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FH Joanneum

# eFuels: Von der Vision zur Realität

## Einblicke in Produktion und Qualität erneuerbarer Kraftstoffe

**Dipl.-Ing. (FH) Karl Dums**

Dr. Ing. h.c. F. Porsche AG, Stuttgart

**D. Schwarzenthal**

Dr. Ing. h.c. F. Porsche AG, Stuttgart

**Marcos Marques**

Dr. Ing. h.c. F. Porsche AG, Stuttgart

**Jan Ohmstedt**

Dr. Ing. h.c. F. Porsche AG, Stuttgart

**Fabian Ehrat**

Dr. Ing. h.c. F. Porsche AG, Stuttgart





**Herausforderung Defossilisierung der Mobilität**

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# WORKING TOWARDS THE VALUE CHAIN IN 2030



Net carbon-neutral value chain  
in 2030 and a net carbon-  
neutral use-phase for future  
BEV\* models

\* BEV = Battery Electric Vehicle, Use Phase based on a mileage of 200.000km / WLTP

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# ELECTRIFICATION GOALS

Goal in 2025

**> 50 %\***  
**electrified**  
(BEV+PHEV)\*\*

Goal in 2030

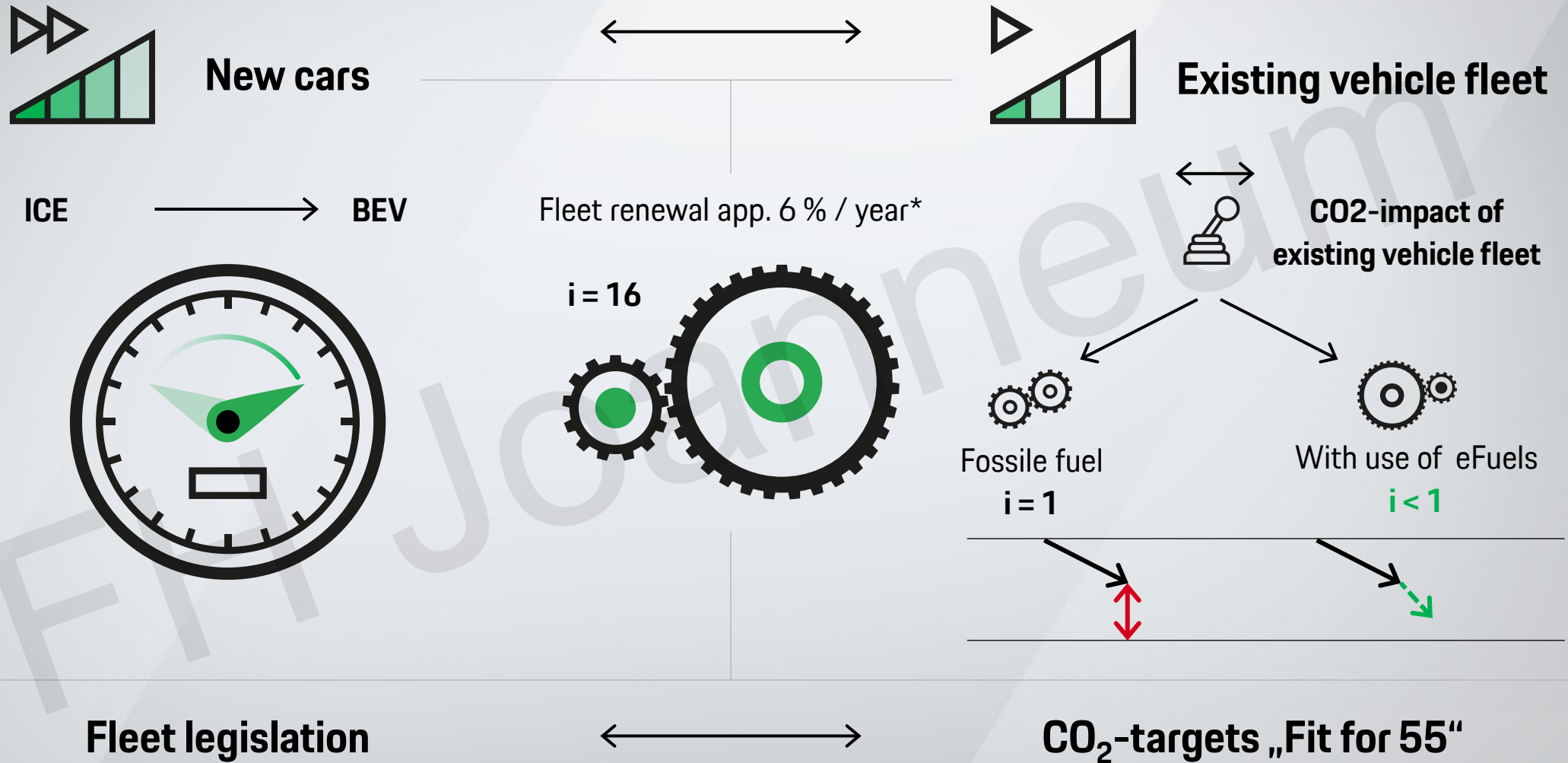
**> 80 %\***  
**fully electric**  
(BEV)\*\*

\* Share of deliveries p.a., in %

\*\* BEV = Battery Electric Vehicle, PHEV = Plugin Hybrid Electric Vehicle

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# Minimizing CO<sub>2</sub>: Correlation between new cars and vehicle fleet



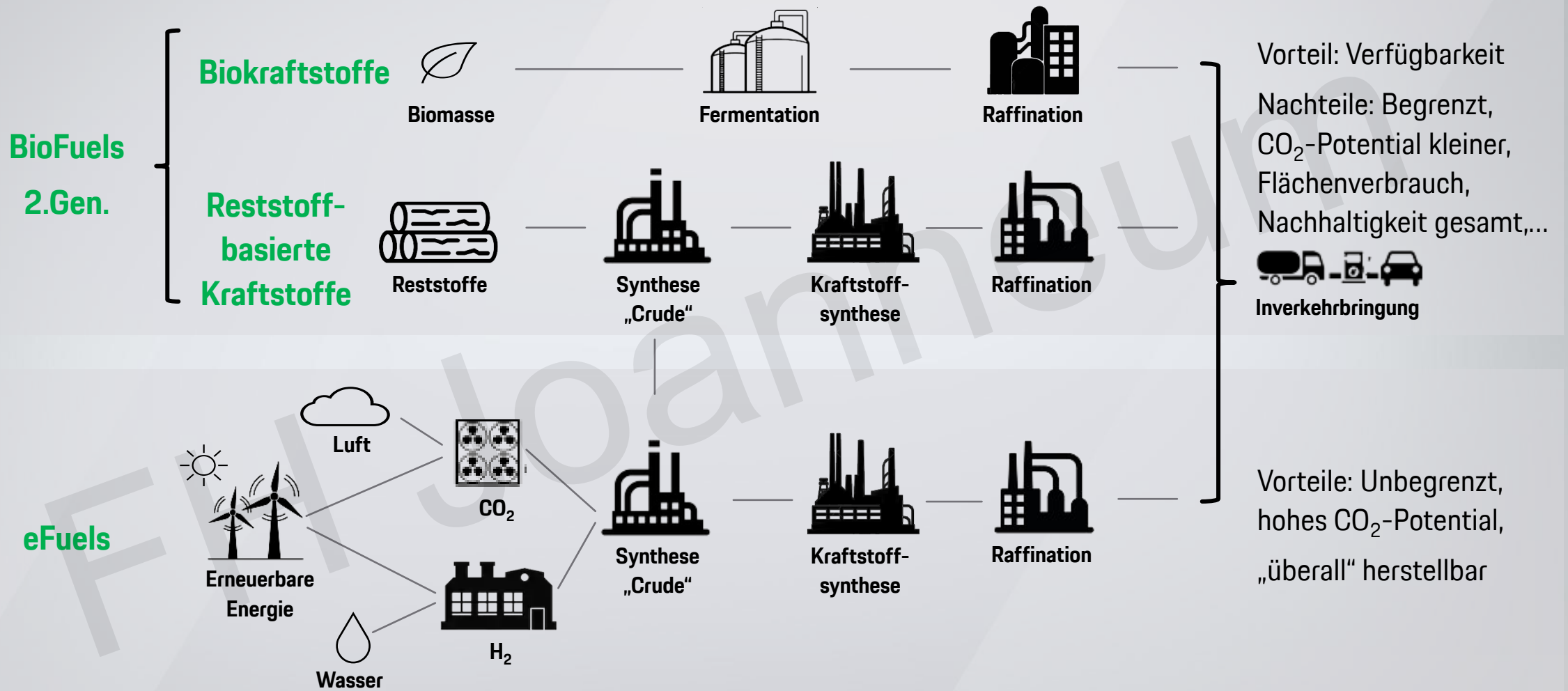
\* Source: Press release KBA Germany January 2022



## Defossilisierung der Energieträger: reFuels und eFuels

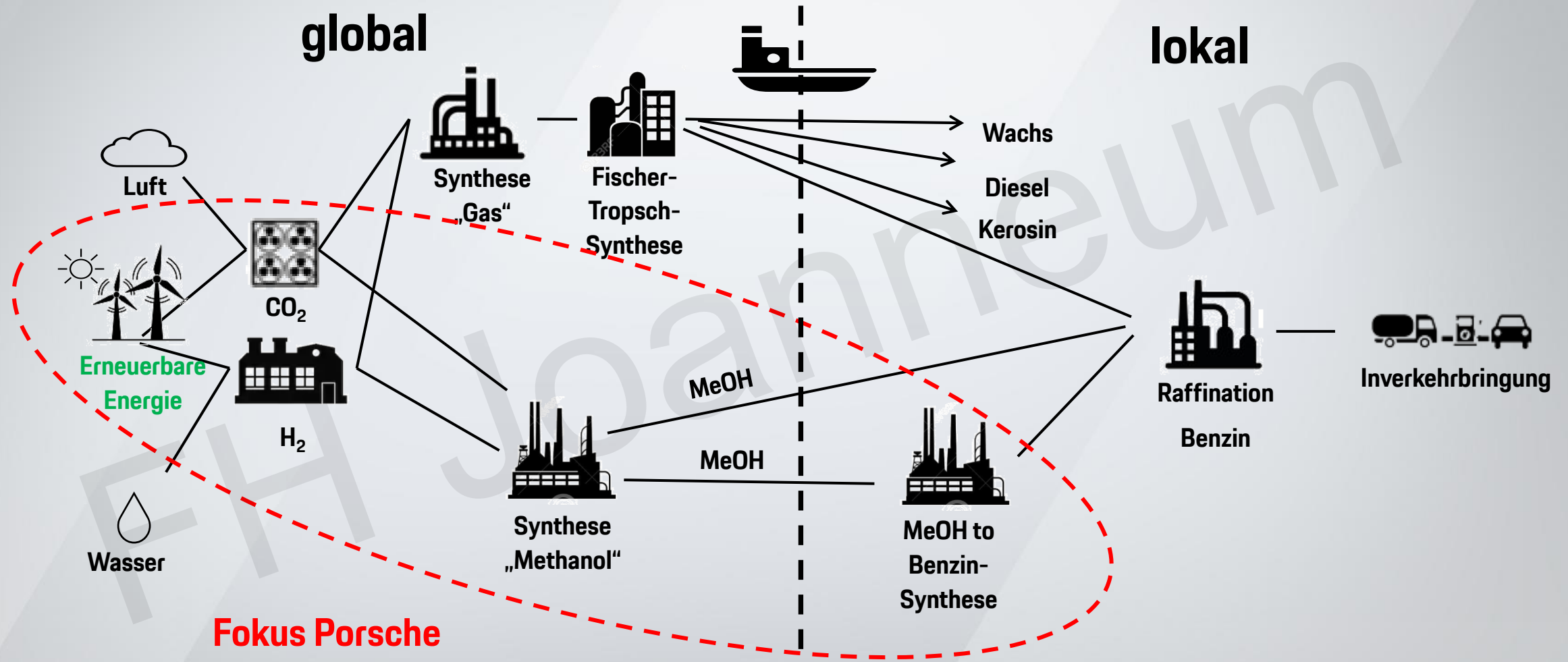
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# Herstellwege von reFuels: BioFuels 2.Gen. + eFuels





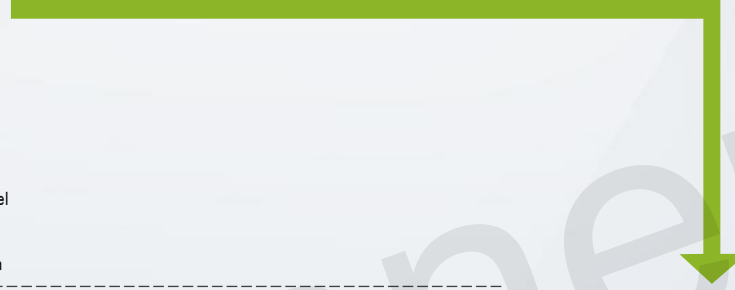
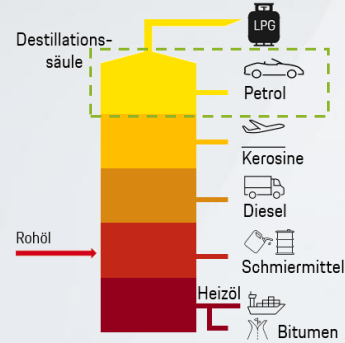
# eFuels: Methanol-Pfad (MeOH) und FischerTropsch-Pfad



# Drei Herstellungsverfahren, ein Ergebnis: Kraftstoff nach DIN EN228

Schematische Darstellung

Fossil



BioFuels



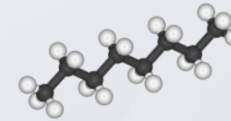
Biomasse



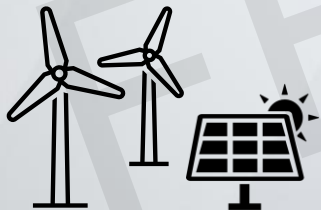
Fermentation



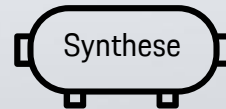
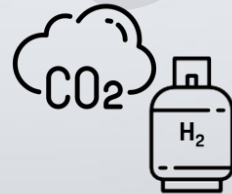
Raffination



eFuels



Erneuerbare Energie

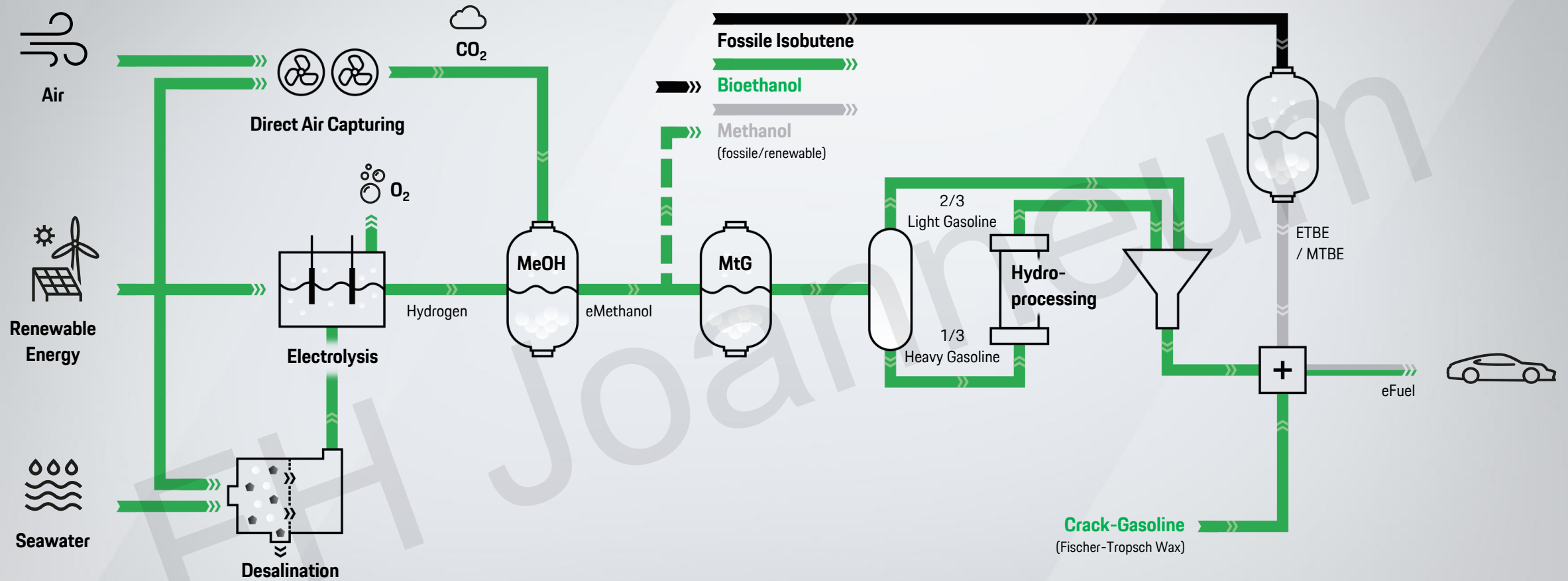


Synthese



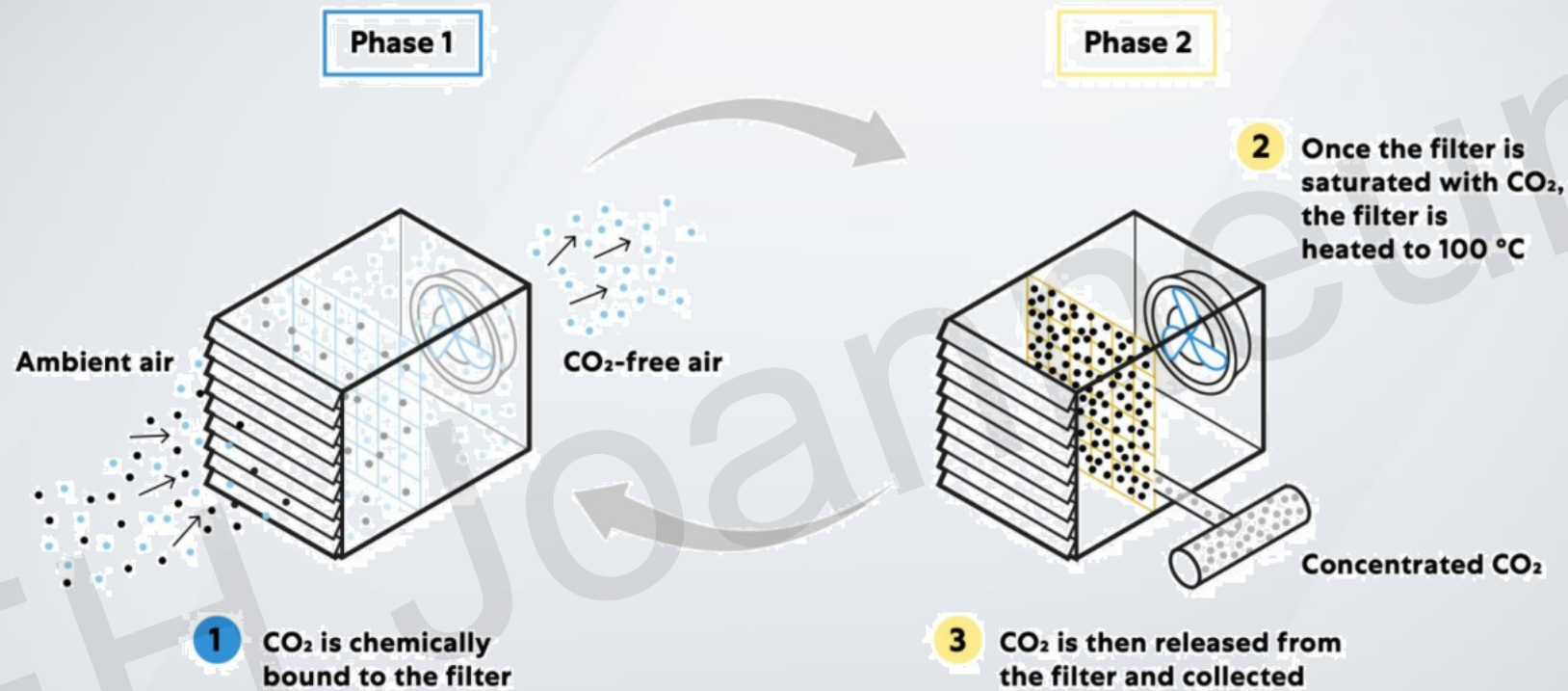
Quelle: Porsche, Internet

# Manufacturing process of eFuels based on MtG (concept)



MtG-base-fuel has to be blended to meet EN228-spec

# Funktionsweise eines Direct Air Capture Verfahrens (DAC) - Beispiel



*Climeworks' collectors capture atmospheric CO<sub>2</sub> using filters*

Quelle: <https://www.dezeen.com/2021/06/14/carbon-climeworks-mining-sky-interview/>



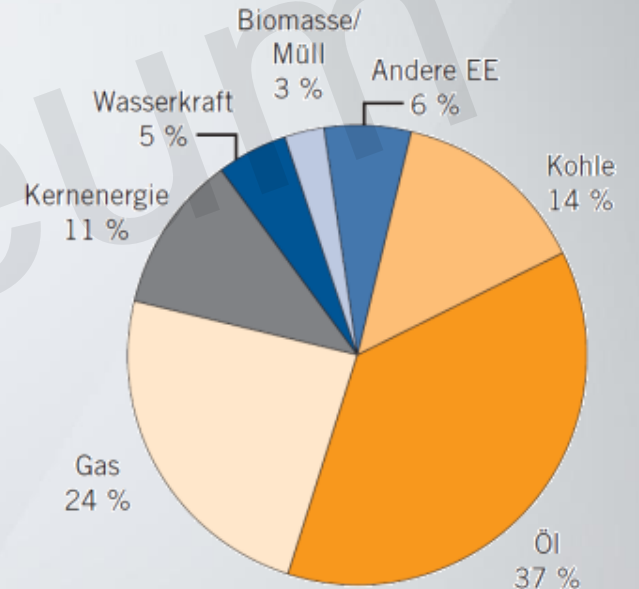
# Wirkungsgrad-Diskussion der synthetischen Kraftstoffe

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# Energiebedarf in Europa 2017

- **Gesamtenergiebedarf Europa 2017:** ca. 1.678 MtOe = **19.515 TWh** (x11,63)
- Davon ca. **56% Import:** ca. 940 MtOe = **10.928 TWh** (Öl, Gas, Kohle)
- Davon ca. **14% regenerativ:** 235 MtOe = **2.732 TWh** (Bio, Wasserkraft, Wind, Solar)

Abbildung 3.3: Struktur des Primärenergieverbrauchs EU-28, 2017, absolut 1.678 Mtoe



Quellen: IHS, Eurostat, IEA Statistiken, BP Statistical Review, nationale Statistiken

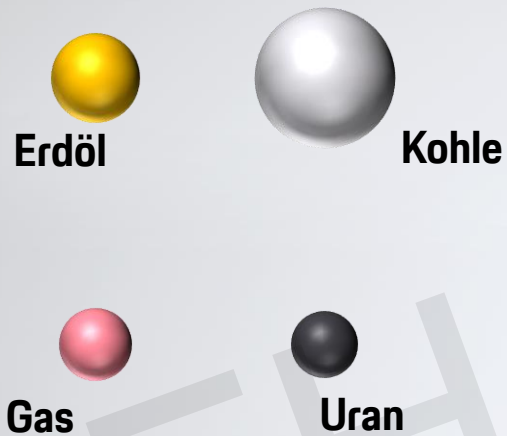


**Ein energieautarkes Europa ist Illusion**

Quelle: Weltenergieat Deutschland e.V.  
(Quelle 2: EUKom: EU Reference Szenario 2016: 1.600 MtOe, also vergleichbar)

# Transformation der Energieträger

Begrenzte Verfügbarkeit konventioneller Energieträger (absolut)



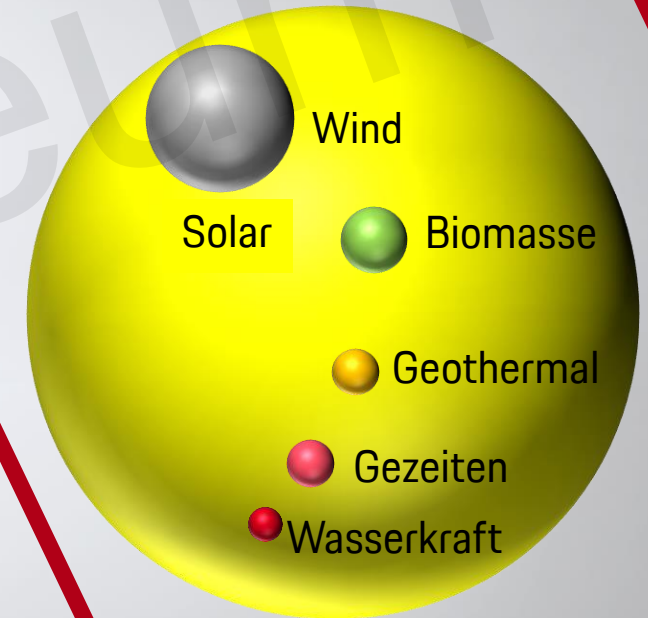
Weltweiter Energiebedarf pro Jahr

Effizienz



Nachhaltigkeit

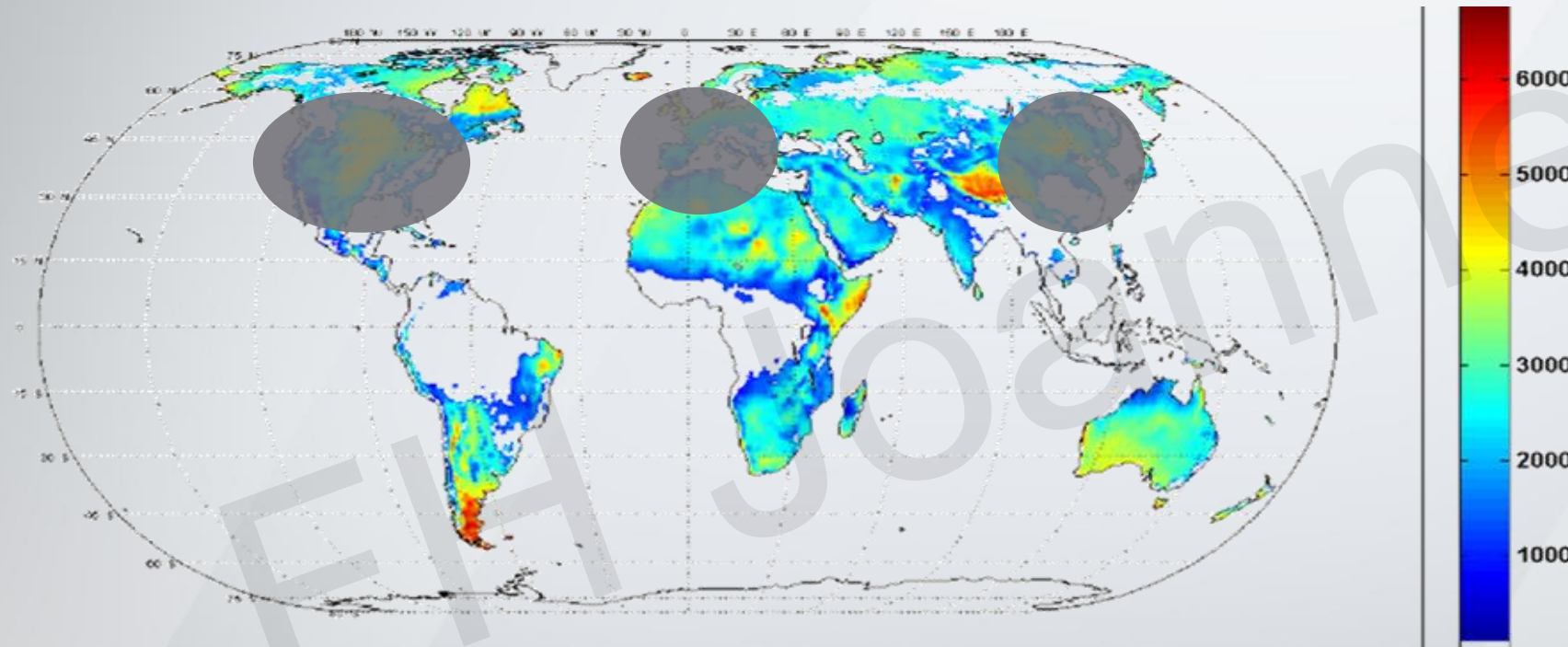
Verfügbarkeit von erneuerbaren Energieträgern pro Jahr



Quelle: Martin Stolterfoht: Charge generation and transport Phenomena in disordered organic semiconductors and photovoltaic diodes (doctor thesis), University of Queensland, Australia (2016)

# Defossilisierung kann nur im globalen Kontext erfolgen

## Wind FLh for cost year 2030



### Legende

■ Länder mit hohem Energieverbrauch

■ bevorzugte Regionen mit einer hohen Verfügbarkeit von erneuerbarer Energie (hier: Windenergie)

[http://www.neocarbonenergy.fi/wp-content/uploads/2016/02/13\\_Fasihi.pdf](http://www.neocarbonenergy.fi/wp-content/uploads/2016/02/13_Fasihi.pdf)  
8760h per Year



# Industrialization of eFuels is a global task, the choice of location is decisive

## GERMANY

~ 5 ct€/kWh  
233 People/km<sup>2</sup>

## MENA

~ 2,5 ct€/kWh  
30 People/km<sup>2</sup>

## PATAGONIA/CHILE

~1,5 ct€/kWh  
2 People/km<sup>2</sup>



## Success factors for eFuels:

1. Availability of:
  - Cheap renewable energy
  - CO<sub>2</sub>
  - Water
2. Acceptance
3. Competitive situation
4. Additionality

Source: LBST International Hydrogen Strategys 08/2020, Statista BMBF 2020; Dr. Ing. h. c. F. Porsche AG; Frontier Economics

# Energy Density

Punta Arenas, Chile



Germany



Source: pixabay



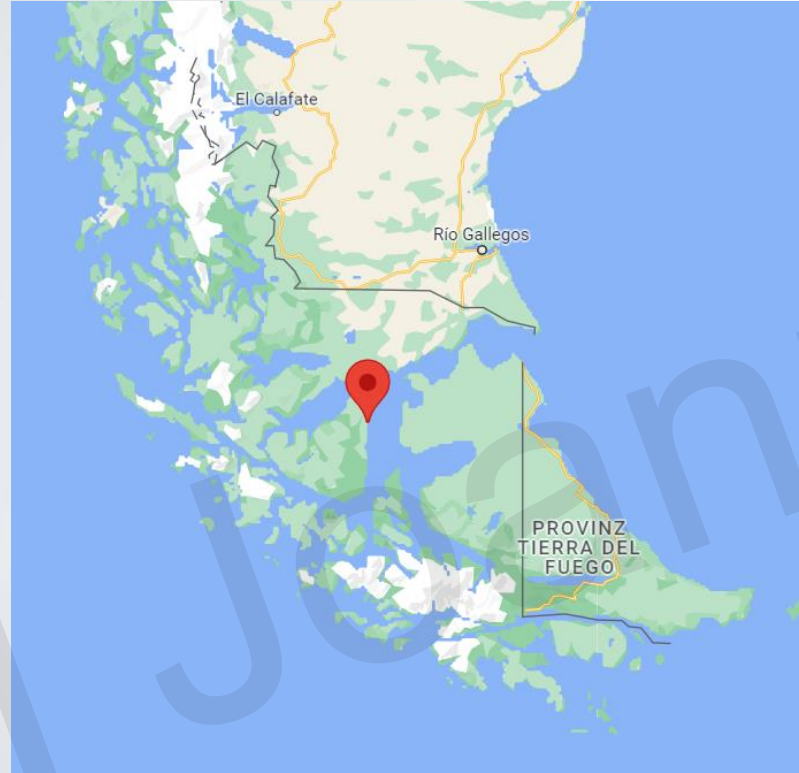
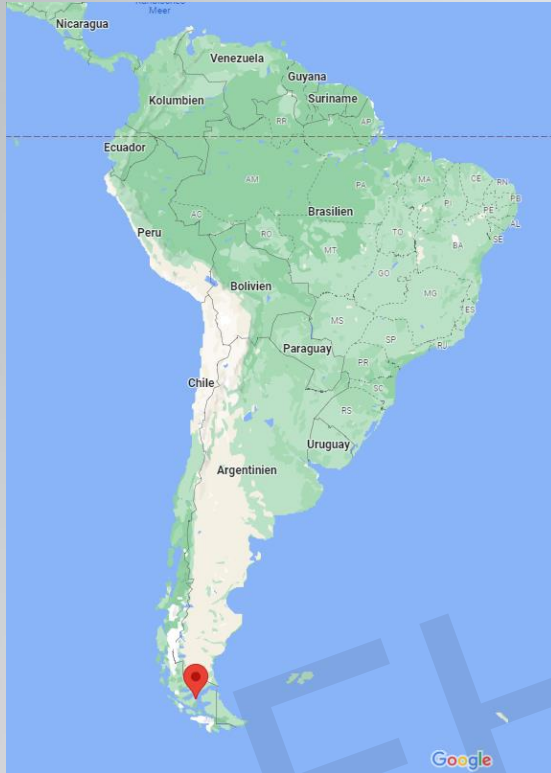
# Projekt Haru Oni

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Haru Oni



# The Pilot Plant is located in the very south of Chile



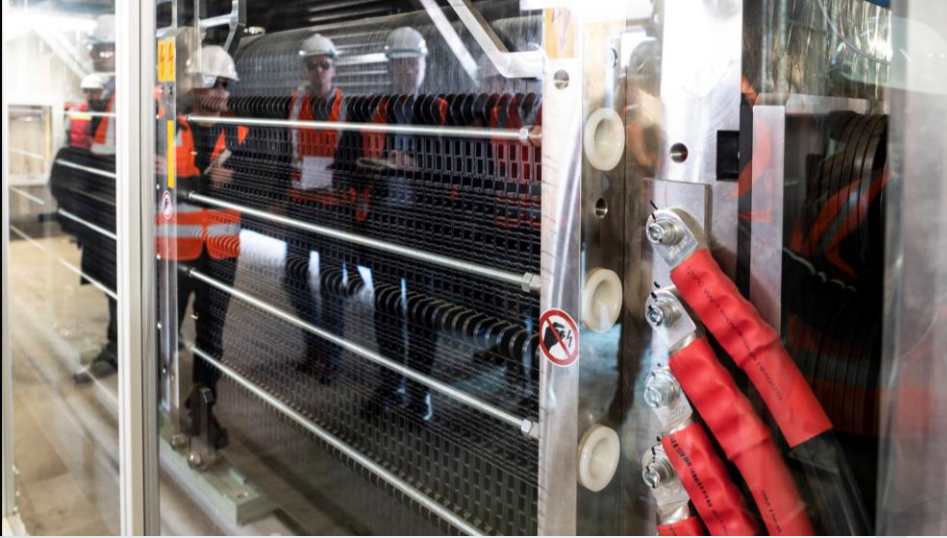
Source: Google Maps, HIF, Porsche

# Opening December 2022



# Opening December 2022

Electrolyzer



Methanol-Synthesis



MtG-Unit



Tank-Farm

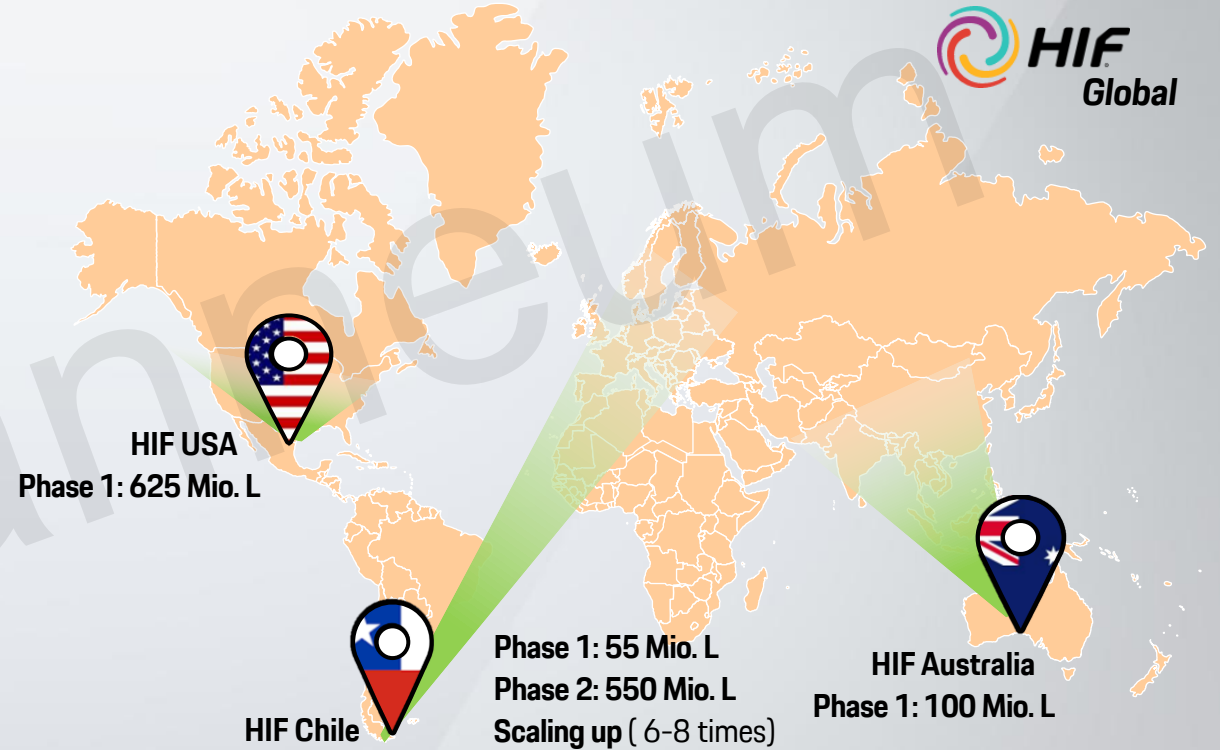


# The Pilot Plant is the starting point of further opportunities



**Haru Oni Pilot Plant, Punta Arenas, Chile**

Source: HIF Global, Porsche



**Global Opportunities**





**Potentiale**

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# Leistungs- und Emissionsbewertung mit Bestandsfahrzeugen und im Motorsport



Porsche Mobil 1 Super CUP 2021



991 II MY 2016

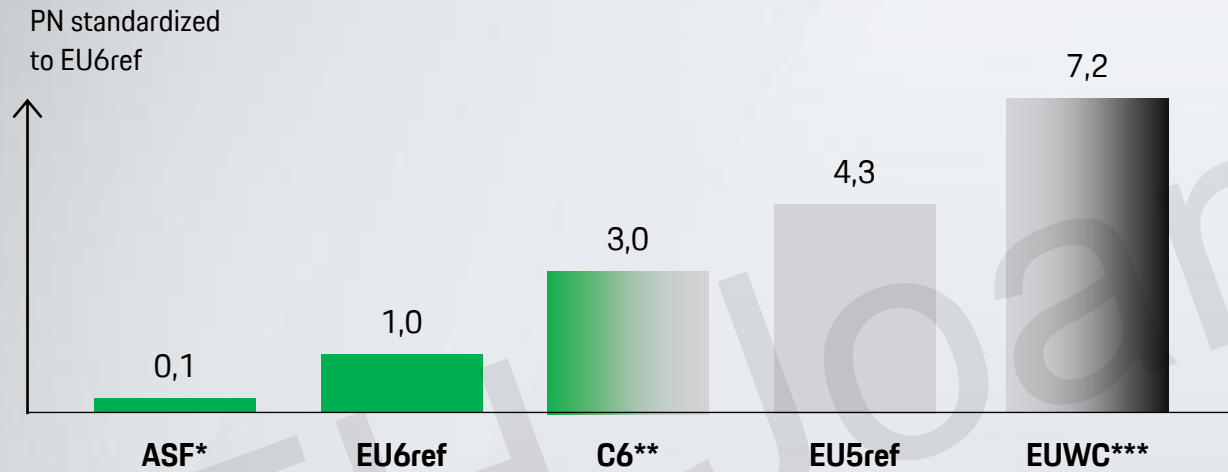


993 MY 1996

Source images: Dr. Ing. h.c. F. Porsche AG

# The current EN228-spec includes wide tolerances

## Scattering of particulate emissions (WLTP cycle)

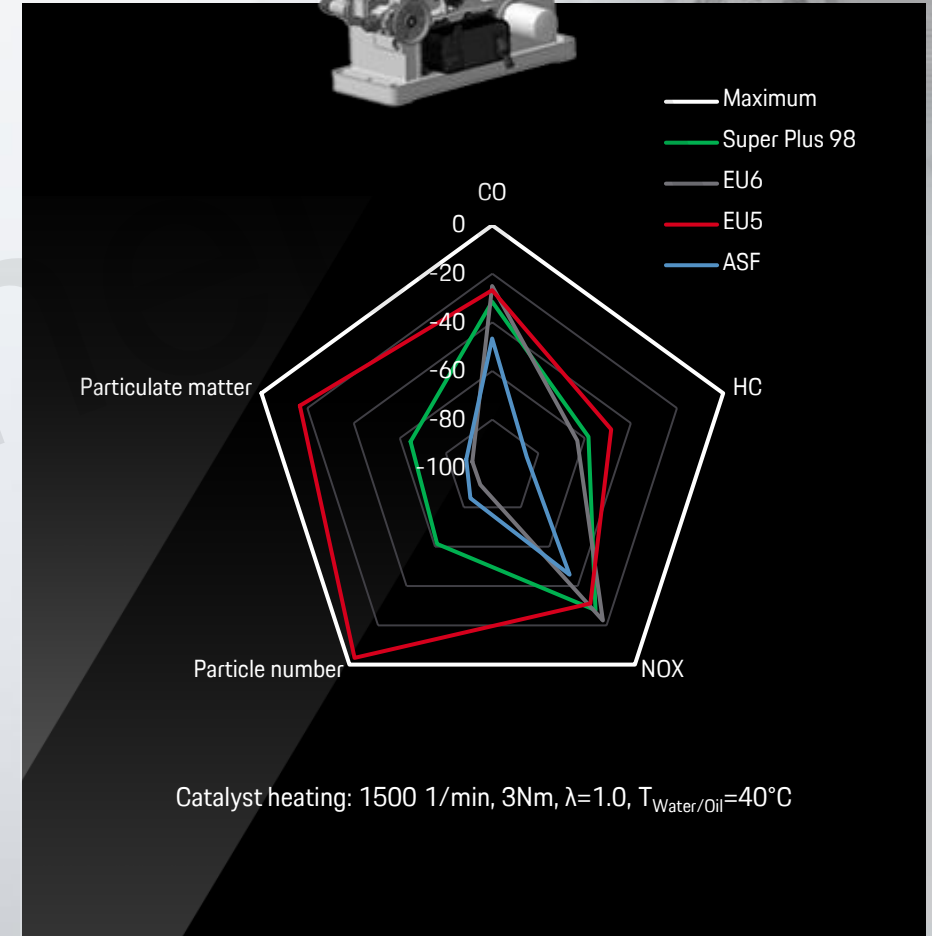


Source: ADA 2017, Vehicle Porsche Boxster B4T 2,0l

\* ASF: with measures (Density) within spec.

\*\* C6: China-C6

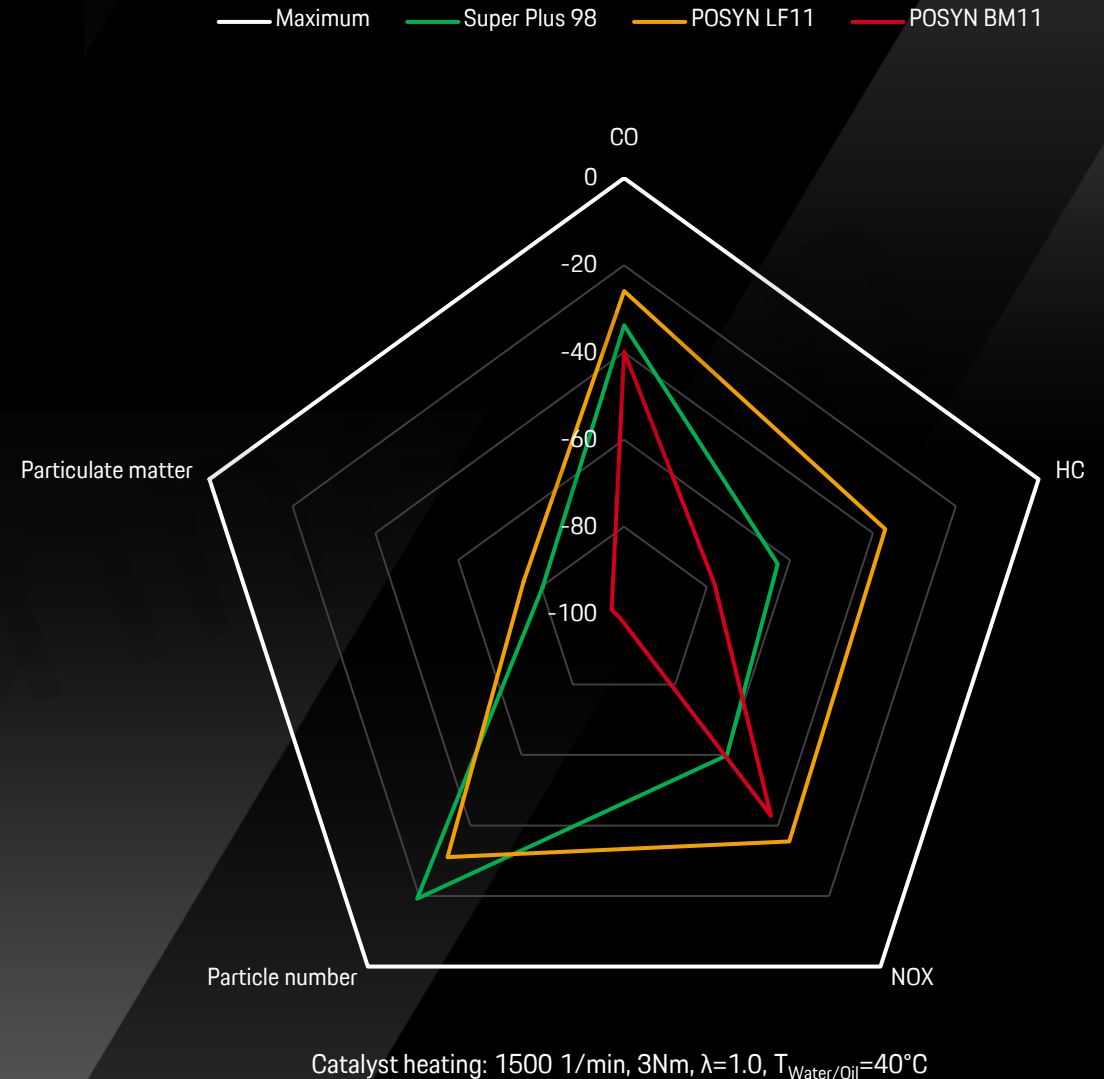
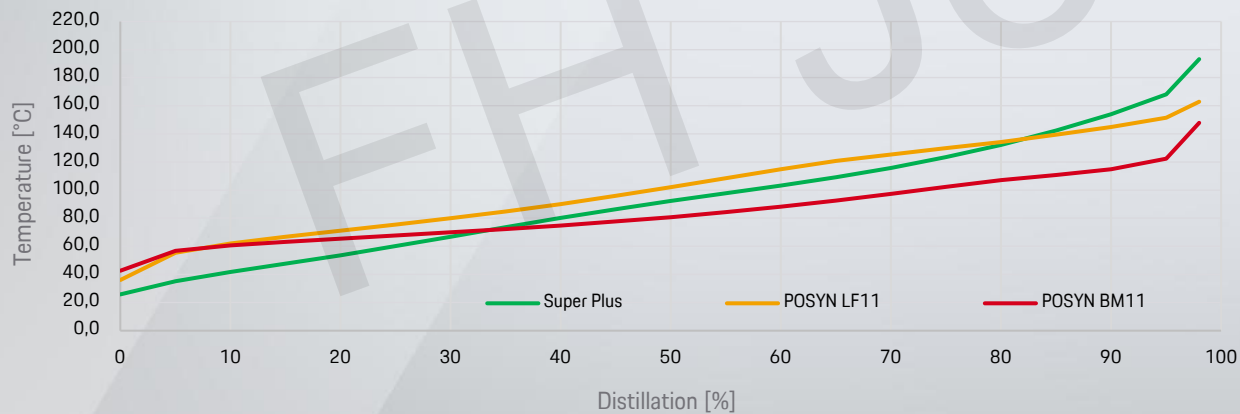
\*\*\* EUWC: EU worstcase gas station fuel



# Testresult potential target-fuel:

	Super Plus	POSYN LF11	POSYN BM11	DIN EN228 „Super Plus“	Suggested limits
ROZ/MOZ	98,1/88,4	95,1/86,6	99,9/90,3	min 98/	-
Density [kg/m <sup>3</sup> ]	743,8	763,4	723,6	720-775	-
Calorific value [MJ/kg]	41,96	41,38	42,92	-	-
Content of Ethanol [% v/v]	0,2	0,1	0,3	max. 5	-
Content of oxygen [% m/m]	2,23	2,91	2,5	max. 2,7	-
Final boiling point [°C]	192,3	162,9	147,8	max. 210	max. 200
Aromatics from C9/ from C10 [% v/v]	9,9/2,2	14,4/4,45	0/0	-	<<, 10/ <2
Renewable content[% v/v]	app. 3,2	85	100	-	-

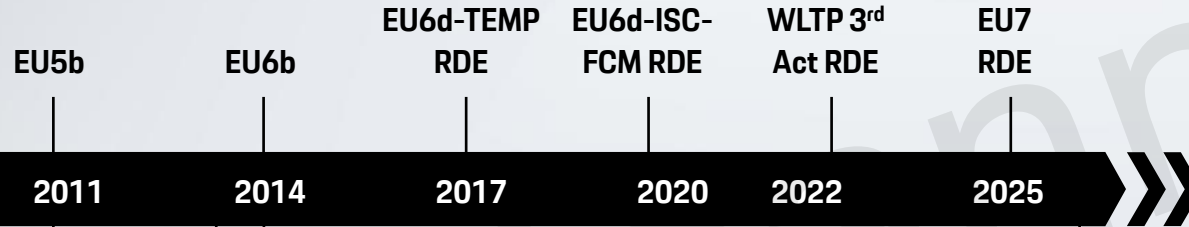
## Comparison of boiling curves



# Potential influence of vehicle technology and fuel quality on air quality in Europe

## Standards

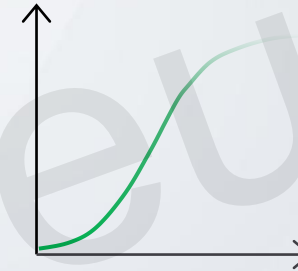
  
Emission-Limits



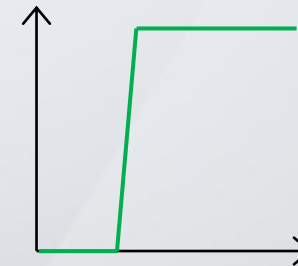
  
Fuel-Quality



## Impact



The market penetration of vehicles with **new emissions technology** is linked to **fleet renewal**



Changes in fuel quality have an **immediate effect** throughout the vehicle fleet

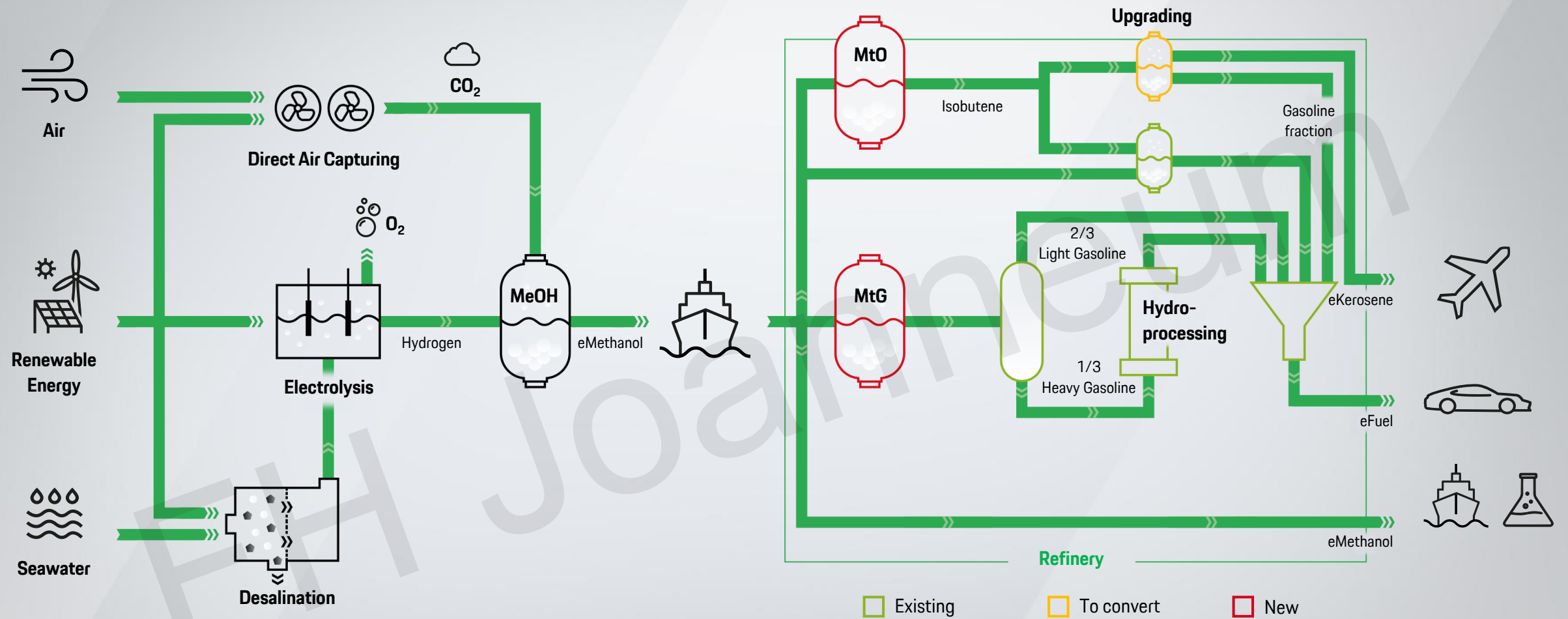
 In addition to further improvements in emissions technology, a narrowing of EN228 tolerances could improve air quality

# eFuels – mehr als Kraftstoff für Sportwagen



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# Global production chain



Local refineries can be transformed to provide products on a totally renewable basis

# eMethanol: a potentially CO<sub>2</sub>-neutral crude oil substitute

## Energy & Fuel

- Existing car fleet, Offroad, Agriculture, Shipping, Aviation
- Energy carrier for **Power industry**
- **Heavy industry, Chemical industry**
- **Flexible energy reserve**

## Worldwide

- **Defossilisation** in structurally weak regions
- **Economically sensible workshare** for CO<sub>2</sub> reduction





# Thank you!



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