

Refinery 2050: a look into opportunities and challenges

Concawe Low Carbon Pathways

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Setting the scene

A vision for manufacturing: Refinery 2050

Main takeaways



Concawe - Environmental Science for European Refining

Concawe Membership

Concawe represents 41 Member Companies ≈ 100% of EU Refining Open to companies owning refining capacity in the EU



Concawe mission

To conduct research to provide **impartial scientific information**, in order to:

- scientific understanding
- Assist the development of technically feasible and cost effective policies and legislation
- Allow informed decision making and cost effective legislative **compliance** by Association members.





The Team



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The role of the refining system in a low-GHG future (for Europe)

Vision 2050 and Low Carbon Pathways programme





Setting the scene





Reducing emissions on a WTW basis





Lower carbon intensity fuels can reduce the CO₂ intensity of older vehicles as well as new





A Clean Planet for all

Eight scenarios to achieve GHG emissions reductions between 80% and 100% by 2050 (compared to 1990)

Long Term Strategy Options

	Long term strategy options								
EUROPEAN COMMISSION		Electrification (ELEC)	Hydrogen (H2)	Power-to-X (P2X)	Energy Efficiency (EE)	Circular Economy (CIRC)	Combination (COMBO)	1.5°C Technical (1.5TECH)	1.5°C Sustainable Lifestyles (1.5LIFE)
Brussels, 28 November 2018	Main Drivers	Electrification in all sectors	Hydrogen in industry, transport and buildings	E-fuels in industry, transport and buildings	Pursuing deep energy efficiency in all sectors	Increased resource and material efficiency	Cost-efficient combination of options from 2°C scenarios	Based on COMBO with more BECCS, CCS	Based on COMBO and CIRC with lifestyle changes
IN-DEPTH ANALYSIS IN SUPPORT OF THE COMMISSION COMMUNICATION COM(2018) 773	GHG target in 2050	-80% GHG (excluding sinks) ["well below 2°C" ambition]					-90% GHG (incl. sinks)	-100% GHG ["1.5°C"	(incl. sinks) ambition]
A Clean Planet for all A European long-term strategic vision for a prosperous, modern, competitive and climate neutral economy	dern, competitive and Major Common Assumptions - Higher energy efficiency post 2030 - Market co Deployment of sustainable, advanced biofuels - BECCS pre Moderate circular economy measures - Significant Digitilisation - Significant						nation for infrastructure deployment t only post-2050 in 2°C scenarios ming by doing for low carbon technologies provements in the fficiency of the transport system.		
© Concave	Power sector	Power is nearly decarbonised by 2050. Strong penetration of RES facil tated by system opt mization (demand-side response, storage, interconnections, role of prosumers). Nuclear still plays a role in the power sector and CCS deployment faces limitations.							aces limitations.
	Industry	Electrification of processes	Use of H2 in targeted applications	Use of e-gas in targeted applications	Reducing energy demand via Energy Efficiency	Higher recycling rates, material substitution, circular measures	Combination of most Cost- efficient options from "well below 2°C" scenarios with targeted application (excluding CIRC)	COMBO but stronger	CIRC+COMBO but stronger
	Buildings	Increased deployment of heat pumps	Deployment of H2 for heating	Deployment of e-gas for heating	Increased renovation rates and depth	Sustainable buildings			CIRC+COMBO but stronger
	Transport sector	Faster electrification for all transport modes	H2 deployment for HDVs and some for LDVs	E-fuels deployment for all modes	Increased modal shift	Mobility as a service			 CIRC+COMBO but stronger Alternatives to air travel
	Other Drivers		H2 in gas distribution grid	E-gas in gas distribution grid				Limited enhancement natural sink	 Dietary changes Enhancement natural sink

A Clean Planet for all - Demand

Biomass as an energy carrier in final energy consumption



Up to ~20% of the total energy demand



Zoom into the transport sector



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Source: PRIMES.

A vision for manufacturing: Refinery 2050

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Vision 2050: The refinery as an ENERGY HUB...

... within an INDUSTRIAL CLUSTER,

with biomass-to-liquid products playing an important role





Concawe Modelling Work (EU Refining system)





Concawe Modelling Work (EU Refining system) Refinery 2050 - Contribution to HLG EII



Figure 1. A walk into the CO₂ emission reduction pathways for the whole EU refining system (2030/2050). Concawe's initial view based on on-going work.



The key uncertainty: Availability!!

A Clean Planet for all - Use of bionergy by sectors and bioenergy feedstock



- Power and industrial sectors would absorb most of the biomass (< 20% allocated to transport)
- Advanced biofuels represent up to 20% (50 Mtoe/y) in transport sector (A Clean Planet for all) or up to 140 Mtoe as max potential availability!

Figure 84: Break down of bioenergy feedstock in 2050



- The production of feedstock could range from 210 to 320 Mtoe, majority coming from waste sector
- All the scenarios assume that most of the biomass used in the EU economy is produced within Europe ⁽¹⁾

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(1) Imports of (sustainable) solid biomass are kept limited in all scenarios at 4% to 6% of the solid biomass used for bioenergy by 2050.

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A look into availability

Advanced biofuels maximum potential demand in EU, based on what can be satisfied with the availability, is estimated to grow from ≈ 0 Mtoe/y by 2015 to 70-140 Mtoe/y by 2050 if the right R&D framework is put in place.



Based on resource availability and allocation across the whole EU Bioenergy sectors, there is a significant variability of potential demand according to different references

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CO2 reduction - JEC Consortium

Well-to-Wheels - Alternative fuels (v5)

WELL-TO-WHEELS ANALYSIS OF FUTURE AUTOMOTIVE FUELS AND POWERTRAINS IN THE EUROPEAN CONTEXT



JEC WTT and WTW figures v5 to be presented in the Sustainable Energy Week (Brussels 19 June)





Main takeaways



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Main takaways

- The EU Commission has recently published its long-term strategy, confirming Europe's commitment to lead in global climate action
- Multiple technologies/pathways can achieve similar GHG reduction at a comparable cost.
- Low-carbon fuels (including biofuels) recognised as key players in transport sector.
- Vision 2050 represents an industrial opportunity for Europe to develop low-carbon technologies (including bio-technologies) and offer them to the world as part of the global climate solution.
- Availability of huge amounts of both renewable electricity and low-carbon feedstocks (including biomass) would be required.

Will EU be ready???

- Challenges go beyond the bio-industry / refining battery limits!!
- Strong R&D and financial support needed!

