

# e-Methanol to higher hydrocarbons Energiforskning



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# Fuel option

## Eu Parliament Decision 2022

- No ICE after 2035
- Approved fuels Electricity, Hydrogen and Ammonia
- Propulsion: Battery, fuel cells

## EU Commission Decision 2023

- ICE approved if
- Synthetic fuels are allowed where no fossils origin components are used  
E-gasoline, HVO, ethers, alcohols

# Ways to Synfuels

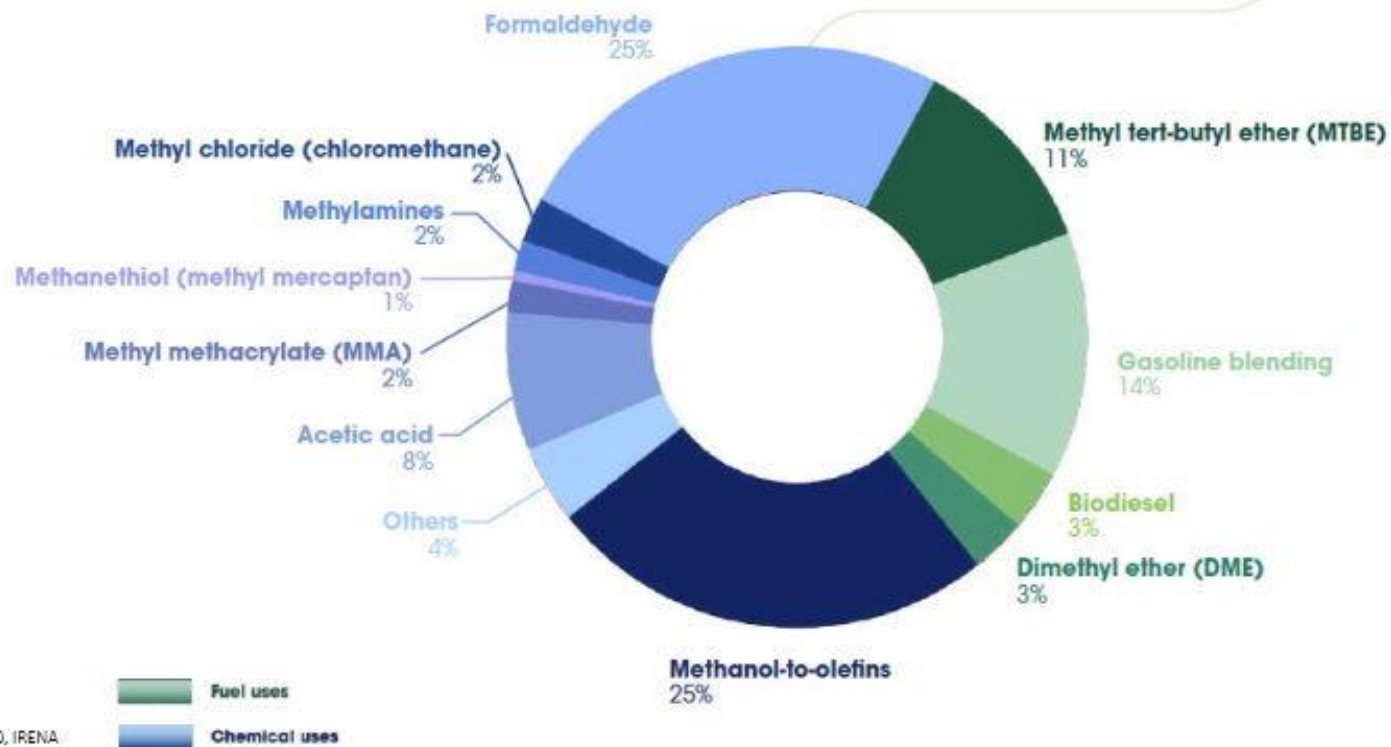
1. Gasification of biomass, biogas and application of Fischer-Tropsch to gasoline
2. Methanol as starting point
  1. Gasification to methanol and than gasoline e.g. Exxon/Mobile MTG process with NG
  2. Methanol to DME (di-methyl ether) and polymerisation Topsoe
  3. Cellulose cooking residuals e.g. Södra
  4. E-methanol from H<sub>2</sub> sun/wind/water and biogen CO<sub>2</sub> Liquid Wind



OBATE Onboard  
alcohol to ether

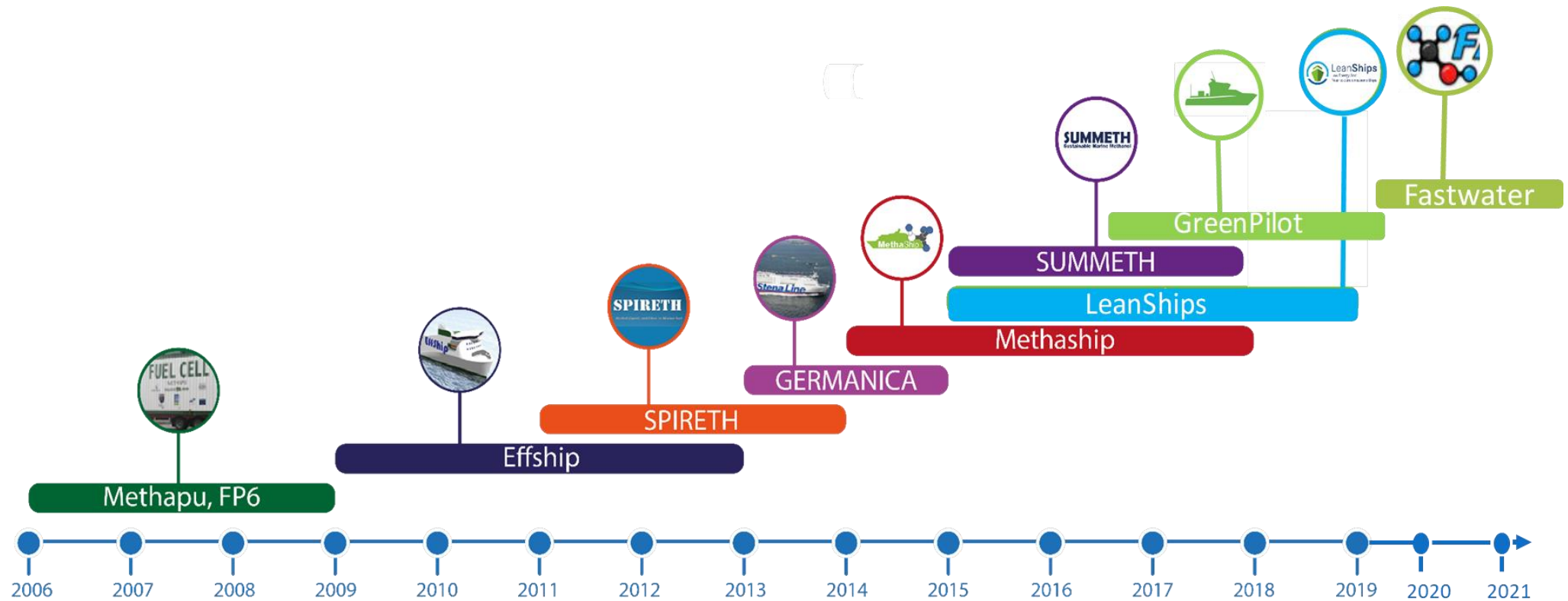
# At scale and diversified

## 98 million tonnes

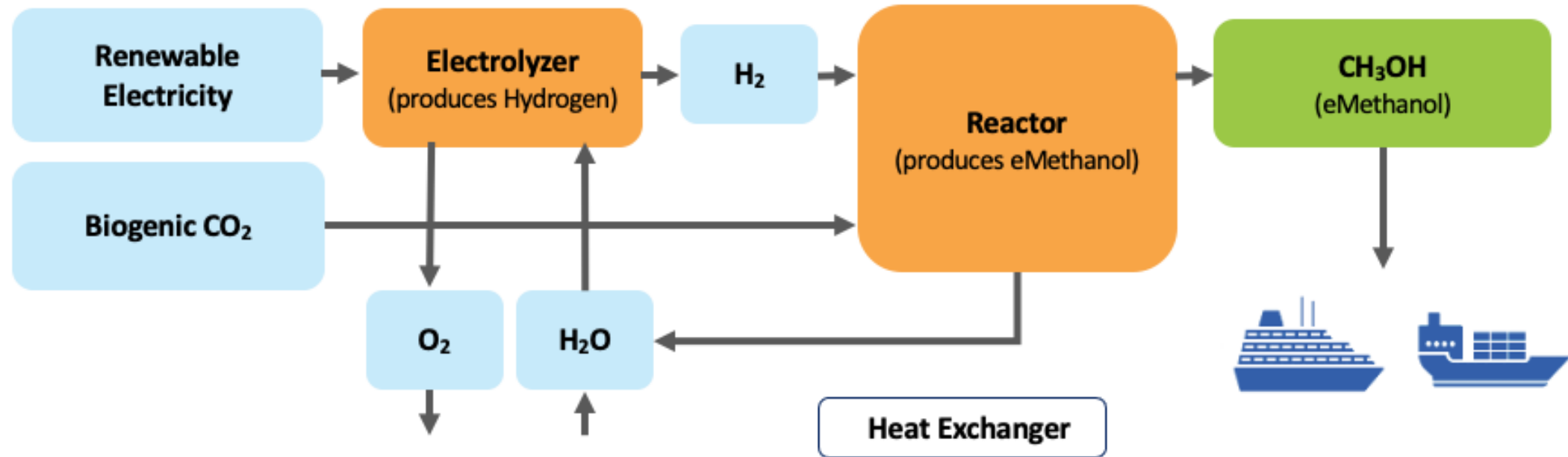


Source: Based on data from MSA 2020, IRENA

# Relevant Research Projects



# Converting Carbon Emissions to Electro-Fuel



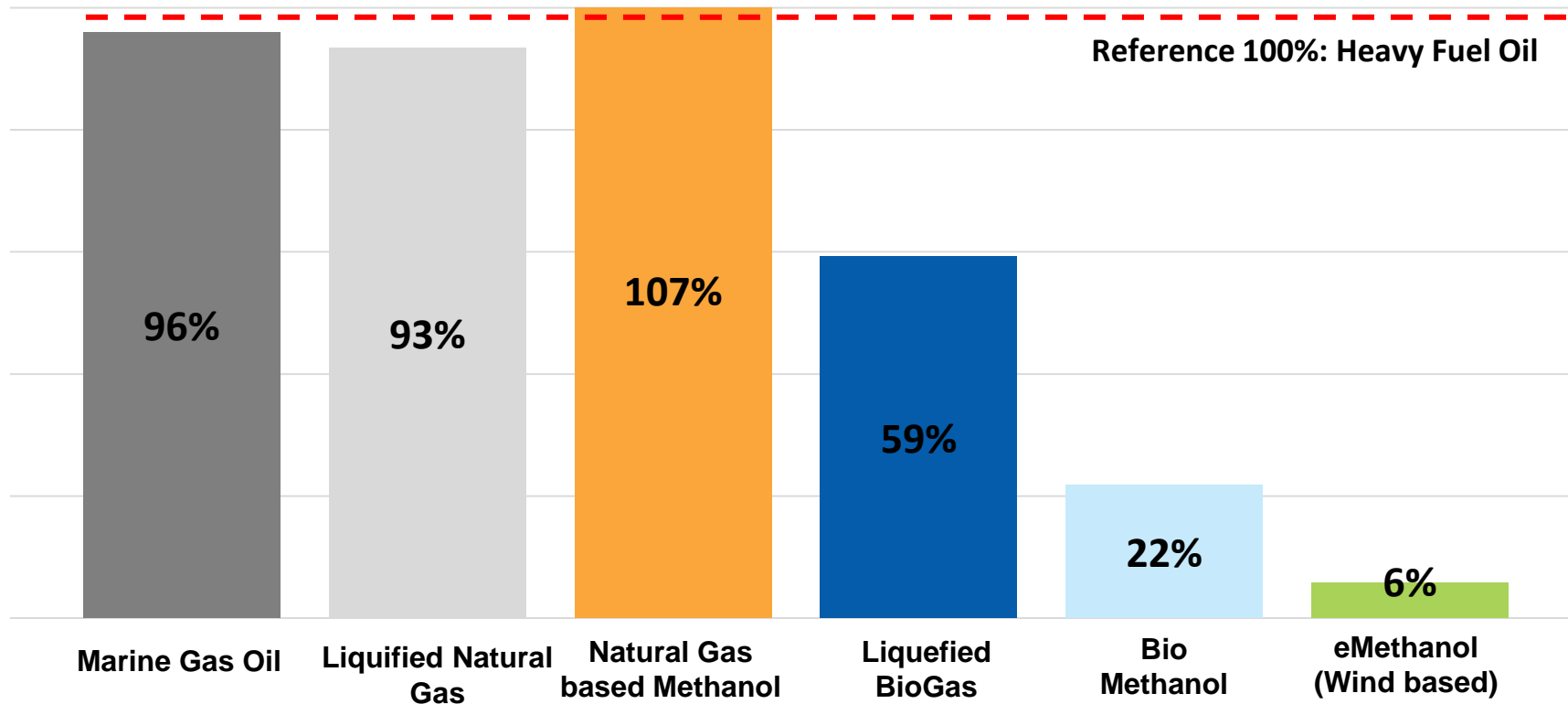
- ✓ Proven Technology
- ✓ Upcycling biogenic CO<sub>2</sub> into valuable resource

- ✓ Prevents new carbon emissions
- ✓ Enables more sustainable industry

# eMethanol reduces marine emissions up to 94%

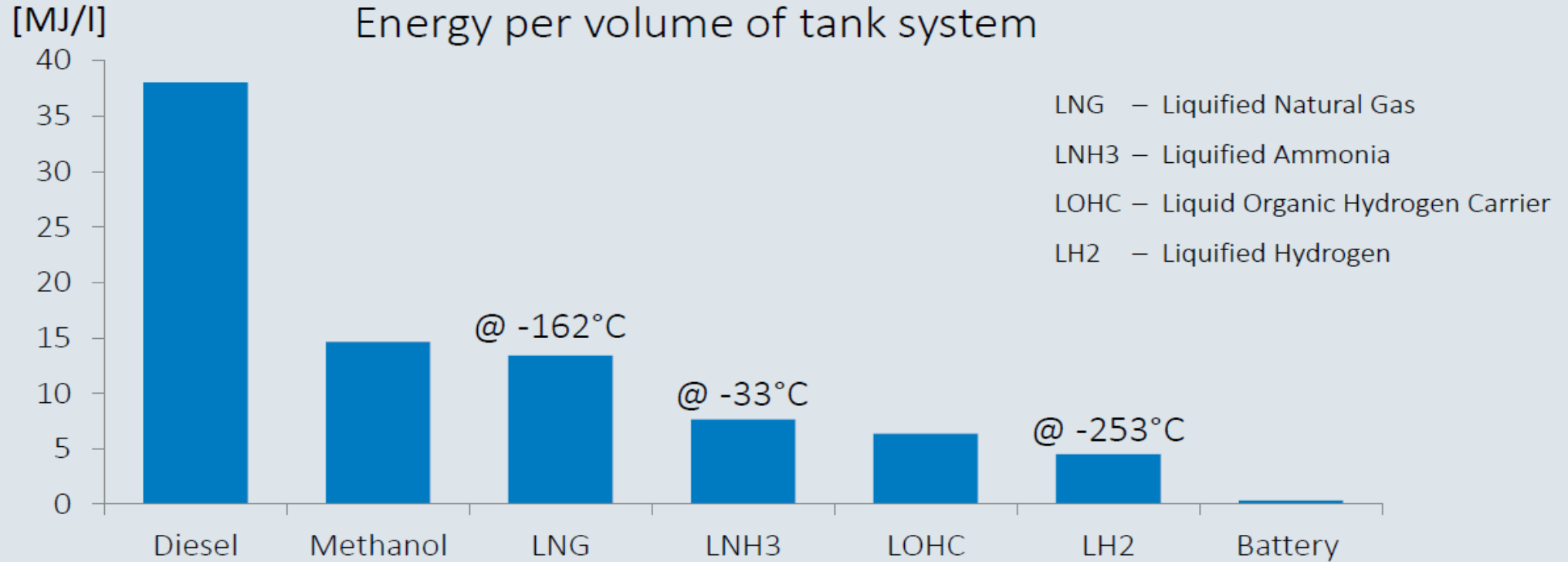
The Marine industry is shifting from Heavy Fuel Oil to reduce emissions. Using eMethanol significantly reduces greenhouse gas emissions.

Greenhouse Gas Emission Compared to Heavy Fuel Oil\*



\*Reference fuels based on Brynolf (2014) - Environmental assessment of marine fuels  
eMethanol based on internal LCA results

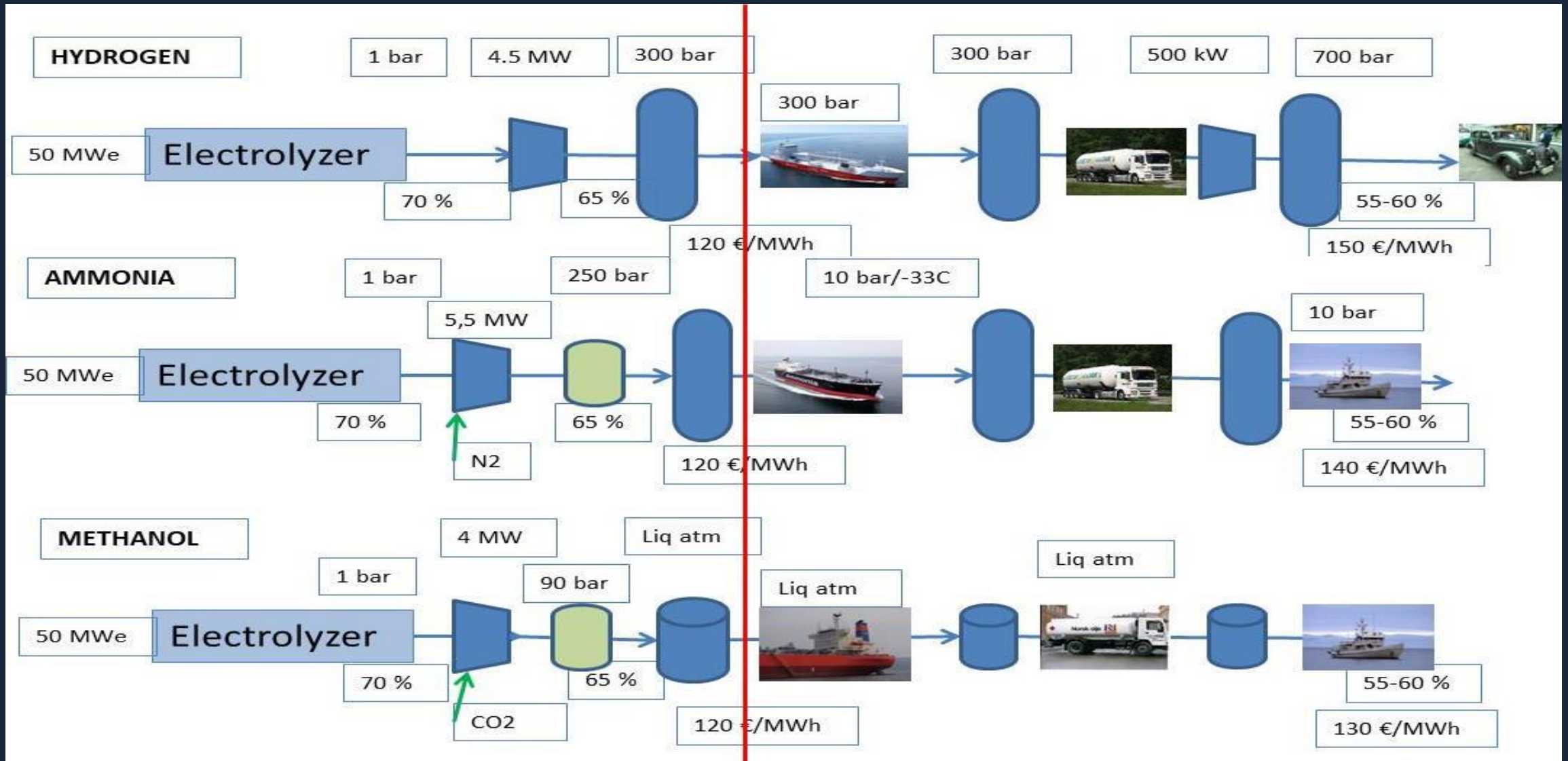
# FUEL STORAGE SEAGOING VESSELS



Battery, H2, LOHC and LNH3 not suitable for long distances



# e-Fuel Comparison

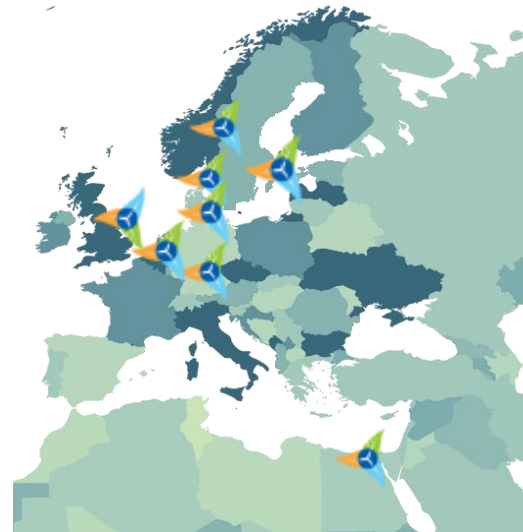


# About Liquid Wind

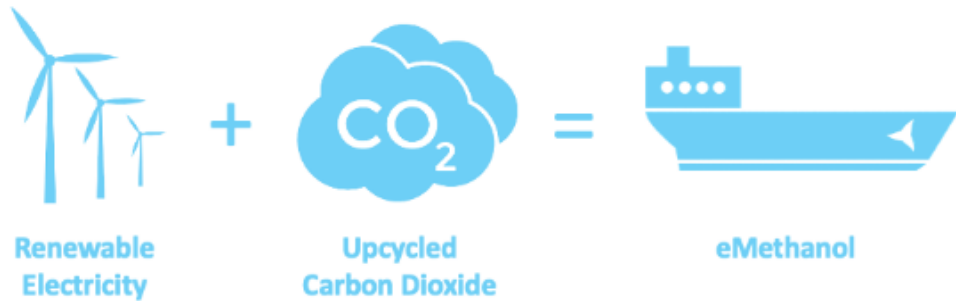
**Liquid Wind is a Power-to-Fuel development company with an innovative, and rapidly scalable solution for production of green electrofuel, eMethanol.**

## Passionate and experienced team

- Founded in 2017
- Headquarter in Göteborg, Sweden
- Local offices around Europe
- 40 employees



# Concept & Vision



## Per year, each Flagship 1 type facility;

Upcycles **70,000mt** of CO<sub>2</sub>  
Generates minimum **50,000mt** of eMethanol  
Prevents **90,000mt** of CO<sub>2</sub> emissions

## Commercial offering

Fixed price 10 year offtake agreements

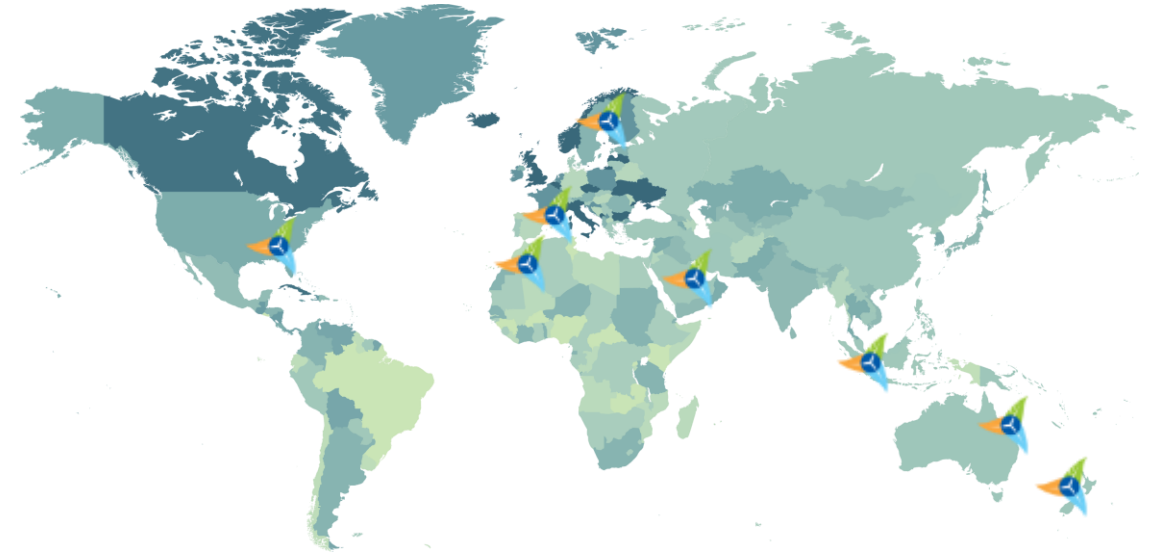
## Establishing commercial-scale global facilities

**2024** First facility in Örnsköldsvik, Sweden

**2025** Second facility in Sundsvall, Sweden

**2030** 10+ facilities

**2050** 500 facilities, globally



# Scalable Carbon Neutral Fuels are Needed

From fossil fuel to renewable alternatives to reach emission reduction targets

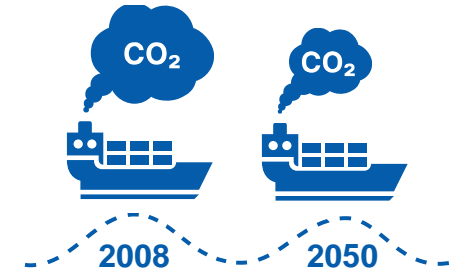


**99.9% of marine fuels are fossil based**

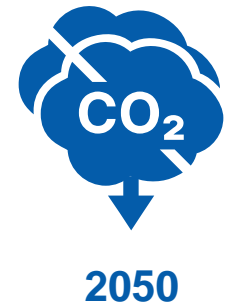
Source: UNCTAD - Review of Maritime Transport 2019



“Reduce the total annual GHG emissions (from International Shipping) by at least 50% by 2050 compared to 2008.”



Committed to “net-zero CO<sub>2</sub> emissions from operations by 2050.”



The EU aims to be climate-neutral by 2050 – an economy with net-zero greenhouse gas emissions.

# Increasing demand

Increasing number of retailers demand green end-to-end transportation, at the same time as engines are becoming more available and methanol-ready vessels are ordered

## Amazon, Ikea and Unilever pledge zero emission shipping by 2040

Adis Ajdin · October 20, 2021 · 2,629 · 2 minutes read



## 19 retailers committed to zero-carbon shipping fuels by 2040

'Support for maritime decarbonization has grown swiftly in just a short time,' director of COZEV says

Alyssa Sporrer · Thursday, September 22, 2022 · 3 minutes read



Cargo Owners for Zero Emission Vessels

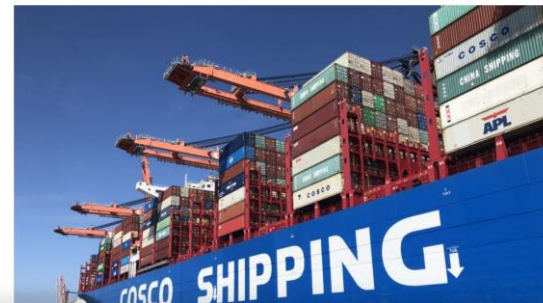
## Wärtsilä hits methanol milestone with first newbuild engine order

Wärtsilä Corporation, Press release, 24 January 2022 at 11:00 UTC+2



## COSCO Shipping eyeing methanol for new round of ship orders

September 16, 2022



## MAN ES: Methanol to become available for shipowners from 2024

## Waterfront Shipping orders 8 methanol dual-fuel ships from Hyundai Mipo Dockyard

VESSELS

December 1, 2020, by Jasmina Ovcina

Canada-based Waterfront Shipping Company (WFS), a wholly-owned subsidiary of Methanex Corporation, has placed an order for eight new methanol dual-fuel vessels with South Korean shipbuilder Hyundai Mipo Dockyard.

## A.P. Moller - Maersk accelerates fleet decarbonisation with 8 large ocean-going vessels to operate on carbon neutral methanol

24 August 2021

Denmark Europe Decarbonisation

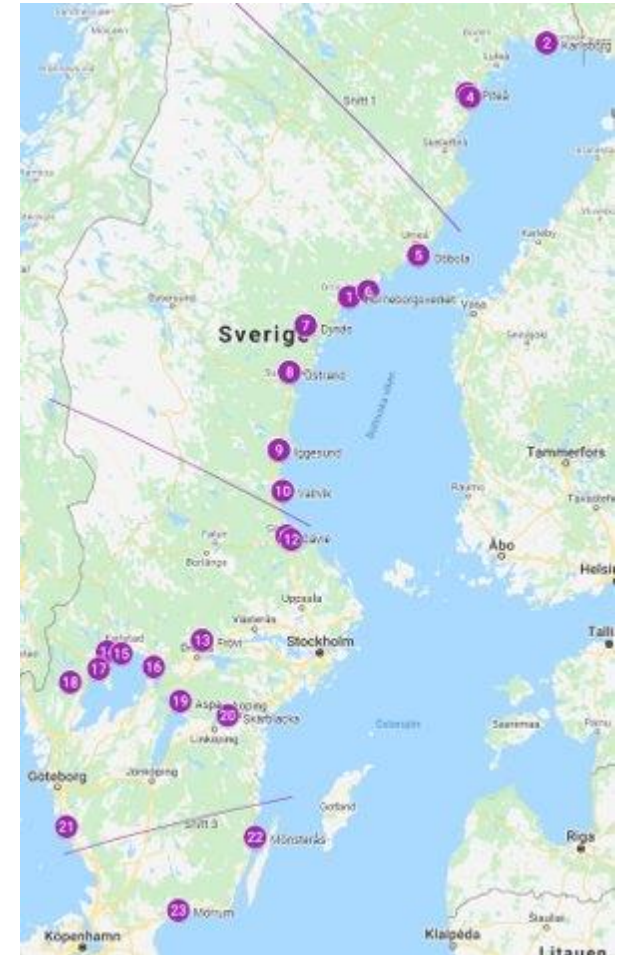
Share



# Nordics offer ideal conditions for production

- ✓ High Renewable Energy Share in SE2 – Over 98%
- ✓ SE2 currently offers the lowest power prices in Europe
- ✓ Wind expansion - lowest prices in Europe
- ✓ Growth & cost reductions – green H<sub>2</sub>
- ✓ Biogenic CO<sub>2</sub> from forestry industry
- ✓ Foundation of strong industrial history
- ✓ Project financing model proven

**Enabling production of cost-effective eFuel**



# Expert team and partners

We are now collaborating on the design for the first eMethanol facility, FlagshipONE, in Örnsköldsvik. Sweden.



**Claes Fredriksson**  
CEO & Founder  
Liquid Wind



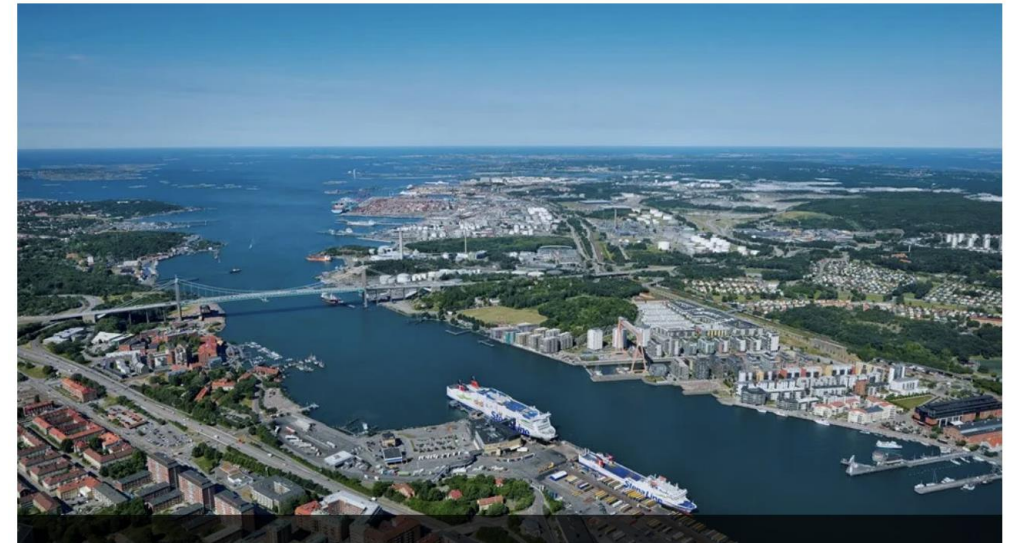
# Industry leaders collaborate to accelerate green transition of shipping



The Port of Scandinavia



## PORT OF GOTHENBURG TO BECOME EUROPE'S FIRST GREEN E-FUELS HUB



Gothenburg Port Authority is collaborating with Stena Line, DFDS, Ørsted and Liquid Wind to establish Europe's first electromethanol (e-fuels) hub.

The parties are engaging to set up an eMethanol value chain with the determination to have significant volumes of eMethanol accessible at the **Port** of Gothenburg.



# Hybrid Synfuel/Wind Propulsion



**HYBRID SOLUTION**  
OUR NEXT GENERATION FLEET

**Terntank Hybrid Solution® contains:**

- Electric power supply system with battery pack and bow thruster drive
- On-shore power connection
- Battery power supply system
- DC Link System
- Frequency controlled cargo and ballast pumps

**Sail into the future**

**Zero emission port operations**

The Terntank Hybrid Solution® revolutionized the tanker industry. In 2021 we equipped the world's first tanker with the pioneering shore power connection combined with our hybrid battery supply system. With the Hybrid Solution® we can perform zero emission port operations, and minimize pollution in urban areas.

**Wind propulsion**

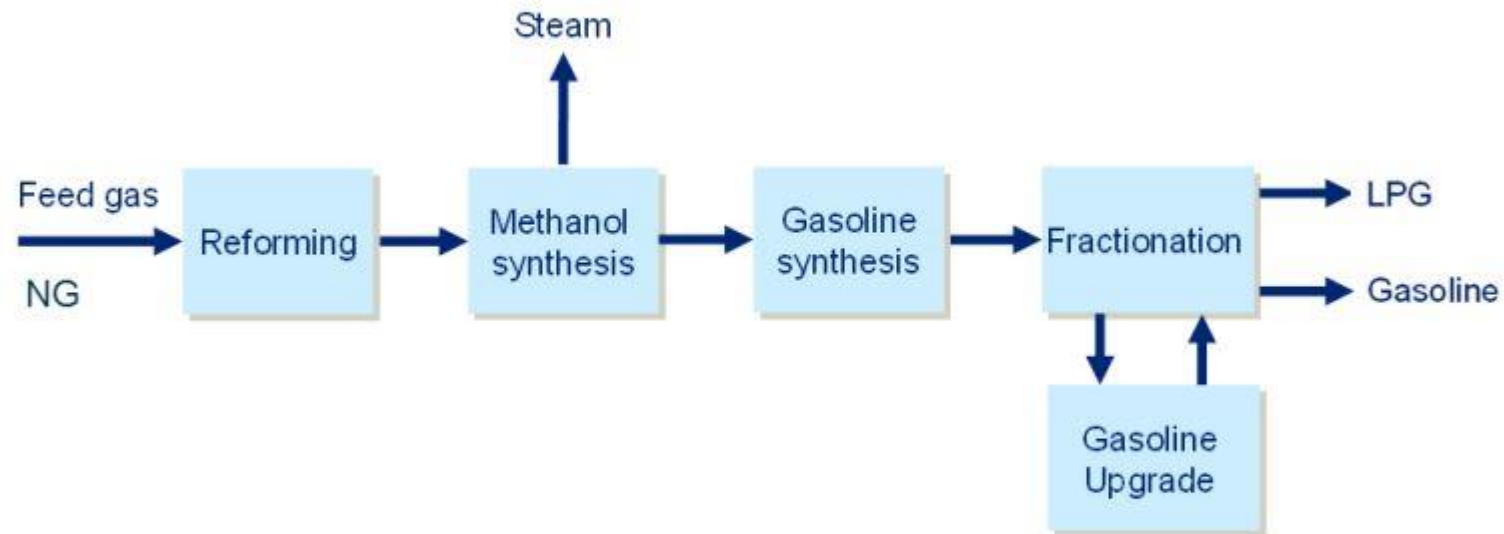
The foldable wind propulsion system, a suction wing/sail is similar to the lifting force produced by an airplane wing. Based on our studies, we expect between 5 up to 20 percent reduction in fuel and emissions. The 20 meter wing can create a thrust power of 300 kW each.

**Methanol fueled future**

The new advanced fuels such as green methanol and e-methanol with their low global warming potential is up to 98% lower than conventional fuels. That plays an important role to meet our net zero emission goal for 2040.

# TIGAS™ Process - Overview

TIGAS: Topsoe Improved Gasoline Synthesis



Single Train: 150 MMSCFD NG => 5200 MTPD MeOH => 1800 MTPD Gasoline + 338 MTPD LPG

0,35 ton Gasoline per ton MeOH, 0,07 ton LPG

HALDOR TOPSOE 

# Synfuel plant

Turkmenistan Natural  
gas to Gasoline



HALDOR TOPSOE 

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