Zentrum für Sonnenenergie- und Wasserstoff-
Forschung Baden-Württemberg

A roadmap for reFuels for Baden-Wuerttemberg –

a strategy for more climate protection and energy security

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Baden-Wuerttemberg Automotive Industry Strategy Dialogue Conference

Brussel, 17.11.2022

A Roadmap for reFuels for Baden-Wuerttemberg

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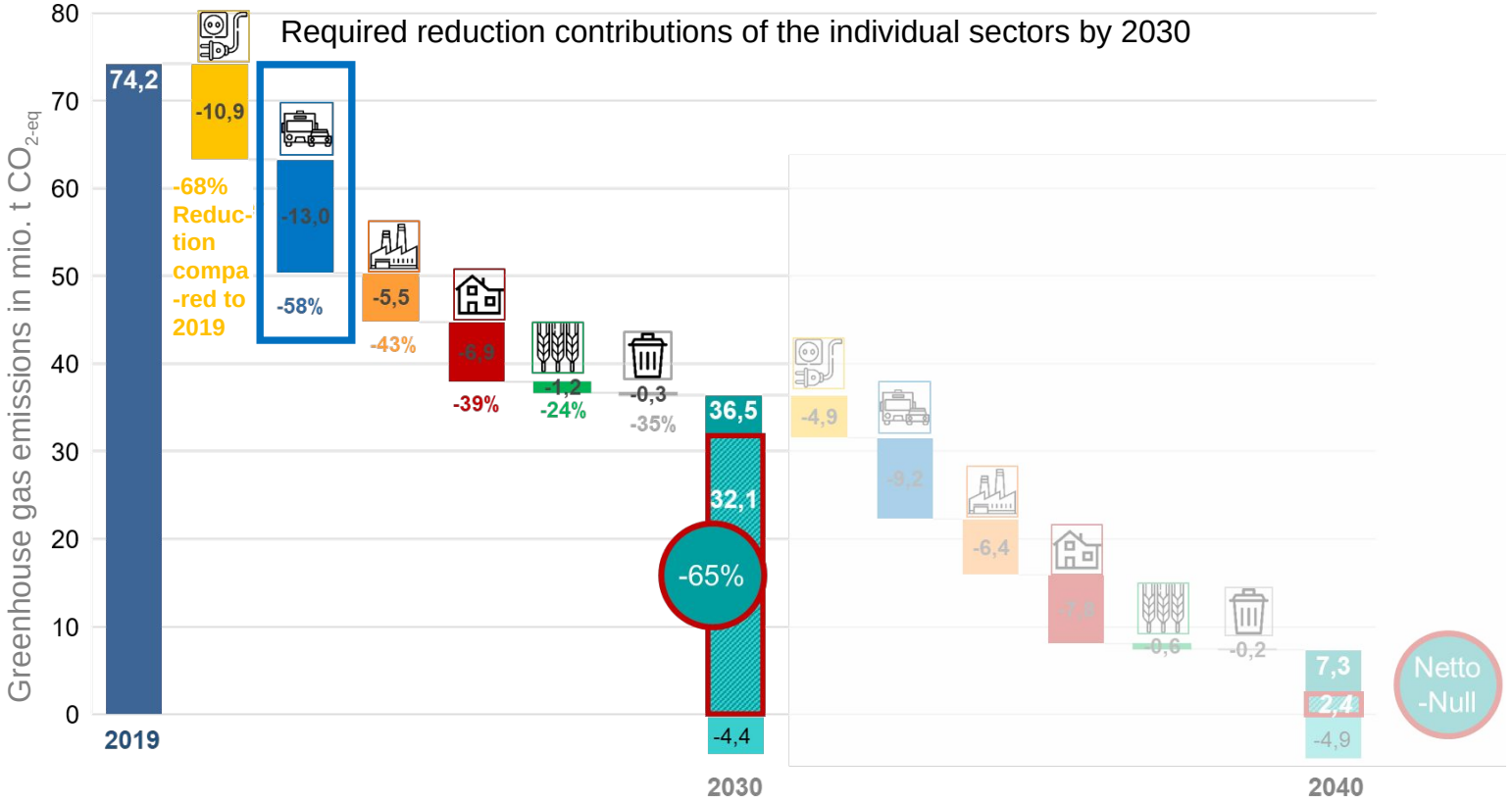
strategiedialog automobilwirtschaft BW
Baden-Württemberg
MINISTERIUM FÜR VERKEHR

Background to the Roadmap for reFuels for Baden-Wuerttemberg

Sector targets for 2030 and climate neutrality in Baden-Württemberg by 2040



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Background to the Roadmap for reFuels for Baden-Wuerttemberg

The objective of **climate neutrality for Europe by 2050** at the latest, for Germany by 2045 and Baden-Württemberg by 2040, combined with the corresponding "ambitioning" of the climate protection targets for 2030 at European, national and state level, as well as the **currently tense situation regarding the security of energy supply, make reFuels a decisive building block!**

Climate neutrality until 2050...2045...20

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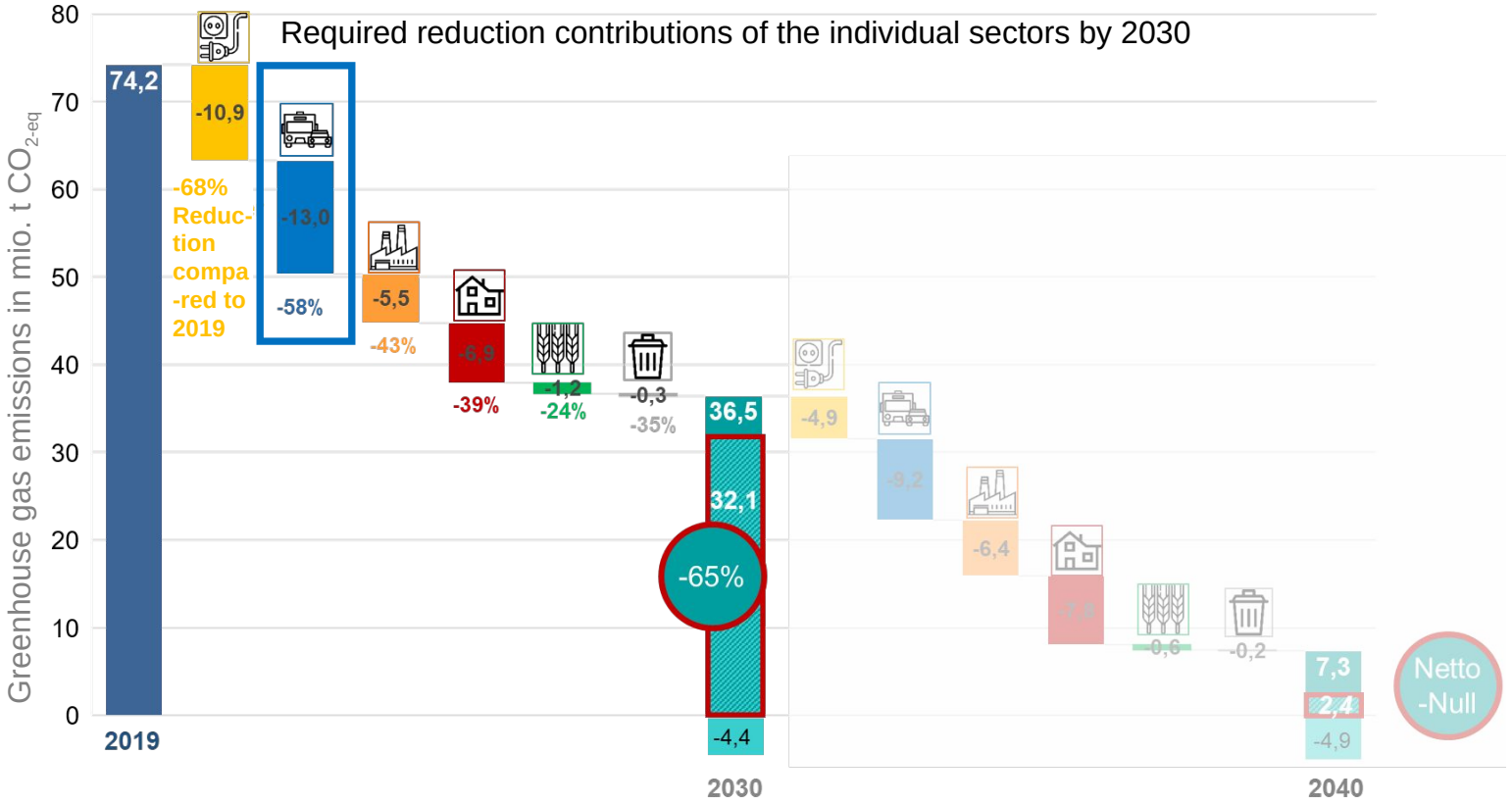

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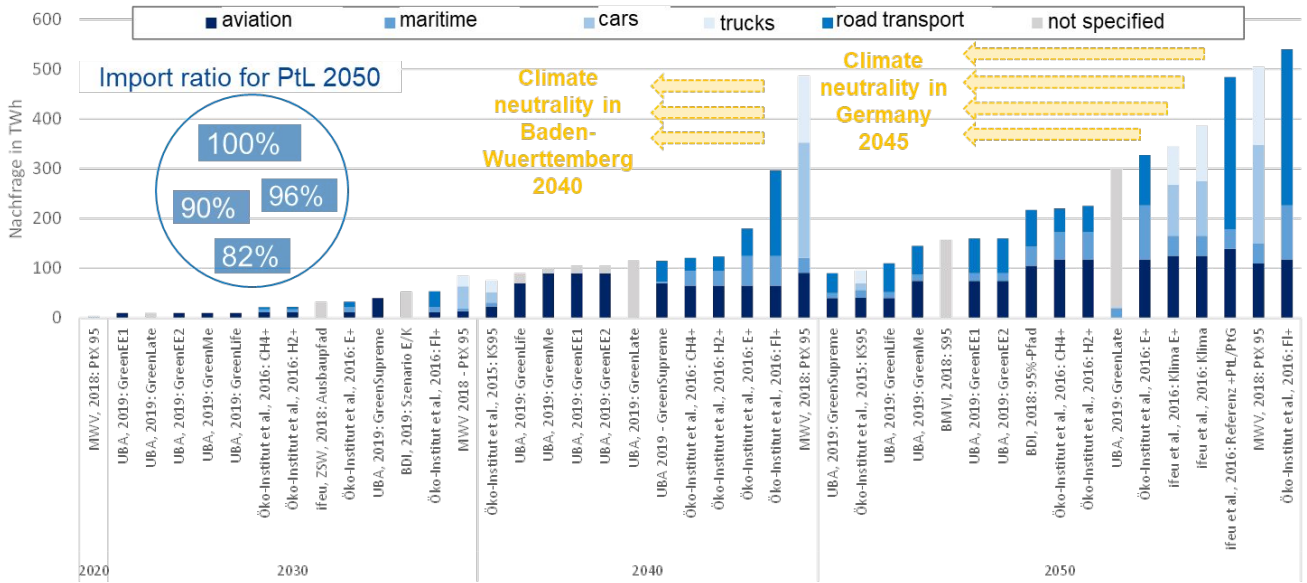
Climate neutrality until 2050...2045...20

*The analysis of the demand for PtL in Germany in 95% scenarios including international transports underlines that reFuels are **absolutely necessary** for a climate-neutral transport sector!*



G7-Gipfel in Elmau: Klimaclub nach Scholz-Idee steht

➡ Synthetic fuels can contribute to the diversification and security of energy supply if production in new energy partner countries **is ramped up quickly enough!**

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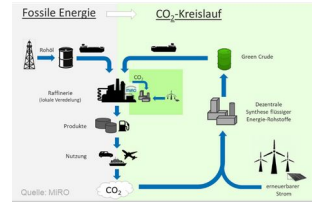
Goals of the roadmap for reFuels

⇨ *Entry into **climate-neutral air traffic** by blending synthetic kerosene at Stuttgart Airport. Mandatory blending under the Act on the Further Development of the Greenhouse Gas Reduction Ratio in Germany: 0.5% in 2026; 1% in 2028; 2% in 2030.*

⇨ *Notable contributions of the **existing fleet** to climate protection in 2030 through blending of synthetic diesel/gasoline. An admixture for reFuels of 7 %, would mean an additional greenhouse gas reduction of approx. 5 %-points (for Baden-Württemberg), provided that the developments in transport take place according to the assumptions underlying the KlimaG.*

⇨ *Establish **energy partnerships and supply relationships** in other European and non-European countries to secure imports of synthetic fuels or green crude.*

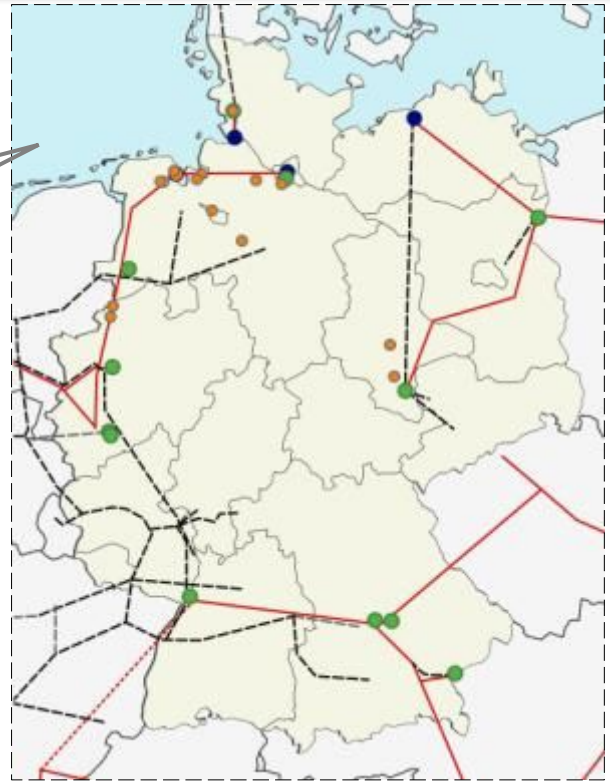
⇨ ***Actively shaping the industrial transformation** toward climate neutrality to preserve existing value-added structures and secure sustainable jobs, particularly in the petroleum industry/refinery, but also in the chemical industry and downstream consumer sectors.*



⇨ *Development of the **sales potential** associated with reFuels of up to **€4.5 billion in 2030** for the mechanical and plant engineering sector and **creation of up to 22,500 jobs.***

Today's fuel routes and petroleum product infrastructures

Crude oil pipeline
Product pipeline
Water way´s (EU only)



Refineries
Oil ports (Germany only)
Oil storage (Germany only)

13 crude oil processing sites.
48 petroleum processing companies.
2,400 km of pipelines (crude oil and product transport).
Crude oil storage capacity 62.8 million m³.
126 oil tankers owned by German shipping companies.
Capital tied up in infrastructures ~32 billion euros.

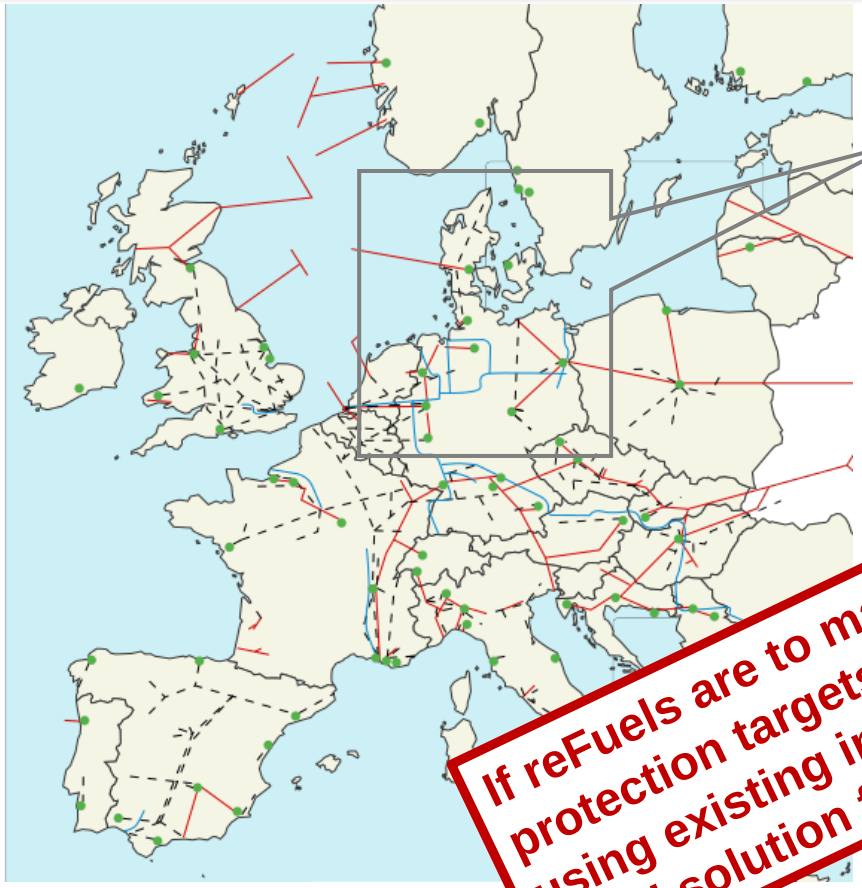
The MiRO in Karlsruhe is

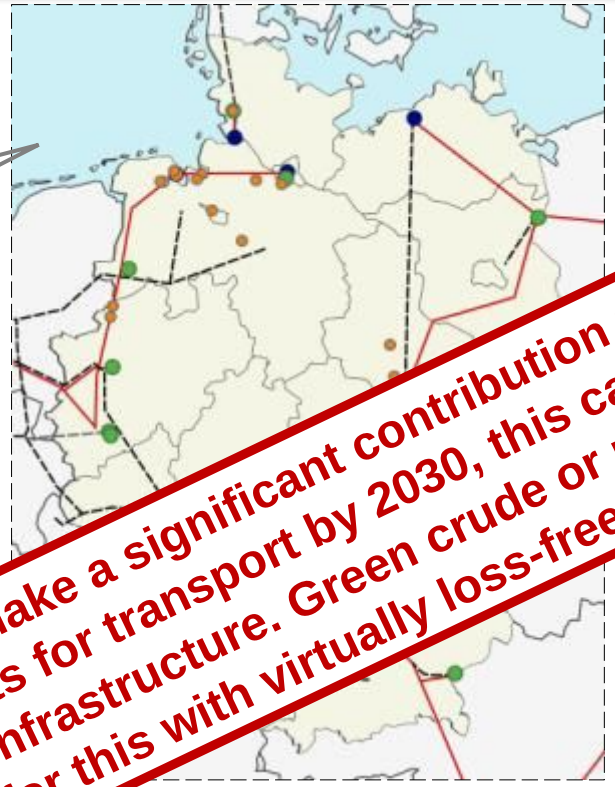
- One of Germany's largest refineries, with an annual production of 14.9 million tons, and also the only one in Baden-Wuerttemberg.
- connected to the port of Trieste via the Trans-Alpine Oil Pipeline (TAL)."Green Crude" must be landed at the port of Trieste and delivered to MiRO via the TAL.

The goal is to produce significant shares of "Green Crude" in partner countries, e.g. in Africa or the Middle East, by 2030 and to deliver it to the MiRO via the existing infrastructures.

Sources:
Left: CIEP (2017): The European Refining Sector: A Diversity of Markets?
Right: Darstellung ZSW based on data of the Mineralölwirtschaftsverbands, Eurostat, CIEP, u.a.

Today's fuel routes and petroleum product infrastructures





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~32 billion euros.

If reFuels are to make a significant contribution to achieving the climate protection targets for transport by 2030, this can only be achieved by using existing infrastructure. Green crude or methanol represent a very good solution for this with virtually loss-free transport!!!

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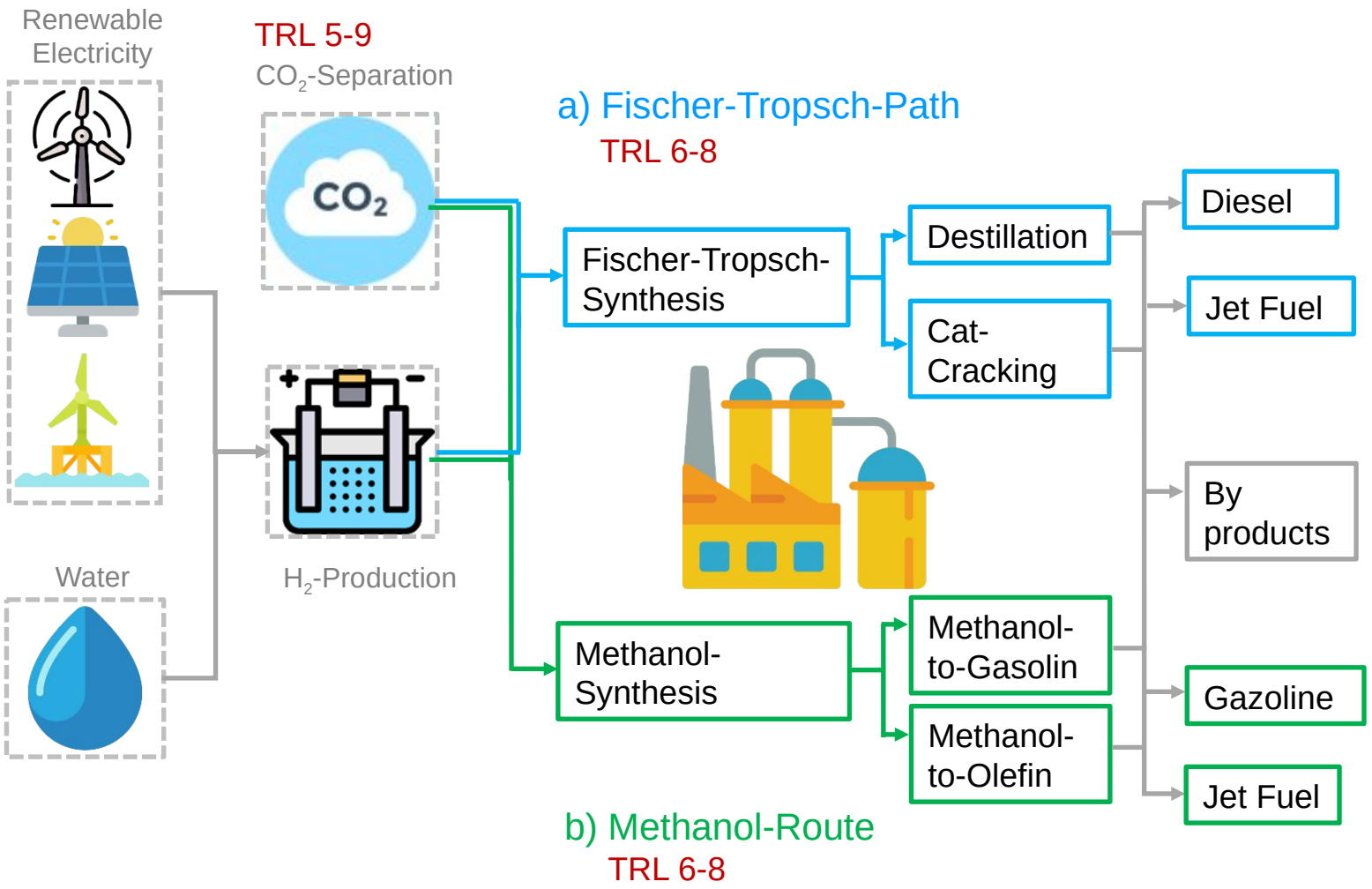
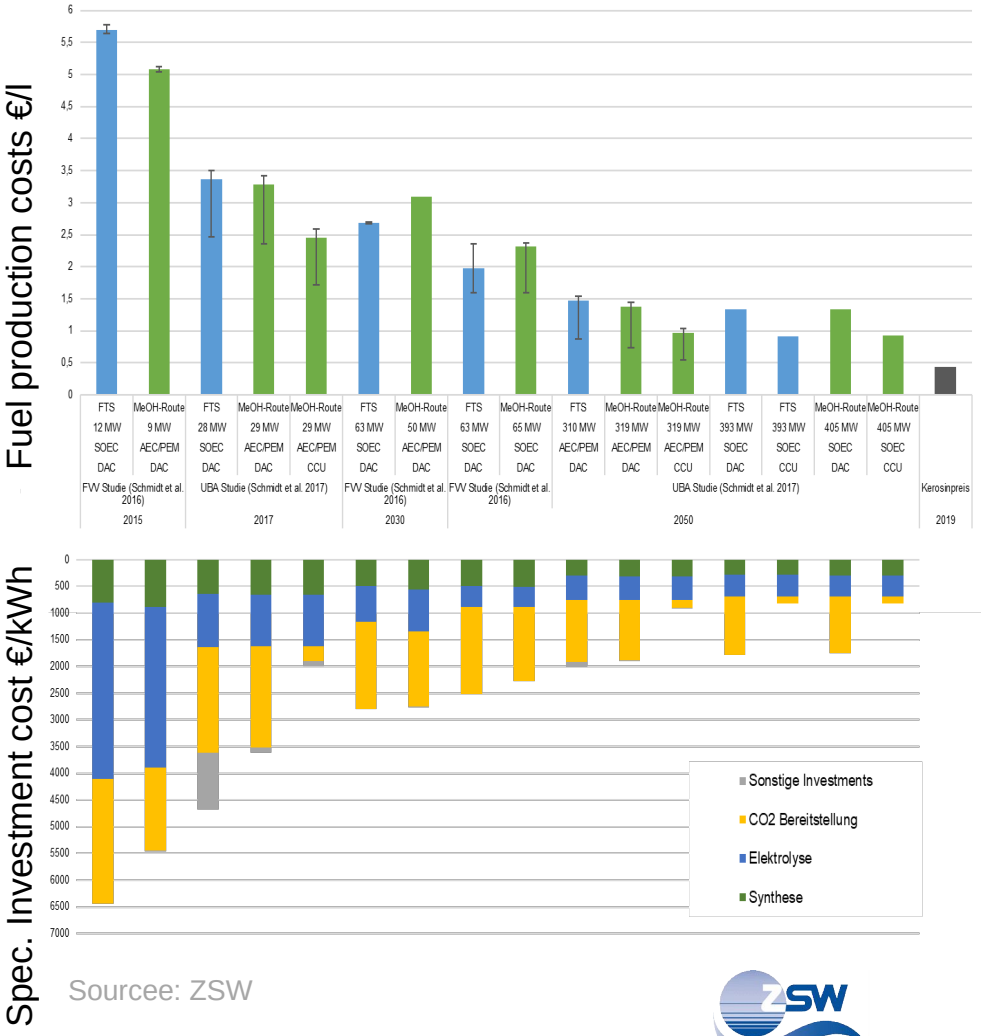
reFuels - production options for synthetic fuels

Fuel supply pathways



Source: ZSW

Cost reduction potential



Sourcee: ZSW

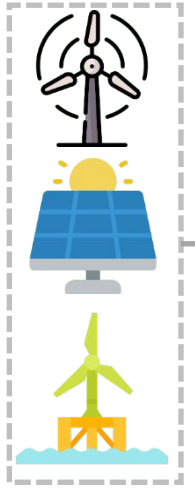
reFuels - production options for synthetic fuels

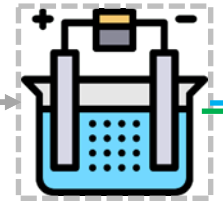
Fuel supply pathways

Renewable Electricity

TRL 5-9

CO_2-Separation





H_2-Production

Water

a) Fischer-Tropsch-Path

TRL 6-8

Fischer-Tropsch-Synthesis

Destillation

b) Methanol-Route

TRL 6-8

Methanol-to-Gasolin

Methanol-to-Olefin

By products

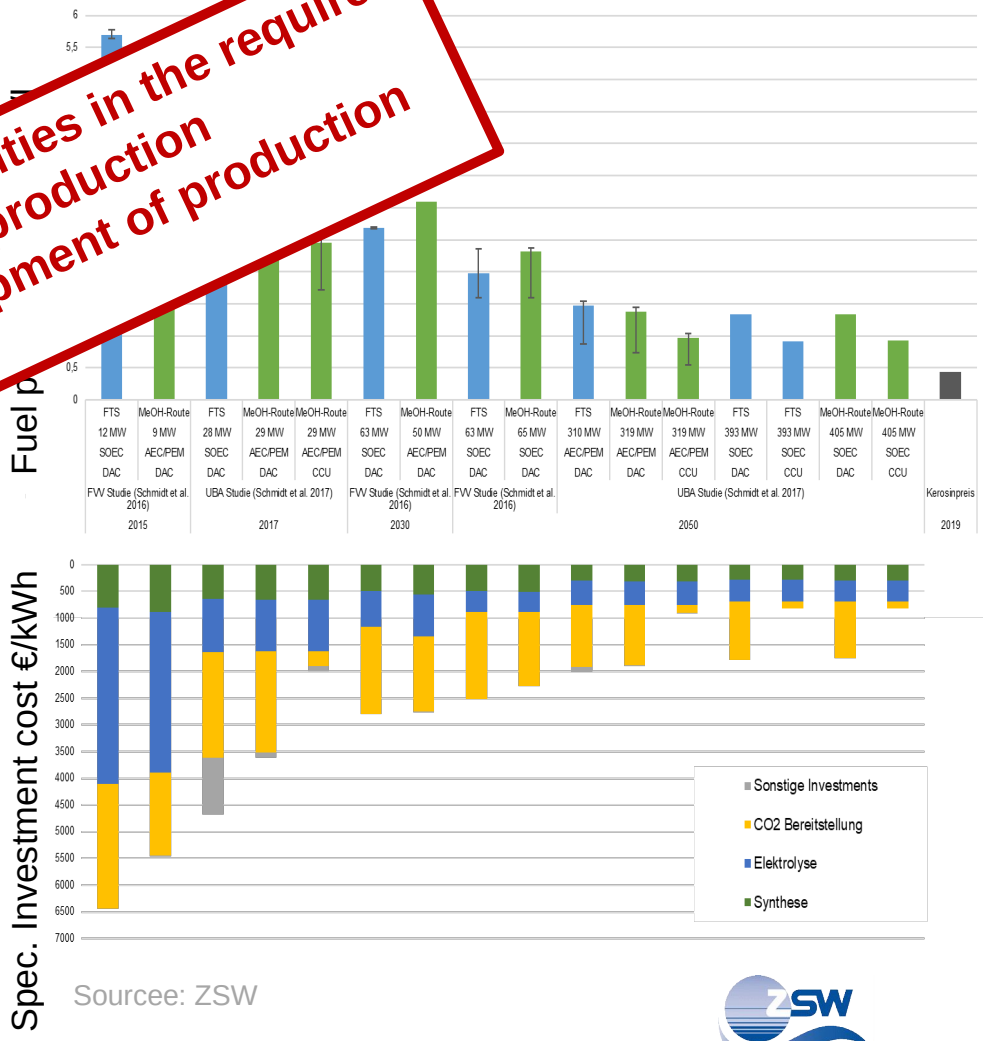
Gazoline

Jet Fuel

For reFuels to be available in significant quantities in the required timeframe up to 2030, the rapid upscaling of production technologies and the corresponding development of production capacities must begin promptly!!!

Source: ZSW

Cost reduction potential



Sourcee: ZSW

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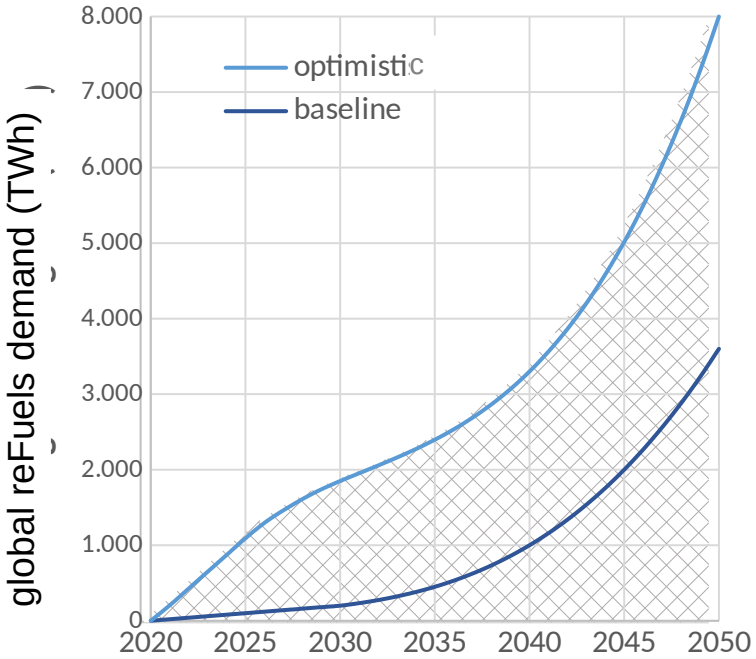
Required scaling of production technology

Expected global development of demand for reFuels



Technology development status quo and required scaling

2022/23:

Research scale plants

Annual production realized <5.000 t/a

2026/27:

Pilot plants

Scaling 1:10

Annual production <50.000 t/a

2028/29:

Industrial plants

Scaling 1:10

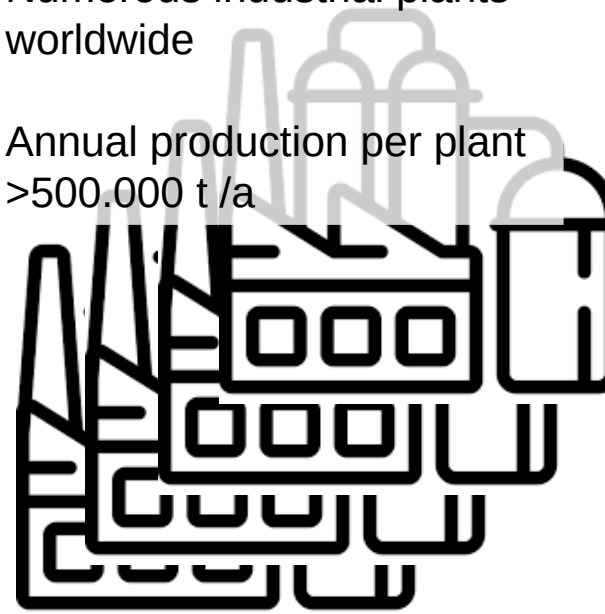
Annual production <500.000 t/a

2030 (the latest):

Global production roll-out

Numerous industrial plants worldwide

Annual production per plant >500.000 t /a



In parallel: scaling of electrolysis technology into the multi-megawatt range and scaling and commercialization of direct air capture technology as a CO_2 supplier.

Proposed measures of the Roadmap for reFuels in Baden-Wuerttemberg

Measures to increase demand for reFuels in Baden-Wuerttemberg

2026:
At least 0.5% admixture in air traffic

2030:
At least 5 TWh reFuels in Baden-Wuerttemberg via blending in road traffic and at least 2% blending in air traffic.

- Climate-neutral fuels as a contribution to more climate neutrality in agriculture
- Climate-neutral bus transport in Baden-Württemberg by 2030
- Climate-neutral state police by 2030
- Climate-neutral train traffic by 2030
- Climate-neutral state administration by 2030
- Climate-neutral Lake Constance (reFuels as fuel of a climate-neutral inland navigation in the leisure sector plus concept of conversion to e-motor)
- Climate-neutral airports by 2030 and climate-neutral flying by 2040

Testing of reFuels in heavy-duty transport compared to trolley trucks and hydrogen trucks.

- Start of construction of pilot plant for 50,000 t/a reFuels + start of R&D work for 1:10 scale-up.
- Further pilot projects (Sustainable Aviation Fuel Stuttgart Airport, pilot production with CO_2 from cement plant)

- Demonstration of scaled-up process technologies (electrolysis, RWGS, DAC,...).
- Production of 50,000 t/a reFuels (pilot plant).

- Construction of an industrial-scale production plant abroad
- Goal: Production of 500,000 t/a of reFuels for import to Baden-Wuerttemberg.

- Production and import of reFuels from abroad (1st plant with 500,000 t/a),
- Start of construction of further plants (abroad)

Measures to increase supply of reFuels in Baden-Wuerttemberg

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Challenge: Establishing the regulatory framework at European level - REPowerEU (EU Commission proposal).

The EU Commission's "REPower-EU" plan of May 2022 to accelerate the energy transition builds on "Fit for 55" and focuses, among other things, on faster expansion of RE and energy savings:

- Renewables are in the "overriding public interest",
- Binding target of 45% for renewables in the energy mix by 2030,
- 10 million tons of domestic production and 10 million tons of imports of renewable hydrogen by 2030,
- Sub-target for RFNBOs (including renewable hydrogen) for transport: 5% by 2030
- Renewable hydrogen / RFNBOs sub-target for industry by 2030: 75%.
- ……

Targets for sustainable aviation fuels (SAF) including a sub-target for synthetic fuels in aviation (ReFuelEU Aviation):

2030: 0,7% RFNBO
2035: 5% RFNBO
2040: 8% RFNBO
2045: 11% RFNBO
2050: 23% RFNBO

→ *still under discussion*

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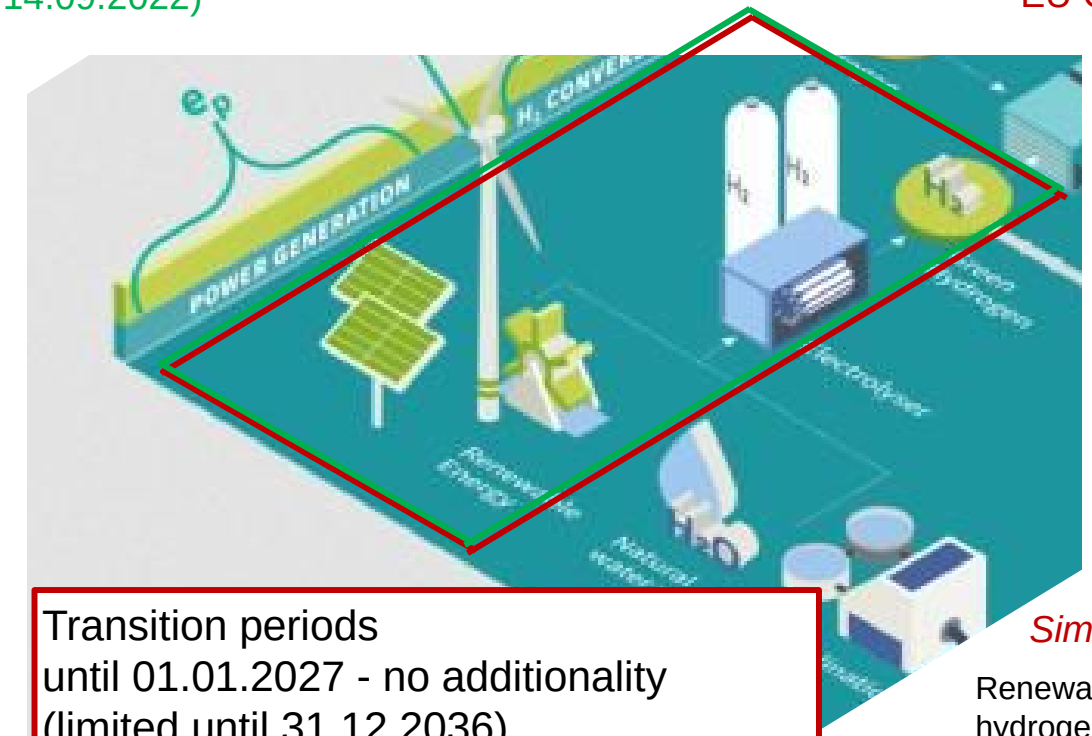
RECAST RED II
(Draft of the EU Parliament from 14.09.2022)

Definition of the green property of RFNBOs directly in the RED II.

The rules for determining the "green" property of RFNBOs (incl. H2) should apply to all application areas (transport, industry, heat).

Greatly simplified criteria for demonstrating "green" property:

- **No addionality**, Evidence of green property exclusively via direct purchase or PPA.
- **Simultaneity** to be demonstrated only on a quarterly basis (from 2030 possibly on a monthly basis)
- Power generation and electrolysis must be located **in the same country or in neighboring countries,** and power generation may also come from offshore bidding zones.



Transition periods
until 01.01.2027 - no additionality (limited until 31.12.2036),
until 31.12.2029 - proof of simultaneity on a calendar month basis

Source:
https://ptx-hub.org/delegated-acts-on-art-27-and-28-explained/

Delegated Act Art. 27 – Green H_2 (Draft of the EU Commission from 15.09.2022)

Additionality

Commissioning of power generation max. 36 months prior to electrolysis
No recourse to subsidies

Electricity purchase via PPA.
Commissioning of power generation max. 36 months before electrolysis.
No recourse to subsidies

Simultaneity

Renewable electricity and hydrogen must be produced in the same calendar hour.

No proof of additionality is required for > 90% RES-E in the bidding zone into which electrolysis occurs.

Geographical correlation

Renewable electricity and hydrogen must be produced in the same bidding zone, or in "linked" bidding zones if the electricity price was the same or higher there.

Outcome currently open...

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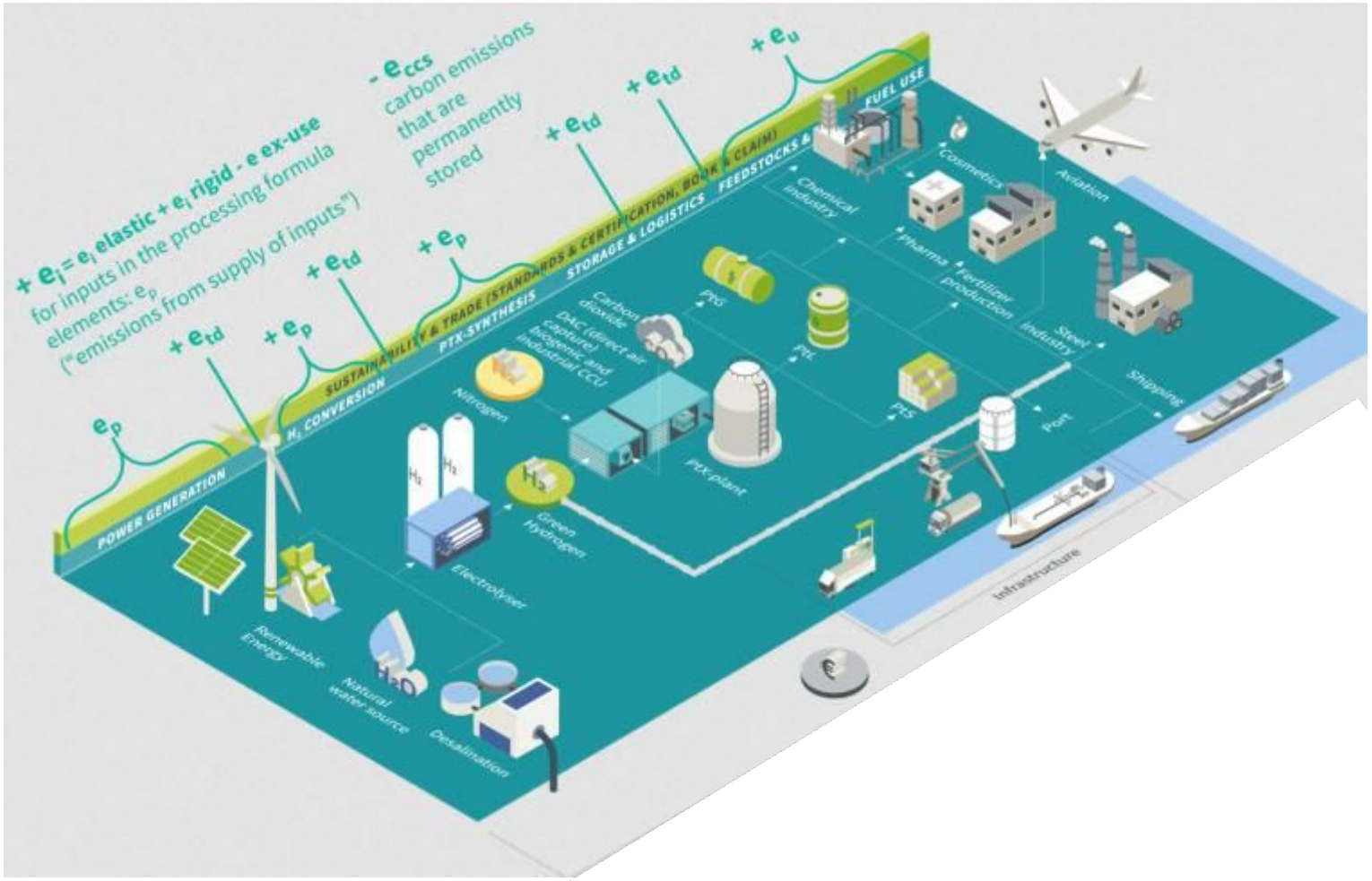
No planning and no investment without a legal framework...

Delegated Act Art. 28 – CO_2-Sources

Greenhouse gas emission savings from RFNBO/H_2 must be at least 70% (based on 94 g CO_2eq/MJ).

- Sources of CO_2 subject to the EU ETS can only be counted as avoided if they **continue to pay the CO_2 price** (feasibility?).
- Capturing of emissions from non-sustainable sources can only be considered as avoiding emissions **until 2035**. This also includes unavoidable CO_2 sources e.g. cement industry.
- Unavoidable CO_2 sources, such as process emissions from the cement industry, cannot be harnessed, as 70% savings cannot be achieved.
- CO_2 from Direct Air Capture (upscaling still missing) and biomass (critical feedstock situation) is allowed.
- **Target achievement for RFNBOs more than questionable!!!**



Source: https://ptx-hub.org/delegated-acts-on-art-27-and-28-explained/

To enable Europe to achieve an international leading position in the innovation competition for green hydrogen and synthetic fuels, the regulations must be very flexible and easy to comply with, especially in the market entry phase and the incipient market ramp-up phase. Once a certain market dynamic has been reached, the requirements can be increased in order to demand stronger contributions to system stabilization.

THANK YOU FOR YOUR ATTENTION

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Widderstall

Ulm

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