CAC PRESENTATION

E-Fuels en la cadena de valor del Hidrógeno Verde

Tuesday, March 28, 2023

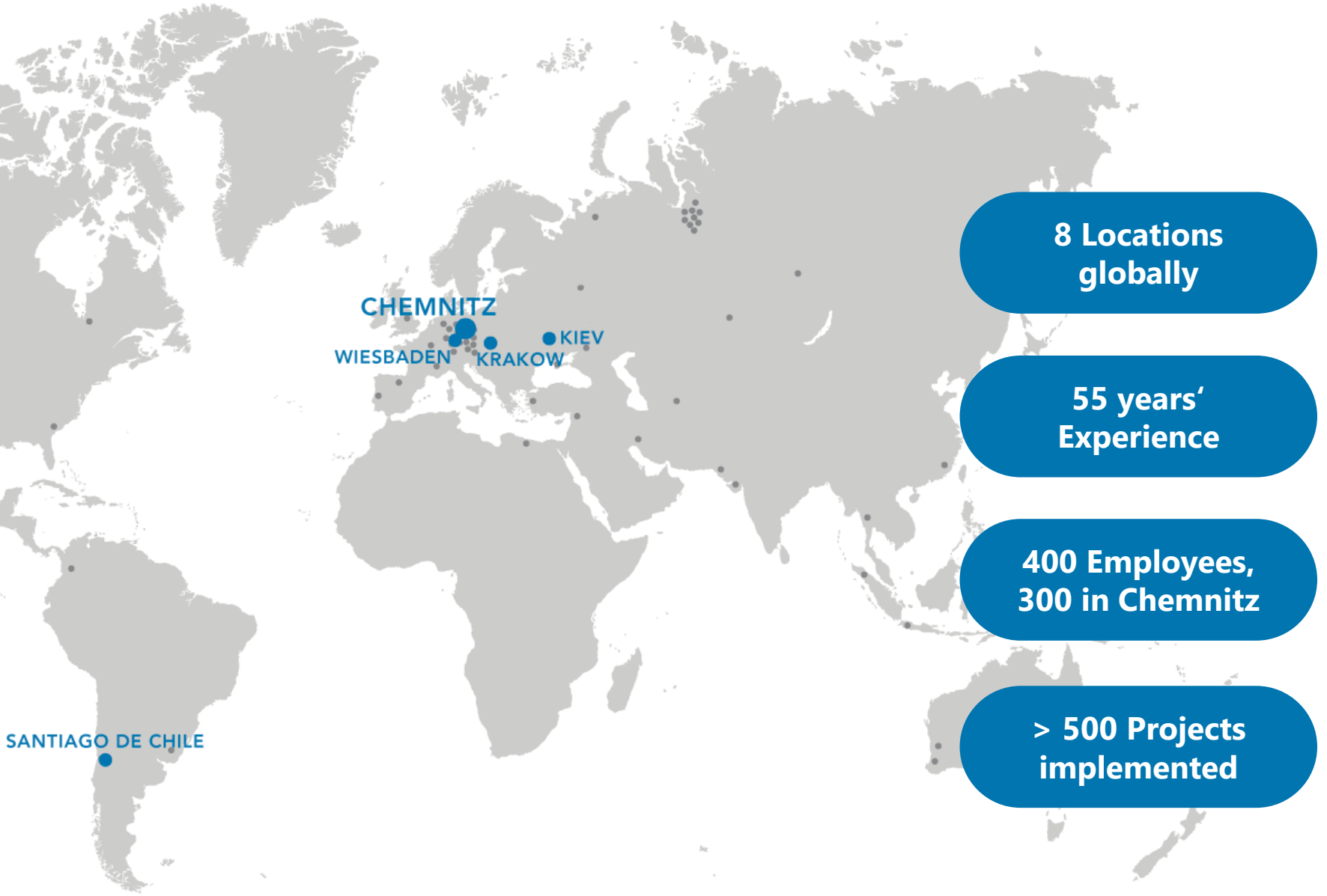
Overview

EPC Contractor

Engineering of Chemical Plants

Mid-sized, Owner-managed

EUR 50m – 120m Turn-over p.a.



8 Locations globally

55 years' Experience

400 Employees, 300 in Chemnitz

> 500 Projects implemented

Major Targeted Industries & Market Segments

Chlor-Alkali Solutions

- Brine Treatment
- Electrolysis
- Ferric Chloride
- Polyaluminium Chloride

(Green) Power-to-X Solutions

- Water Electrolysis
- eMethanol
- CO_2 Recovery
- Synthetic Fuels / E-Fuels
  - Methanol-To-Fuel
  - Methanol-To-Jet fuel

C·A·C SYNFUEL

Hydrocarbon Solutions

- Refinery Technologies
- Expandable Polystyrene
- Butadiene
- Maleic Anhydride
- Cumene
- Natural Gas Underground Storage
- Gas Compressor Station

Chemical Solutions

- Sulphuric Acid
- Production Facilities for Catalysts and Intermediate Products
- Other Batch and Multipurpose Plants
- Nitrogen Derivatives

Cadena de Valor del Hidrógeno Verde

Los Portadores de Energía

Hidrógeno – Barreras y Desafios

Entrada al Mercado

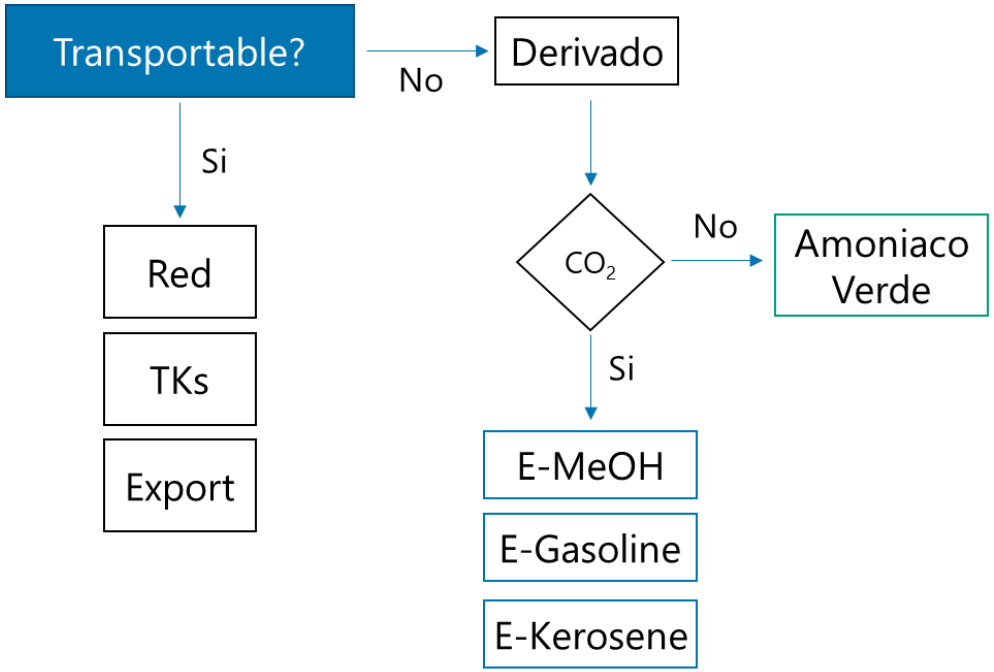
- Inversión privada
- Incentivos
- Costos

Almacenamiento

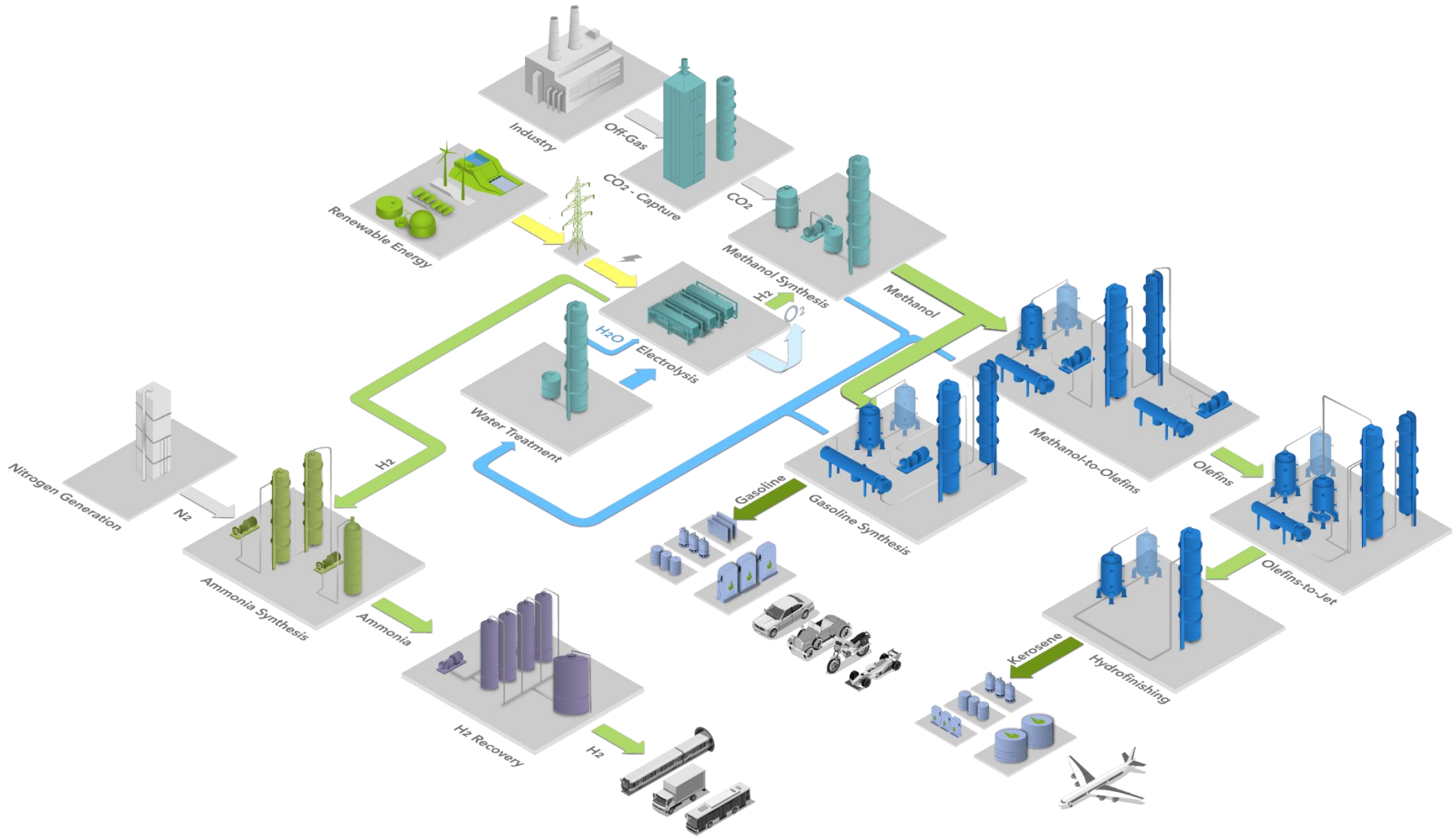
- Parámetros
- Infraestructura

Transporte

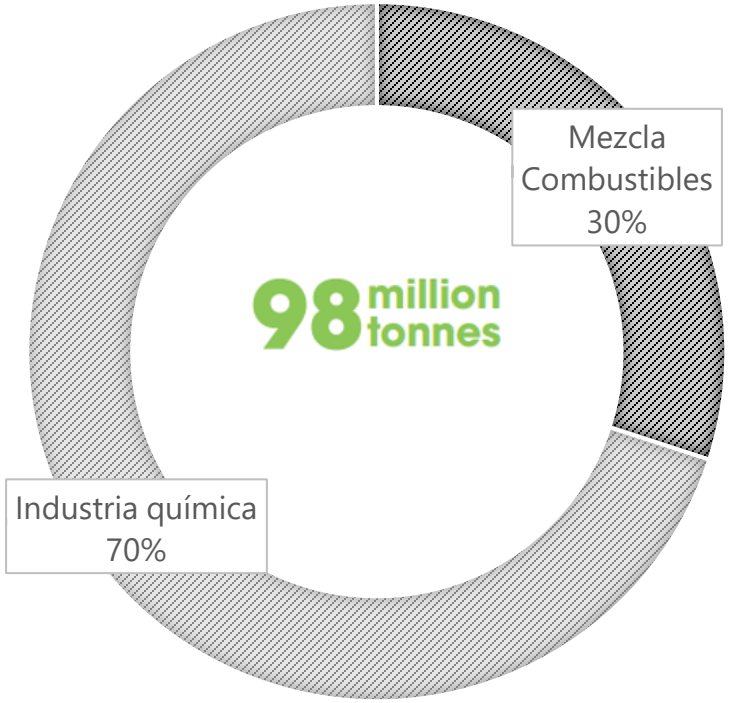
- Pipelines dedicados o combinados
- Road or Maritime

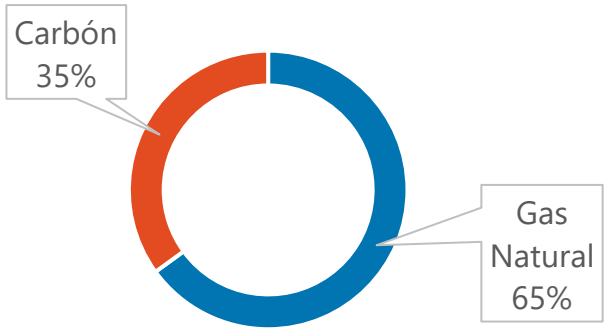


La Cadena de Valor del Hidrógeno Verde



La ruta del Metanol





Economía Circular del Metanol

MAERSK

Green transport

Síntesis de Metanol

$$3H_2 + CO_2 \rightarrow CH_3OH + H_2O$$

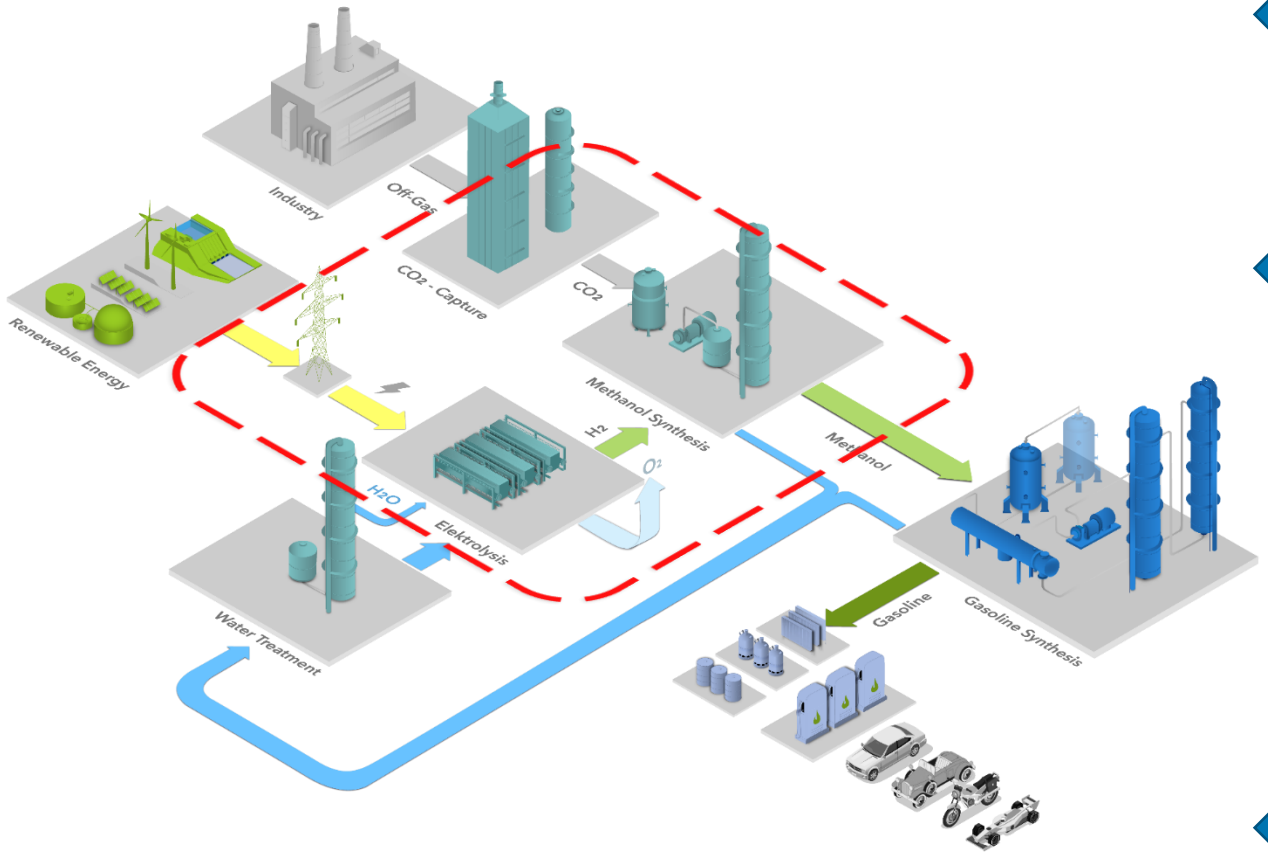
Captura y Tratamiento CO_2

Producción de Hidrógeno Verde

Reacción Catalítica

↑T ↑P

Separación y Purificación



Alta madurez

LCA superior

Plantas operando

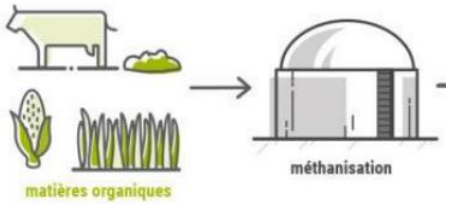
Fuentes de CO_2

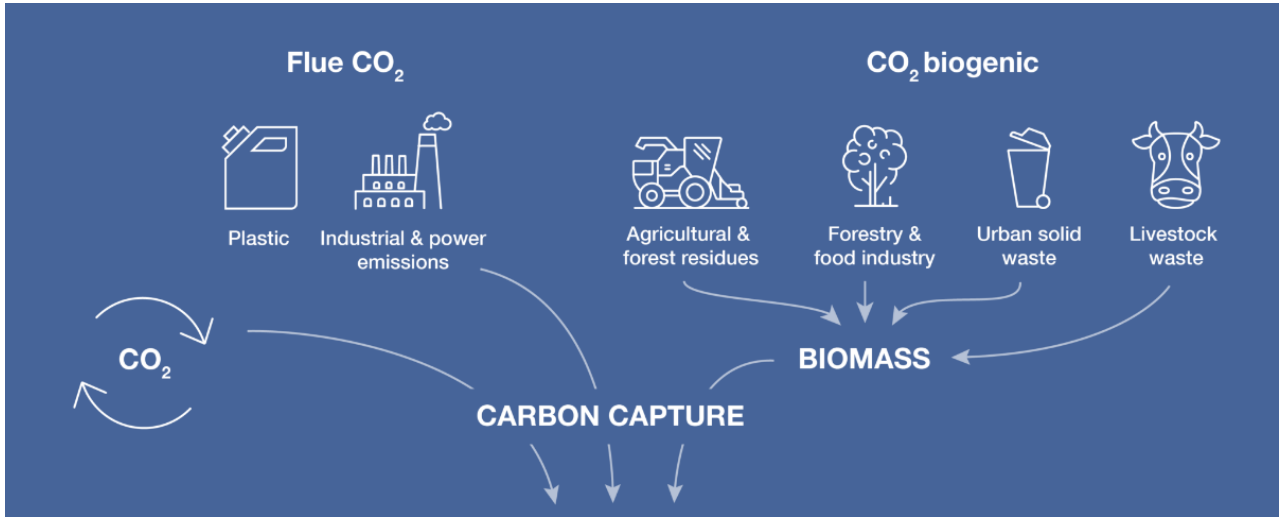
Fuentes Industriales

→ Carbon Capture Process:

- CO2 Biogénico
- CO2 No – Biogénico

- Actualmente 230 Mt CO2/year operando

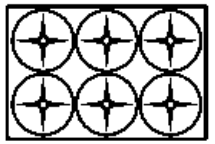




CO2 del Aire

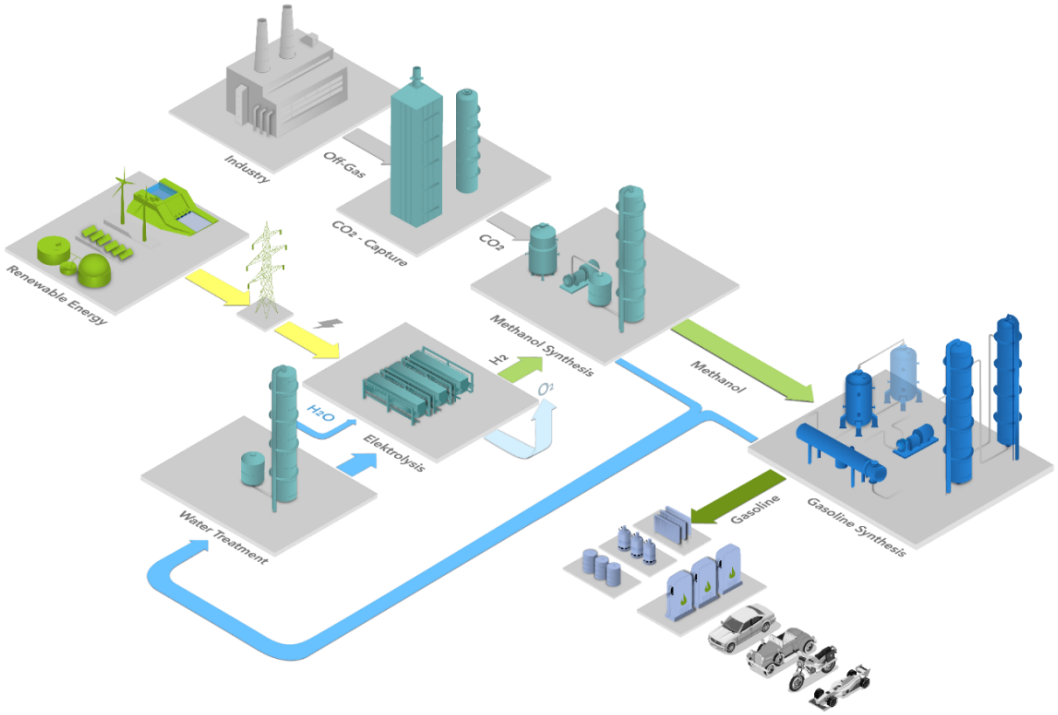
→ Direct Air Capture

- Actualmente 0,01 Mt CO2/year operando



Proceso Methanol-to-Fuel

(Synthetic Gasoline/E-Fuel)



Mercado de la Gasolina

Industria de Automóviles de pasajeros

- 1,4 billones de vehículos en el mundo
- → Alemania: 49 millones de autos
- → Brasil: 45 millones
- → México: 36 millones
- → Argentina: 14 millones
- → Chile: 6 millones

Edad promedio del parque automotriz

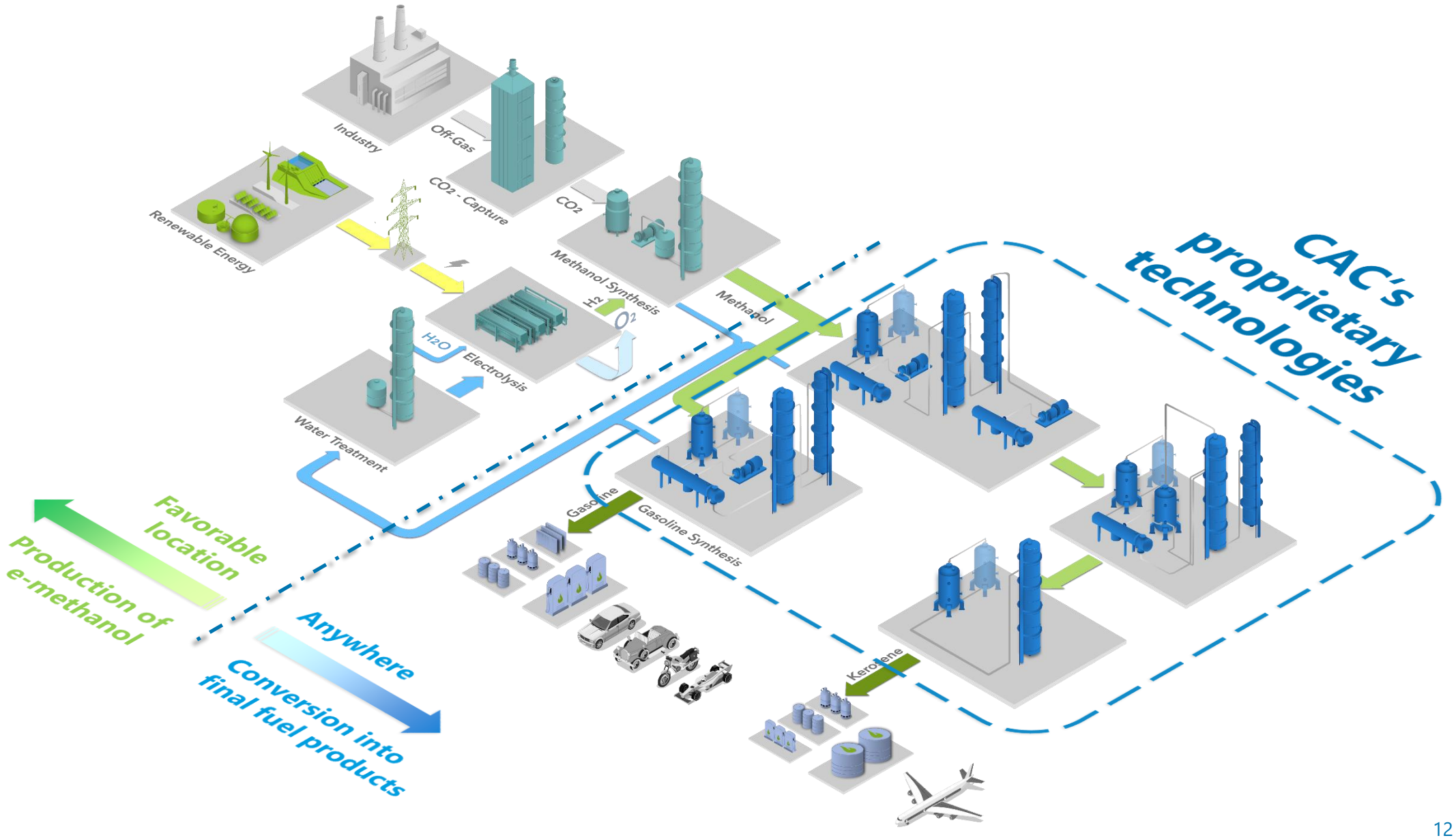
- → Alemania 10 years
- → LAC 17 years

Refinerias

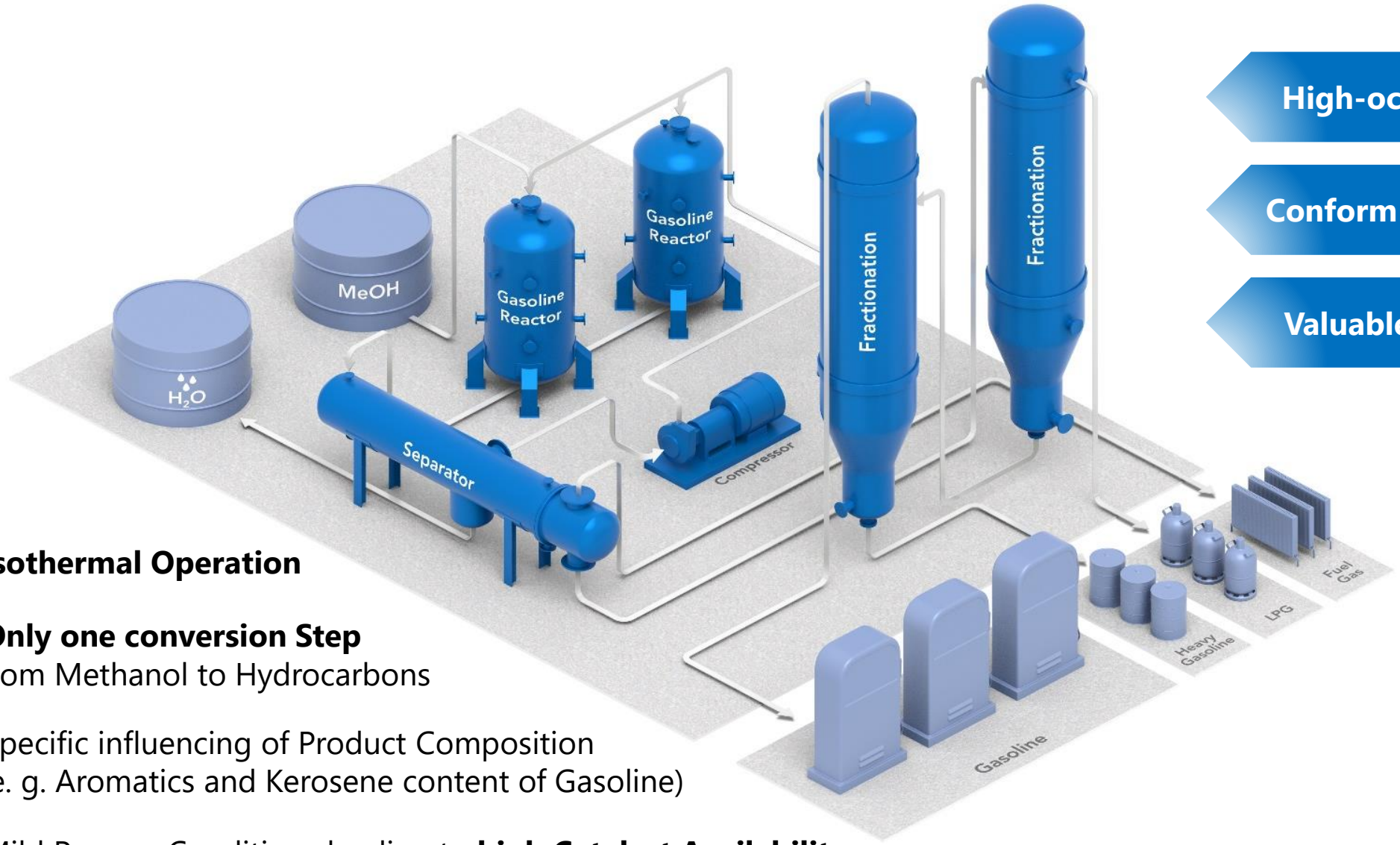
- 740 refinerías en el mundo
- → Europa: 156
- → LAC: 62

- Estrategias de descarbonización y combustibles "Low-Carbon"

CAC en el área del Power-to-X



Proceso de Gasolina Sintética



High-octane Gasoline

Conform to DIN EN 228

Valuable By-Products

- **Isothermal Operation**
- **Only one conversion Step**
  from Methanol to Hydrocarbons
- Specific influencing of Product Composition
  (e. g. Aromatics and Kerosene content of Gasoline)
- Mild Process Conditions leading to **high Catalyst Availability**

Nuestra Exitosa Ruta

June 2010
First test campaign

2015
Development of the new reactor design

2019
Reconstruction of reactor in Freiberg and production of approx. **16,000 l** gasoline within the C^3 mobility research project

March 2009
Ground-breaking ceremony at the plant in Freiberg

2013
100,000 l of stable gasoline produced by 2013, over 3,600 operating hours since 2010

Market-ready Technology

2008
Start development

The construction of the plant was funded by the EFRE.

2012
Commissioning of gasoline synthesis in the bioliq plant (KIT)

2017
Laboratory plant at CAC

The construction of the laboratory plant was funded by the EFRE. No. 100292060.

2020
Production of **30,000 l** gasoline within 2nd run of C^3 mobility

Process demonstrated in Large-Scale Facility

Facility located at the Site of Technical University Bergakademie Freiberg (TU BAF)

- Nominal Capacity of 1,000,000 l/a synthetic Gasoline
- Operation in Campaigns; close Cooperation between CAC and TU BAF

Proven MTF Technology with proven Product

C·A·C SYNFUEL

Summary

- MtG fuel classified as drop-in-capable by all project partners involved (conformity EN standard)
- By using MtG fuel in the entire vehicle fleet, an enormous reduction in greenhouse gas potential can be realized

Certified

- The synthetic Gasoline produced in DIN EN 228 Quality has been REACH[1)] certified.

[1)] REACH regulation (EG) 1907/2006 represents European chemicals regulation on the Registration, Evaluation, Authorization and restriction of Chemicals.

24h race Nürburgring

Toyota GR Supra GT4, Inline 6-Cylinder Engine -- 3.0 l -- 430 PS

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

Technology Readiness

Readiness of CAC

- **Technology Market Ready**
  Technology Readiness Level: 8 to 9
  - ✓ Lab tests successfully since 2008, continuously accompanying
  - ✓ Demonstration plant in operation since 2010 (campaigns)

2023

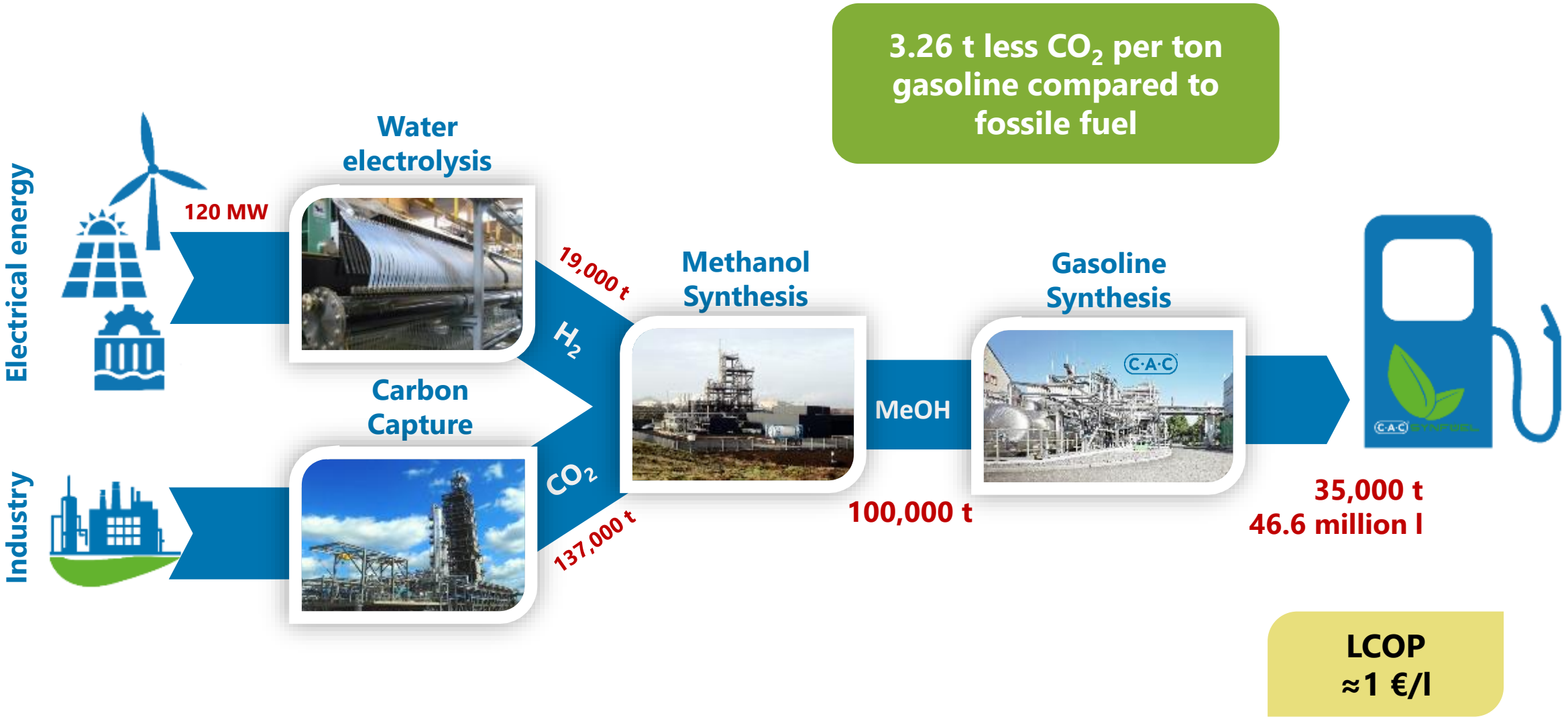
- **Next step 10.000 to 50.000 t/a Gasoline**

...2026

- **Subsequent 50.000 to 250.000 t/a Gasoline**

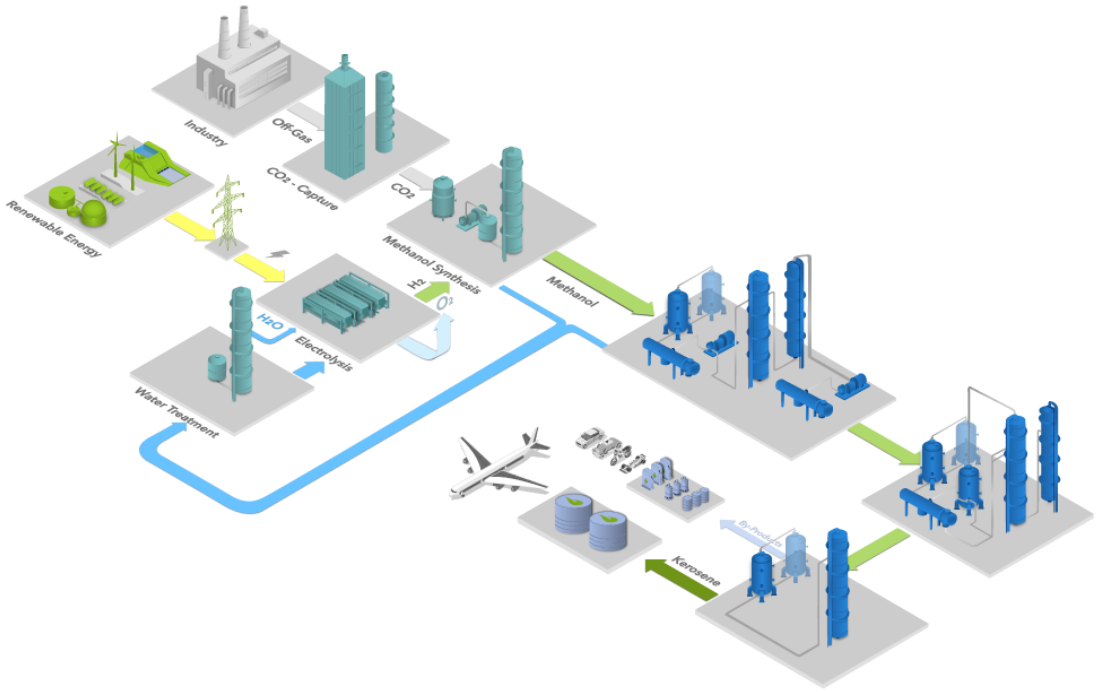
View from top of MtF plant

Example for Power-to-Gasoline concept



Methanol-to-Jet Fuel

(E-Kerosene/SAF)



Contact data

Constanza Berckemeyer
Regional Sales Manager

Phone: +49 371 6899 344
E-mail: Constanza.berckemeyer@cac-chem.de

Chemieanlagenbau Chemnitz GmbH
Augustusburger Straße 34
09111 Chemnitz, Germany

www.cac-synfuel.de | www.cac-chem.de







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ALWAYS AN **IDEA AHEAD**