

Low-Carbon Liquid Fuels for Transport

Policy Evolution to Drive the Investments

John Cooper – Director General



-
- Emerging OEM strategy & Political expectations.
 - Perception vs. current outlook for electrification.
 - The concept of Vision 2050.
 - We have the technologies.
 - The developing role for refineries.
 - What does policy need to provide, to make this happen?
 - Why Road Transport first? Why not Aviation & Maritime?
 - Conclusions.

An Uncertain Future: Diminishing support for ICE from OEMs



- “From 2019, every new Volvo will come with an electric motor. Mild hybrids and plug-in hybrids will be available as transition options on the road to fully electric cars. By 2025, we aim for half of all new cars sold globally to be fully electric”.



- “Electric vehicles form the only practical and affordable solution in existence today to our planet’s transport-related environmental challenges”.



- “In the year 2026 will be the last product start on a combustion engine platform”.



- “We expect that by 2050 we will have reduced CO2 emissions from vehicles by 90% compared to the figure in 2010”, “To achieve that from 2040 simple internal combustion engine cars will not be made”.



- “At Daimler we are convinced: The future is electric”.
- (no new “families of ICE” after the current one).



Some EU Parliament Groups Public Statements



“We support innovation and welcome the moves towards more zero-emission vehicles on our roads and decarbonisation of all transport modes”. *Source: RenewEurope Manifesto*

“No new fossil-fuel cars should be sold in Europe after 2030”.

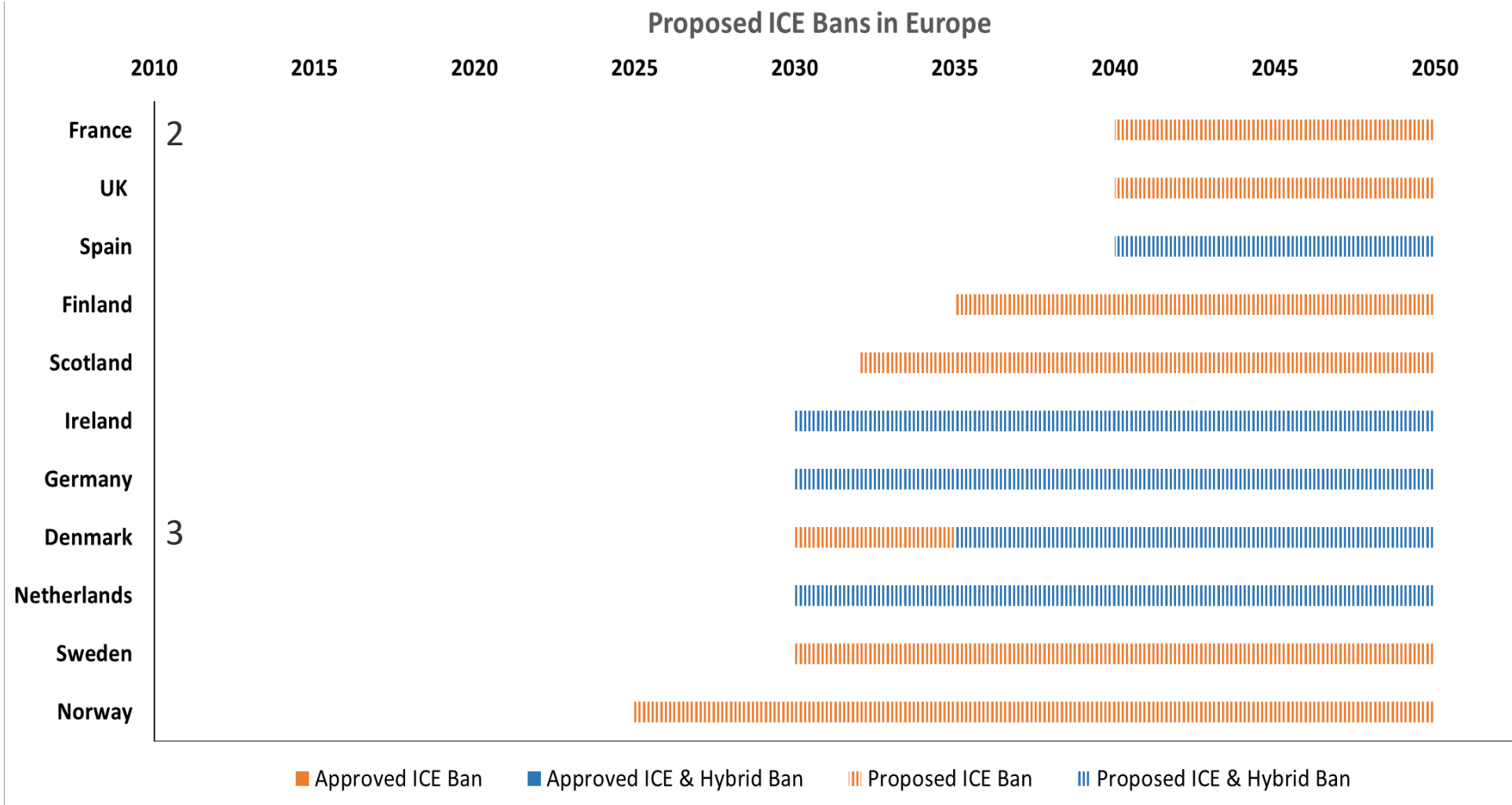
“All trucks, vans, trains, ships and planes must eventually become zero emission vehicles”. *Source: European Greens Manifesto*



The logo for the Socialists and Democrats (S&D) political group. It features the letters 'S&D' in a white, bold, sans-serif font, centered within a solid red square.

“[...] ensure that by 2035 all new vehicles placed on the market are zero-emissions”. *Source: open letter to Ursula von der Leyen*

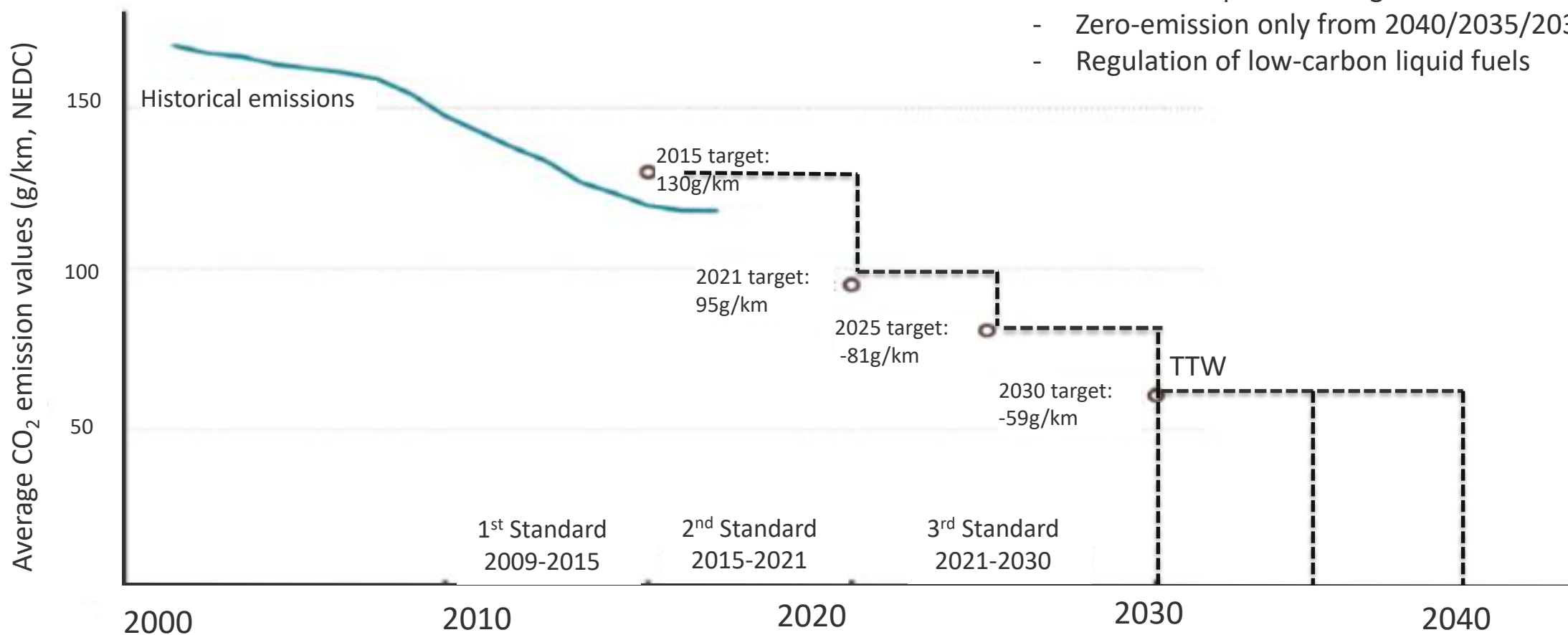
Proposed Bans in Europe (“ICE” or “petrol and diesel cars” or “fossil powered cars”)



1. No gasoline or diesel car allowed on the Road - **Brussels 2030 diesel & 2035 gasoline**
2. Ban on the sales of new ICE petrol and diesel vehicles
3. Ban on the use of gasoline and petrol (fuels)

The CO₂ standards for vehicles

Average historical CO₂ emission values and adopted CO₂ standards for new passenger cars in the EU.



Possible development of regulation from 2030:

- Zero-emission only from 2040/2035/2030
- Regulation of low-carbon liquid fuels

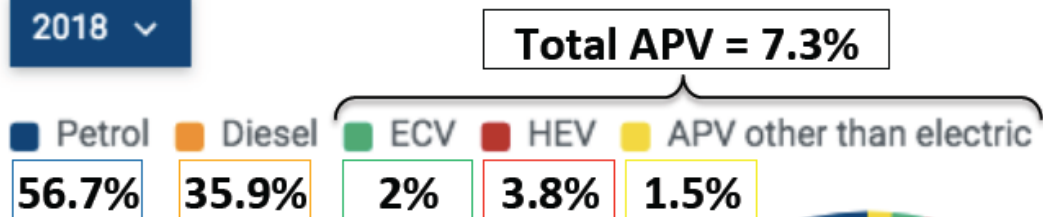
Reference: ICCT – 2019 – all values expressed in NEDC-equivalents / GHG emissions from transport from EEA - 2019

New Passenger Cars by Fuel Type – ACEA data

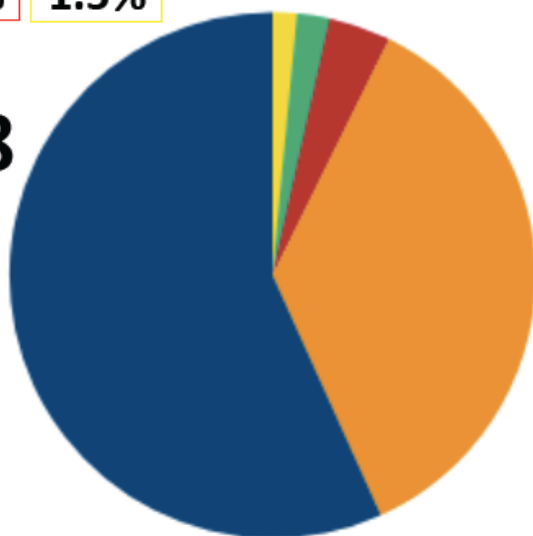
New passenger cars by fuel type in the EU

Market share (%)

2018 ▾

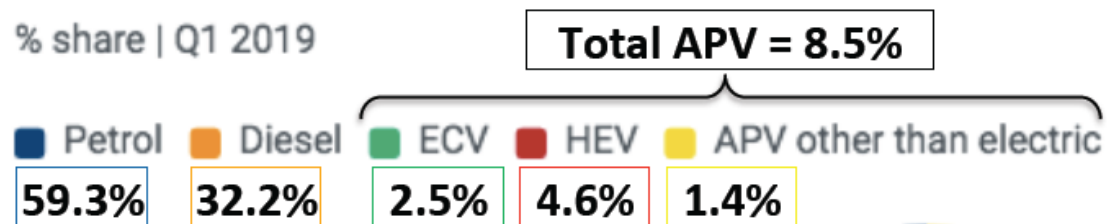


Year 2018

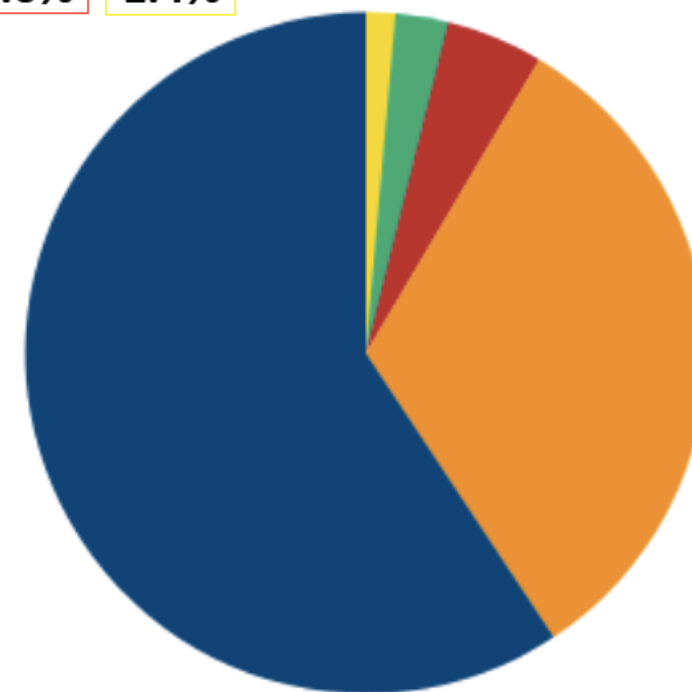


New passenger cars by fuel type in the EU

% share | Q1 2019



Q1 2019



Created with LocalFocus

Source: ACEA

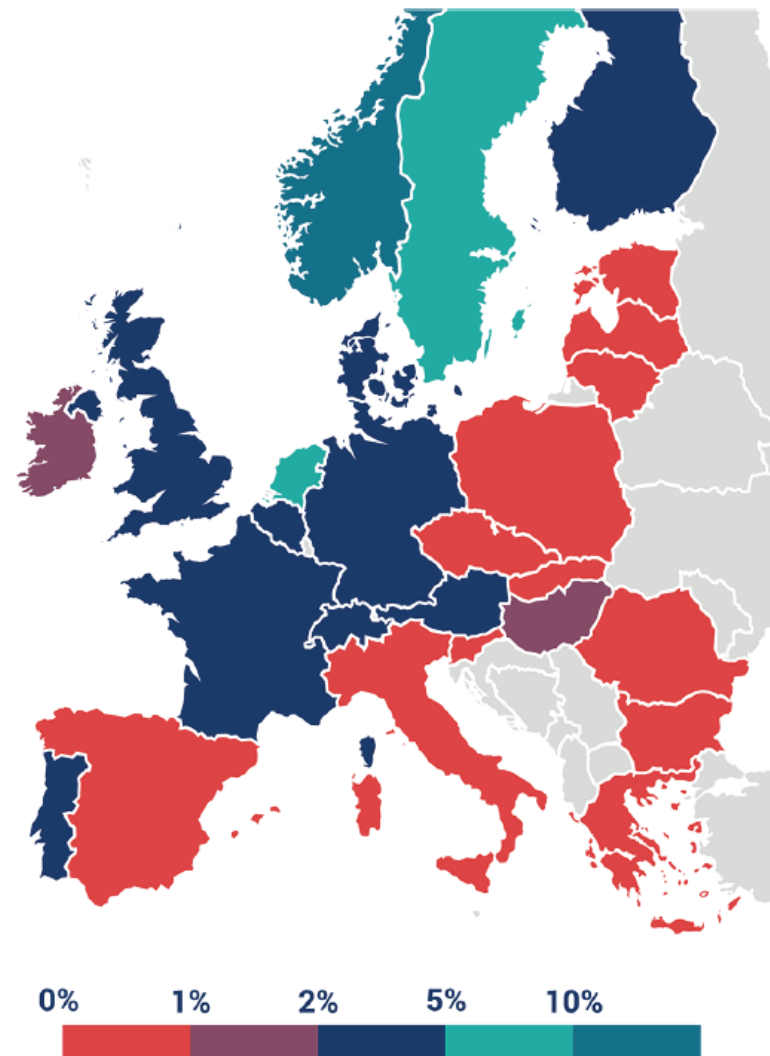
ELECTRIC CAR SALES AND NATIONAL INCOME

LESS THAN 1% **ONLY ABOVE 3.5%**
GDP < €29,000 IF GDP > €42,000

> 80% OF ALL ELECTRIC CARS ARE SOLD IN JUST 6 COUNTRIES (WITH SOME OF THE HIGHEST GDPs)

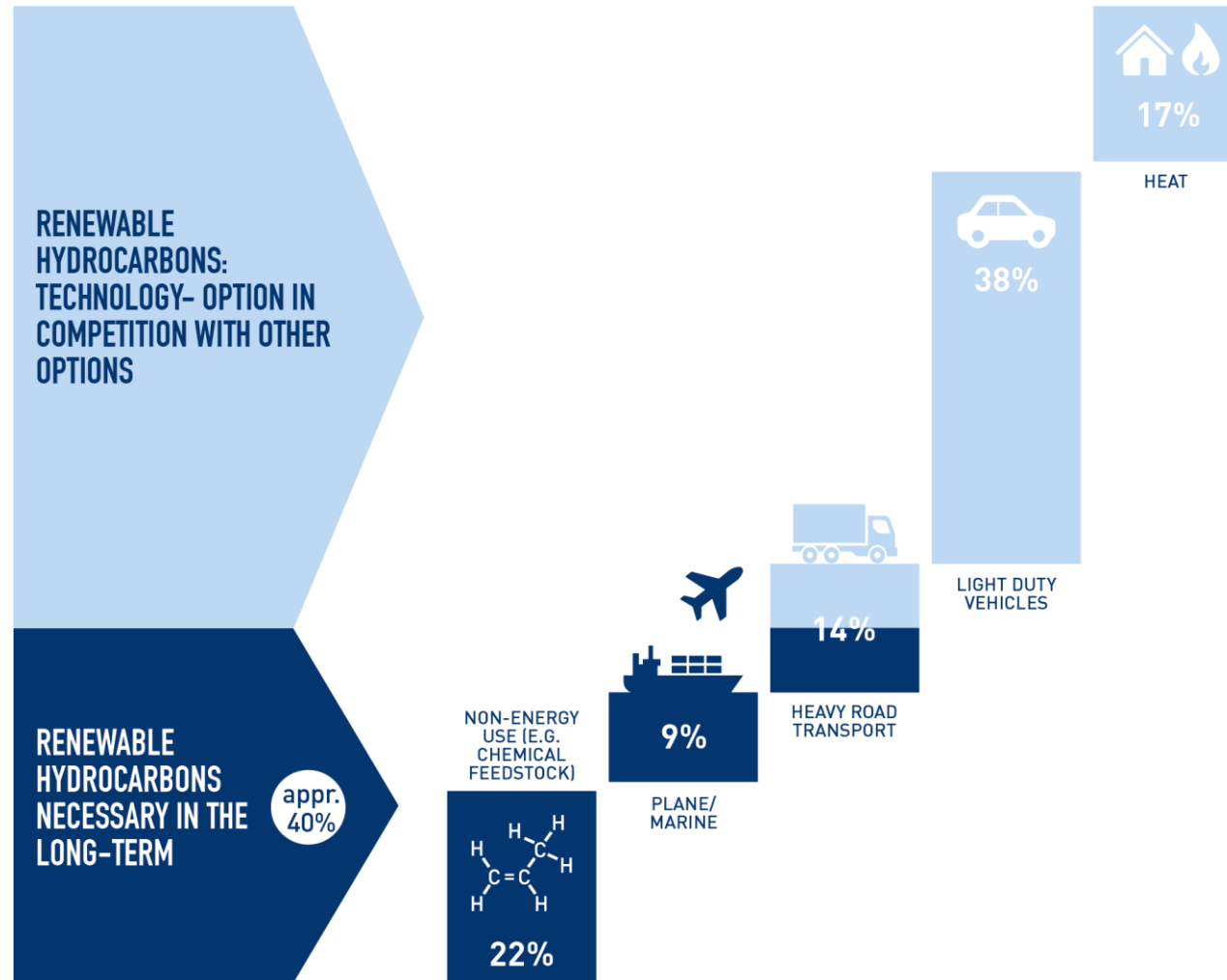
TOP 3: LOWEST MARKET SHARES (2018)

POLAND	SLOVAKIA	GREECE
0.2%	0.3%	0.3%
1,324 ECVs	293 ECVs	315 ECVs
GDP €12,900	GDP €16,600	GDP €17,100



Source: ACEA

The need for more solutions – The view of Prognos, for DENA



Source: Prognos AG, Berlin

Aviation and energy storage – beyond the limits for batteries

Boeing 787



230 tons
at take-off

Jet fuel



100 tons¹

Electric battery

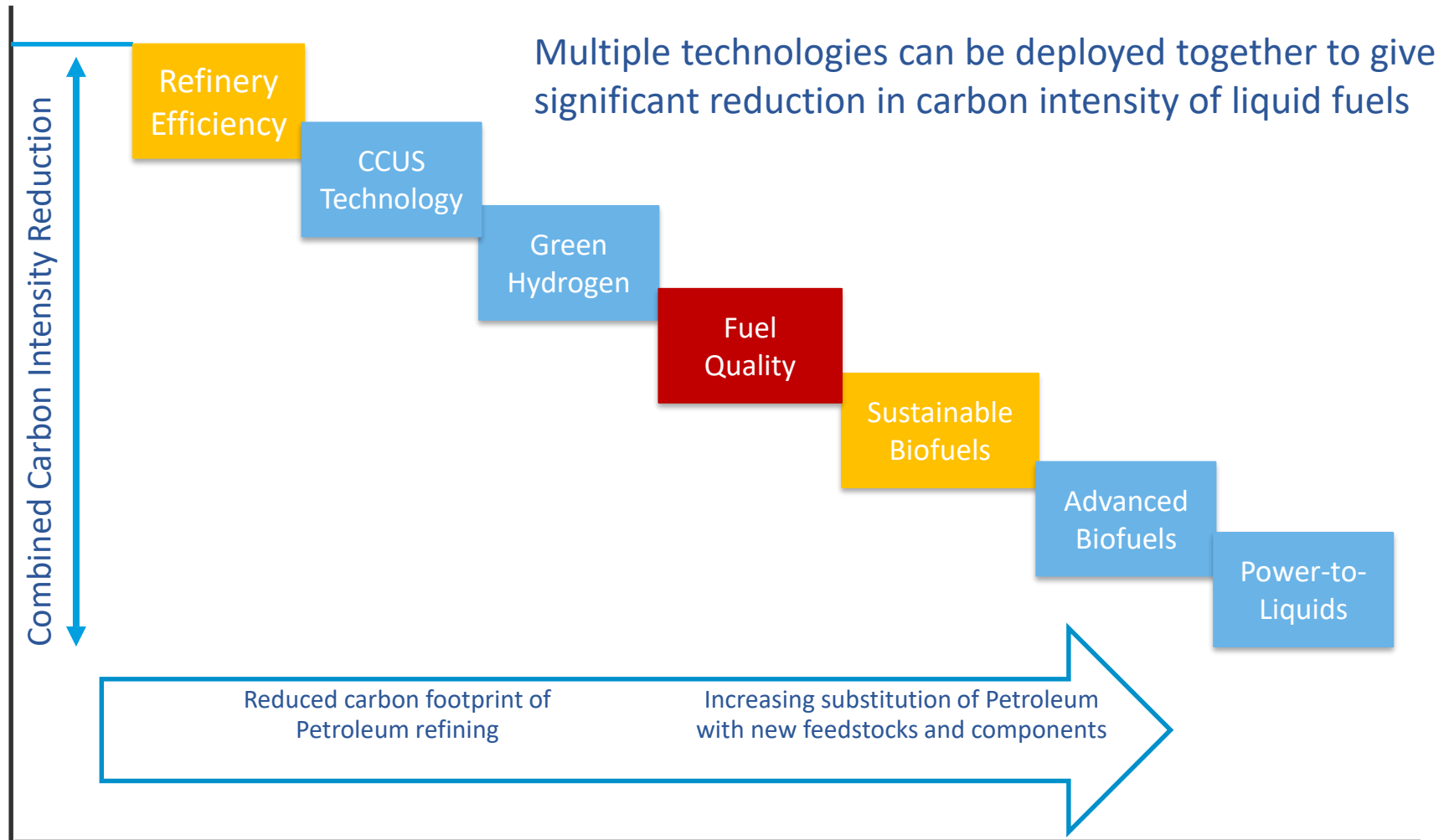


2000 tons¹

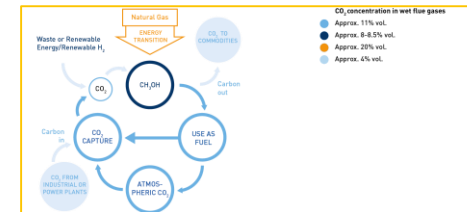
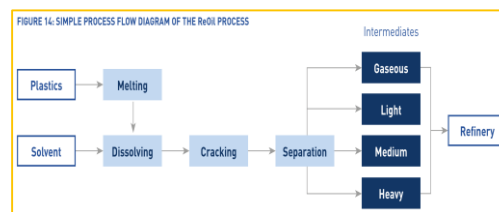
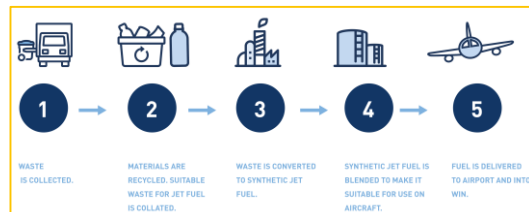
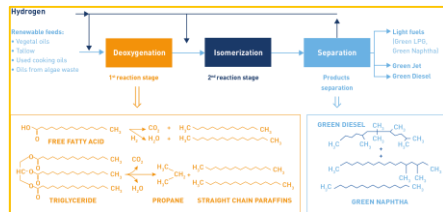
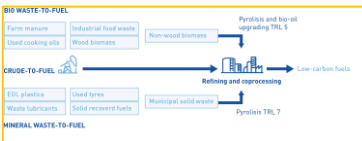
(1) <http://www.latimes.com/business/la-fi-electric-aircraft-20160830-snap-story.html>



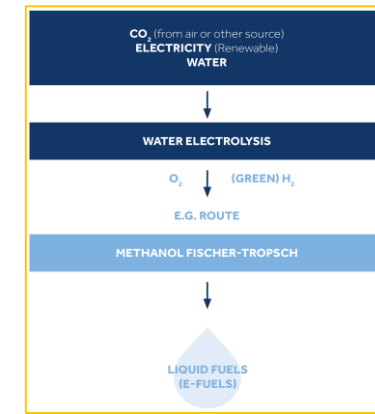
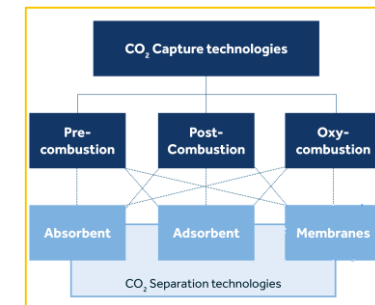
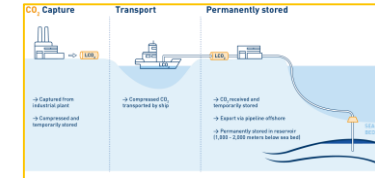
Vision 2050: We have the technologies for Low Carbon Liquid Fuels



We have the technologies....



Join us
in a (quick) journey...



We have the technologies....

Algae, a biofuel of tomorrow

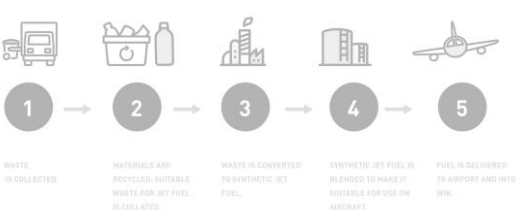
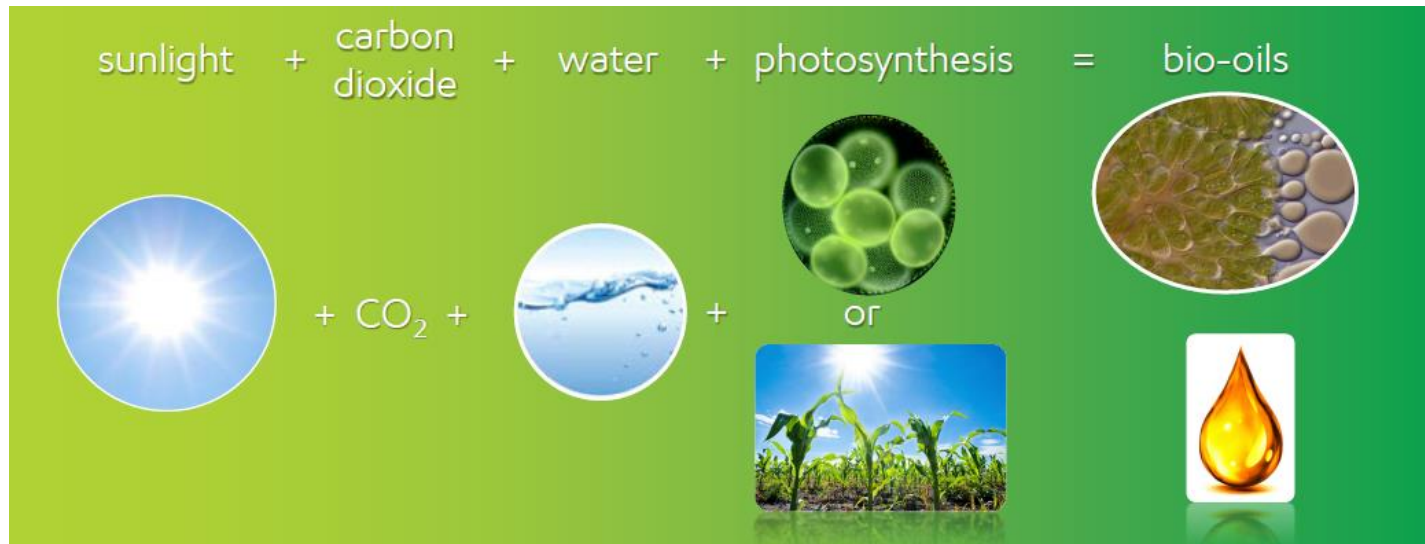
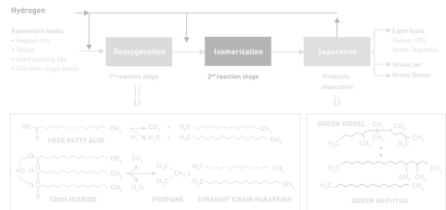
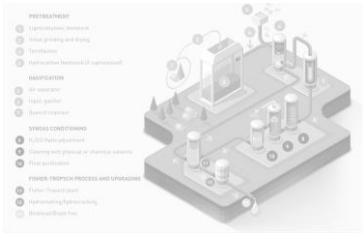
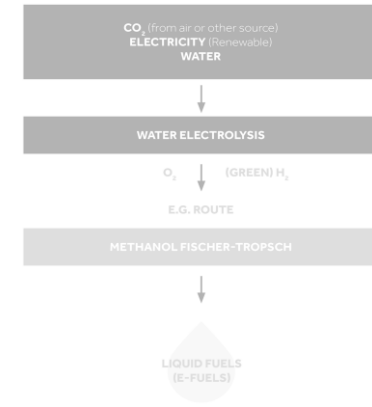
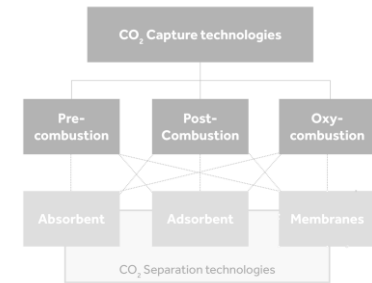
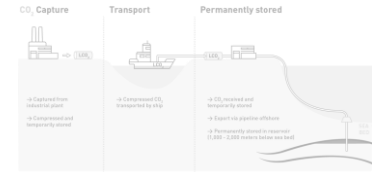
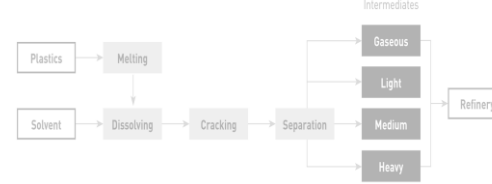


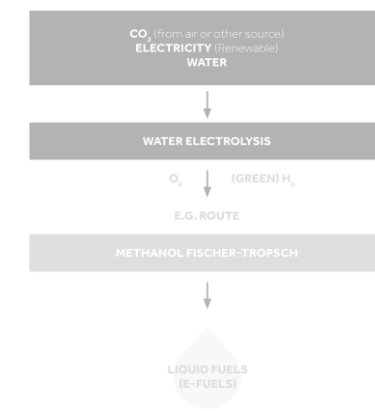
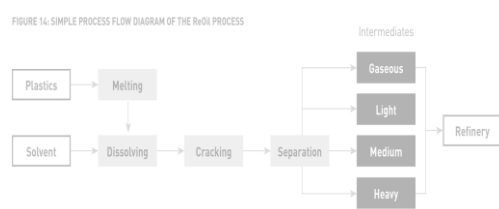
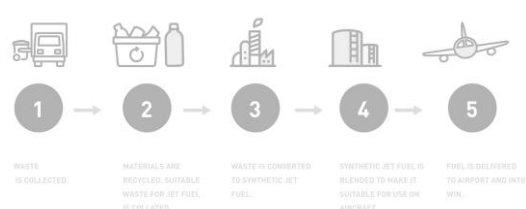
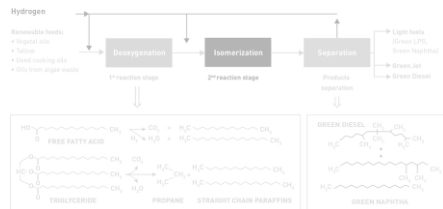
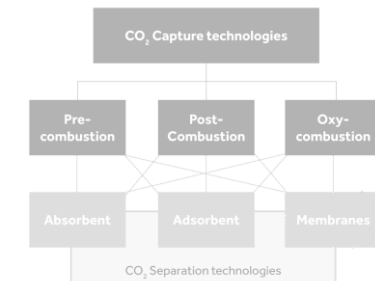
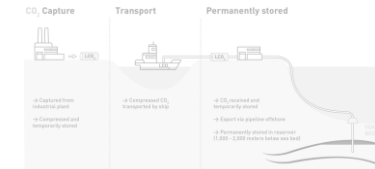
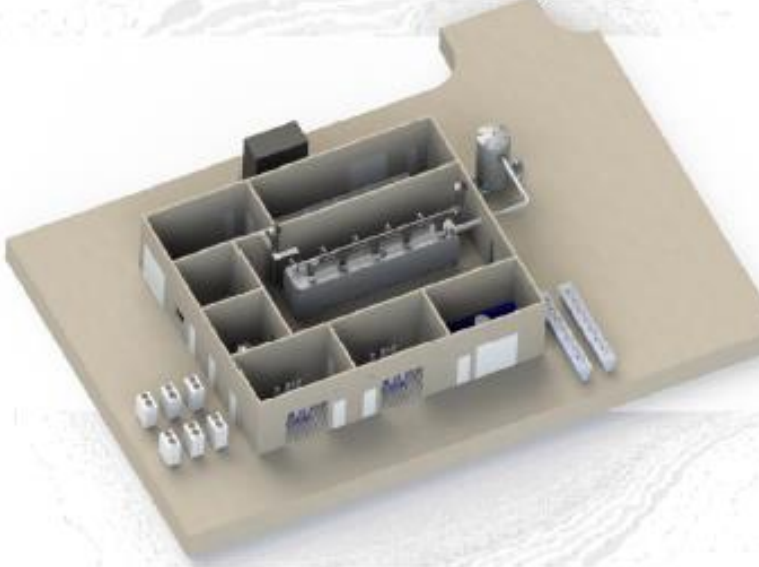
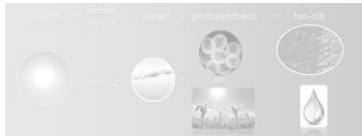
FIGURE 14. SIMPLE PROCESS FLOW DIAGRAM OF THE ROKO PROCESS



We have the technologies....

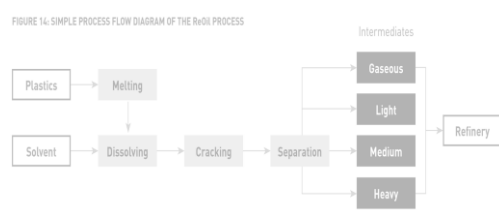
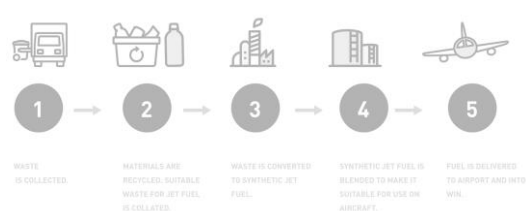
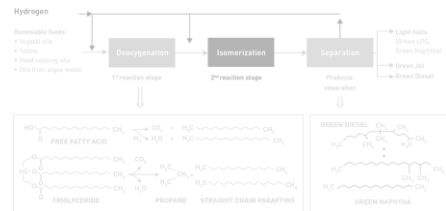
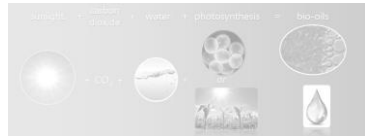
REFHYNE Project, 10 MW PEM Electrolyser

10 MW electrolyser



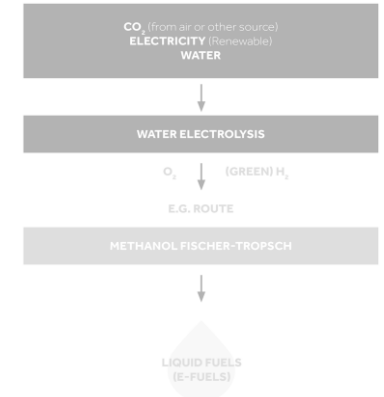
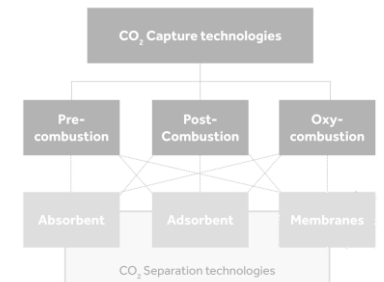
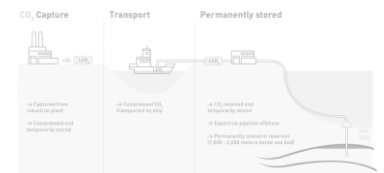
We have the technologies....

BioTfuel, producing biofuels via thermochemical conversion



CO₂ concentration in wet flue gases

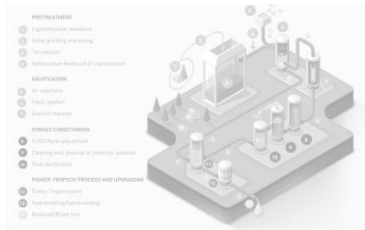
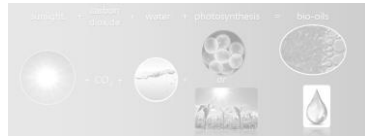
- Approx. 11% vol.
- Approx. 8-8.5% vol.
- Approx. 20% vol.
- Approx. 4% vol.



We have the technologies....

Waste-to-Fuel

BIO WASTE-TO-FUEL



CRUDE-TO-FUEL



MINERAL WASTE-TO-FUEL

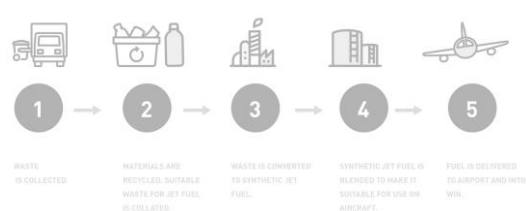
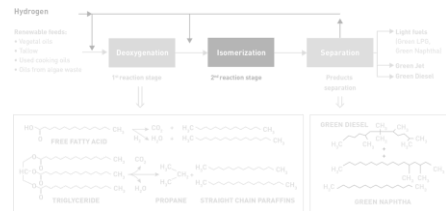
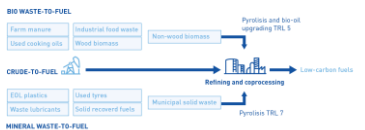
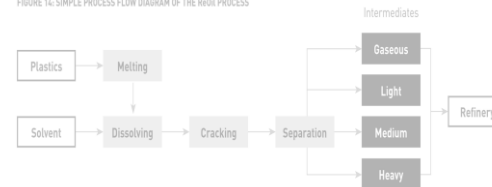


FIGURE 14. SIMPLE PROCESS FLOW DIAGRAM OF THE ROOK PROCESS

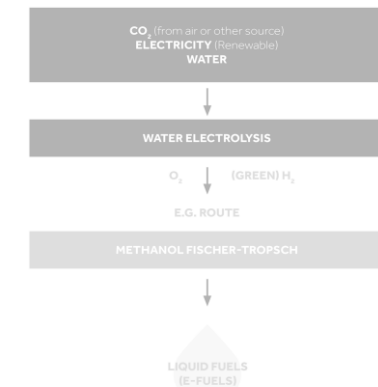
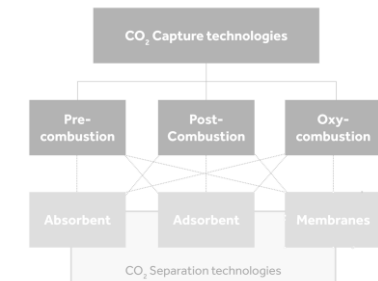
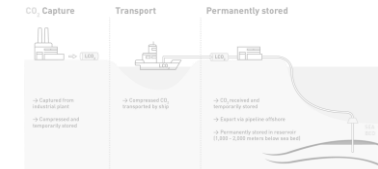


Pyrolysis and bio-oil upgrading TRL 5

Refining and coprocessing

Pyrolysis TRL 7

Low-carbon fuels

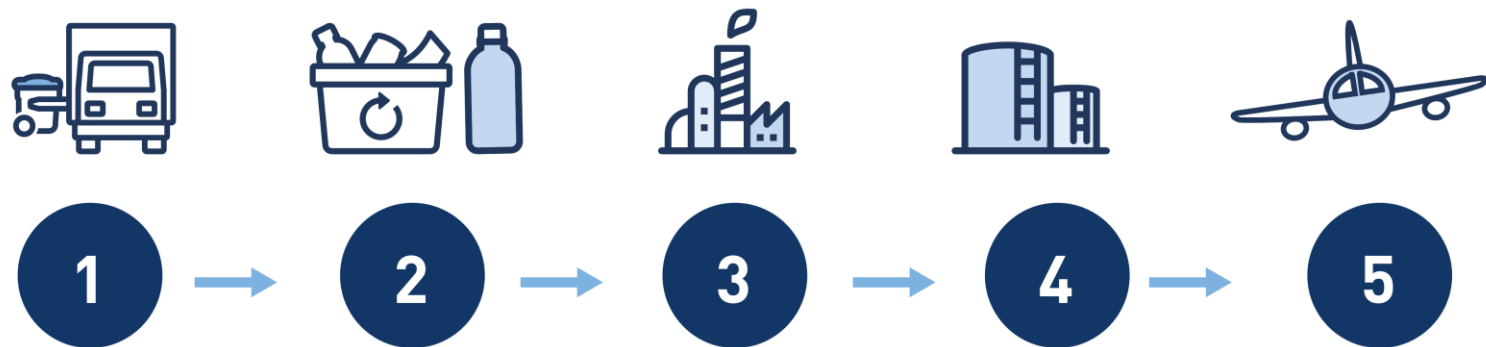
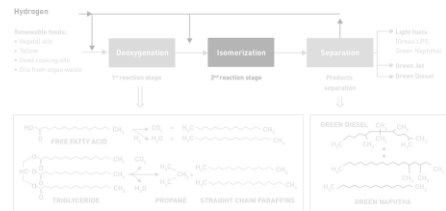
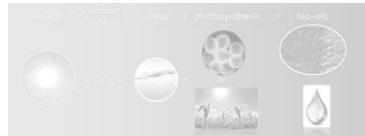


CO₂ concentration in wet flue gases

- Approx. 11% vol.
- Approx. 0-8.5% vol.
- Approx. 20% vol.
- Approx. 4% vol.

We have the technologies....

Fulcrum BioEnergy, Municipal Waste-to-Fuel



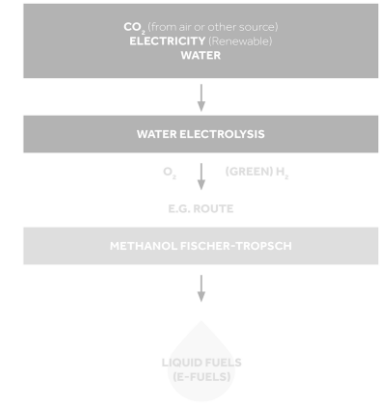
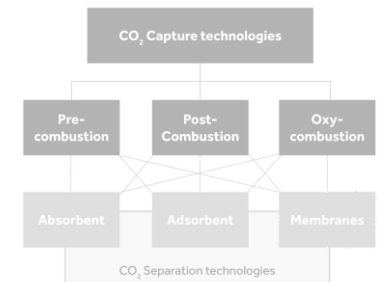
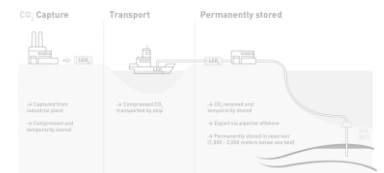
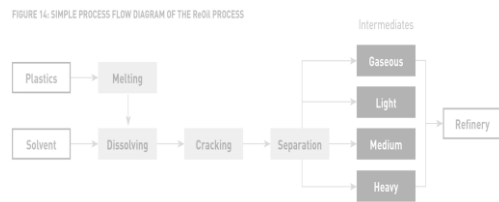
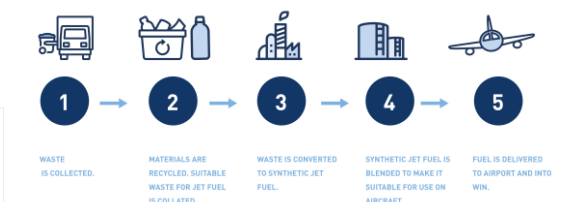
1 WASTE IS COLLECTED.

2 MATERIALS ARE RECYCLED. SUITABLE WASTE FOR JET FUEL IS COLLECTED.

3 WASTE IS CONVERTED TO SYNTHETIC JET FUEL.

4 SYNTHETIC JET FUEL IS BLENDED TO MAKE IT SUITABLE FOR USE ON AIRCRAFT.

5 FUEL IS DELIVERED TO AIRPORT AND INTO WIN.



We have the technologies....

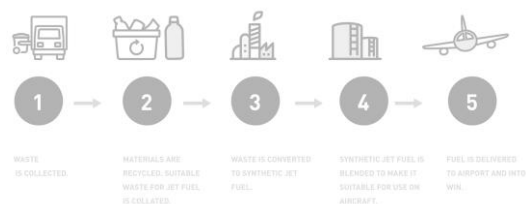
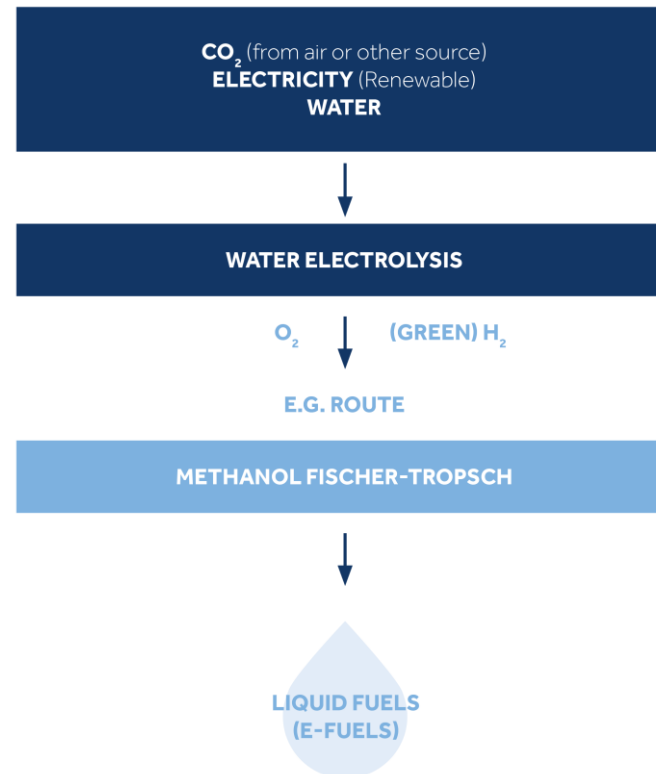
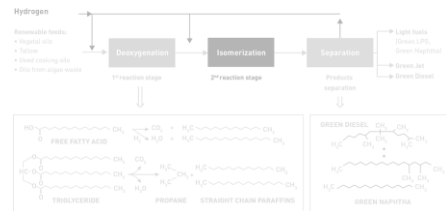
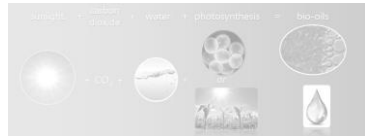
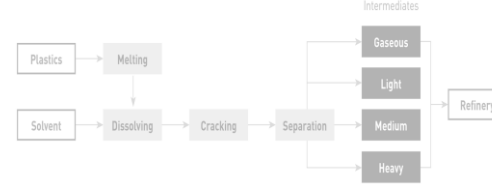


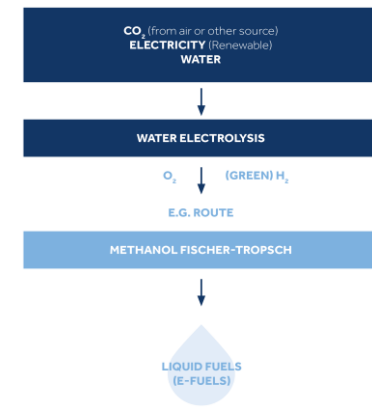
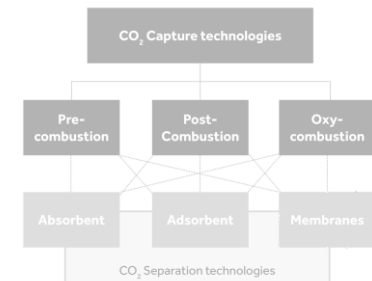
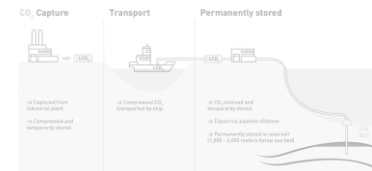
FIGURE 14. SIMPLE PROCESS FLOW DIAGRAM OF THE ROKO PROCESS



CO₂ concentration in wet flue gas

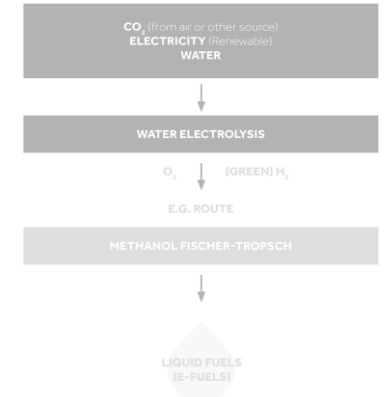
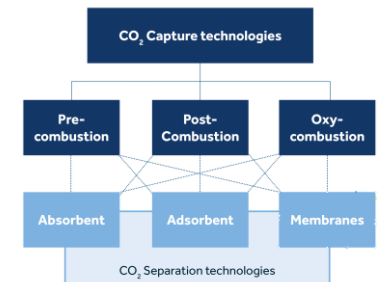
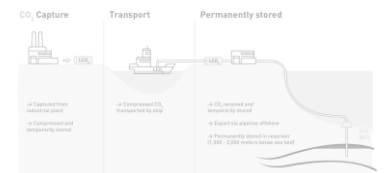
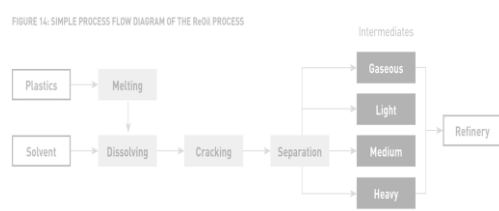
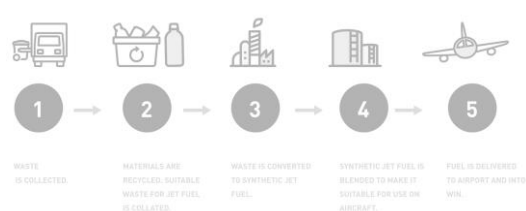
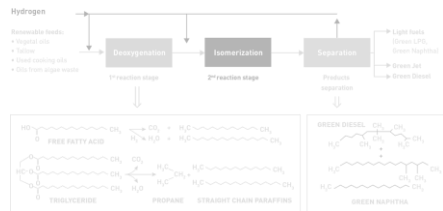
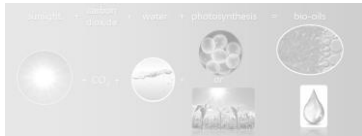
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Sunfire, Power-to-Liquid



We have the technologies....

On-board Carbon, Capture & Storage



We have the technologies....

Carbon Capture & Storage

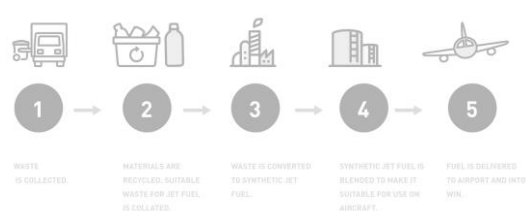
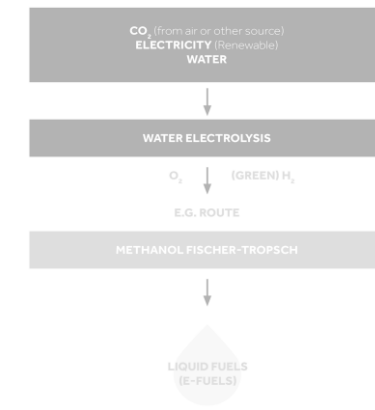
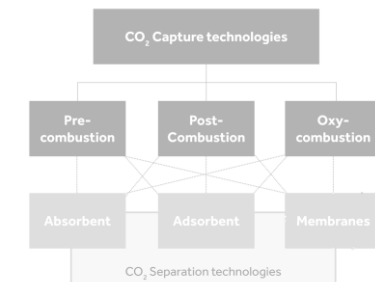
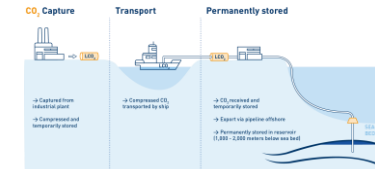
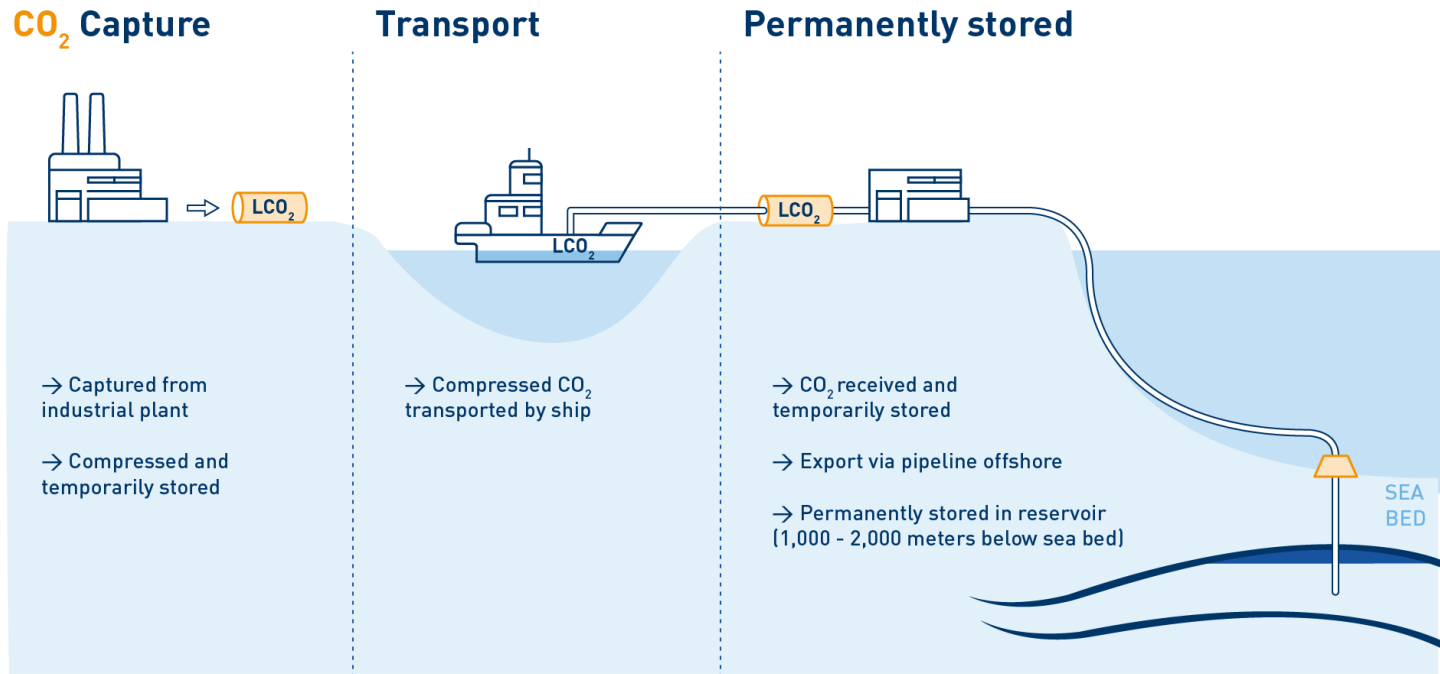
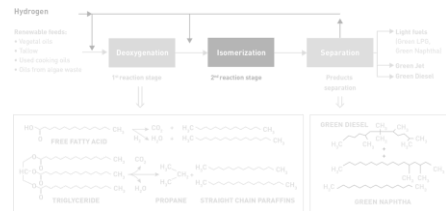
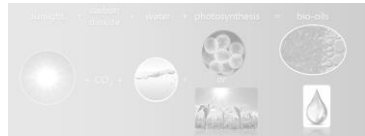
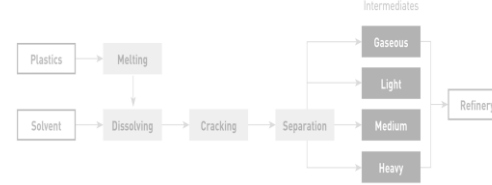


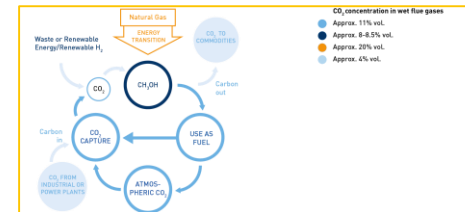
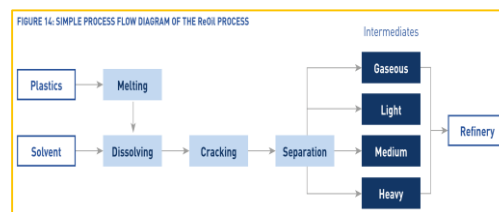
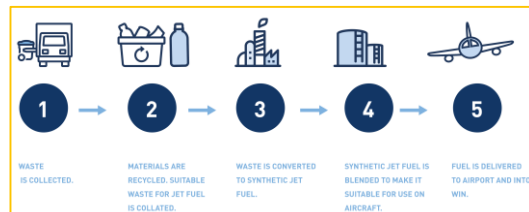
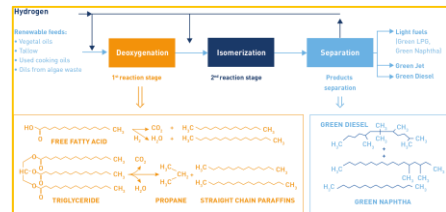
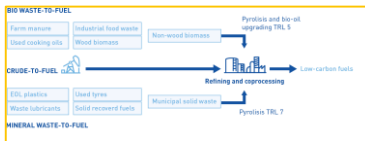
FIGURE 14: SIMPLE PROCESS FLOW DIAGRAM OF THE ROK PROCESS



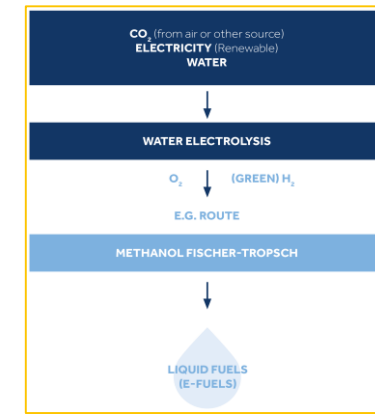
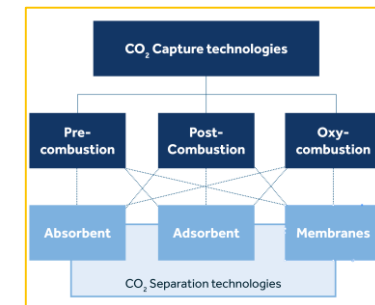
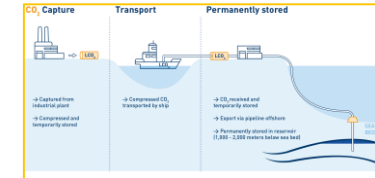
CO₂ concentration in wet flue gases

- Approx. 11% vol.
- Approx. 8-8.5% vol.
- Approx. 20% vol.
- Approx. 4% vol.

We have the technologies....

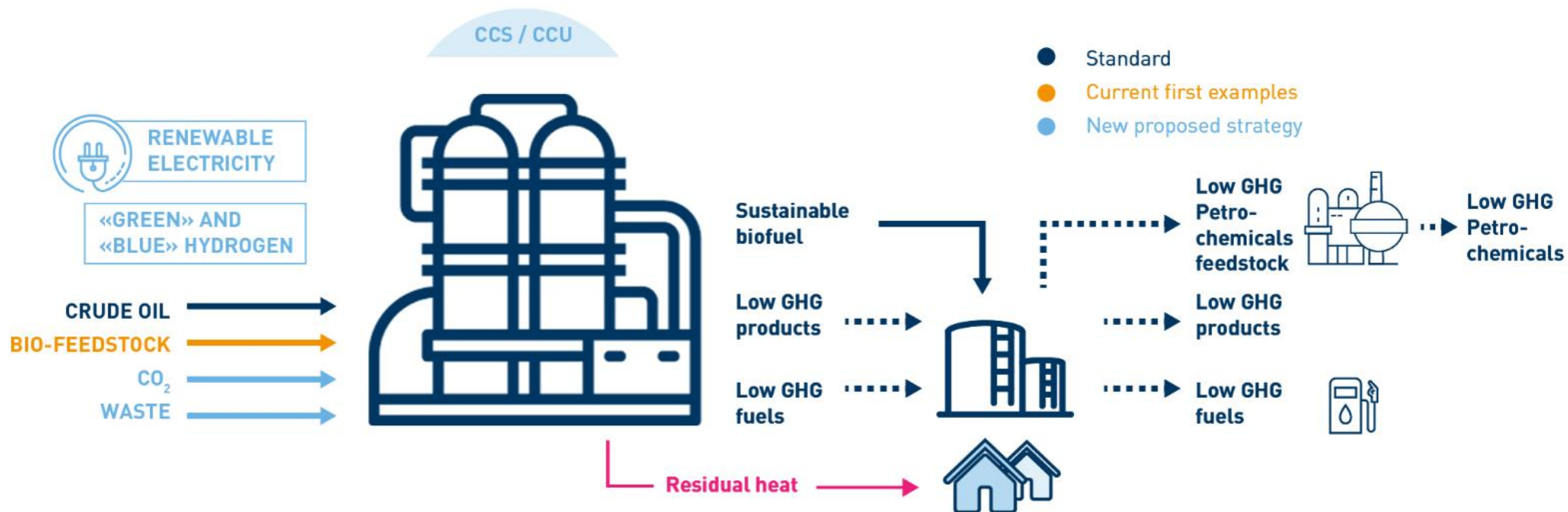


.....and this is just a sample of all the R&D and Innovation projects currently underway



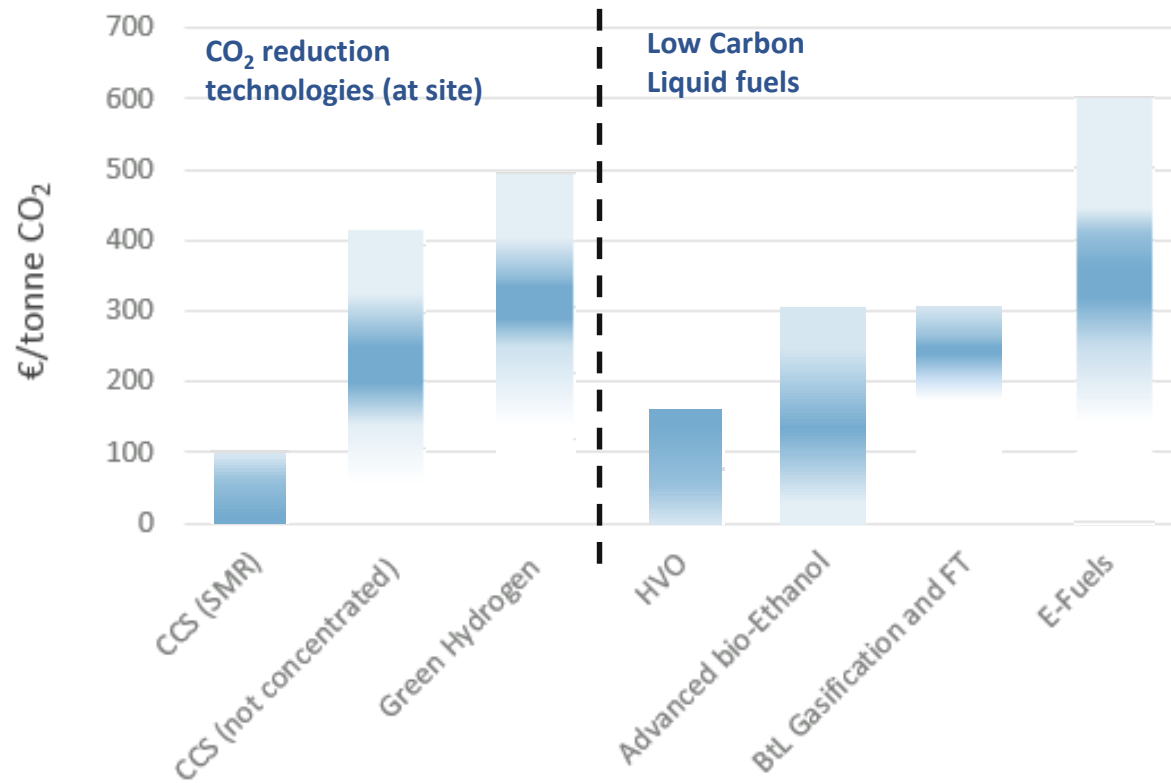
The refinery as an ENERGY HUB...

... within an INDUSTRIAL CLUSTER

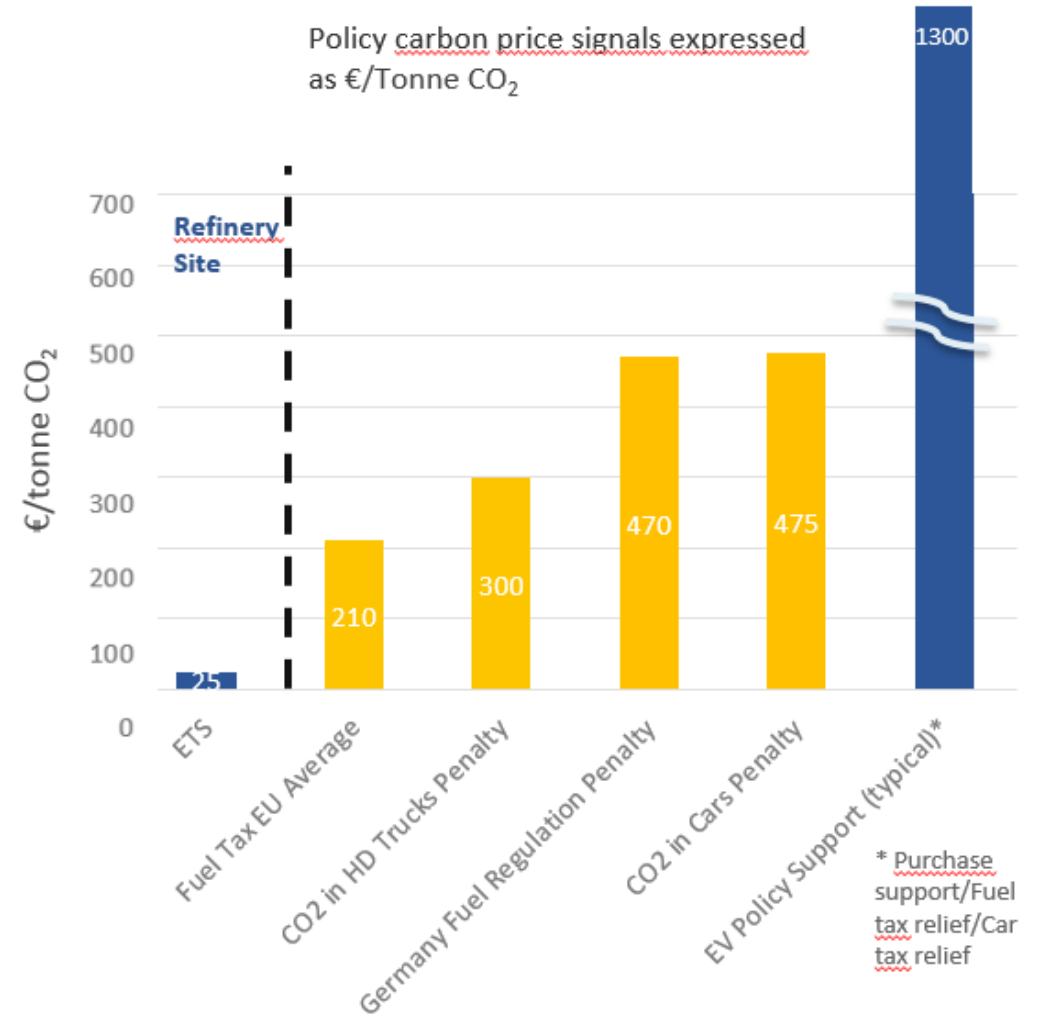


Low Carbon Fuels: Technology Costs and Policy Price Signals

Decarbonised fuel costs expressed as €/tonne CO₂ avoided.
(Fully-built-up capex + opex costs)



Policy carbon price signals expressed as €/Tonne CO₂



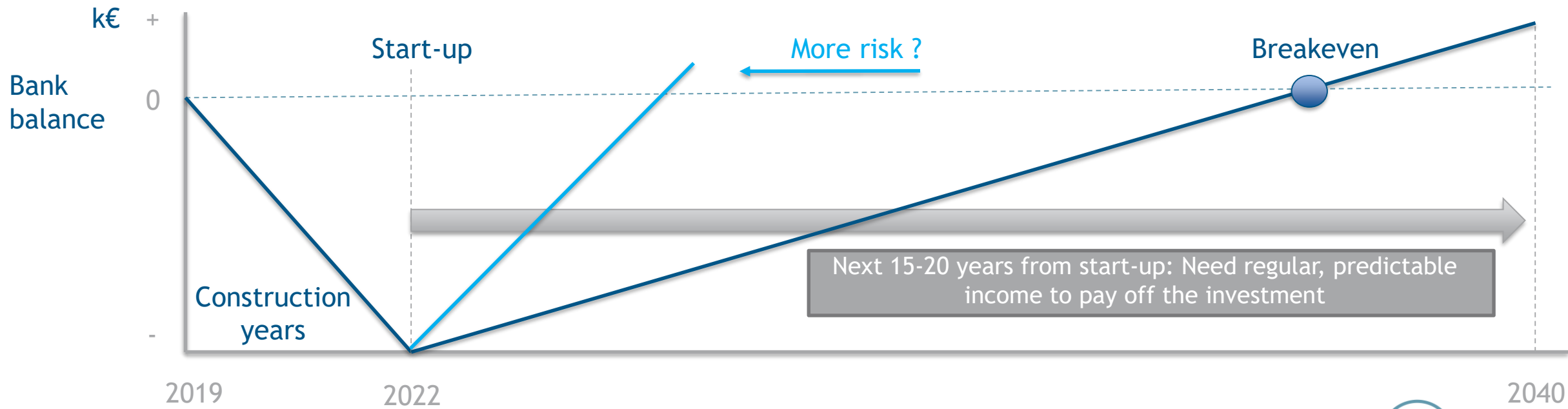
* Purchase support/Fuel tax relief/Car tax relief

Financial Planning for Low-carbon liquid projects

YEAR	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
BENEFIT					x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€
- Volume sales					x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton	x ton
- Price					€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton	€/ton
EXPENDITURE																						
- Maintenance					x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€
- Other Fix Costs					x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€
- Amortization					x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€
- Taxes					x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€
- Investment	x k€	x k€	x k€	x k€																		
CASH FLOW	-x k€	-x k€	-x k€	-x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€	x k€

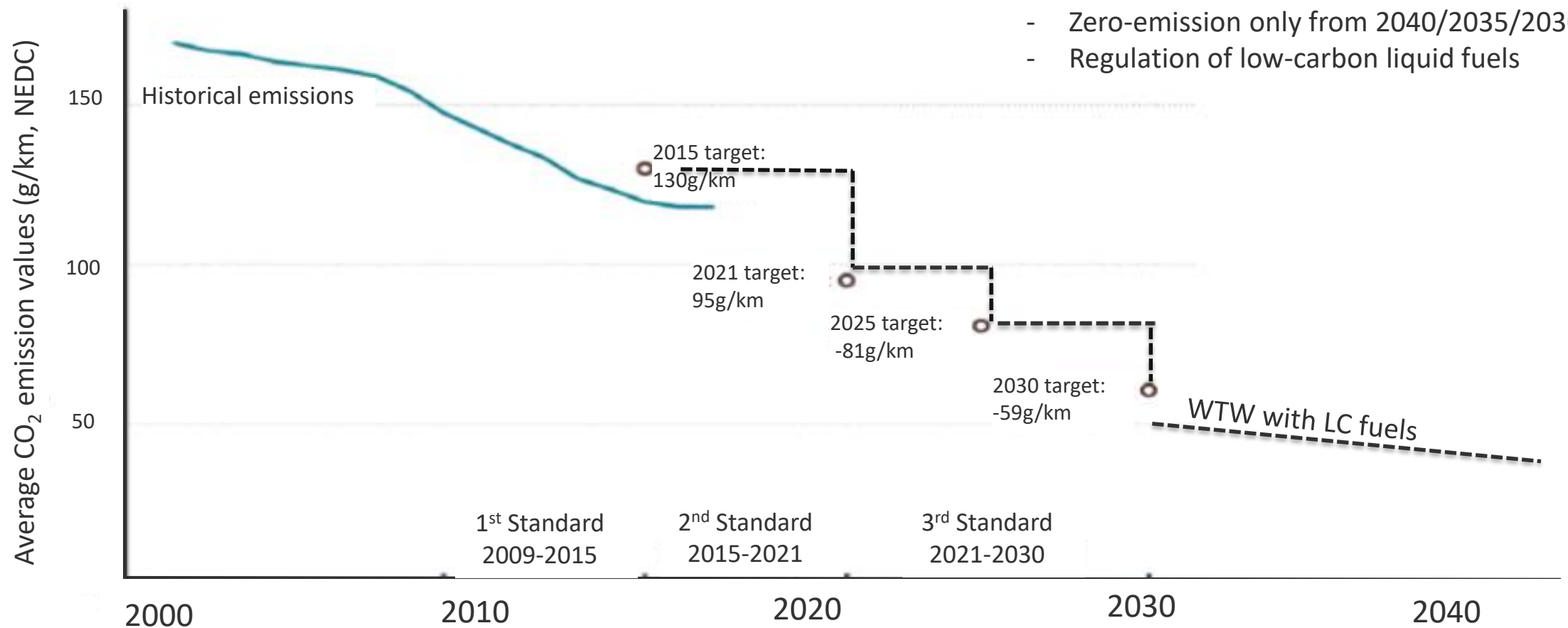
Technology risk

Policy risk



The CO₂ standards for vehicles – A possible evolution?

Average historical CO₂ emission values and adopted CO₂ standards for new passenger cars in the EU.



Reference: ICCT – 2019 – all values expressed in NEDC-equivalents / GHG emissions from transport from EEA - 2019

Why Road Transport? Why not focus on Aviation?

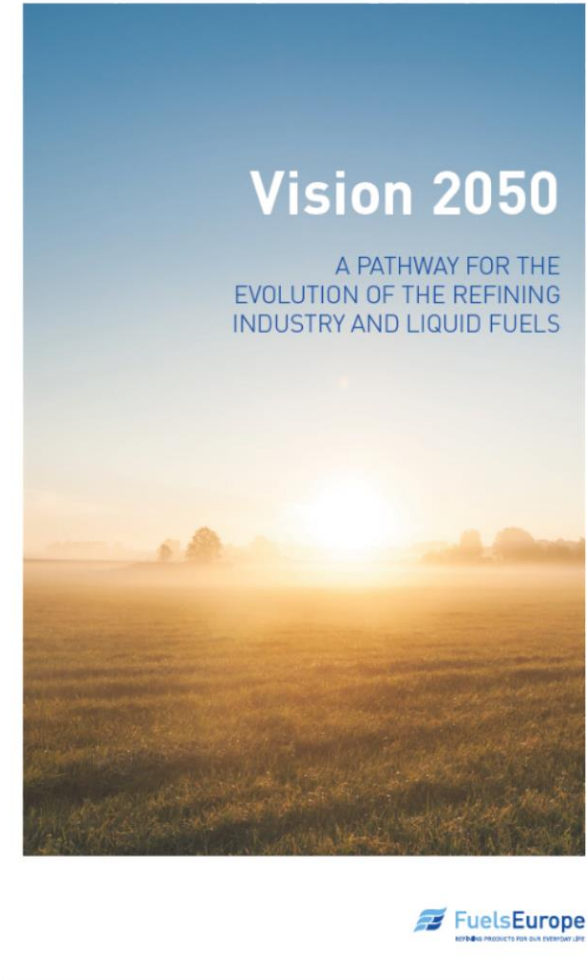
1. We are not 'unfocussed' on aviation or marine.
2. But aviation / maritime lacks the necessary policy and regulation framework.
3. We need to start now.
4. Road transport has several key policies and regulations that can be evolved to enable an earlier scale-up.
5. The likely higher manufacturing cost of low carbon liquid fuels is more affordable in road transport.
6. There is no regret for starting in road transport, these liquid fuels can also be used for aviation and marine.

Conclusion

1. There is a need for more technology solutions at scale.
2. We have the technologies.
3. We need stable and predictable policies to enable the heavy investments necessary.
4. We need to be realistic: strong price signals for transport decarbonisation.
5. We can evolve current policies and regulations to achieve this.

Final

- Vision 2050: Ambitious, Needed, and Possible.
- Let's work together to turn this Vision into reality.



THANK YOU FOR YOUR ATTENTION

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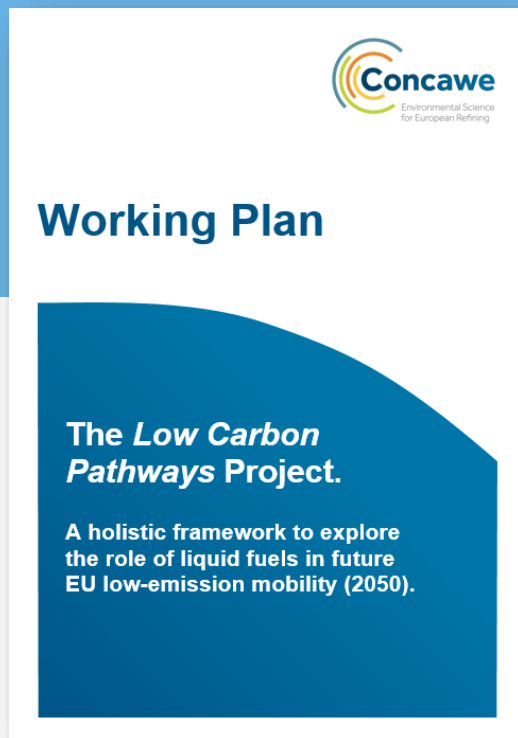
John Cooper, Director General


john.cooper@fuelseurope.eu

FuelsEurope Vision 2050

A Pathway for the Evolution of the Refining Industry and Liquid Fuels

<https://www.fuelseurope.eu/vision-2050/>

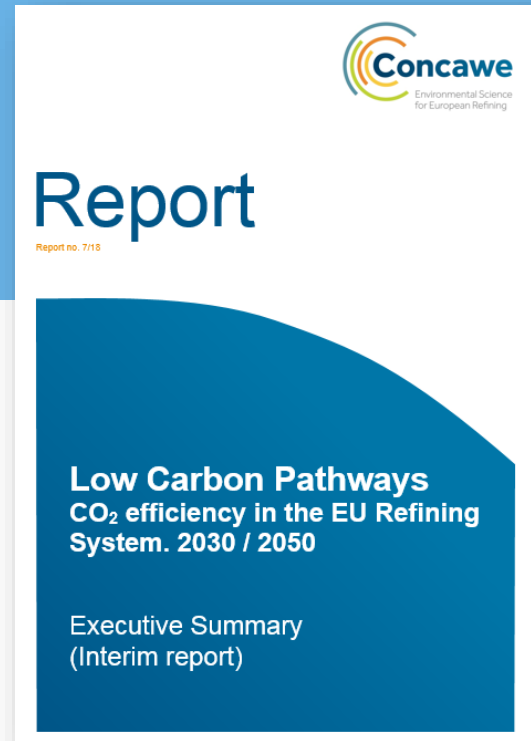




Environmental Science
for European Refining

Working Plan

The Low Carbon Pathways Project.

A holistic framework to explore the role of liquid fuels in future EU low-emission mobility (2050).



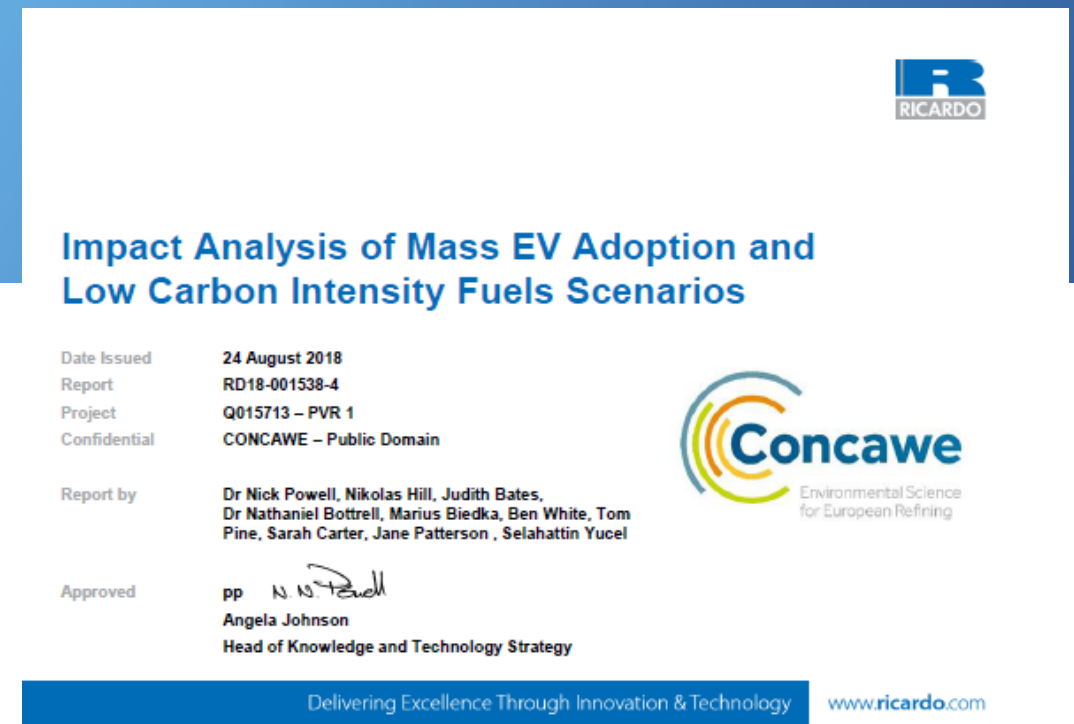

Environmental Science
for European Refining


Report

Report no. 7/18

**Low Carbon Pathways
CO₂ efficiency in the EU Refining System. 2030 / 2050**

Executive Summary
(Interim report)

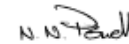





Impact Analysis of Mass EV Adoption and Low Carbon Intensity Fuels Scenarios

Date Issued	24 August 2018
Report	RD18-001538-4
Project	Q015713 – PVR 1
Confidential	CONCAWE – Public Domain

Report by
Dr Nick Powell, Nikolas Hill, Judith Bates,
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pp 
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