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PTX TECHNOLOGIES AND THE INDUSTRIAL-SCALE HYKERO PLANT

INSPIRING TECHNOLOGY

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PÖRNER GRUPPE

EDL ANLAGENBAU GESELLSCHAFT MBH

Leading technology-driven engineering company, being active in the process industries and looking back on a history of more than 100 years.

Since 2003 EDL has been a member of the Pörner Group after many years as part of RWE / DEA and Texaco under the company name Edeleanu GmbH.

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 depolymerization.
- 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.

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DEWAXING EDL•TECHNOLOGY

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COMPARISON OF DIFFERENT SYNTHETIC FUELS

Kerosene (and liquid HC) has best volume- and weight-based system energy density.

Airbus A321LR

Range 7,400 km
Seats 206
Tank volume 32,940 l

	Kerosene	LNG [a]	CNG [a]	NH_3 FC [a]	H_2 FC [a]	Electric
	35.0 MJ/l [b] 40% [c]	22.2 MJ/l [b] 40% [c]	9.0 MJ/l [b] 40% [c]	12.7 MJ/l [b] 50% [c]	4.5 MJ/l [b] 50% [c]	1.8 MJ/l [b] 90% [c]
Volume in '000 liter (of fuel and tank system)	33	52	128	91	256	862
Weight in t (of fuel and tank system)	42	65	144	79	192	985

[a] LNG @ -160°C, CNG @ 250bar, NH_3 @ -33°C, H_2 @ 690bar
[b] energy content (LHV, capacity) [c] assumed tank-to-wing efficiency in %

Sources: Airbus, EDL

EU SAF QUOTA

Jet A1 (kerosene, SAF) is the only option to fuel the majority of aircrafts for several decades.

ReFuelEU Aviation trilogue April 24th:

Year	SAF quota		PtL SAF sub-quota	
2025	2%	(1 MM t)		
2030	6%	(3 MM t)	1.2%	(0.5 MM t)
2035	20%	(10 MM t)	5.0%	(2.5 MM t)
2040	34%	(17 MM t)	stepwise	
2045	42%	(21 MM t)	up to	
2050	70%	(35 MM t)	35%	(17 MM t)

PLANT EFFICIENCY – PTL PATHWAYS

Sources	Pathways: Hydrogen	Syngas	Intermediates	Fuels	Ely Eff. kWh/Nm³	Consumption: Power kWh/kg*	CO_2 kg/kg*	CH_4 kg/kg*	Prod. H_2O kg/kg*	Overall Eff. %**	Lowest TRL ***
Electricity	PEM	RWGS	Fischer-Tropsch	Refining	4.5	21.9	3.1	-	2.5	**55.8**	< 5
Water	PEM	MeOH	MTO	Oligomerization	4.5	21.9	3.1	-	2.5	**55.8**	< 8
Carbon	PEM	Fermentation	ETO	Oligomerization	4.5	21.9	3.1	-	2.5	**55.8**	< 8
		Co-SOEC	Fischer-Tropsch	Refining	3.4	16.5	3.1	-	1.3	**73.9**	< 5
	PEM	Dry Reforming	Fischer-Tropsch	Refining	4.5	6.8	1.4	0.6	1.3	**81.5**	9
	SOEC	Dry Reforming	Fischer-Tropsch	Refining	3.5	5.3	1.4	0.6	1.3	**90.5**	9
	SOEC		Plasma Catalysis	Oligomerization	3.5	13.4	3.4	-	-	**91.4**	< 3

* Per kg synthetic fuel ** Maximum theoretical yields and efficiencies based on main chemical reactions and LHV (excl. losses) *** Lowest TRL in process route

Source: EDL

PLANT EFFICIENCY – PTL PATHWAYS

Sources	Pathways: Hydrogen	Syngas	Intermediates	Fuels	Ely Eff. kWh/Nm^3	Consumption: Power kWh/kg*	CO_2 kg/kg*	CH_4 kg/kg*	Prod. H_2O kg/kg*	Overall Eff. %**	Lowest TRL ***
Electricity Water Carbon	PEM	RWGS	Fischer-Tropsch	Refining	4.5	21.9	3.1	-	2.5	**55.8**	< 5
	PEM	MeOH	MTO	Oligo-merization	4.5	21.9	3.1	-	2.5	**55.8**	< 8
	PEM	Fermen-tation	ETO	Oligo-merization	4.5	21.9	3.1	-	2.5	**55.8**	< 8
	Our HyKero process route										
	PEM	Dry Reforming	Fischer-Tropsch	Refining	4.5	6.8	1.4	0.6	1.3	**81.5**	9
	SOEC	Dry Reforming	Fischer-Tropsch	Refining	3.5	5.3	1.4	0.6	1.3	**90.5**	9
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Source: EDL

HYKERO PROJECT OVERVIEW

HYKERO – INDUSTRIAL-SCALE PLANT FOR PTL SAF

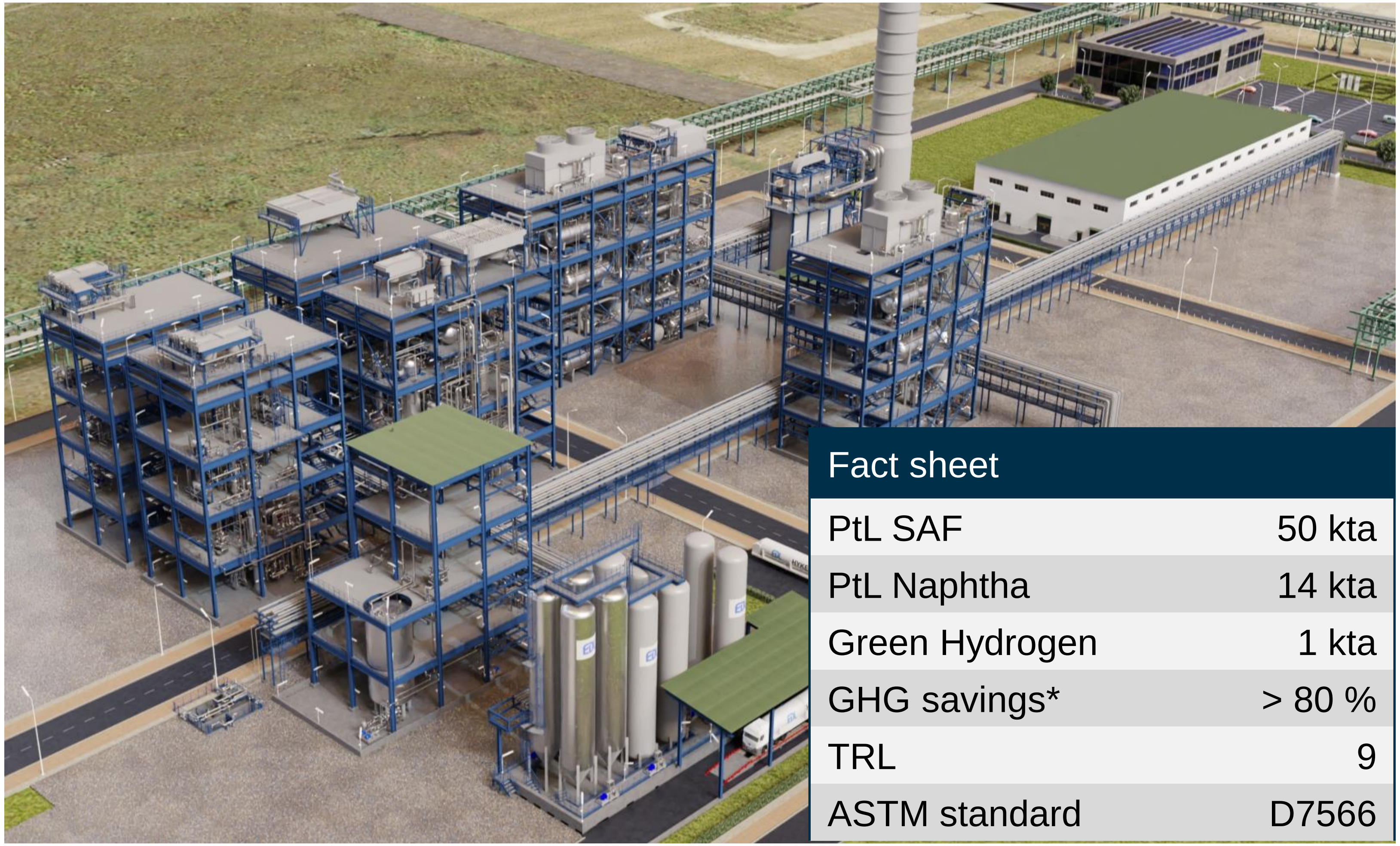
Fully integrated plant design developed by EDL based on TRL 9 technologies, CO_2 emission free.

Located at industrial park Böhlen-Lippendorf (in the south of Leipzig).

Production of green heat, e.g. for supply to existing district heating.

Linked to existing hydrogen pipeline and optional underground storage.

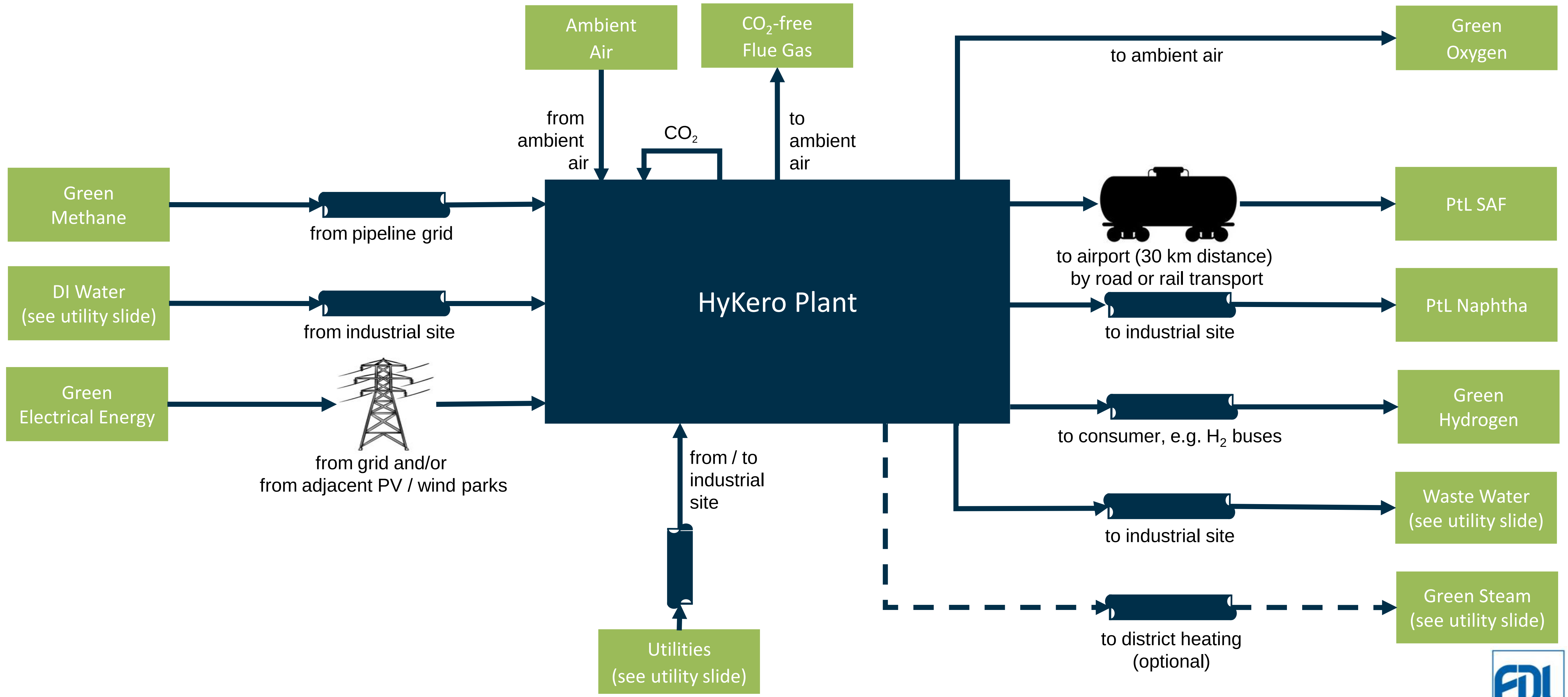
Optional connection to future adjacent 1.5 GW PV / wind parks.



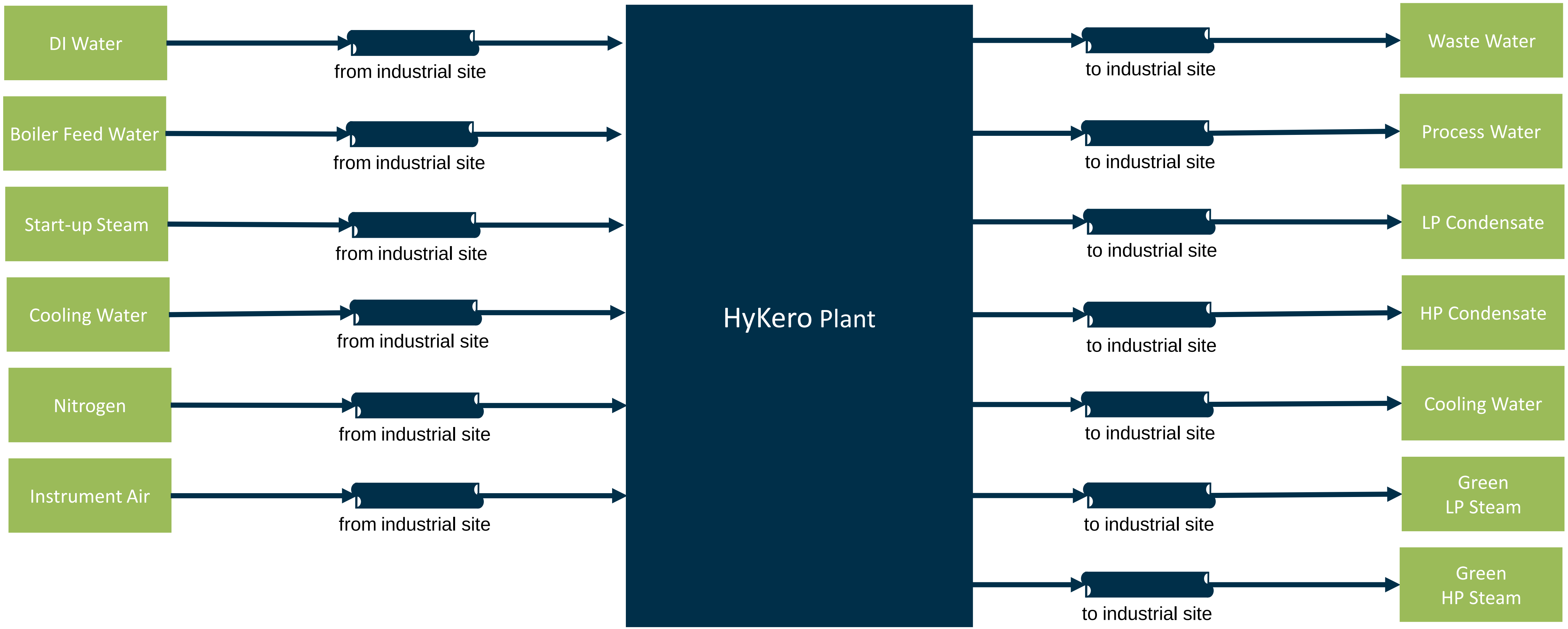
Fact sheet	
PtL SAF	50 kta
PtL Naphtha	14 kta
Green Hydrogen	1 kta
GHG savings*	> 80 %
TRL	9
ASTM standard	D7566

* GHG saving without bonus acc. to EU RED II Annex 9 A.

HYKERO PLANT – FEED AND PRODUCT STREAMS



HYKERO PLANT – UTILITY STREAMS



HYKERO PLANT – GHG EMISSION FACTORS

Approved calculator for HyKero plant GHG emission reduction.

Emission factor: 9.05 g CO_2eq/MJ

Based on average GHG emission savings bio methane in Germany in 2019,
RED II manure bonus not considered:
-20 to -103 g CO_2eq/MJ (Annex VI D)

Emission factor: 0.00 g CO_2eq/MJ

RFNBO RCF GHG methodology draft:
fully renewable electricity (Article 4 (1))

Calc. emission factor: 18.64 g CO_2eq/MJ
(80.2% GHG emission reduction)

Calc. emission factor: 7.53 g CO_2eq/MJ
(91.5% GHG emission reduction)

Calc. emission factor: 4.03 g CO_2eq/MJ
(95.7% GHG emission reduction)

Sources: EDL calculation, emission values used for conventional products: kerosene 94 g CO_2eq/MJ, naphtha 89 g CO_2eq/MJ, hydrogen 90 g CO_2eq/MJ

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THANK YOU

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