Hydrogen Europe

End Uses of Hydrogen with focus on its utilization as a feedstock

DanuP-2-Gas stakeholder event
13.7.2022.

Dinko Đurđević

Hydrogen Europe: Who we are?

Our Mission

Propelling global carbon neutrality by accelerating the European hydrogen industry.

Our Vision

We bring together diverse industry players, large companies and SMEs, national associations and other non-for-profit organizations who support the delivery of hydrogen and fuel cells technologies. We do this to enable the adoption of an abundant and reliable energy which efficiently fuels Europe's low carbon economy.

Hydrogen Europe in numbers

380+ Members

We represent the whole value chain
from producers to end users

40+ Employees

103k+

Followers
on Social Media

We are the fastest growing association in Europe

What do we do?

- We represent the views and aspirations of the hydrogen and fuel cells industry in Europe.
- We promote hydrogen and fuel cells as clean and efficient technologies.
- We are a dedicated resource for stakeholders wanting more information on the benefits hydrogen and fuel cells could bring to society.
- We develop, in coordination with our members, the necessary materials, documents and position papers to achieve our mission.
- We help our members to develop their business activities in Europe.

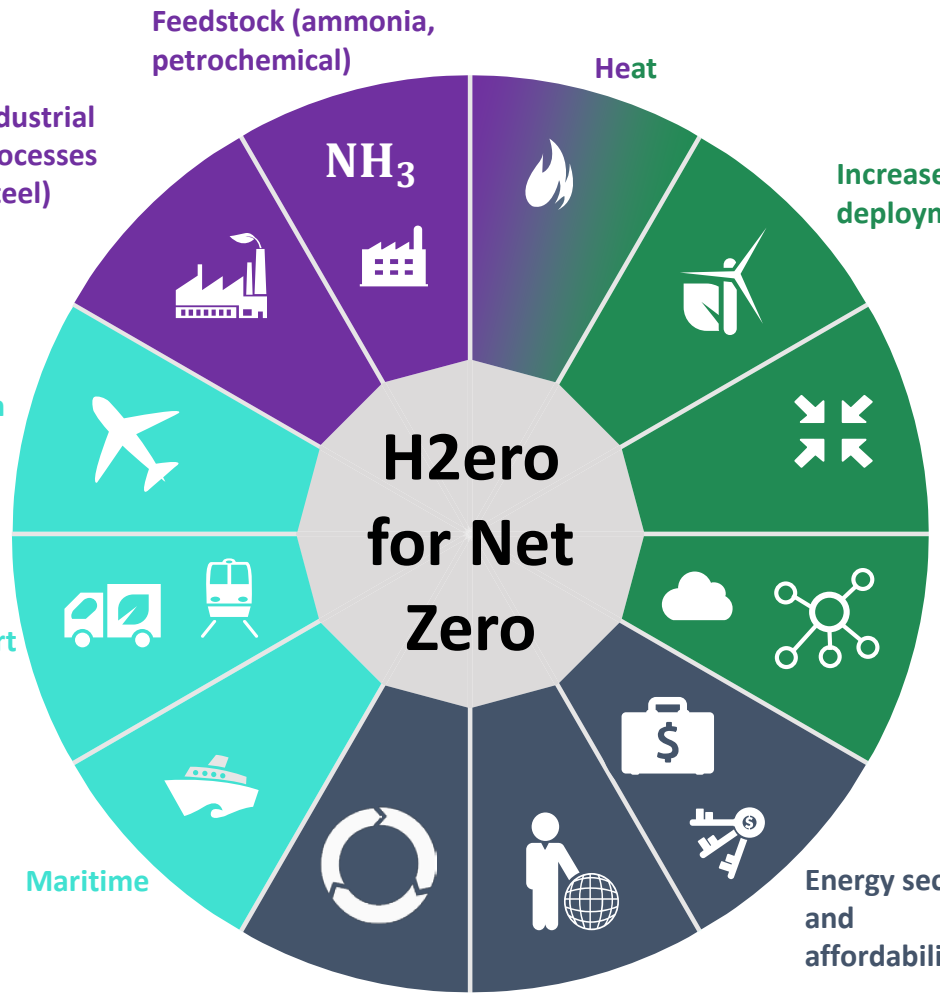
Hydrogen will provide a myriad of benefits in transition to Net Zero

Industry

- Decarbonizing “hard to abate” industrial sectors

Transport

- No transport mode left behind
- No compromise (range, refuel time)
- No consumer segments left behind (fleets, long-distance travelers)



Energy

- Making a net-zero energy system possible

Societal

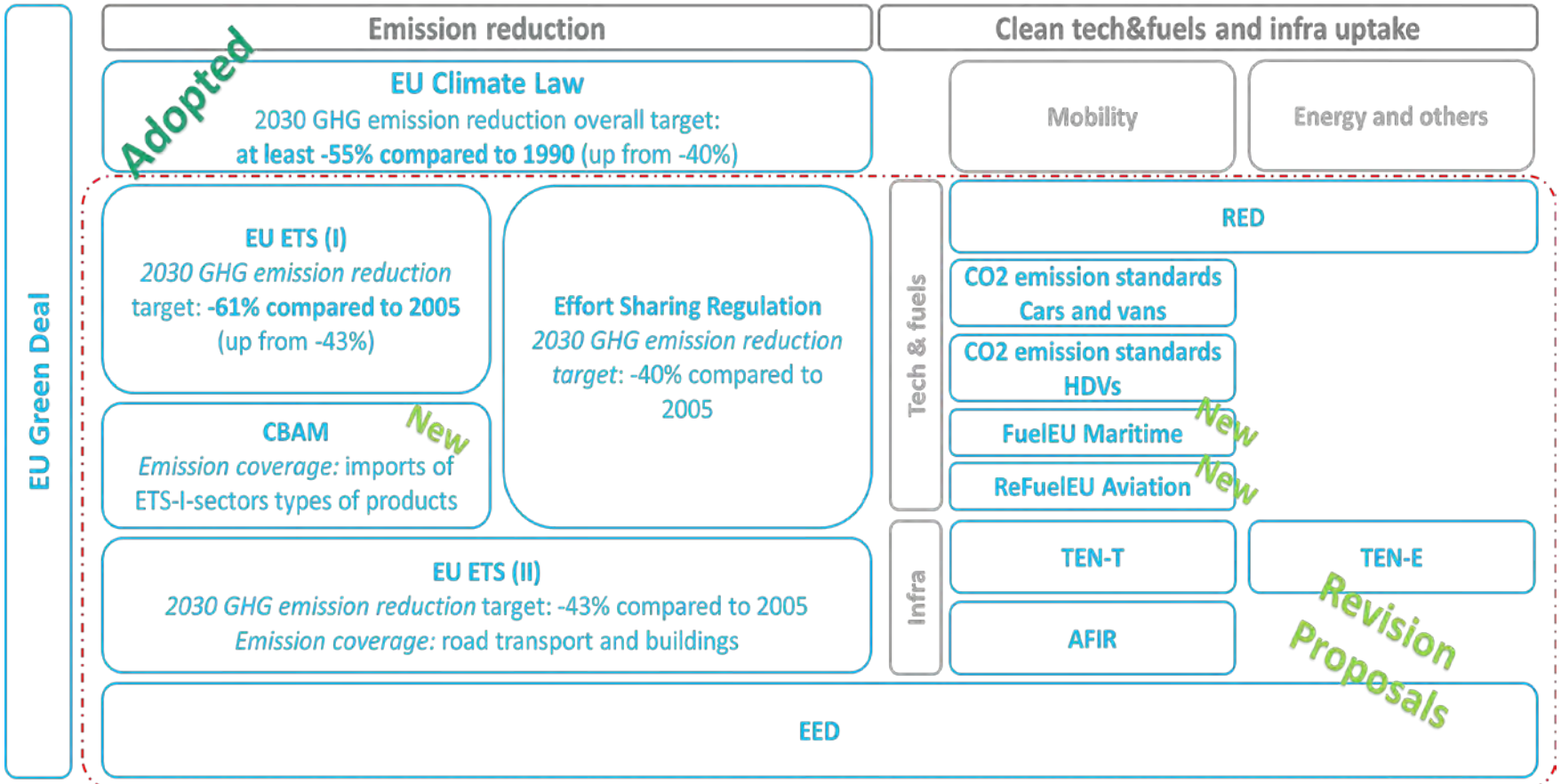
- Ensuring prosperity
- Reducing waste

Hydrogen Europe

The EU Policy landscape

The Fit-for-55 legislative package, proposed by the European Commission on 14 July 2021, represents perhaps the most fundamental change in the EU's legislative acquis since the completion of the EU's single market.

The package touches on almost all aspects of the EU economy, in particular in the areas of energy, industry and mobility.



Main energy and climate legislation and proposals relevant for hydrogen published or proposed in 2020 and 2021 (Source: Hydrogen Europe)

Hydrogen Europe

REPowerEU Plan

More rooftop solar panels, heat pumps and energy savings to reduce our dependence on fossil fuels, making our homes and buildings more energy efficient.

Speeding up renewables permitting to minimise the time for roll-out of renewable projects and grid infrastructure improvements.

Decarbonising Industry by accelerating the switch to electrification and renewable hydrogen and enhancing our low-carbon manufacturing capabilities.

Diversifing gas supplies and working with international partners to move away from Russian gas, and investing in the necessary infrastructure.

A Hydrogen Accelerator to develop infrastructure, storage facilities and ports, and replace demand for Russian gas with additional 10 mt of imported renewable hydrogen from diverse sources and additional 5 mt of domestic renewable hydrogen.

2030

Doubling the EU ambition for biomethane to produce 35 bcm per year by 2030, in particular from agricultural waste and residues.

Hydrogen Europe

REPowerEU: 4 Main Pillars

3

ACCELERATE CLEAN ENERGY TRANSITION

REPowerEU

PHASE OUT DEPENDENCY ON RUSSIAN FOSSIL FUELS

2

DIVERSIFY ENERGY SOURCES

1

SAVE ENERGY

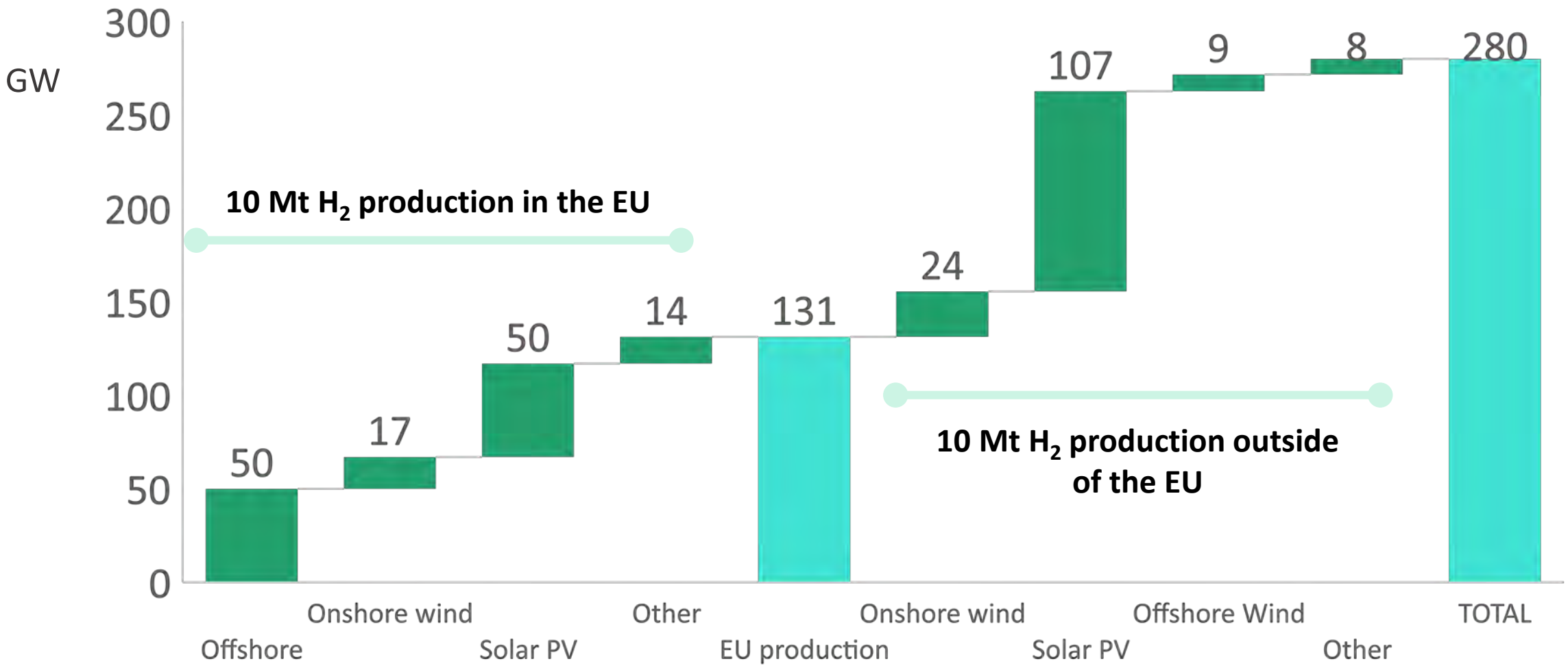
4

SMART INVESTMENT

National and European plans: reforms and investments, faster permitting and innovation

Hydrogen Europe

Required electrolysis capacity by 2030



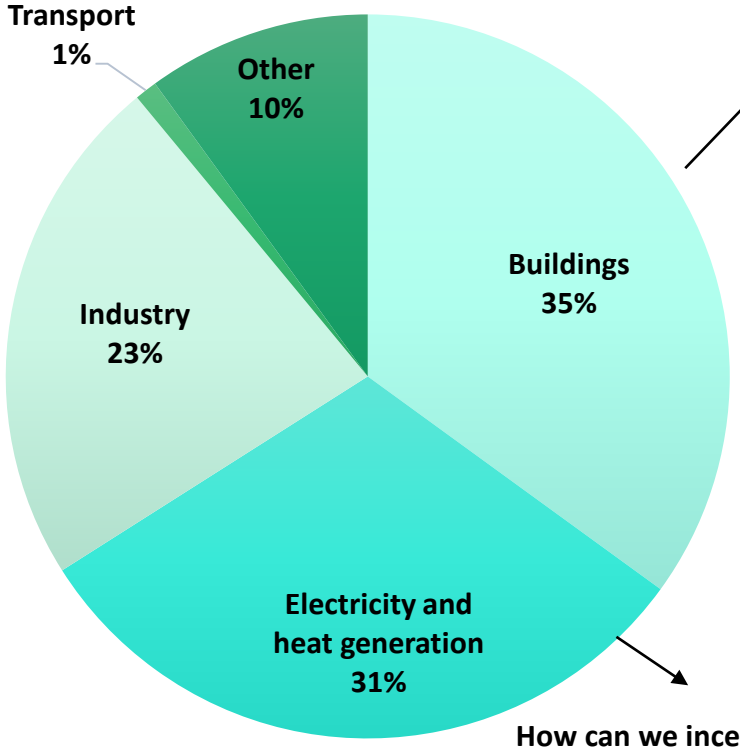
Source: Hydrogen Europe

Assuming: Capacity utilization factors of 5,000h for Offshore wind, 2,900h for onshore Wind, 2,000h for solar PV and 7,000 for grid connected electrolysers

Hydrogen Europe

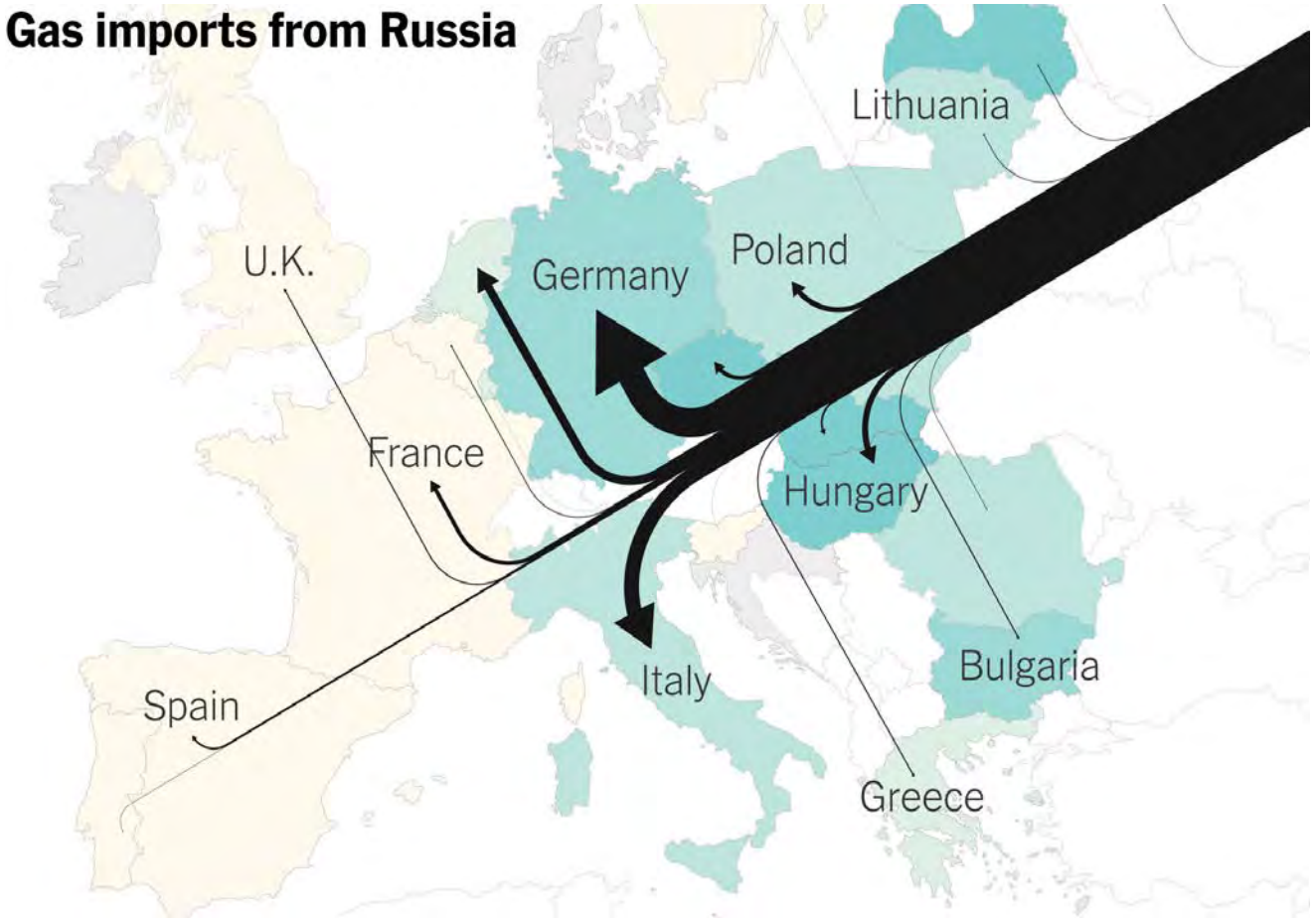
What sectors should we tackle?

2020 Gas Consumption by Sector (EUROSTAT)



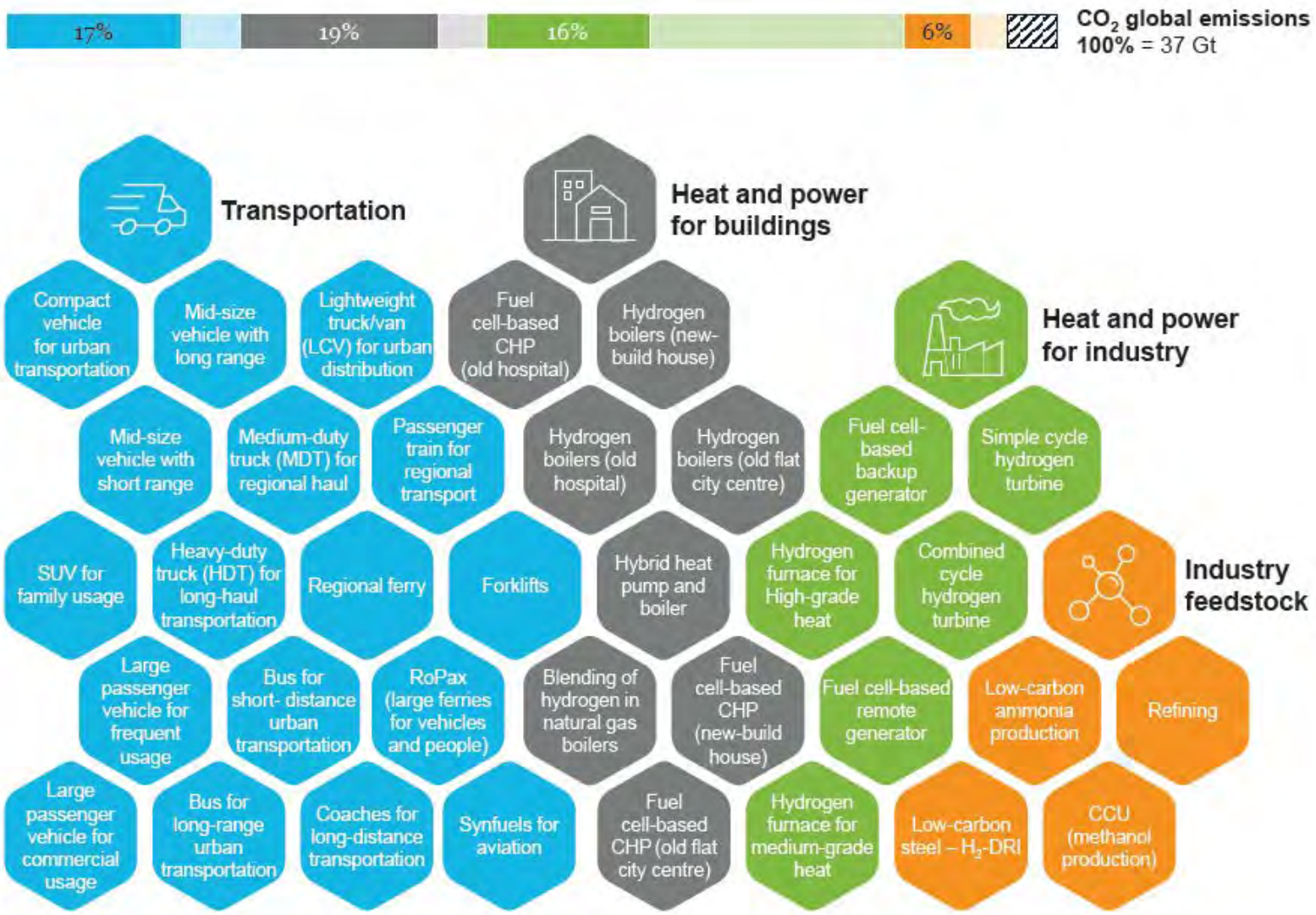
Can we afford to exclude hydrogen from heating in buildings?

How can we incentivize renewable energy to deliver energy throughout the year?



Hydrogen Europe

Overview of H_2 applications



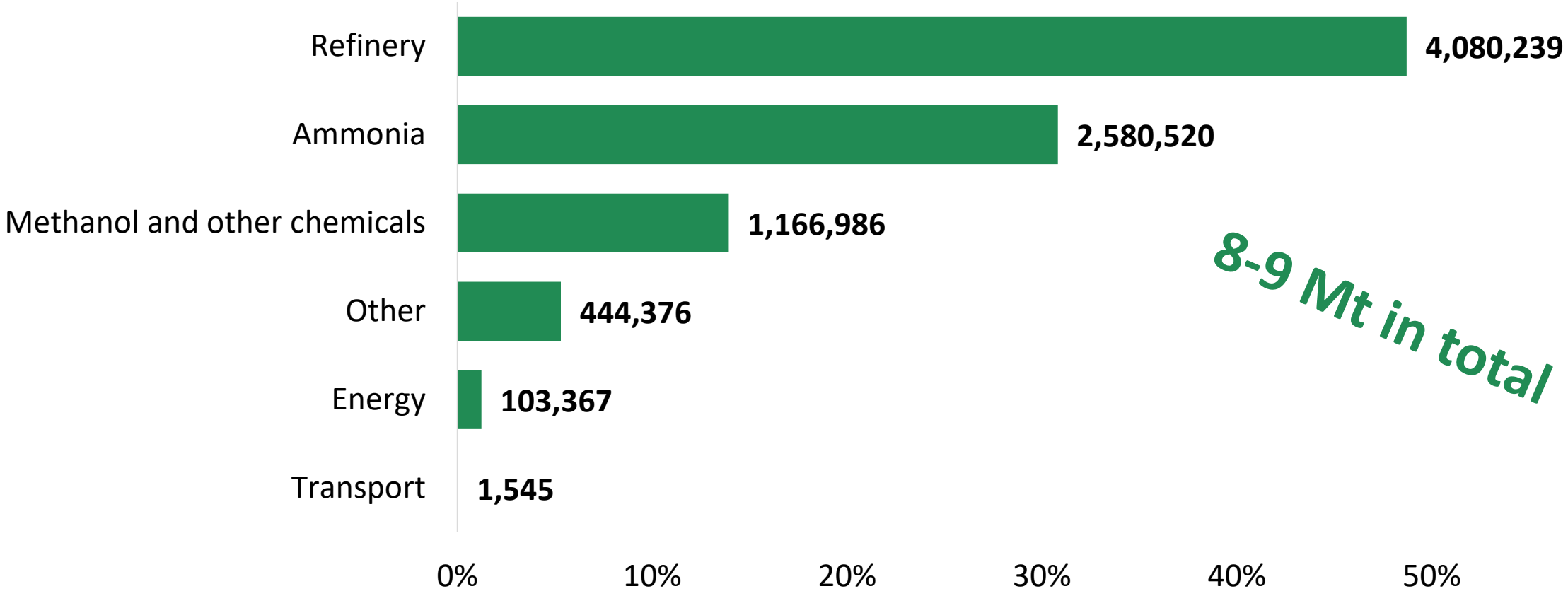
- Additionally:
  - Mobility: container ships, tankers, tractors, motorbikes, off-road applications, fuel cell airplanes
  - Other: auxiliary power units, large scale CHP for industry, mining equipment, metals processing (non-DRI steel), etc.

Source: Hydrogen Council, Path to hydrogen competitiveness – A cost perspective

Hydrogen Europe

Refining and ammonia sectors represent 80% of total consumption

Hydrogen consumption by sector (% of total and tonnes per year)

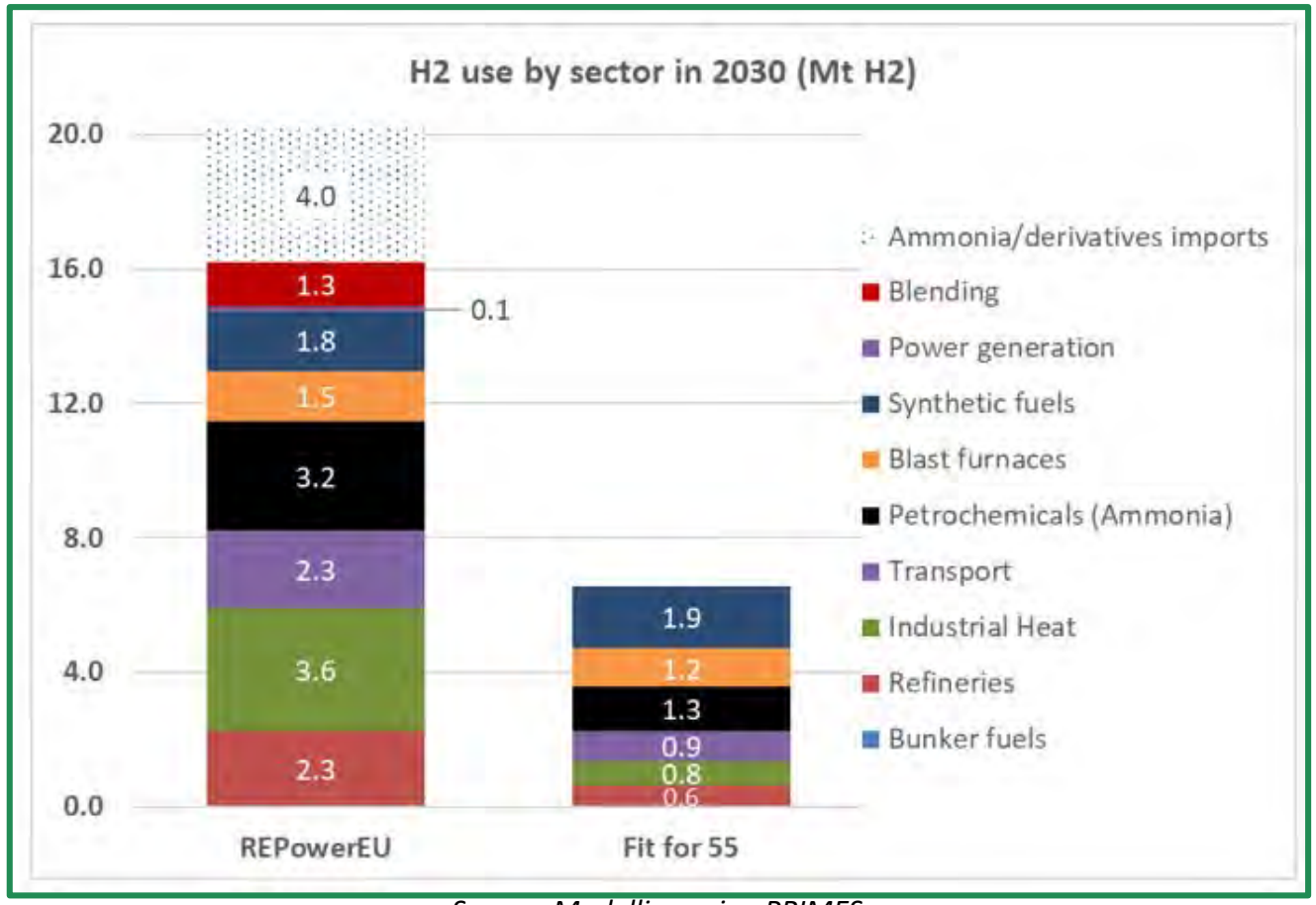


Source: Hydrogen Europe, Fuel Cells and Hydrogen Observatory

Hydrogen Europe

Increase H_2 Demand: Industry & Mobility

EC calls upon Council and EP to align the sub-targets for renewable fuels of RFNBOs in RED II



Source: Modelling using PRIMES

75 % for industry (an increase from 50%)

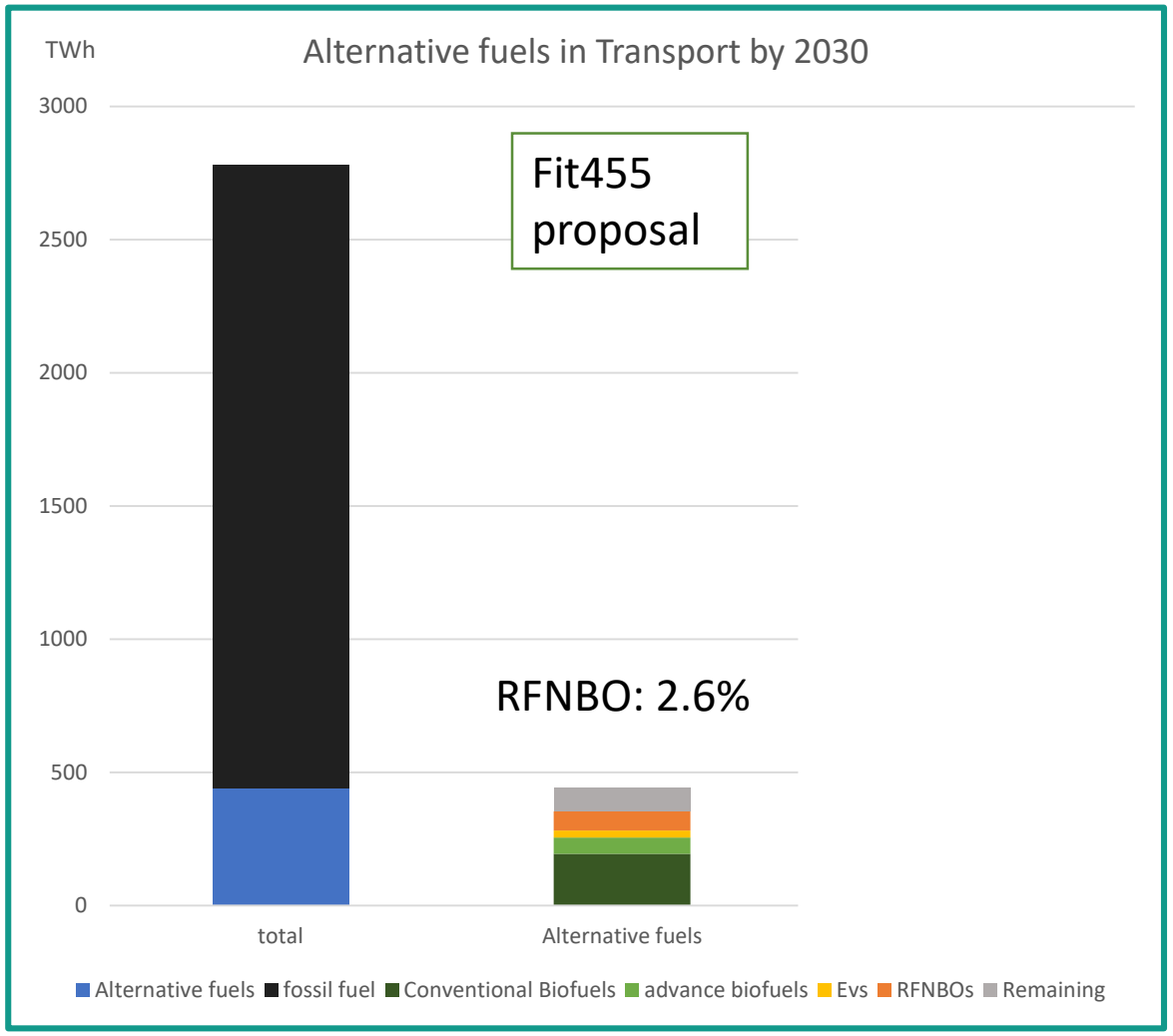
- Estimated demand by 2030: 8.4 mt (excl. refineries)
- 3.6 mt for industrial heat (x4)
- 3.2 mt in chemicals (x2.5)
- 1.5 mt in steelmaking (switch 30% steel production to hydrogen-based DRI-EAF)

5% for transport (an increase from 2.6%)

- Estimated demand by 2030: 6.4 mt (incl. in refineries) (x3)
- Increase the share of zero-emission vehicles
- Adopt proposals on Alternative fuels
- Adopt a legislative package on greening freight transport by 2023

Hydrogen Europe

H_2 demand in transport



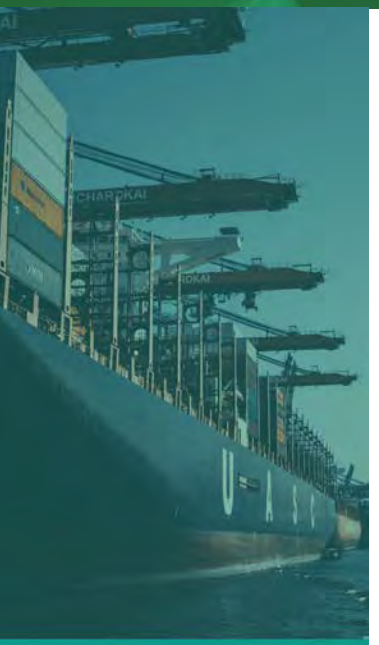
- Target: 13% GHG emission reduction.
- Plus 3 sub-targets on energy content:
  - RFNBO: 2.6% (1.2x in maritime and aviation)
  - Advance biofuels: 2.2% (1.2x in maritime and aviation)
  - Conventional biofuels: ~7%
  - EV: no target (volumes based on impact assessment)
- Mechanism allowing fuel suppliers to exchange credits for supplying renewable energy to the transport sector.

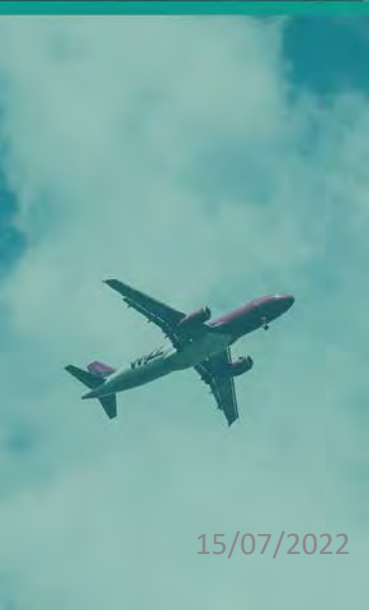
- RFNBO: 2.6% ~ 72TWh (2.2 Mton H_2)
- RFNBO: 5% ~139TWh (4.2 Mton H_2)

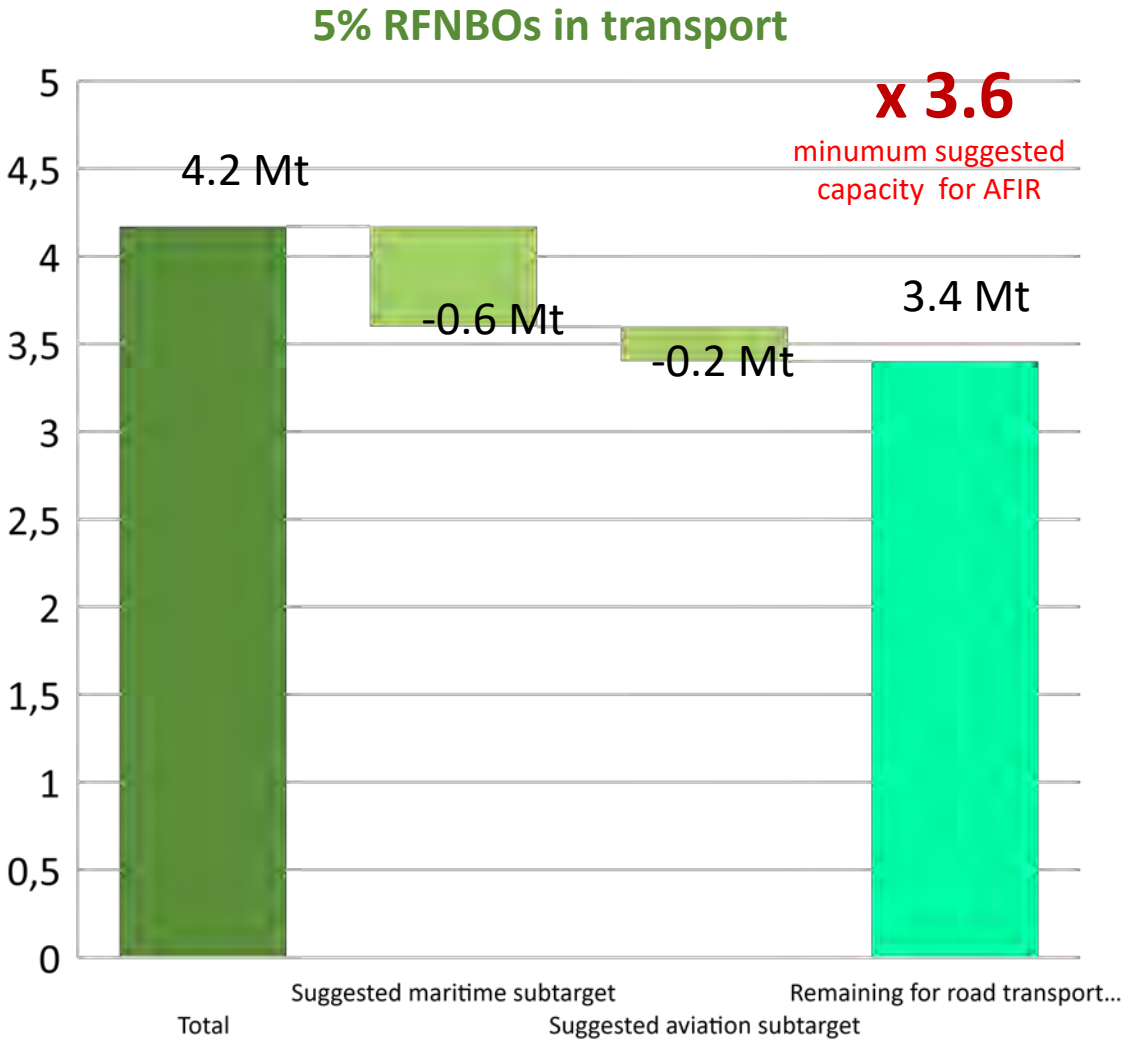
- RES electricity is determined by multiplying the amount of electricity supplied to that sector by the average share of RES-E supplied in that MS in two previous years
- Remaining: Assuming zero-emission fuels with no multipliers

Hydrogen Europe

Suggested RED transport subtarget in RePowerEU







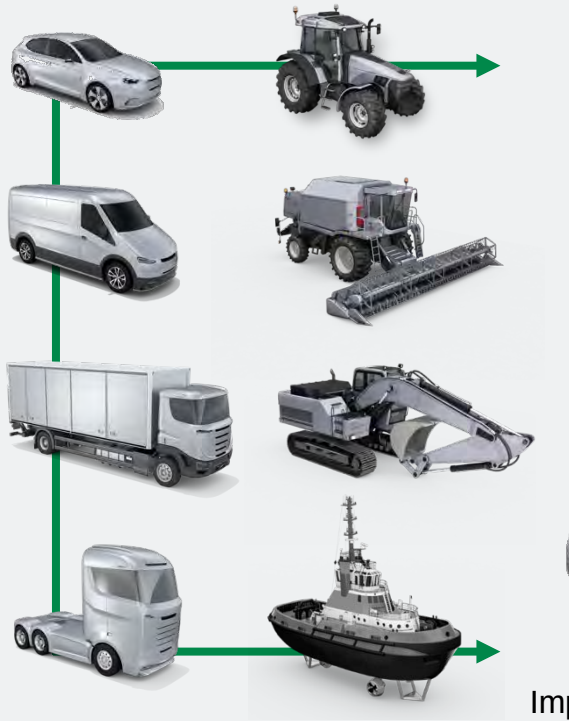
Current sub-sector targets on RFNBOs within FuelEU Maritime And REfuelEU Aviation do not match the increased ambition and strategy regarding RFNBOs in road transport

- FuelEU Maritime- proposed 6% e-fuels target
- RefuelEU aviation- 0.7% e-fuels by 2030

Hydrogen Europe

Technology openness as basis for climate neutrality

All kind of vehicles



Mild-Hybrid

HV-Hybrid
incl. Plug-In

Battery-
electric vehicle

Fuel cell electric
vehicle

100 %
renewable
energy

High air quality

Increasing part of renewable energy

CO_2-neutral

Improved combustion
engines

Alternative
fuels

Ammoniac engine

Hydrogene engine

100 % renewable
fuels

Hydrogen Europe

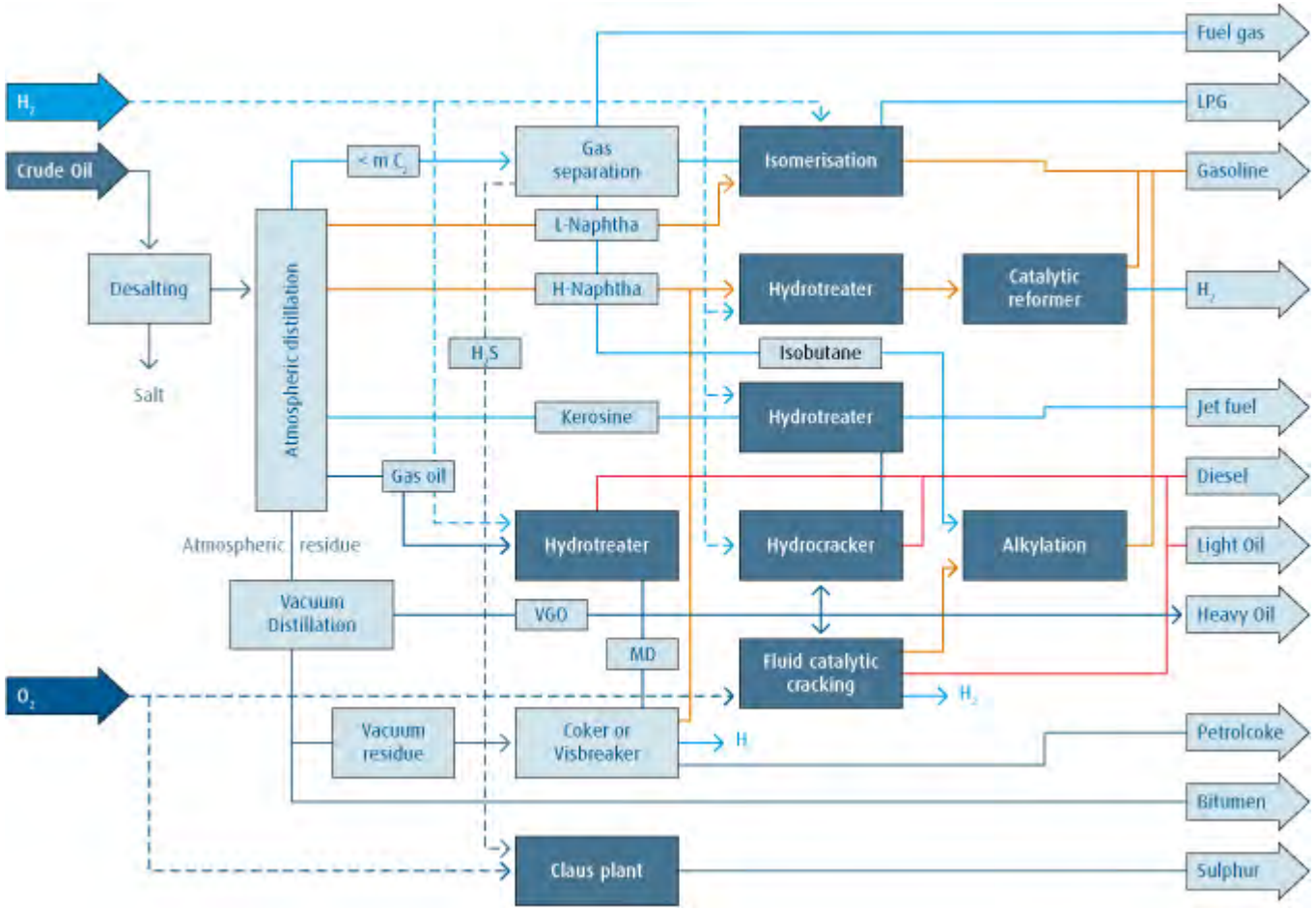
Segment relevance

- Types of decarbonization in mobility:
  - Direct Electrification
    - Passenger cars
    - Light-duty vehicles
    - Rail
    - Shipping and aviation not possible (FT fuels)
  - Fuel Cell technology
    - Road vehicles (H_2 tanks) – ICE and/or FCEV
    - Rail, aviation and shipping sectors
  - Combustion engines fuelled by hydrogen or synthetic fuels
    - Hydrogen
    - Synthetic MeOH
    - Synthetic Methane
    - Dimethylether (DME)
    - Complex hydrocarbons (FT Fuels)

Source: FVV, Future Fuels Study IV

Hydrogen Europe

H_2 in refineries

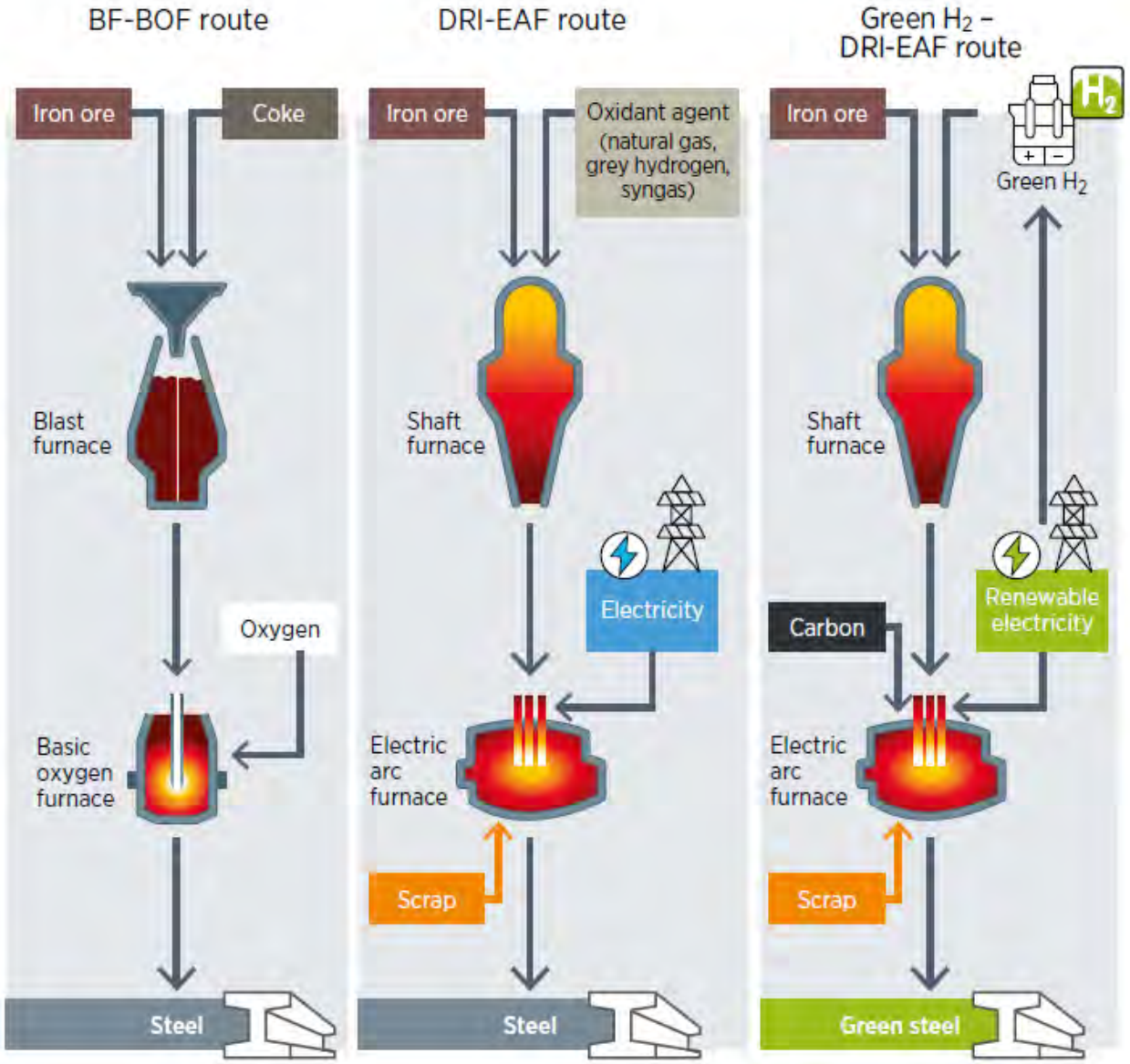


- Demand for hydrogen will increase in the upcoming years as a result of stricter environmental legislation
- Hydrogen volumes consumed increasingly exceed those produced in a platformer and have to be supplemented by other sources.
- Main processes for hydrogen on-site supply:
  - Steam reforming of methane or other hydrocarbons
  - Recovery from refinery off-gases
  - Recovery from syngas
  - Gasification of oil refining residues.

Hydrogen Europe

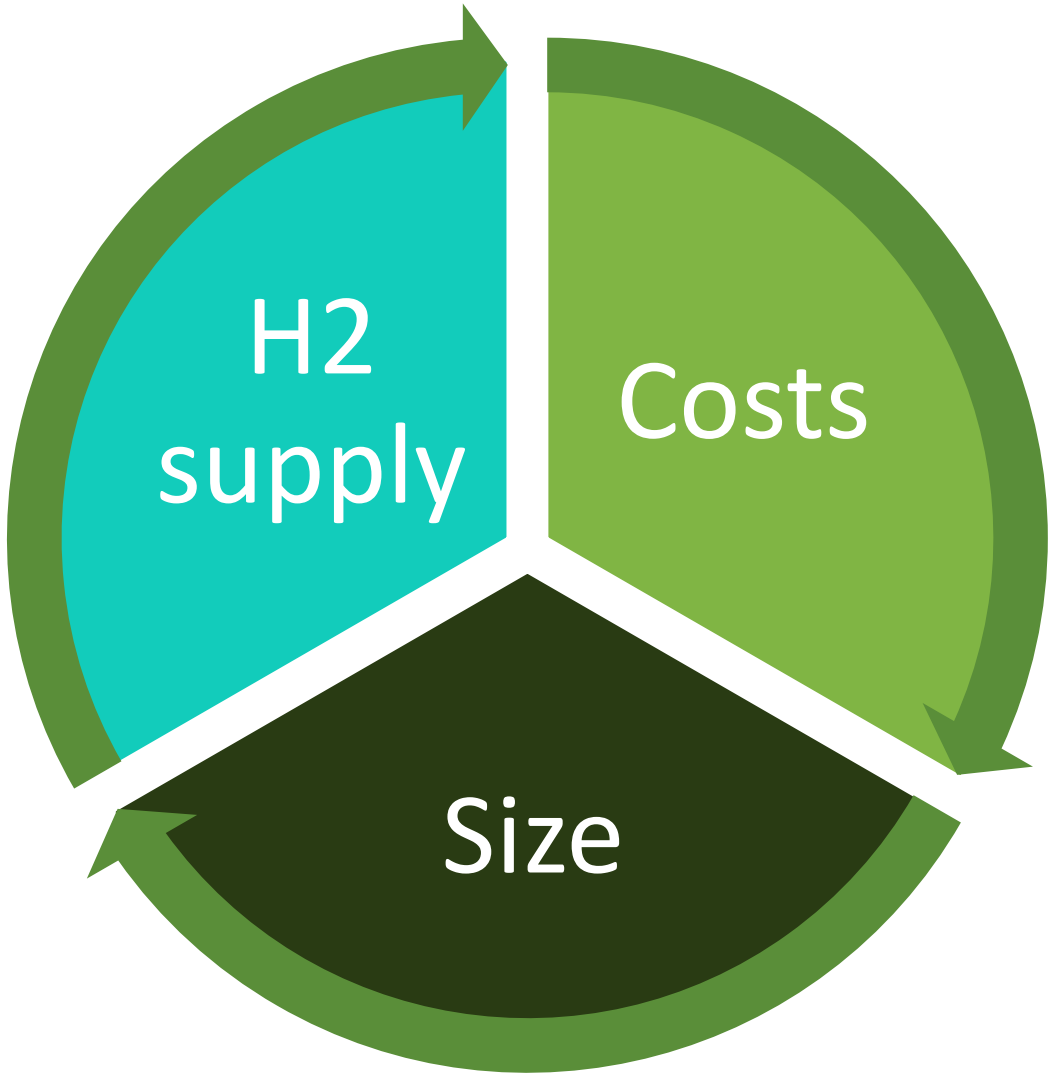
H_2 in steel industry

- Most often pathways:
  - Blast furnace-basic oxygen furnace (BF-BOF) route to produce primary steel (from iron ore)
  - Electric arc furnace (EAF) to produce secondary steel (from scrap)
- BF-BOF is the leading production method
- In the absence of steel scrap, the direct reduction of iron (DRI) can be used to feed the EAF
  - DRI is the group of processes for making iron from iron ore, typically using a syngas.



Hydrogen Europe

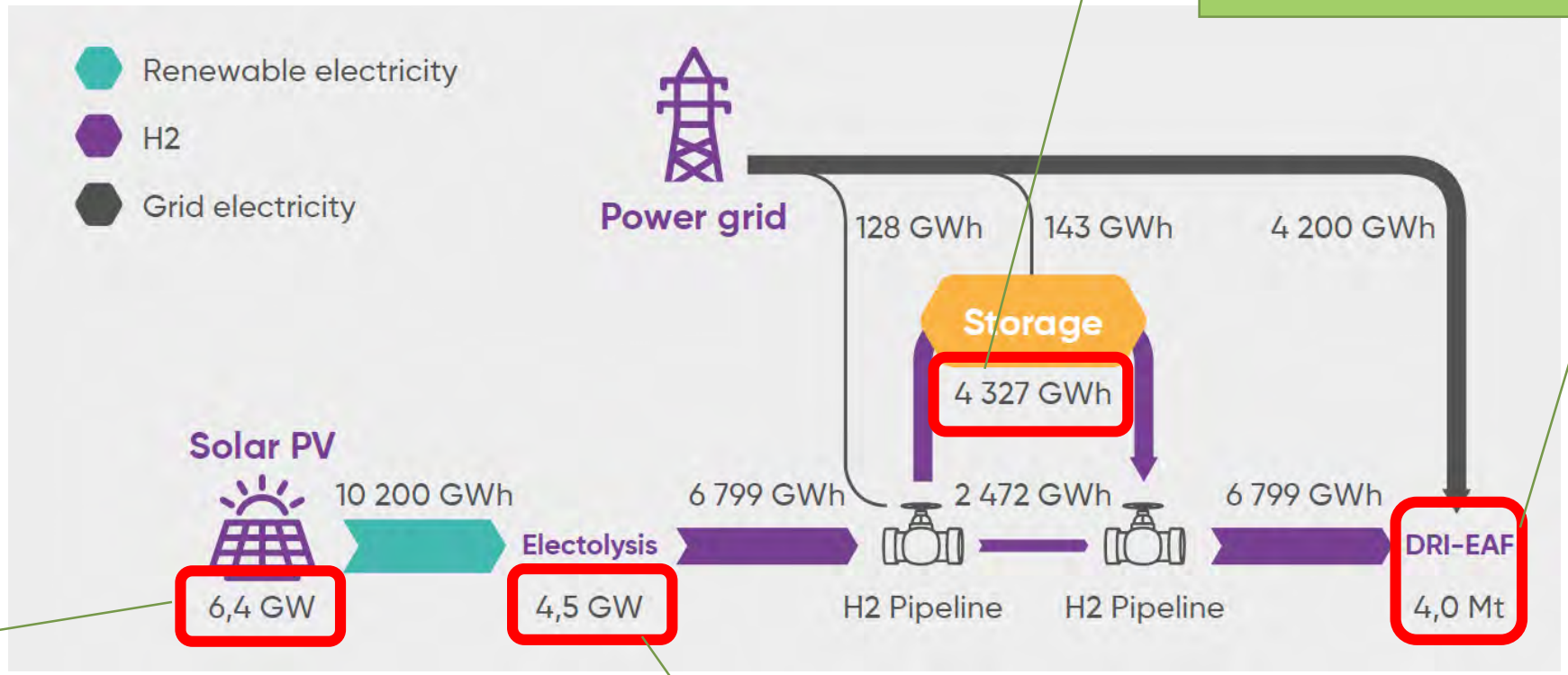
The key challenges



Hydrogen Europe

Challenge: Size

3 000 x more than the largest battery storage facility in the world



Average size of EU primary steel production plant

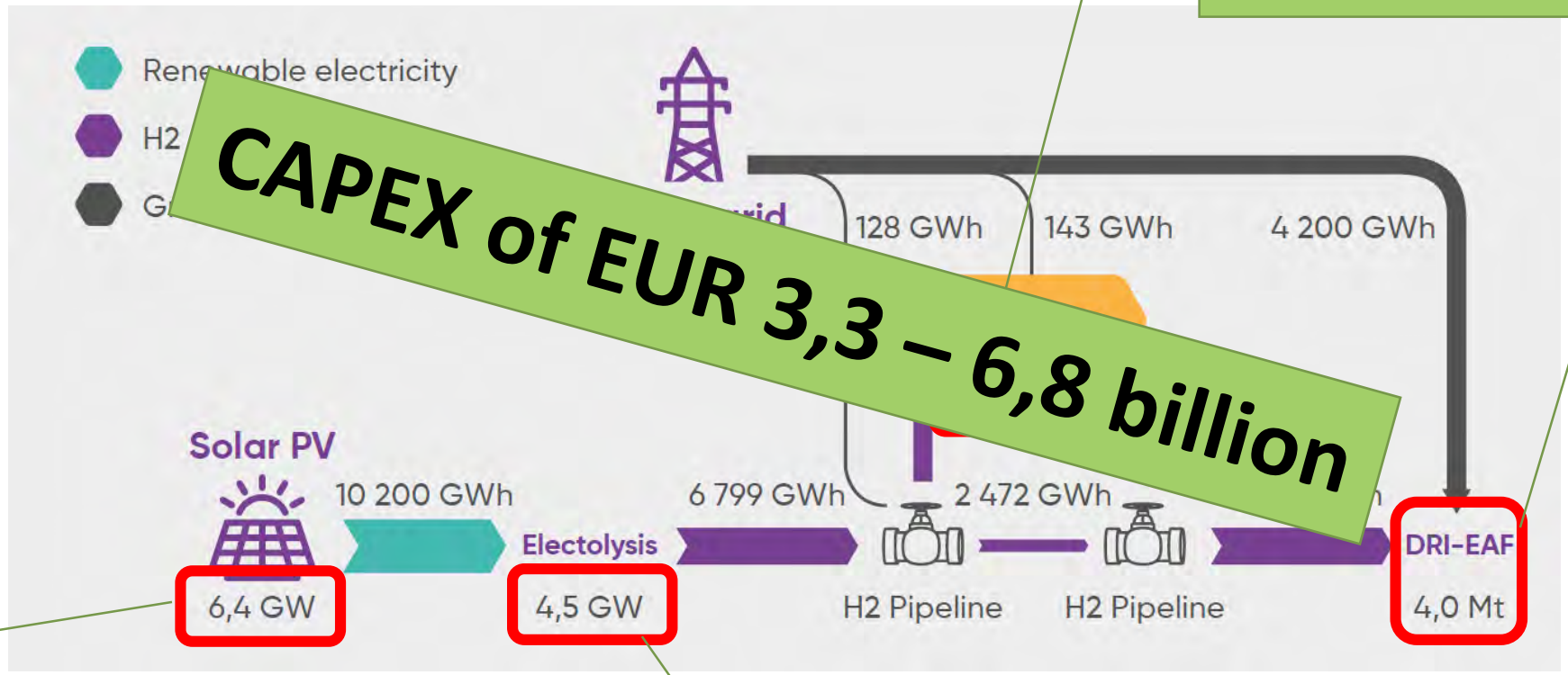
4 Mtpa of steel would require 200 ktpa of hydrogen → 10,2 TWh of Renewable electricity

Depending on capacity factor.
Solar PV only would require up to 5 GW
Grid connected running at full load would require „only" 1,3 GW

Hydrogen Europe

Challenge: Size

3 000 x more than the largest battery storage facility in the world



CAPEX of EUR 3,3 – 6,8 billion

Average size of EU primary steel production plant

4 Mtpa of steel would require 200 ktpa of hydrogen → 10,2 TWh of Renewable electricity

Depending on capacity factor.
Solar PV only would require up to 5 GW
Grid connected running at full load would require „only" 1,3 GW

Hydrogen Europe

Challenge: Steady supply of hydrogen

OPTION 1

Losses: 0 GWh

Losses: 3 401 GWh

OPTION 2

Losses: 0 GWh

Losses: 3 401 GWh

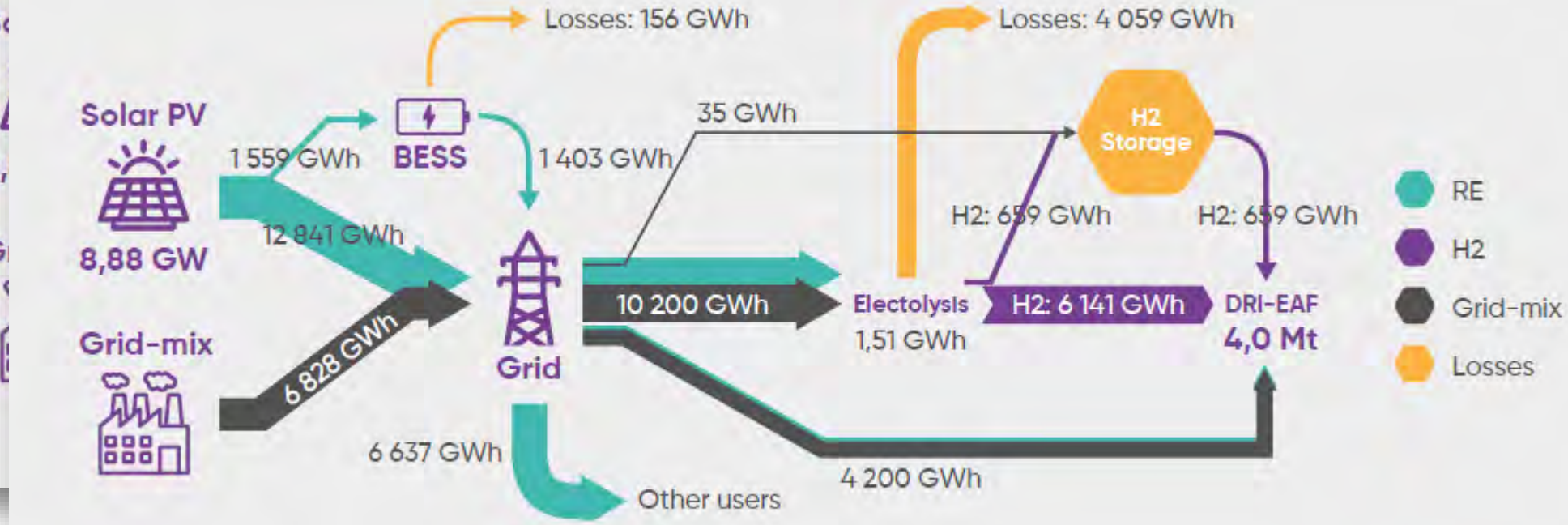
OPTION 3

OPTION 4

Losses: 0 GWh

Losses: 4 059 GWh

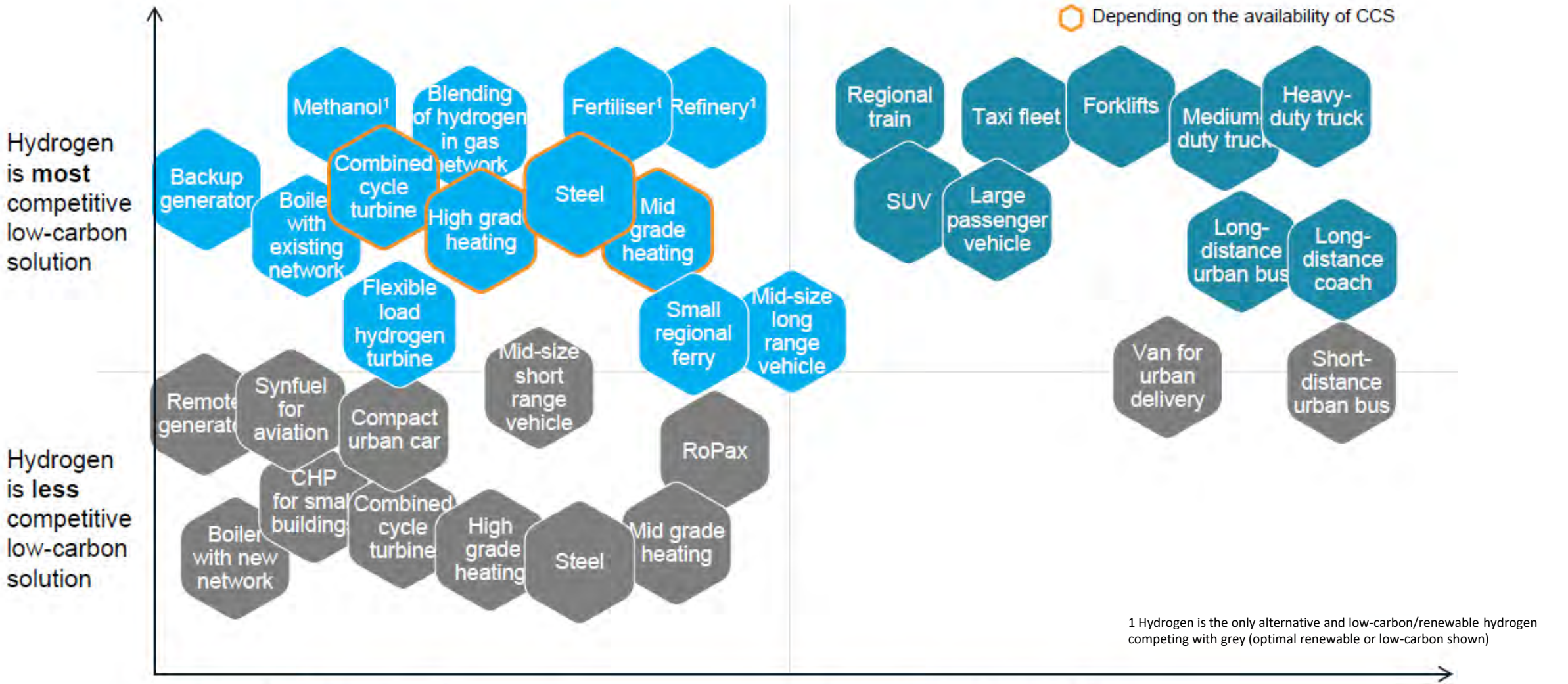
OPTION 5



- Switching all primary steel production in Europe to hydrogen-based DRI-EAF **could potentially save up to 196 Mt of GHG** emissions per year
- In order to do so would require up to **5,3 Mt of renewable hydrogen** and up to 370 TWh of additional renewable electricity generation (including EAF electricity consumption).
- With the current Renewable hydrogen production costs, for a typical ICE passenger car, the extra costs of green steel would translate to an **added cost of 100 – 170 EUR per vehicle.**
- Unwise regulations are potentially a bigger obstacle than costs and technology

Hydrogen Europe

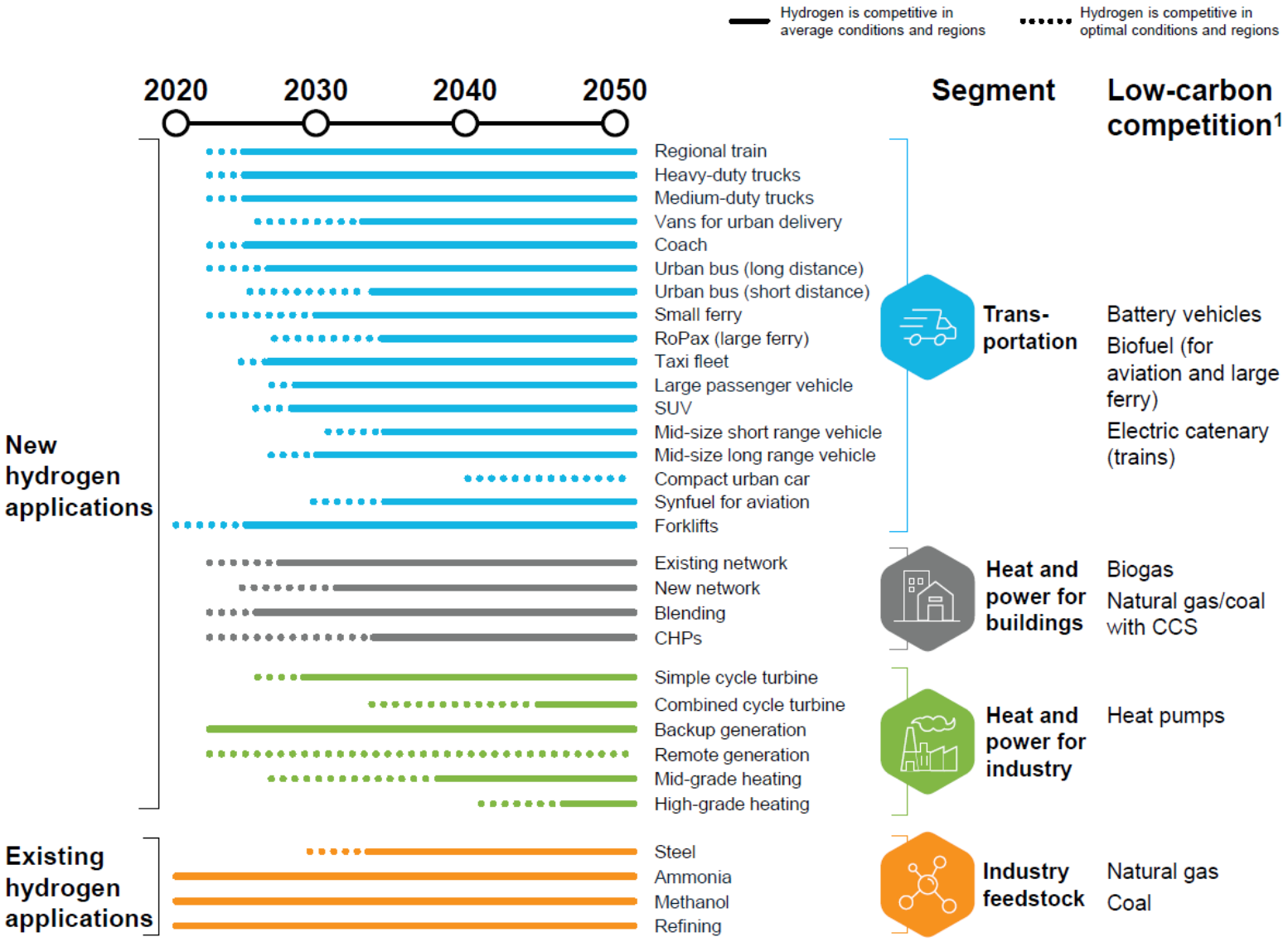
H_2 competitiveness vs low carbon and conventional alternatives



1 Hydrogen is the only alternative and low-carbon/renewable hydrogen competing with grey (optimal renewable or low-carbon shown)

Source: Hydrogen Council, Path to hydrogen competitiveness – A cost perspective

H_2 cost competitiveness trajectories



1. In some cases hydrogen may be the only realistic alternative, e.g. for long-range heavy-duty transport and industrial zones without access to CCS

Hydrogen Europe

Source: Hydrogen Council, Path to hydrogen competitiveness – A cost perspective

Thank you for your support!

Hydrogen Europe

Propelling global carbon neutrality by accelerating the European hydrogen industry.

Hydrogen Europe

Flagship Event

25-27 October 2022 • Brussels , Belgium

Web: h2flagship.eu

Email: t.marolt@hydrogeneurope.eu
events@h2flagship.eu

WHAT TO EXPECT?

3 day exhibition

3000+ visitors

Over 4000+ sqm+

3 day high level political conference

600+ conference attendees

2 networking opportunities

Show cases & demos

40 start ups

100 B2B meetings