



PTX TECHNOLOGIES & THE INDUSTRIAL-SCALE HYKERO PLANT

INSPIRING TECHNOLOGY

Zero Emission City 2023
19 January 2023, Vienna

Dr.-Ing. Michael Haid

EDL ANLAGENBAU GESELLSCHAFT MBH

EDL is a leading technology-driven engineering company for the process industries looking back on a history of over 100 years.

Since 2003 EDL is **part of the Pörner group** after many years as part of RWE / DEA and Texaco under the company name Edeleanu.



Portfolio – Technologies, Plants, Services

- Green- and brownfield projects from feasibility up to turn key delivery.
- Process and auxiliary plants for refining, petrochemical & chemical, lubricants & wax and renewable energy industry.
- Licensing of advanced technologies for residue processing, oil and wax production and waste plastics depolymerisation.
- Power-to-X (PtX) and Biomass-to-X (BtX) technologies for sustainable synthetic fuels and chemicals with climate neutral carbon footprint.
- Technical and commercial consulting services.

SDA PLUS

EDL•TECHNOLOGY

DEWAXING

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DEOILING

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LEPD

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AROMEX

EDL•TECHNOLOGY

POWER2X

EDL•TECHNOLOGY



THE EFFECTS OF CLIMATE CHANGE

Effects of human-caused global warming are

- happening now,
- irreversible on the timescale of people alive today,
- worsening in the decades to come.

Carbon budget used up in

- 6 years, 6 months for 1.5 °C path,
- 24 years, 3 months for 2.0 °C path.
- In case all states meet their commitments a 2.5 to 2.8 °C path can be expected.

Fast ramp-up of GHG emission saving requires industrial scale solutions.

Sources: Synthesis reports, IPCC, 2021; NASA, 2021; npj Climate and Atmospheric Science (2020)3:18, <https://doi.org/10.1038/s41612-020-0121-5>; <https://www.mcc-berlin.net/en/research/co2-budget.html>



Land covered in water by 1 m sea level rise is shaded red. In scenario RCP 2.6 (2 °C target) the sea level will rise by 1.0 m / 2.5 m in 2100 / 2300.



Land covered in water by 6 m sea level rise is shaded red. In scenario RCP 8.5 (unchanged GHG emissions) the sea level will rise by 2 m / 8 m in 2100 / 2300.

LEGISLATION – EU RED II / REFUEL AVIATION

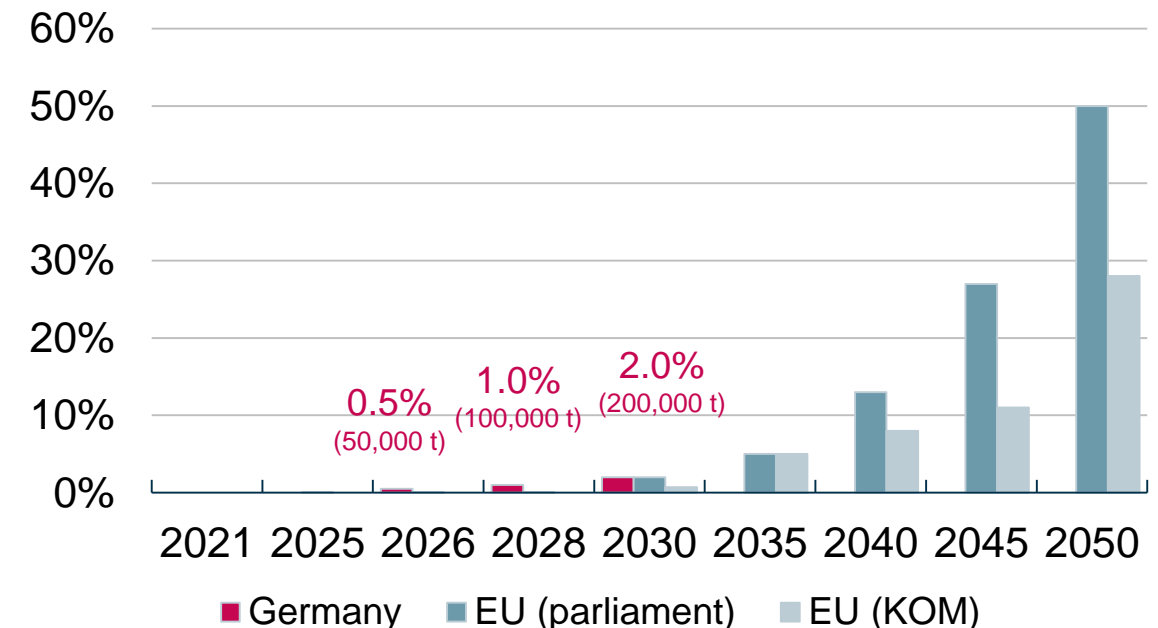
Recent proposal from EU parliament

- Higher PtL sub-quotas compared to original KOM-proposal.
- Target for 2050 EU SAF quota increased to 85%, compared to KOM-proposal of 65%.
- Electrical power and hydrogen can be considered now in quotas.
- Pool of eligible sustainable feedstocks shall be as inclusive as possible. Crop-based biofuels are non-eligible.
- By 2025 commission shall adopt delegated acts to supplement this regulation.
- Current step: trilogue between parliament, council and KOM.

Sources: P9_TA(2022)0297 dated 07.07.2022; EU 9805/22 dated 02.02.2022

Implementation of RED II in EU / States

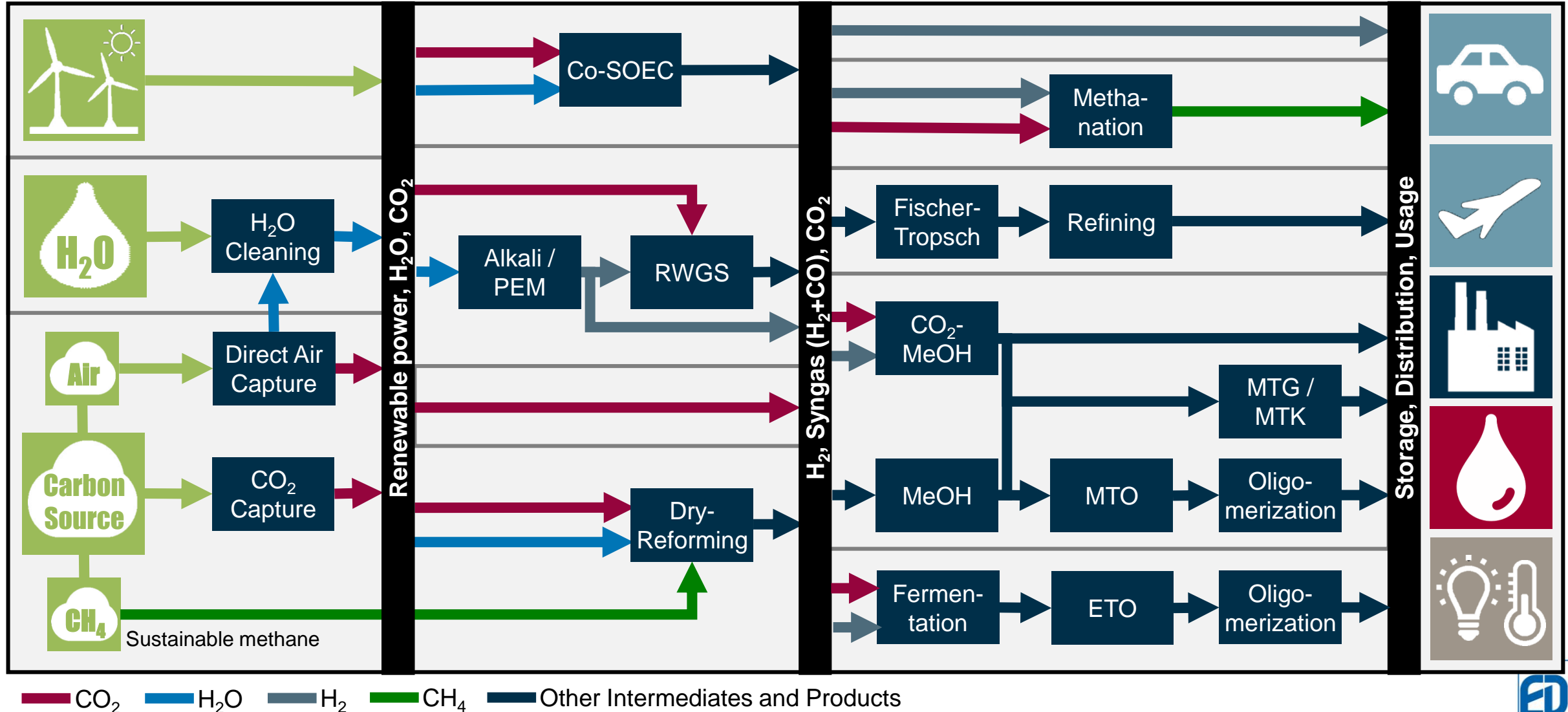
Defines / proposes following minimum limits for synthetic SAF*:



* German law since 01.10.2021; EU parliament proposal from 07.07.2022; EU KOM proposal from 14.07.2021

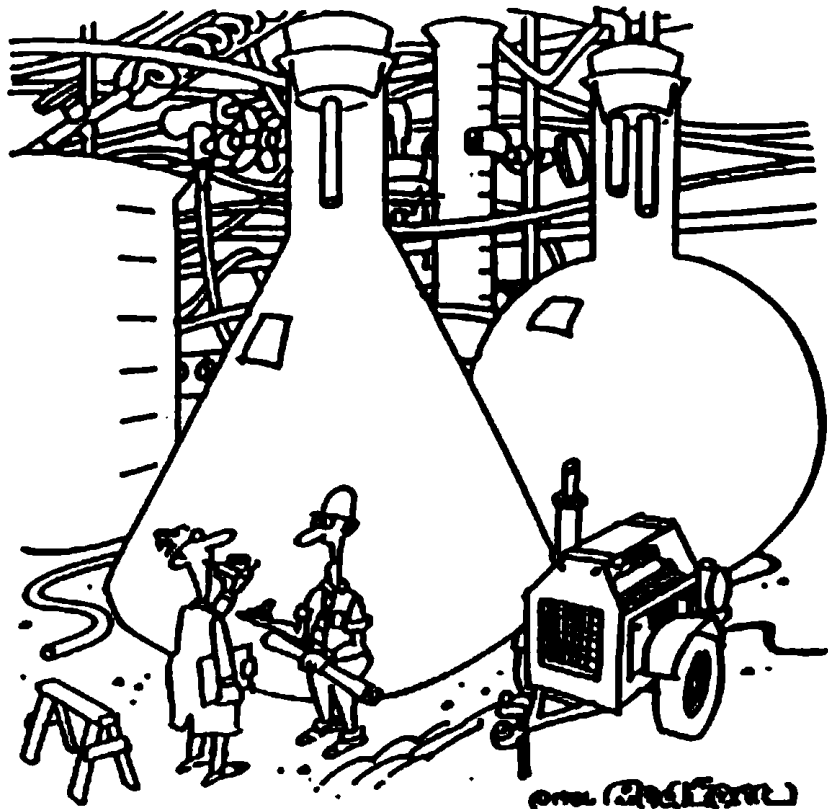
PTX TECHNOLOGIES

PATHWAYS TO SUSTAINABLE SYNTHETIC FUELS

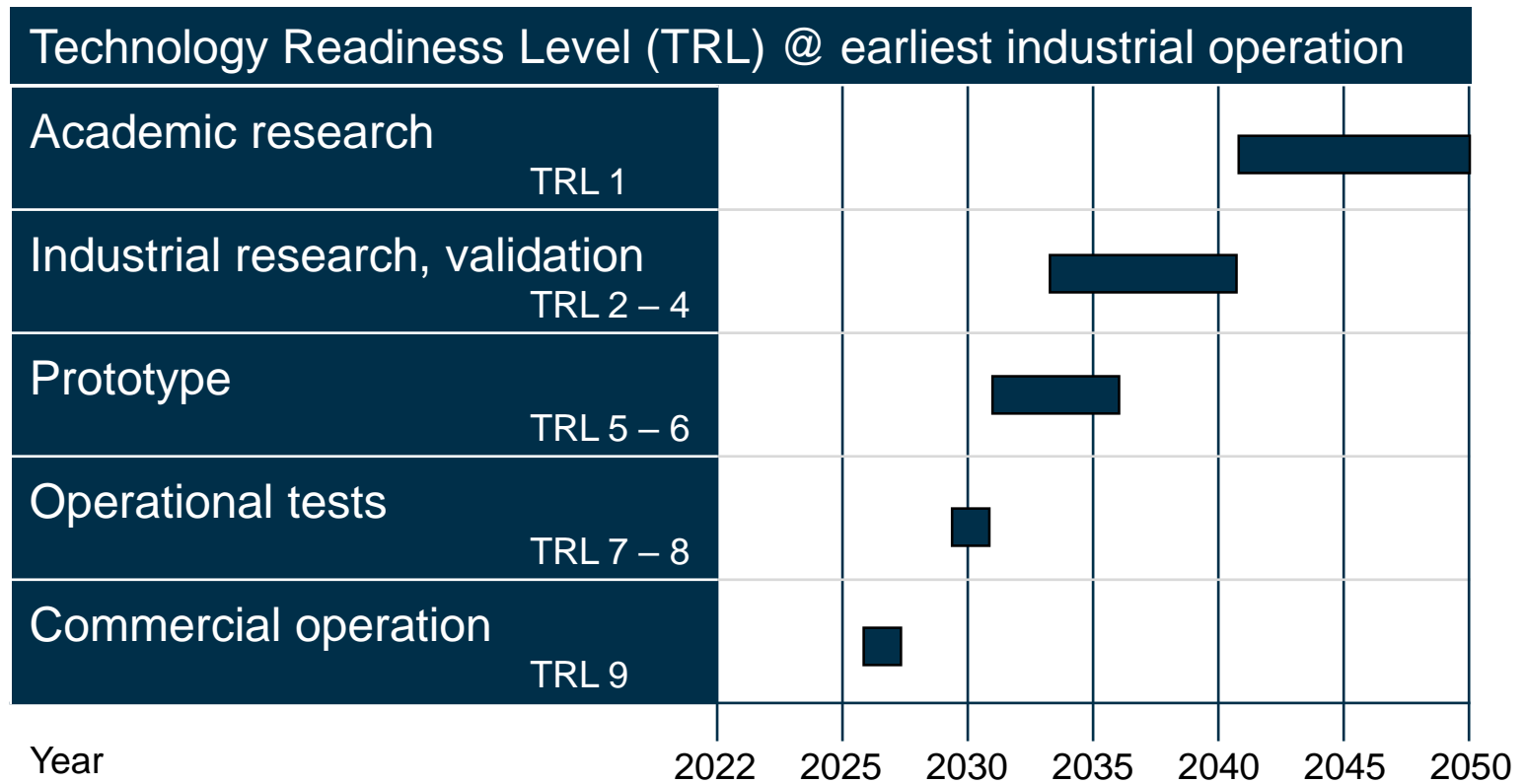


TECHNOLOGY READINESS AND TIME TO OPERATION

Technology development until readiness for commercial use (TRL 9) and designing and building commercial plants take considerable time.



"Got a few problems going from lab scale up to full-scale commercial."



PATHWAYS TO SUSTAINABLE LIQUID SYNTHETIC FUELS

Comparison of maximum theoretical achievable yields and efficiencies based on main chemical equations and energy content of molecules.

Pathway	Ely Eff. kWh/Nm ³	Consumption			Prod. H ₂ O kg/kg*	Overall Eff. %**	Lowest TRL ***
		Power kWh/kg*	CO ₂ kg/kg*	CH ₄ kg/kg*			
PEM ⇨ RWGS ⇨ FTS ⇨ Refining	4.5	21.9	3.1	-	2.5	55.8	< 5
PEM ⇨ MeOH ⇨ MTO ⇨ Oligomerization	4.5	21.9	3.1	-	2.5	55.8	< 8
PEM ⇨ Fermentation ⇨ ETO ⇨ Oligom.	4.5	21.9	3.1	-	2.5	55.8	< 8
Co-SOEC ⇨ FTS ⇨ Refining	3.4	16.5	3.1	-	1.3	73.9	< 5
PEM ⇨ DryReforming ⇨ FTS ⇨ Refining	4.5	6.8	1.4	0.6	1.2	81.5	9
Crude oil refineries						> 95.0	9

* per kg synthetic fuel (kerosene)

** ideal energy content in synthetic fuel in relation to energy input from electricity and CH₄ based on LHV (excl. losses)

*** lowest TRL in process route

Sources: various, EDL calculation

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our HyKero process route – today, the only pathway						> 95.0	9
<ul style="list-style-type: none"> ▪ to achieve acceptable energy efficiency ▪ with TRL 9 technologies. 							

electricity and CH₄ based on LHV (excl. losses)

*** lowest TRL in process route

HYKERO PLANT – 50,000 TPA PTL SAF PRODUCTION

HYKERO PLANT – KEY INFORMATION

Feedstock

- 998 GWh/a electricity
- 74 kta methane

Products

- 50 kta PtL SAF
- 14 kta PtL naphtha
- 1 kta green hydrogen

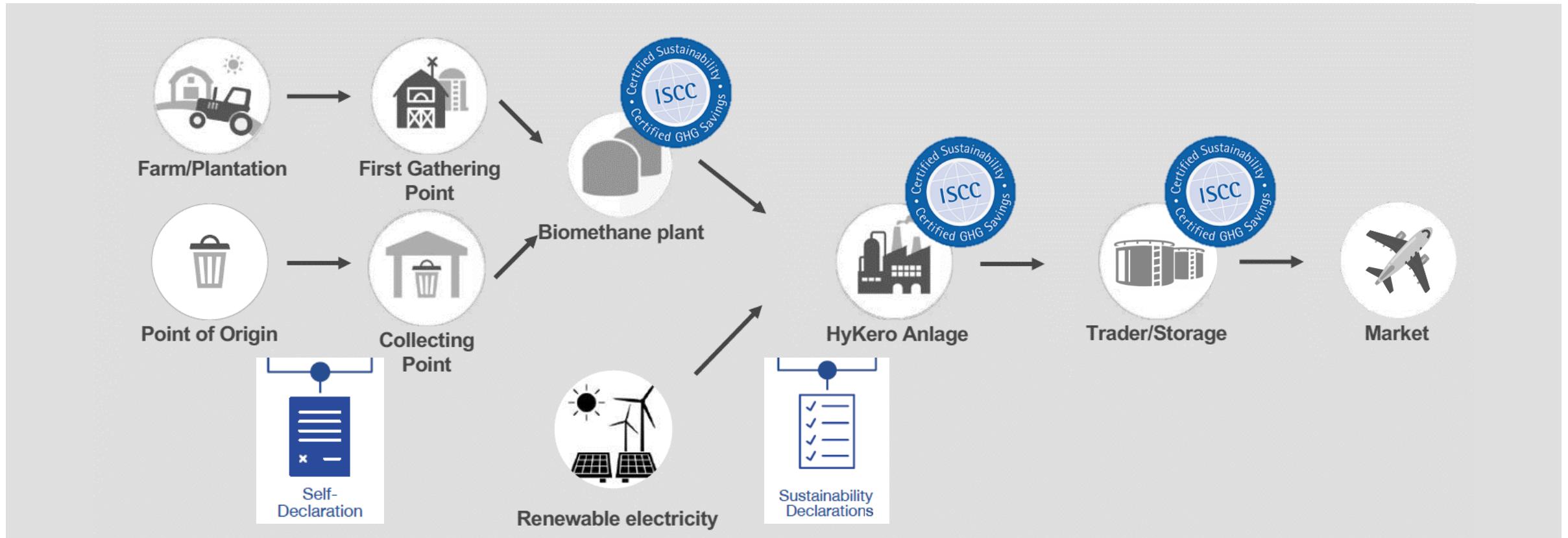
Highlights

- Fully integrated plant design developed by EDL based on TRL 9 technologies, CO₂ emission free.
- 16 kta green hydrogen, thereof 15 kta used for production of PtL-SAF and PtL-naphtha.
- Excellent conditions for site integration with optional production of green district heat.
- Direct connection to existing hydrogen pipeline.
- Expansion with own wind park; optional direct connection to adjacent 1.5 GW PV / wind parks.

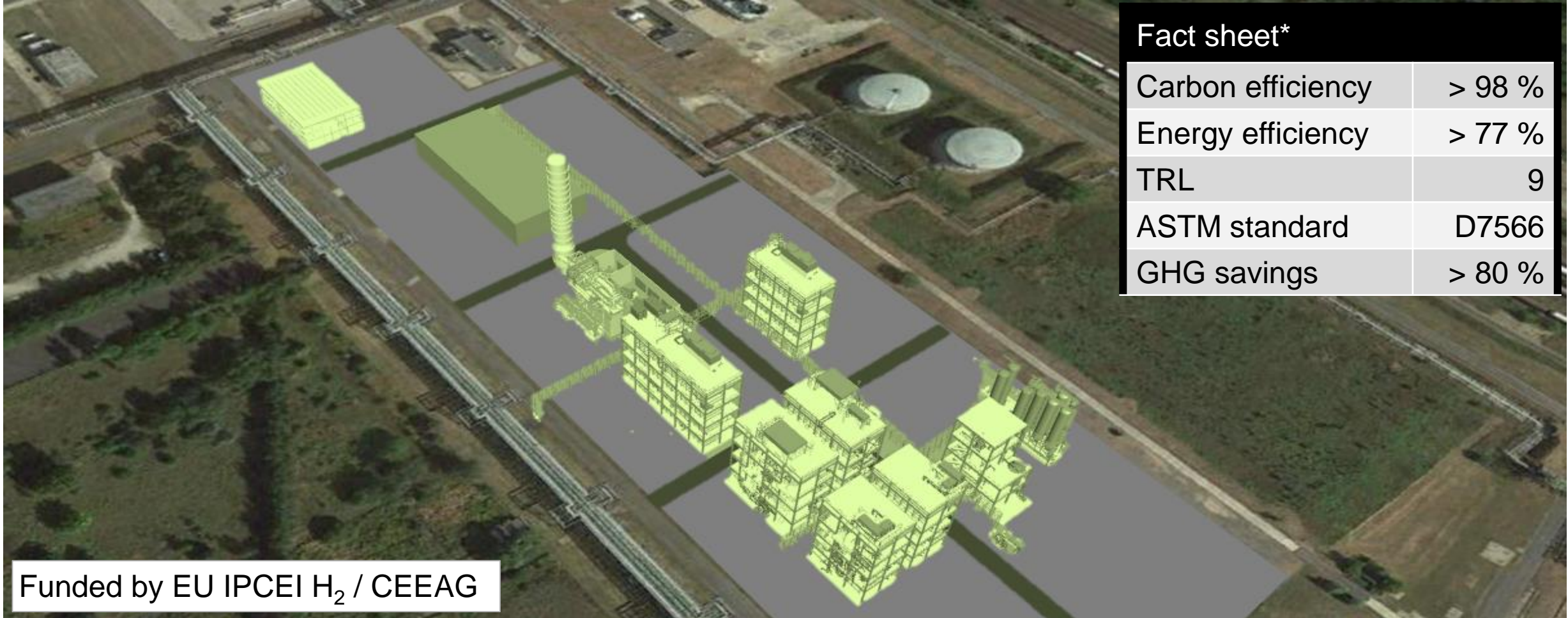


HYKERO PLANT – ISCC EU / ISCC PLUS CERTIFICATION

ISCC ensures compliance for GHG emission reduction along the value chain.



HYKERO PLANT – 3D VIEW



Fact sheet*

Carbon efficiency	> 98 %
Energy efficiency	> 77 %
TRL	9
ASTM standard	D7566
GHG savings	> 80 %

Funded by EU IPCEI H₂ / CEEAG

* Carbon efficiency: C in products vs. feed; energy efficiency: energy in products vs. feed; GHG-saving without RED II bonus for manure.

NEW TECHNOLOGIES FOR FUTURE PTL PLANTS

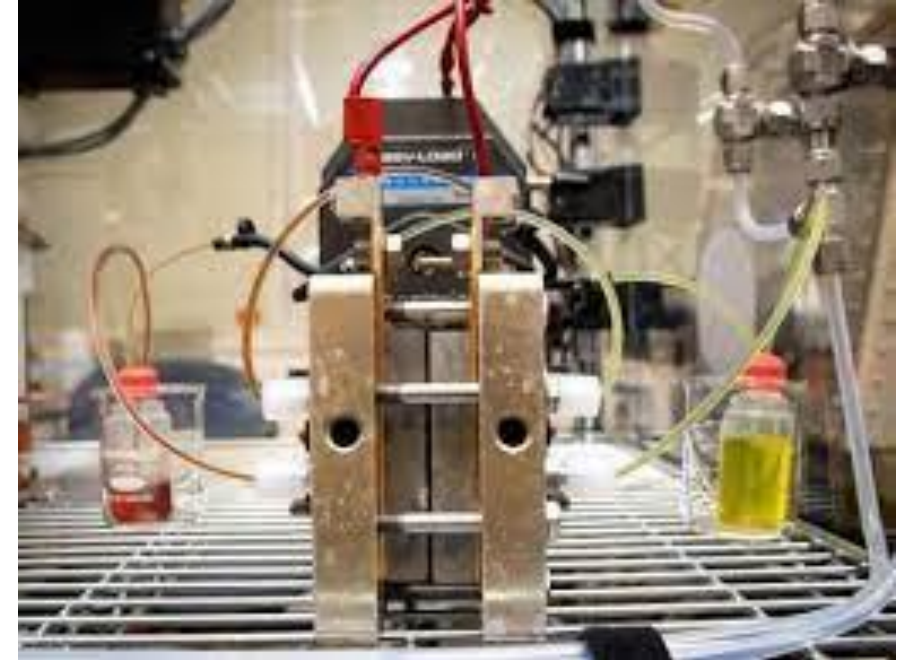
OUTLOOK NEW PTX TECHNOLOGIES

New technology for Direct Air Capture (DAC)

- Initial laboratory tests have been performed successfully.
- First small demonstration system to be developed and tested.
- Expected advantages:
 - 3 - 8-times lower energy need
 - ~40 % higher CO₂ yield
 - low CAPEX need
 - excellent scalability

New technology for synthetic hydrocarbon production

- Laboratory test stand preparation under way.
- Initial laboratory tests to be performed during next months.
- Expected advantages:
 - ~45 % higher energy efficiency
 - almost no water formation from CO₂
 - low CAPEX need
 - excellent scalability



Market ramp-up requires sound and clear legal framework open to all technologies and to the full band width of green energy and green carbon sources.

TRL 9 technologies are a must for market ramp-up on industrial scale.

New “game changing” technologies are a key for better energy efficiencies and yields on medium / long term.





THANK YOU



gf@edl.poerner.de
michael.haid@edl.poerner.de



EDL Anlagenbau Gesellschaft mbH

Lindenthaler Hauptstr. 145

04158 Leipzig, Germany

Telephone: +49 341 4664-400, Telefax: -409

www.edl.poerner.de