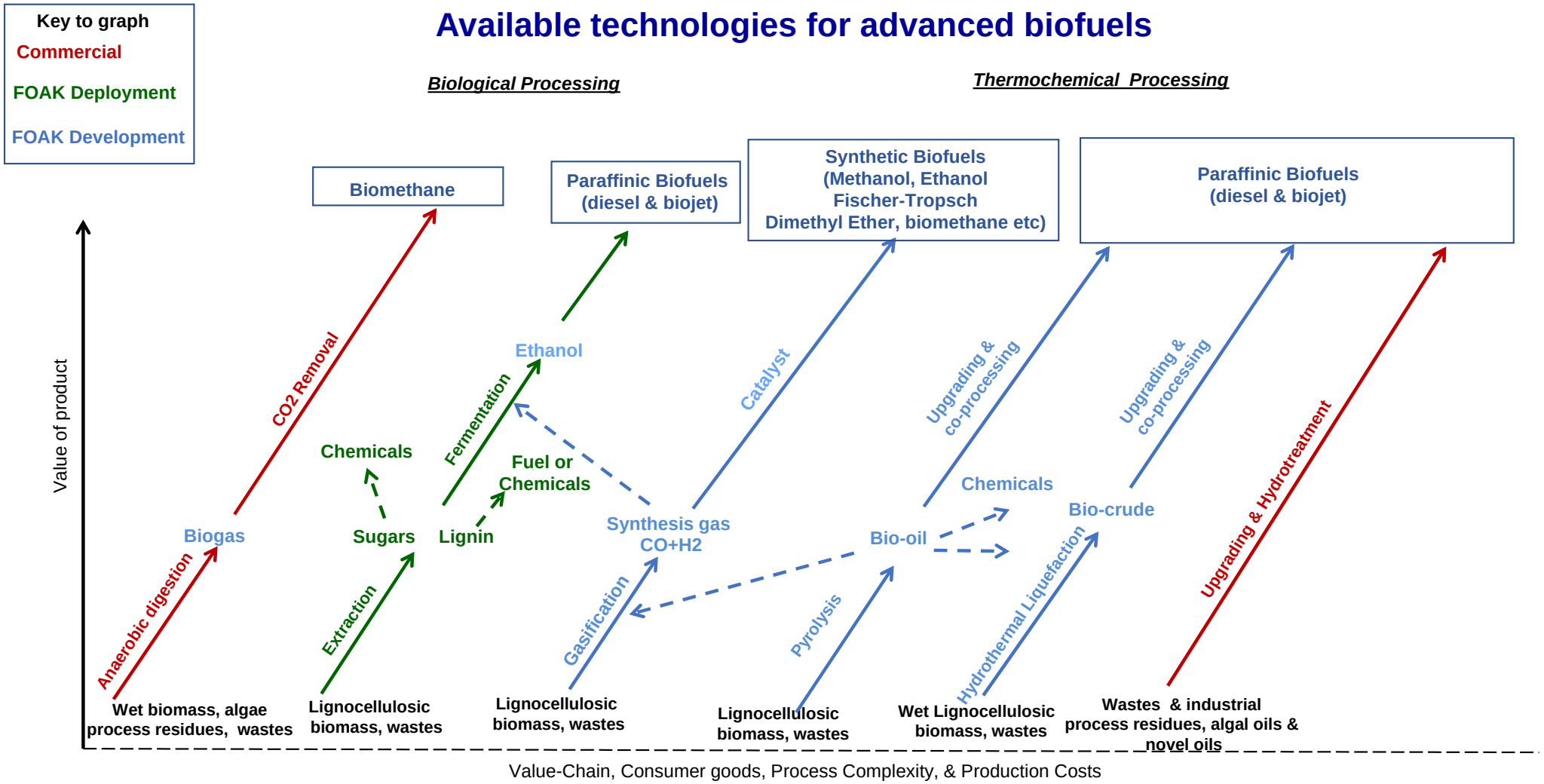
iii) Enhanced availability through Research and Innovation (R&I) measures as well as improved mobilisation due to improvements in cropping and forest management practices.

Key Messages on Biomass Availability

What is the sustainable biomass availability (2030/2050) with no impact on biodiversity?

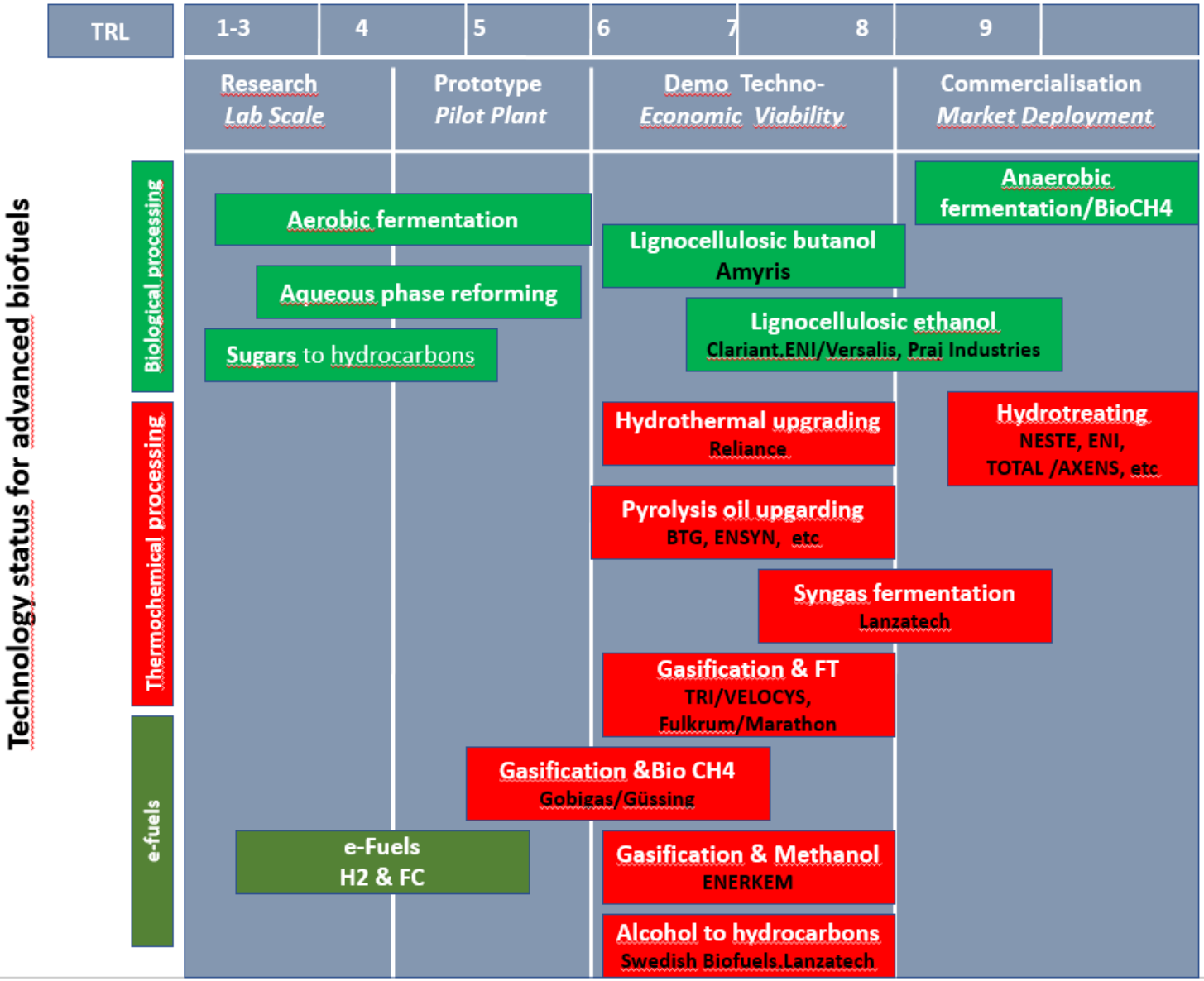
- Many different publications providing different ranges with not always transparent assumptions
- Concawe has commissioned a study with Imperial College. Main results:
  - ✓ Total EU potential sustainable biomass availability (agriculture, forestry and biowastes) for all sectors of 392-533 Mtoe/y (low-high scenario) by 2030/2050.
  - ✓ Allocation to bioenergy sector of 208-366 Mtoe/y (low-high scenario) by 2030/2050.
  - ✓ These results show the total bioenergy sector, as competition in bioenergy sectors (power, industry, residential, transport) have not been explored in detail.
  - ✓ The European Commission (A Clean Planet for all, Impact Assessment) is allocating ~120-170 Mtoe/y (2030/2050) of the bioenergy to power + industry + residential sectors. This means that, even with EU COM power allocation, there is a potential of 88- 196 Mtoe/y of biomass for transport sector in 2050.
- Concawe will use this estimate to support the assessment on the potential deployment of low carbon fuels in the transport sector towards 2050.

Status of Biomass Conversion Technologies for Advanced Biofuels



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

Status of advanced biofuels technologies based on their TRL level as well as their status based on the technology development roadmap



Assumptions

Assumption N°	Description
1	By 2050 there is abundance of renewable hydrogen (RH) that can also be used in advanced biofuel production.
2	Fischer-Tropsch (FT) is commercial by 2030. The drop-in characteristic of FT facilitates blending in various applications in addition to using FT neat in diesel engines.
3	Conversion yield for FT increases to 40% (mass) in 2050 with hybrid gasification + Renewable Hydrogen (RH). Using RH in the gasification process allows significant conversion of the carbon from carbon dioxide and carbon monoxide to fuel resulting in significant higher carbon conversion efficiencies.
4	Pyrolysis FCC-coprocessing is commercial by 2030.
5	Stand-alone fast pyrolysis with Renewable Hydrogen is commercial by 2050. Using RH to upgrade the bio-oil allows in-situ production of hydrocarbon fuels.
6	Hydrothermal liquefaction (HTL) is commercial by 2030 and is applied with the FCC coprocessing.
7	Stand-alone HTL with Renewable Hydrogen is commercial by 2050. Using RH to upgrade the bio-crude allows in-situ production of hydrocarbon fuels.
8	All biomethane produced in 2030 and 2050 is fed to the natural gas grid.
9	Conversion of biomass to hydrogen is not considered for simplification.
10	Conversion of biomass to methanol is not considered for simplification. There are no prospects at present to increase the oxygen content in the petrol EN228 standard. Methanol is considered by the shipping industry as a potential fuel but there are also several other alternatives for shipping.
11	Cellulosic ethanol is commercial by 2030.
12	Ethanol conversion to hydrocarbons is considered in 2050. Light duty vehicles are expected to be completely electrified by 2050. This will facilitate the utilisation of ethanol in aviation and other sectors.
13	For well-established commercial technologies such as hydrotreated vegetable oils (HVO) biomethane via anaerobic digestion and ethanol via gasification and fermentation, no improvement in conversion yield is foreseen in 2050

High Technology Scenario: Potential advanced biofuel quantity per feedstock for 2030 and 2050, taking into account the maximum yields per pathway and the total sustainable biomass for bioenergy)

Biofuel	Feedstock	2030 Estimated advanced biofuel quantity (Mtoe)	2050 Estimated advanced biofuel quantity (Mtoe)
Hydrotreated Vegetable Oil /renewable diesel	Waste oils and fats	1.9	1.9
	Used Cooking Oil (UCO)	2.6	6.5
Biomethane	Sewage sludge	0.1 - 0.2	1.0 - 1.2
	Manure (solid and liquid)	1.1 - 1.3	0.4 - 0.4
	Agricultural residues (high moisture; sugar beet leaves, etc.)	0.1	0.1
Ethanol and hydrocarbons from Enzymatic hydrolysis & fermentation	Agricultural residues (straw-like)	21.0 - 25.3	N/A
	Lignocellulosic crops (grassy)	5.5 - 16.6	6.5 - 19.6
Fischer-Tropsch from Gasification + catalytic synthesis	Biowaste	9.2 -16.8	13.2 - 24.4
	Solid industrial waste (secondary agro and forest industries)	27.9 - 40.1	56.8 - 84.0
	Agricultural residues (straw-like)	N/A	54.4 - 62.4
	Agricultural (woody) & forestry residues	1 - 1.5	2.4 - 3.2
	Lignocellulosic crops (woody)	7.6 - 22.7	16.8 - 50.8
Total		78.0 – 129.1	160.0 – 254.5

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Comparison of biomass available for biofuels among this study including imports and PRIMES allocation to other non-transport sectors (Mtoe) and total estimated biomass for biofuel

	2030	2050
Estimated biomass for bioenergy (this study)	208-344	215-366
Estimated biomass imports (this study, see Annex 2)	48	56
Estimated biomass for advanced biofuels (*): balance of biomass for biofuel accounting the demand for other uses estimated by PRIMES (EU Commission)	78 – 214	45 – 196
Total estimated biomass left for biofuels in transport (with imports)	126 - 262	101.- 252

(*) Estimated biomass for advanced biofuels if the power, industry, services & agriculture and residential heat demand biomass allocation estimated by PRIMES is taken into account.

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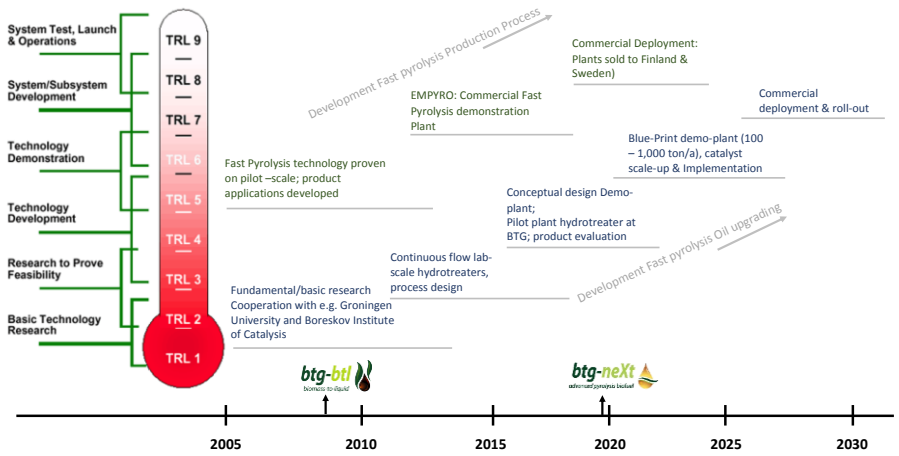
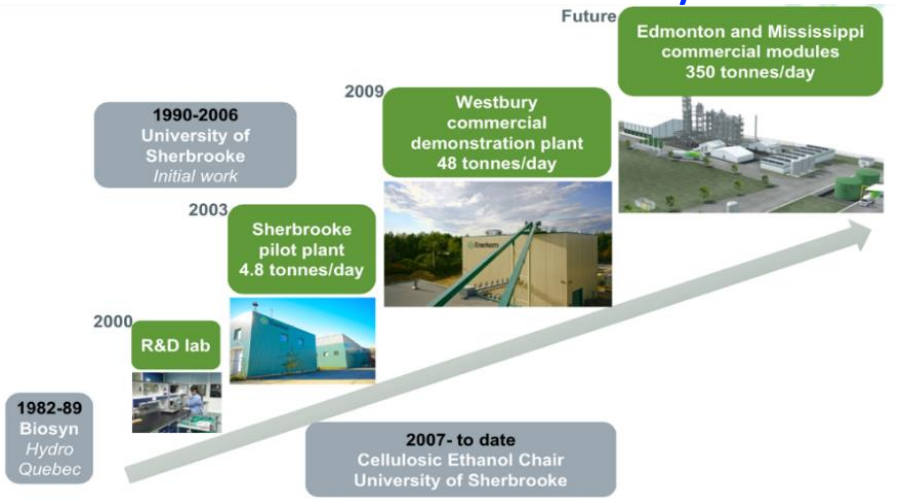
It takes a long time to bring a technology from lab scale to First-of-a-Kind and market deployment

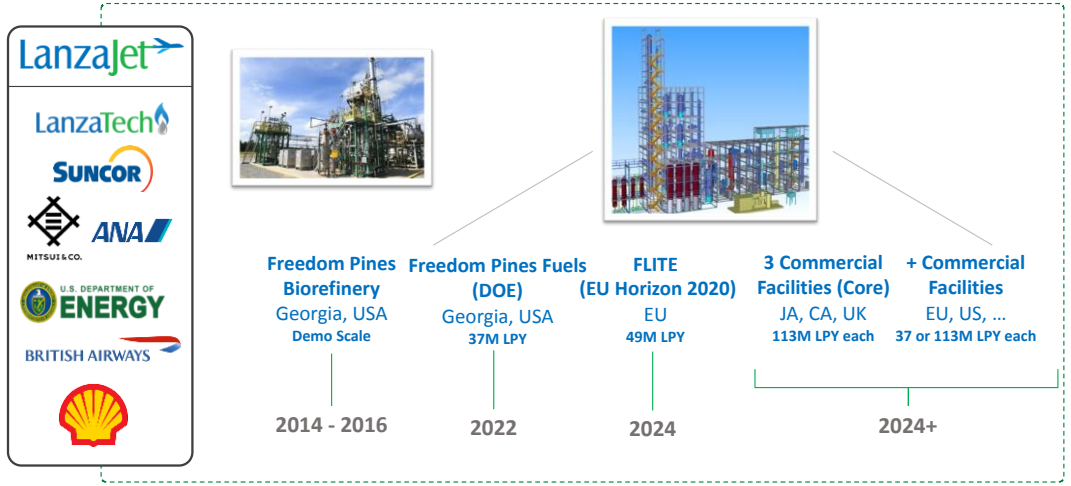
BTG Fast pyrolysis



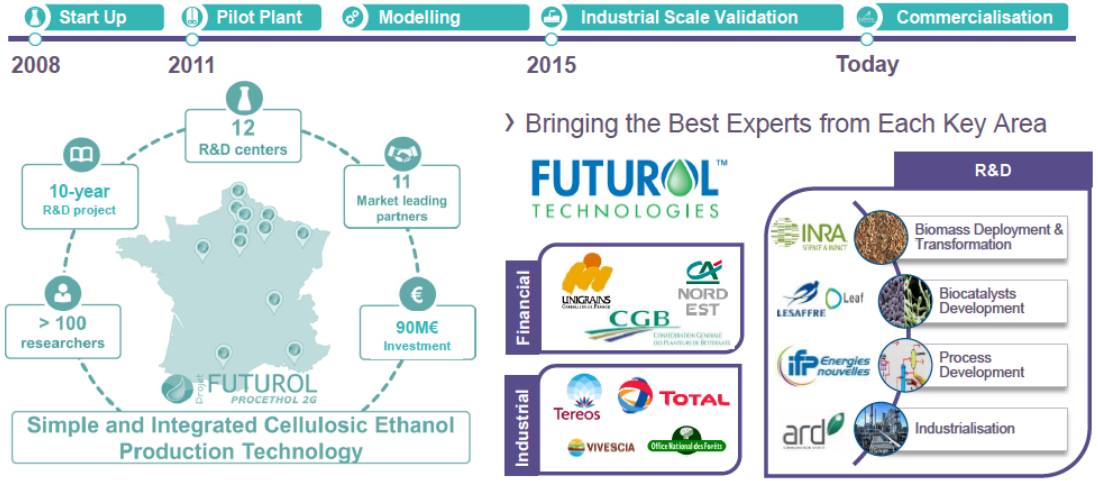
ENERKEM Gasification to ethanol/methanol



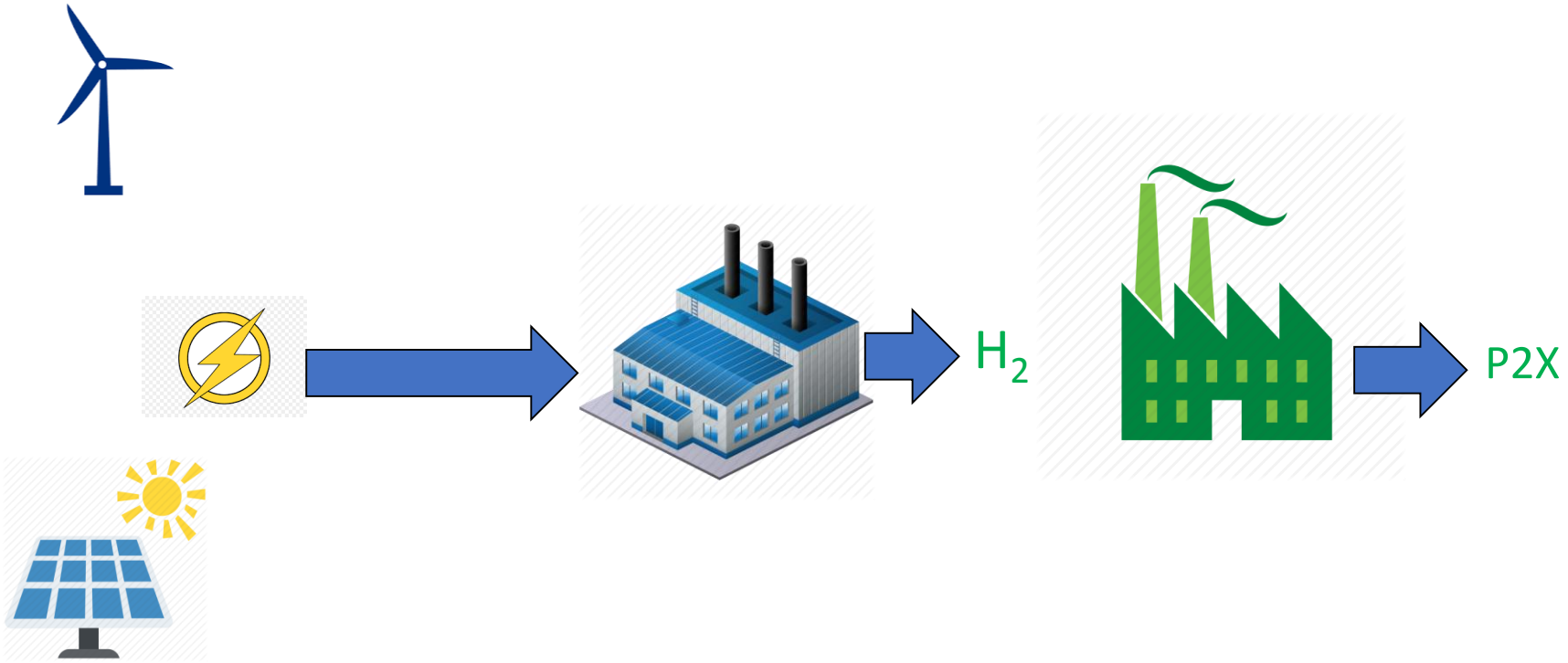
Commercial Scale-up of Sustainable Aviation Fuel



Development & Commercialisation of Futurol™



Available technologies for renewable fuels



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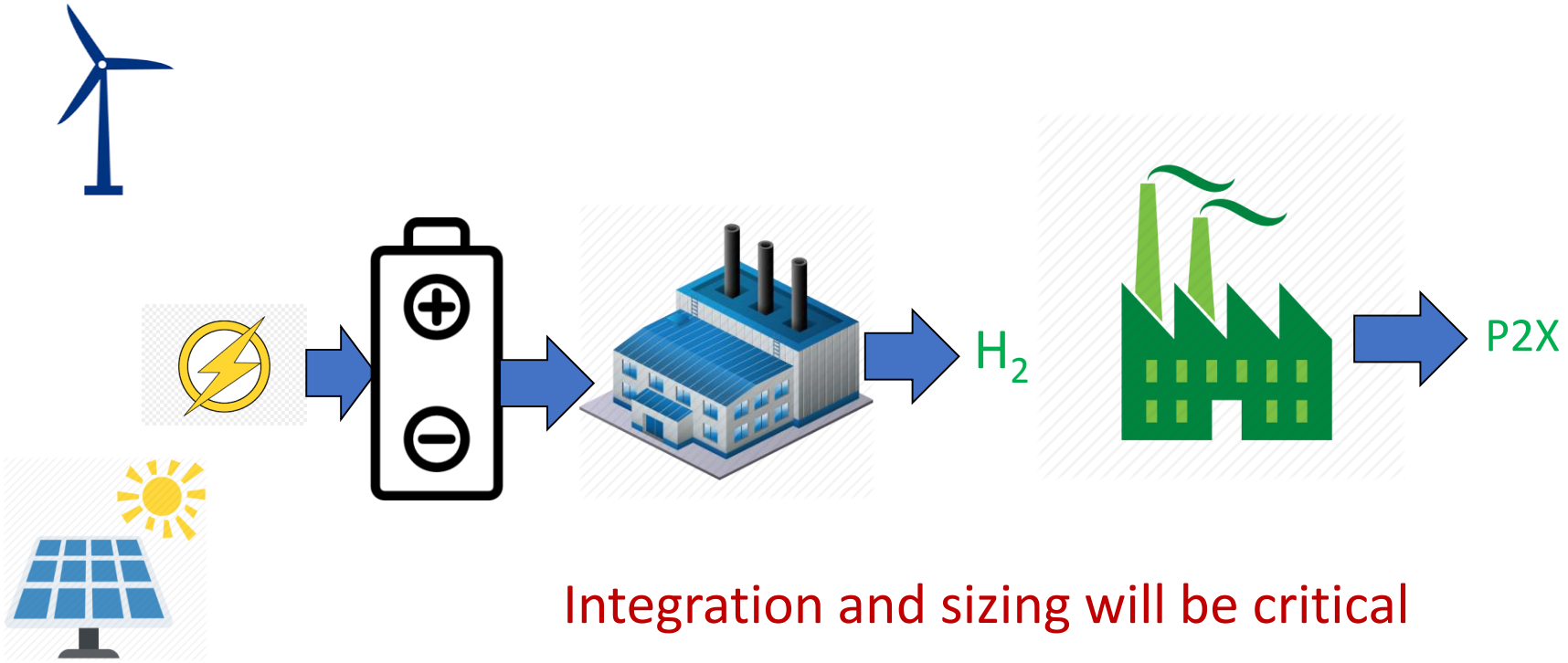

Integration and sizing will be critical

3500-4000 ?????? 8000

Time scale h/y

Some thoughs looking beyond COP 26….

Significant progress has been achieved on electrolysis batteries etc, and several technologies are approaching commercialisation.

However, their cost remains very high.

CCS/CCU remain still elusive and little progress has been reported.

Promoting the use of renewables, although a successful policy, is inadequate to ensure the 1.5 °C scenario by 2050.

This can only be ensured if new legislation will be enacted to actual limit and reduce the use of fossil carbon on a fixed, continuous and determined road map to 2050. The lack of such policies puts in question the Fit for 55 and achieving the EU 2050 targets.

The EU oil Majors and several other in the US has put forward their net-zero 2050 strategies. The industry has to undertake a leadership role in close coordination with governments and the civil society.

Some thoughs looking beyond COP 26….

Biomass and bioenergy are critical to meet the 2050 targets.

There are sufficient quantities of sustainable biomass to produce sustainable advanced biofuels far beyond what RED III proposes.

At present they need policy and financial support since they complete against fossil fuels.

Should policies be enacted to curtail fossil fuels on a steady, continuous and fixed roadmap, the policy and financial support for biomass, biofuels and bioenergy (as well as all renewables) will start to decrease significantly.

Biomass could become indispensable for:

- **Stabilising the power grid,**
- **Providing sustainable biofuels in sectors such aviation, heavy duty transport and maritime,**
- **Securing negative emissions via CCBS,**
- **Providing job in rural areas.**

And its contribution shouldn’t be ignored or minimized so long as land management is sustainable.

On Wednesday 17 November 2021….

Regulation to mimimise EU-driven deforestation and forest degradation.

Aim to promote the consumption of ‘deforestation-free' products and reducing the EU's impact on global deforestation and forest degradation, the new rules are expected to bring down greenhouse gas emissions and biodiversity loss.

Beef, wood, soy, palm oil, cocoa and other agricultural commodities will be banned from entering the EU unless proven they are not linked to deforestation….

https://ec.europa.eu/commission/presscorner/detail/en/qanda_21_5919

Pioneering legislation….long overdue….to fight climate change!

But is it the most urgent we need??

What about the same type of legislation designed for fossil fuels?

Thank you for your attention

https://www.concawe.eu/publication/sustainable-biomass-availability-in-the-eu-to-2050/

"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