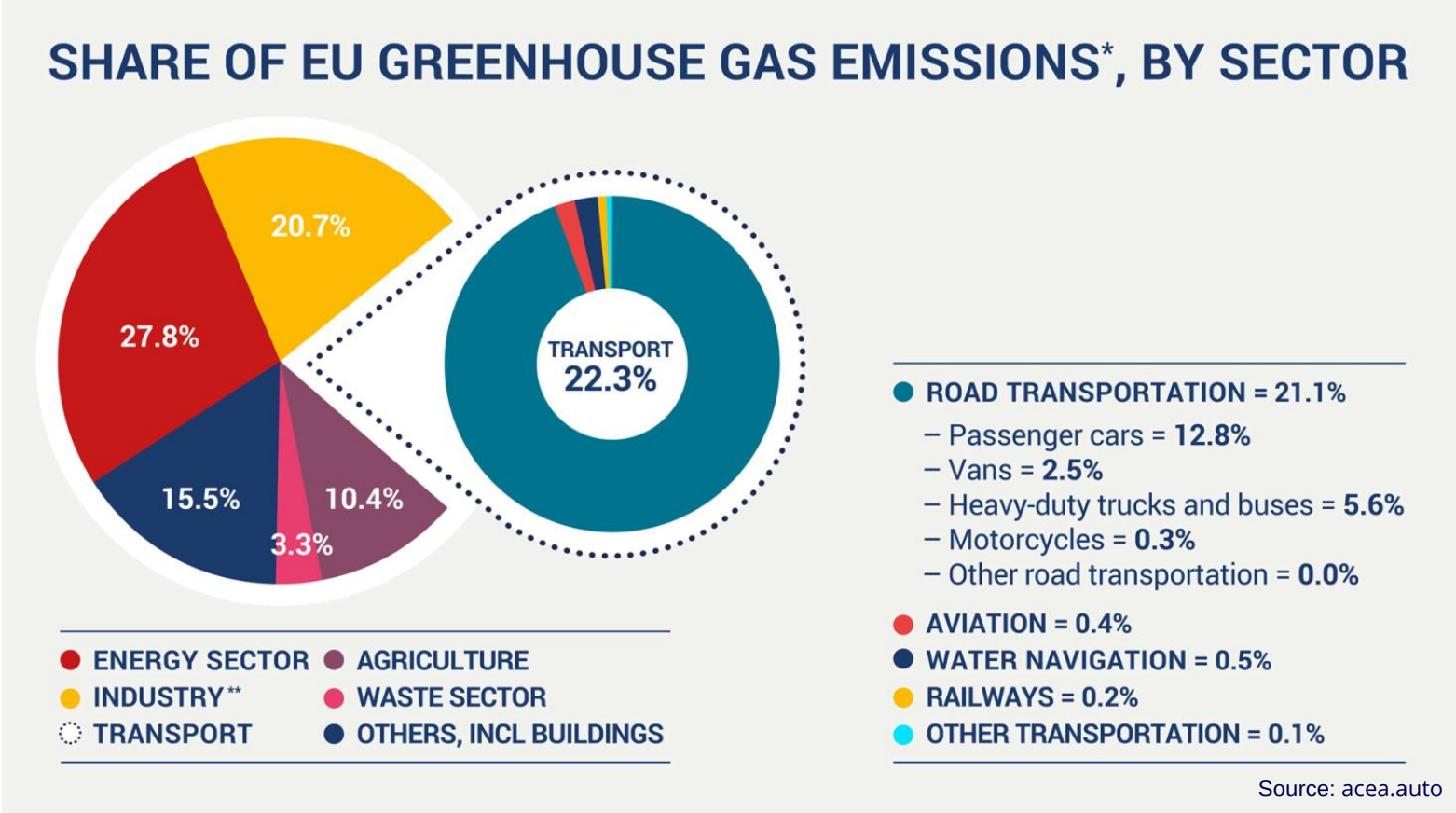
Decarbonization of long-haul heavy-duty transportation

07 September 2022

Decarbonization drives the need for Alternative fuels

- **The European Green Deal**
  - In 2021, the EU made **climate neutrality,** the goal of **zero net emissions by 2050,** legally binding in the EU.
  - Set an interim target of 55% emission reduction by 2030.
- **CO2 emission standards for heavy-duty vehicles**
  - from 2025 onwards: 15% reduction
  - from 2030 onwards: 30% reduction

  - compared to EU average in the reference period (1 July 2019–30 June 2020)
- **Transportation companies & Customers**



What options are available?

TYPE	RANGE	INFRASTRUCTURE	AVAILABILITY	COMMENT
Battery Electric Vehicle	250 km	-	+	Mercedes-Benz, Scania, Volvo, Renault
Electric powerlines	2 x test tracks	-	-	Development
Liquid Biofuels	~ 2 500 km	+++	-	HVO100, FAME
CNG / BioCNG	500 – 600 km	+	+	Iveco, Scania, Volvo, Mercedes-Benz
LNG / BioLNG	up to 1 600 km	+	+	Iveco, Scania, Volvo
Hydrogen 350 bar	400 km	-	-	Customer pilots
Hydrogen 700 bar	500 – 600 km	-	-	Development
Liquid hydrogen	up to 1 000 km	-	-	Development
eFuels	~ 2 500 km	+++	-	Price, Production capacity

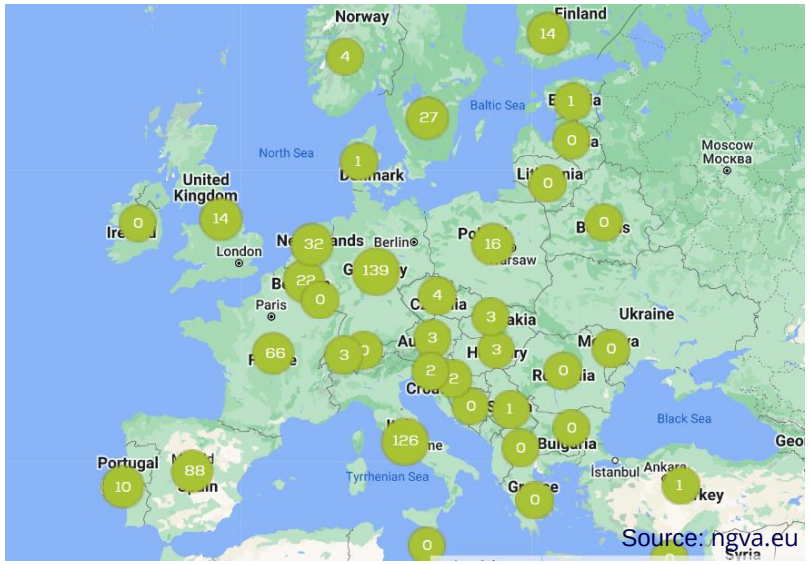
LNG/BioLNG – solution for heavy loads and long distances

- Natural gas cooled below –162°C @ 0,1 Mpa
- 600 x smaller volume than gaseous natural gas

- **Fully available and technologically reliable alternative fuel**
- Existing backbone & strongly growing stations network in Europe
- **LNG vehicles available** – proven technology **(range up to 1 600 km)**
- Using **same payment means as for classic fuels**
- Potential for **strong reduction of CO2 emissions by using BioLNG**

582

~20 000



281
Active in 13 countries

Kozomín (CZ)
Modletice (CZ)
- by end of 2022

H2 Trucks in Europe

Daimler Trucks – GenH2

- Series production 2027
- Liquid hydrogen technology – 1000 km+

DAF

- Developing hydrogen combustion engine
- 10 years until large scale application

Hyzon Motors

- Begins vehicle deployments in early 2021
- HyMax 450 delivered for FrieslandCampina

Volvo

- Volvo AB and Daimler Trucks are teaming up to produce H2 FC long-haul trucks
- 06/2022 – announced testing H2 fuel cell truck; commercialization end of decade

IVECO & Nikola - Nikola Tre

- FCEV model will enter production in Ulm by the end of 2023

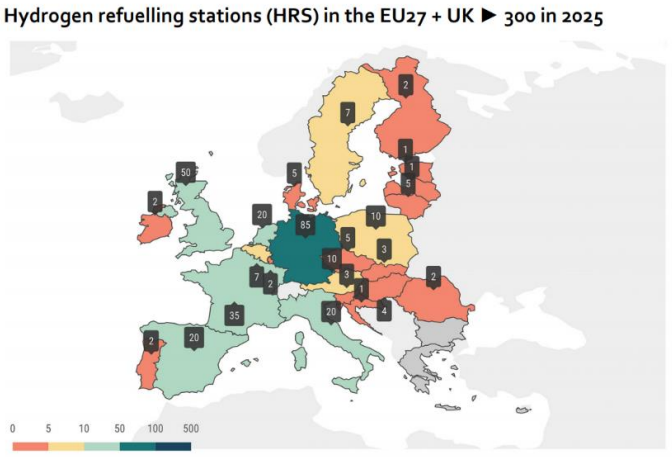
Hyundai - XCient

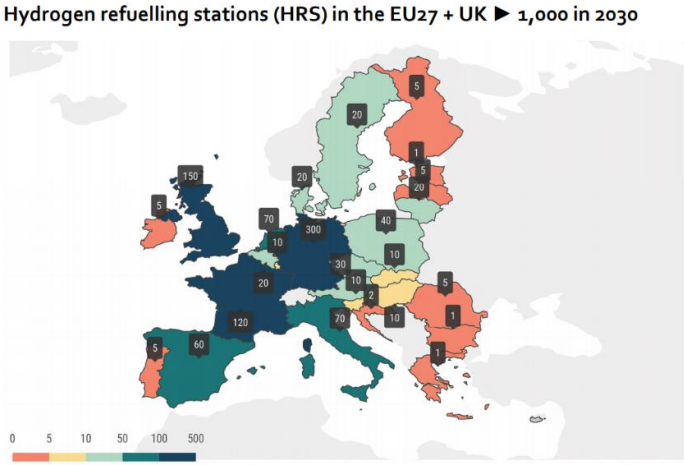
- In use in Switzerland – early movers (Hyundai Hydrogen Mobility)
- 1 000 trucks by 2023 & 1 600 by 2025
- 07/2022 Hyundai will export to Germany

Hydrogen infrastructure

- **228** stations by the end **2021**
  - Germany: 101
  - France: 41
  - UK: 19
  - Switzerland: 12
  - Netherlands: 11
- **Only a handfull of truck suitable**

- The revised AFID should set a target of around 300 truck-suitable hydrogen refueling stations by 2025, and at least 1,000 no later than 2030. *
- In addition, a target should be set to ensure one hydrogen refueling site is available every 200 km on the TEN-T core network by 2030. *
- A hydrogen refueling station for trucks should have a minimum daily capacity of at least six tones of H2 with at least two dispensers per stations. *

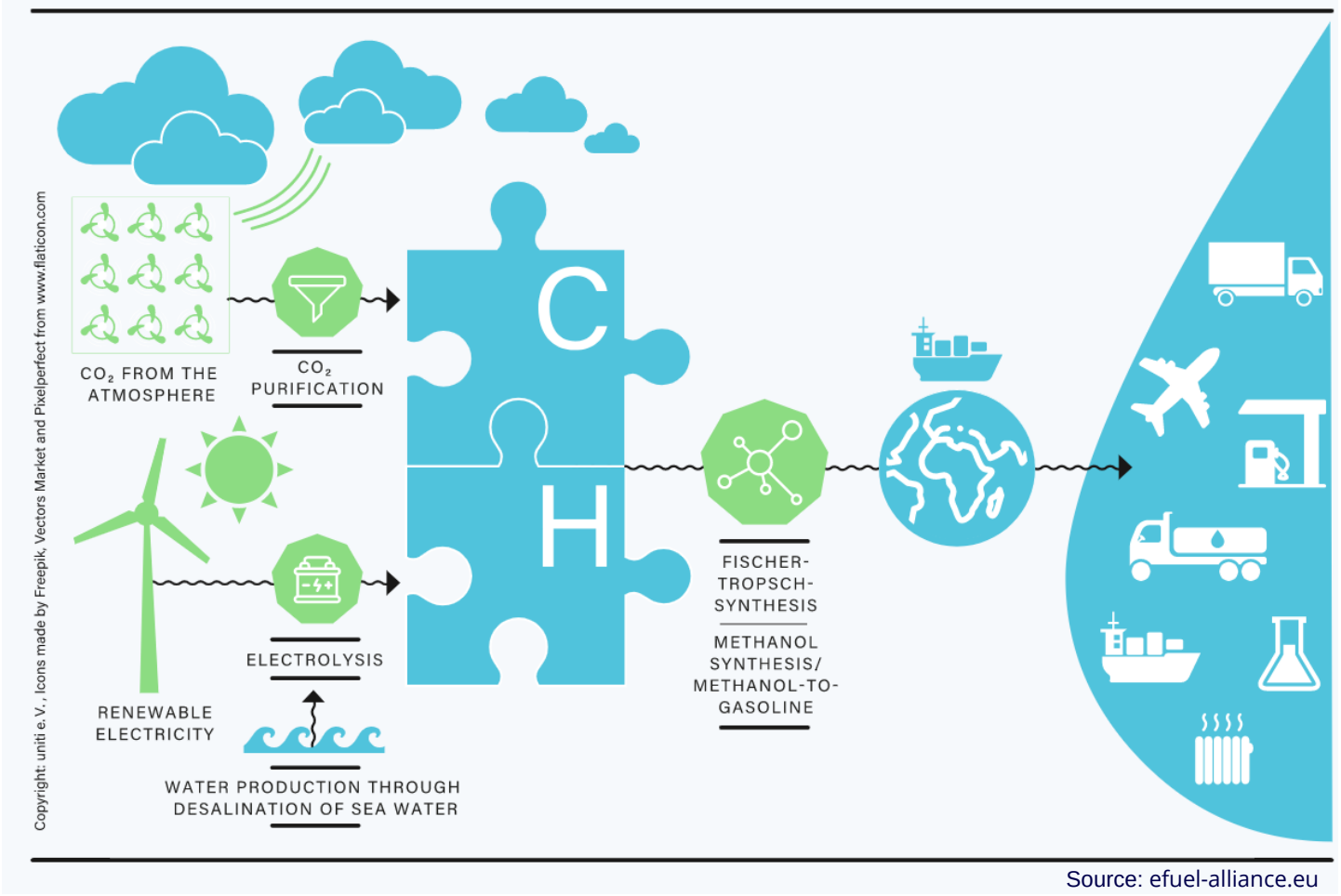




*ACEA Position Paper: Heavy-duty vehicles: Charging and refueling infrastructure – May 2021

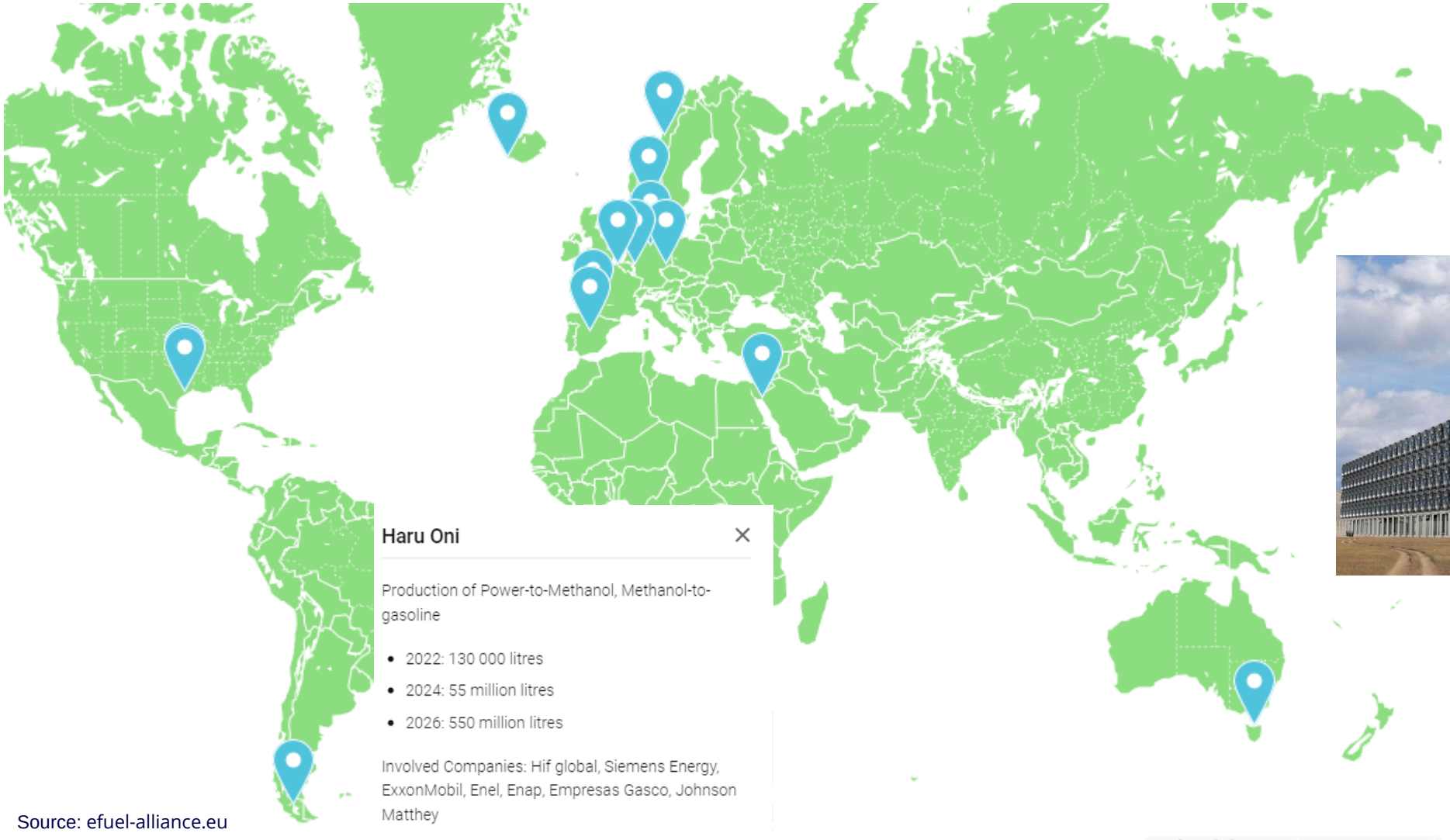
e-Fuels – Synthetic fuels

- Produced from renewable energy sources – Power to Liquide, Power to Gas
- eGasoline, eDiesel, eHeating oil, eKerosene and eGas
- High energy density – easy to store & transport
- Use in current internal combustion engines
- Distribution via existing fuels infrastructure
- Can be mixed with fossil fuels
- Higher price then classic fuels
- Price expected to decrease sharply between 2025 - 2050



Source: efuel-alliance.eu

e-Fuels – Today´s production in pilot plants



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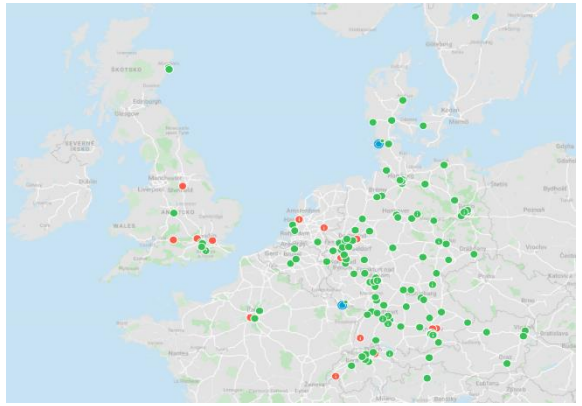
Success of Alternative fuels

INFRASTRUCTURE



VEHICLES

COSTS - TCO

EUROWAG

Thank you for your attention.