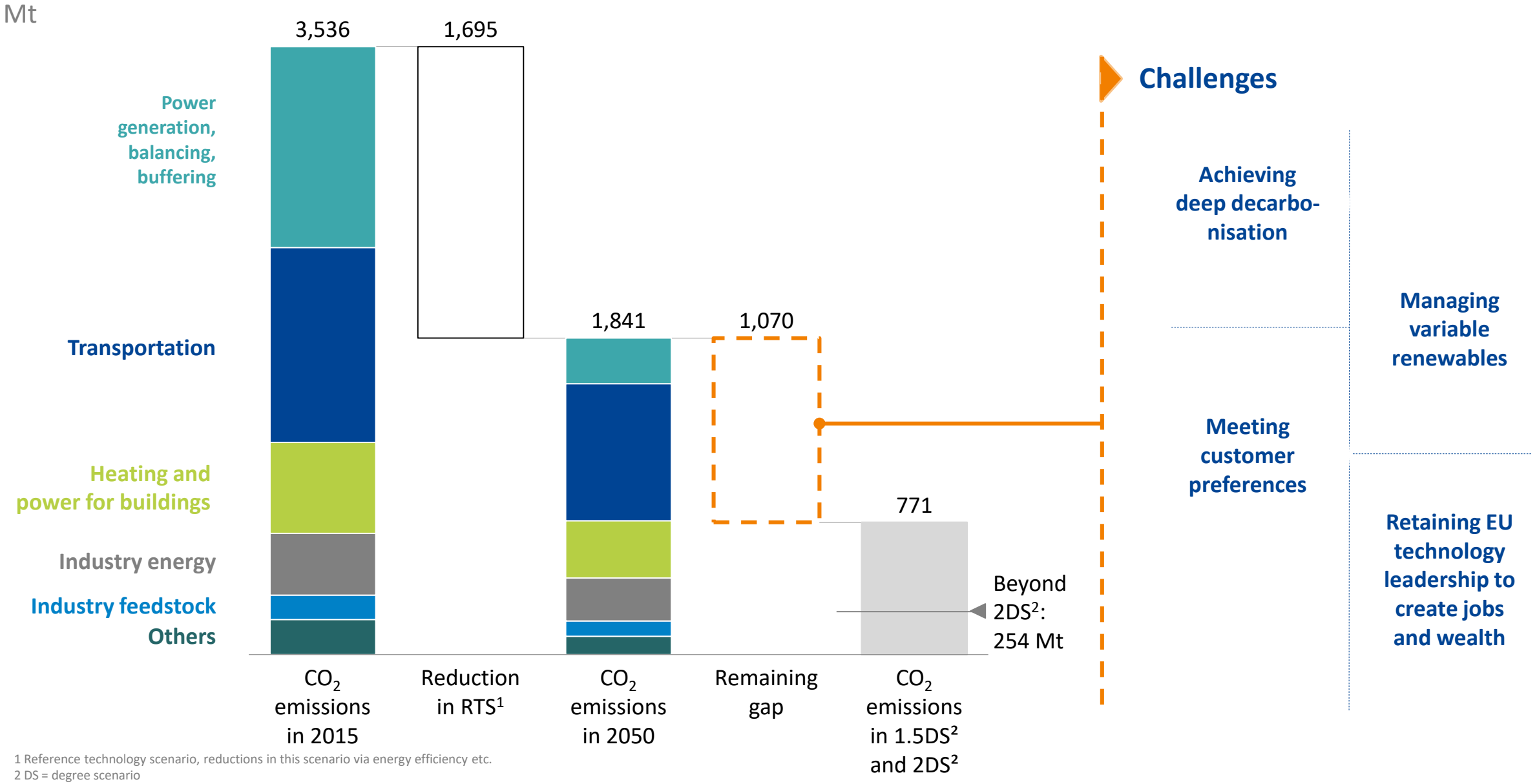
Hydrogen Europe

Hydrogen technologies for energy, climate and environmental policy objectives

The Problem



1 Reference technology scenario, reductions in this scenario via energy efficiency etc.
2 DS = degree scenario
SOURCE: IEA Energy Technology Perspectives 2017; Hydrogen Roadmap Europe team

Hydrogen is a key solution

Hydrogen Europe

Enable the renewable energy system → Decarbonize end uses

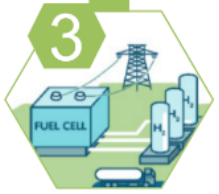
Enable **large-scale renewables integration** and **power generation**

1

Distribute energy across sectors and regions

2

3



Act as a **buffer** to increase system resilience

4

Help decarbonize **transportation**

5

Help decarbonize **industrial energy** use

6

Help decarbonize **building heat and power**

7

Serve as renewable **feedstock**

SOURCES: Hydrogen Council

Hydrogen Europe

Energy companies

Industrial companies

Hydrogen Europe RESEARCH

National Associations

Transport companies

Fuel Cell & Hydrogen Join Undertaking (FCH-JU)

Hydrogen Europe

Hydrogen Europe
Industry

Hydrogen Europe
Research

&

European Commission

FCH

FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING

ENERGY
- Hydrogen production and distribution
- Hydrogen storage for renewable energy integration
- Fuel cells for power & combined heat & power generation

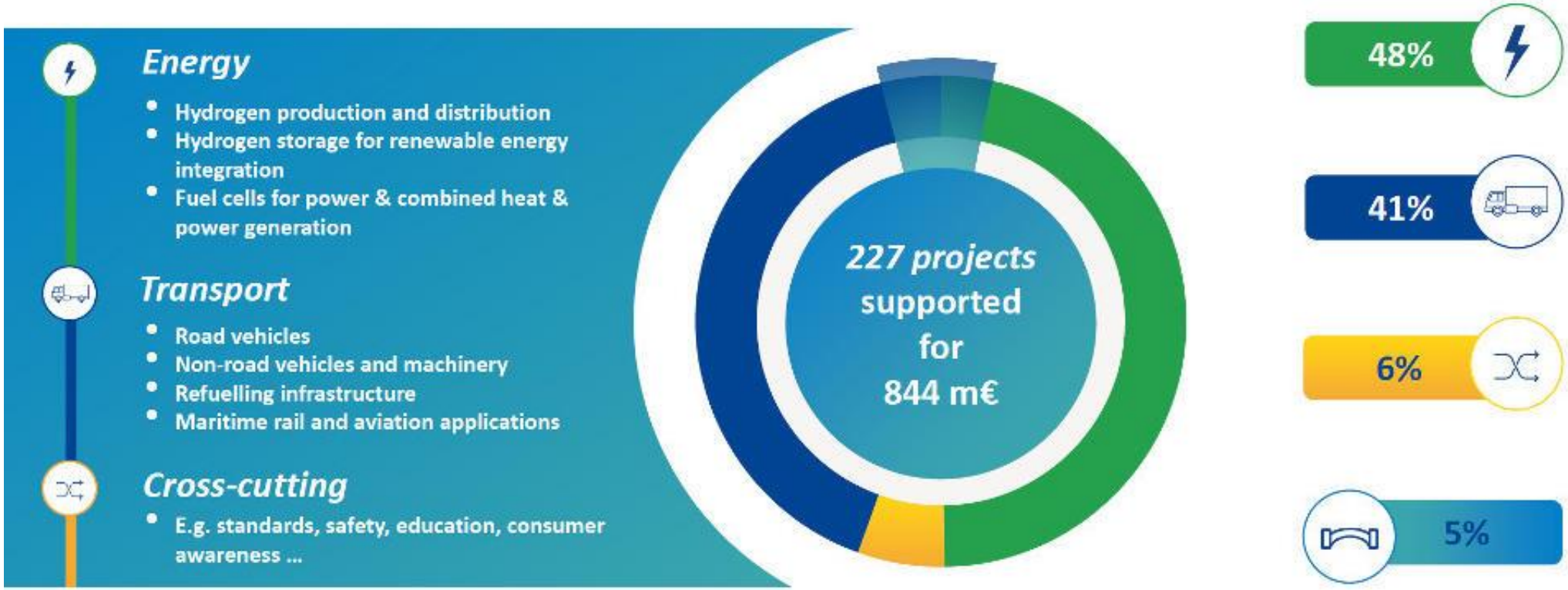
TRANSPORT
- Road vehicles
- Non-road vehicles and machinery
- Refuelling infrastructure
- Maritime, rail and aviation applications

CROSS-CUTTING
(e.g. standards, safety, education, consumer awareness, ...)

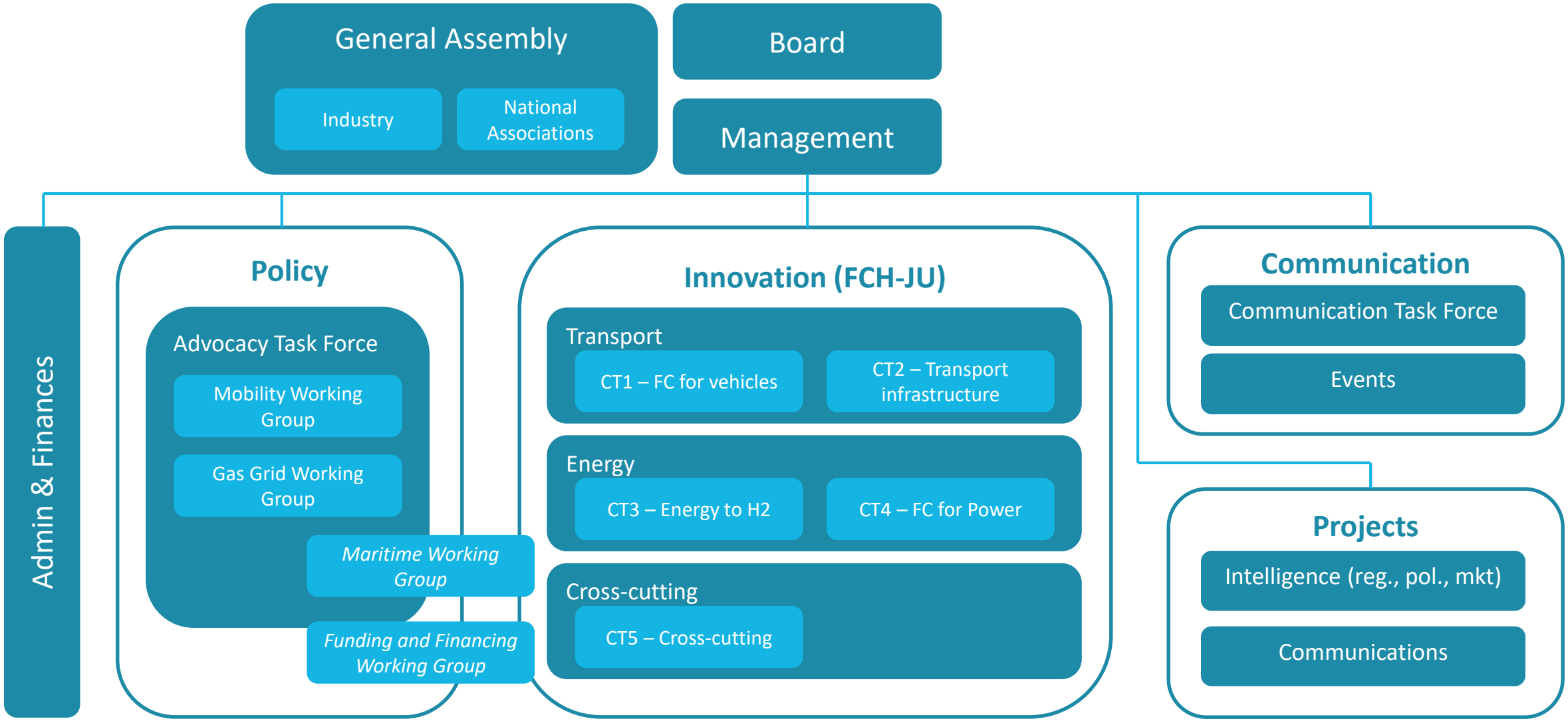
A portfolio of clean, efficient and competitive solutions based on fuel cells and hydrogen technologies **in energy and transport.**

Fuel Cell & Hydrogen Join Undertaking (FCH-JU)

Hydrogen Europe



Hydrogen Europe Structure/Activities



EU framework

Sector	Requirement	Legislative Tools	Financial Tools	Hydrogen's role
Transport	-CO_2 reduction -$PM/NO_X/SO_X$ reduction -Integration of RES	**1. Renewable Energy Directive (RED2)** 2. CO2 emission standards for LDVs/LCVs 3. CO2 emission standards for HDVs 4. Clean vehicle Directive 5. Alternative Fuel Infrastructure Directive	CEF transport/blending Enhanced use of Union funds, including additional funds - (Art 3.5 RED2)	-H2 as a fuel -H2 made fuels -Renewable hydrogen for refineries
Energy-intensive industries	Decarbonisation	EU ETS	Modernisation Fund / Innovation Fund	Renewable / low - carbon hydrogen as feedstock switch
Gas/ Heating	Decarbonisation (to remain a player) Integration of RES	**1. Renewable Energy Directive (RED2)** 2. Upcoming Gas Regulation (2020 - 2021)	Possibly CEF Energy Art 3.5 - RED2	Renewable / low - carbon hydrogen as feedstock Fuel cell as energy converter
Power	Storage / ancillary services Integration of RES	**1. Renewable Energy Directive (RED2)** 2. Electricity Market Design	Art 4.2 - RED2*	Rapid response electrolysers + Sectoral Integration

Which regulatory framework on CO2?

EC President-elect Ursula von der Leyen

"**I want Europe to become the first climate-neutral continent in the world by 2050.** To make this happen, we must take bold steps together. Our current goal of reducing our emissions by 40% by 2030 is not enough.

We must go further. We must strive for more. A two-step approach is needed to **reduce CO_2 emissions by 2030 by 50, if not 55%**.

To make this happen, I will put forward **a Green Deal for Europe** in my first 100 days in office. I will put forward the first ever **European Climate Law** which will set the 2050 target into law."

Opening Statement in the European Parliament Plenary Session by Ursula von der Leyen, Candidate for President of the European Commission, 16.07.2019, Strasbourg

Climate and Energy Obligations

	GREENHOUSE GAS EMISSIONS	RENEWABLE ENERGY	ENERGY EFFICIENCY	INTER-CONNECTION	CLIMATE IN EU-FUNDED PROGRAMMES	CO_2 FROM:
2020	-20%	20%	20%	10%	2014-2020 20%	
2030	≤ -40% -30% Non-ETS	≥ 32%	≥ 32.5%	15%	2021-2027 25%	CARS -37.5% Vans -31% Lorries -30%

Upwards revision clause by 2023

RED II Obligations are, collectively, **on all Member States***!

National contributions towards this target are set by MS, within **Integrated national energy and climate plans (NECPs)** in accordance with Regulation (EU) 2018/1999. (The Governance Regulation) and other acts (e.g. Effort Sharing Regulation)

EU Commission **assesses renewable energy share commitments** based on a formula laid down in Annex II of the Governance Regulation** – these represent the "expected" shares from MS

EU framework – Renewable Energy Directive

A. Minimum 32% renewables in gross final consumption of energy (Art 3 and 7)

- Calculated as:

((a) Electricity **produced** from renewable sources* +

(b) Renewable energy **produced** by district **heating and cooling** sector **+** Renewable energy **consumed** in industry, households, etc. […] for heating, cooling and processing

(c) Renewable energy (biofuels, biomass and RFNBO**) **consumed** by the **transport** sector

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Gross final consumption of energy from all energy sources

- GoO's shall have no role towards this target. (Art 19.)
- MS may agree on statistical transfers under the union renewable development platform ('URDP') (Art 8)
- Bio fuels, bioliquids and biomass fuels must fulfil sustainability and GHG saving criteria (Art 29)**

EU framework – Renewable Energy Directive

To help MS meet the 32% obligation, Hydrogen can:

(a) – enable higher renewable integration into the power grid as **grid balancing service**

(b) – increase the share of renewable gases in the **gas grid**.

(c) - help decarbonize industrial energy consumption

(d) - increase renewable integration in transport, directly **as a transport fuel** and/or **as intermediate feedstock** for conventional fuels.

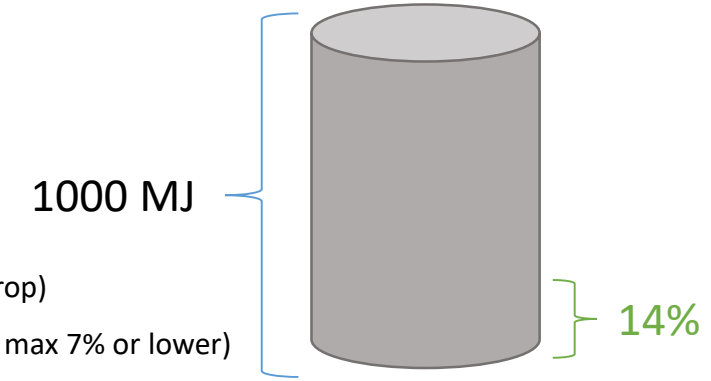
Renewable Energy Directive - Transport

Obligation on fuel suppliers* to integrate 14 % renewables in transport by 2030 (Art 25)

Renewable energy content of:

(RFNBO used as intermediate product in conventional fuels) x1
+ (advanced biofuels*) x2 (min 3.5%, max 7% from feed & crop)
+ (electricity supplied to road vehicles) x 4
+ (electricity supplied to rail) x 1.5
+ (fuels** supplied to aviation and maritime) x 1.2 (except feed and crop)
+ (all other fuels in all other transport sectors) x1*** (max 1% / year max 7% or lower)

Energy content […] all transport fuels supplied for the road and rail sectors



1,2 Kg of H2 as intermediate (if 100%)
OR
0,3 Kg of H2 as fuel for road vehicles (if 100%)
OR
2,6 kg of "advanced" ethanol*
OR
126 kwh of grid electricity in DE (39 kwh of renewable electricity)

Electricity can be supplied to road vehicles (i) directly (i.e. batteries) or (ii) through RFNBO (i.e) hydrogen. The 4x multiplier should apply to both direct charging and electrolytic hydrogen used as fuel!

In order to count towards these targets, sustainability and GHG emission criteria need to be met! –

- For biofuels: Art 29. for RFNBO: Art 25.2 and Art 30.1 – methodology to be developed by delegated Act by 31/12/2021

National Energy and Climate plans

Member States shall set national contributions to meet, collectively, the binding overall Union target […] as part of their **integrated national energy and climate plans (NECP)**. (c.f. Regulation 2018/1999)

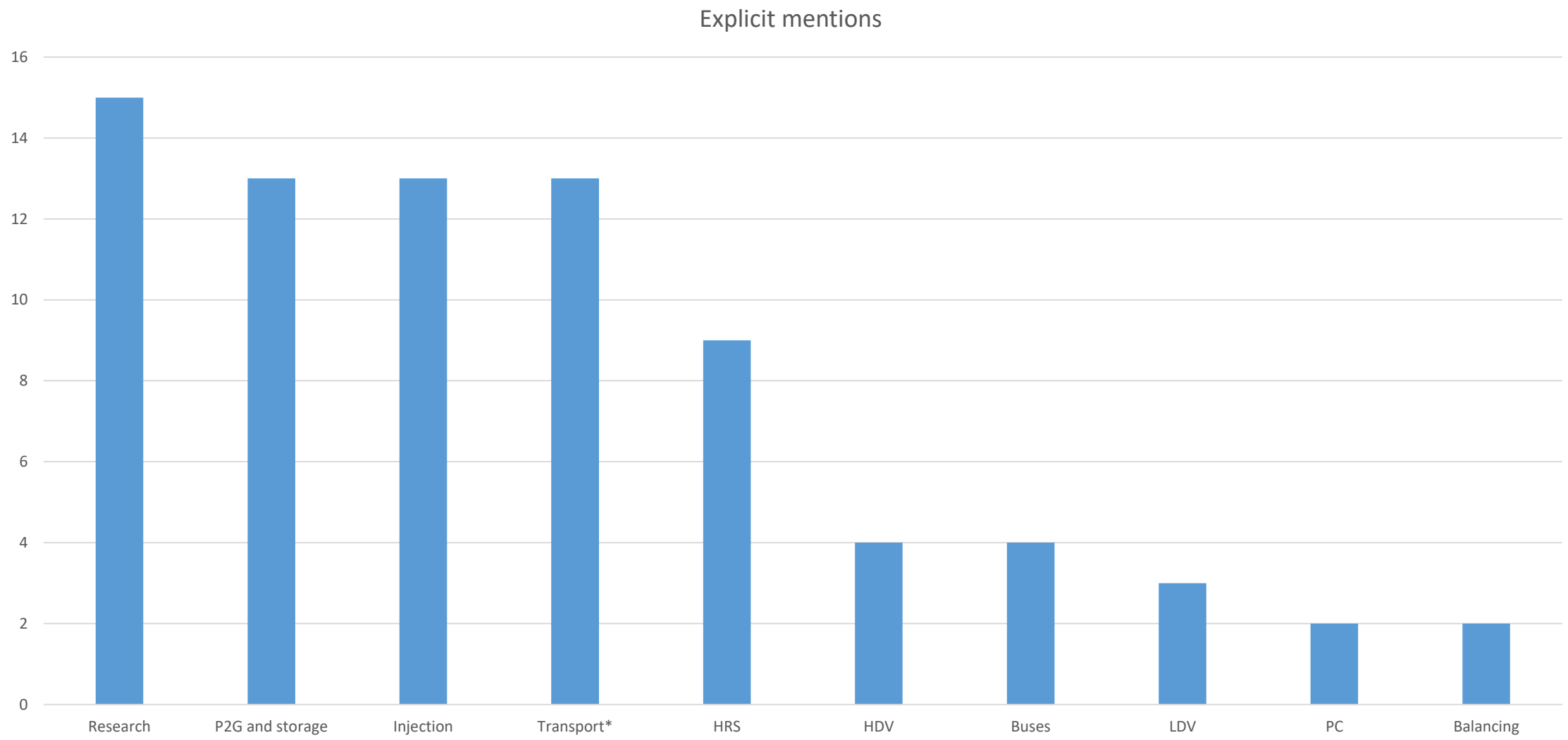
MS to submit draft NECP by 31 December 2018 and **final plans by 31 December 2019** to the European Commission

- **Drafts and Commission recommendations available at:**
  - https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union/national-energy-climate-plans

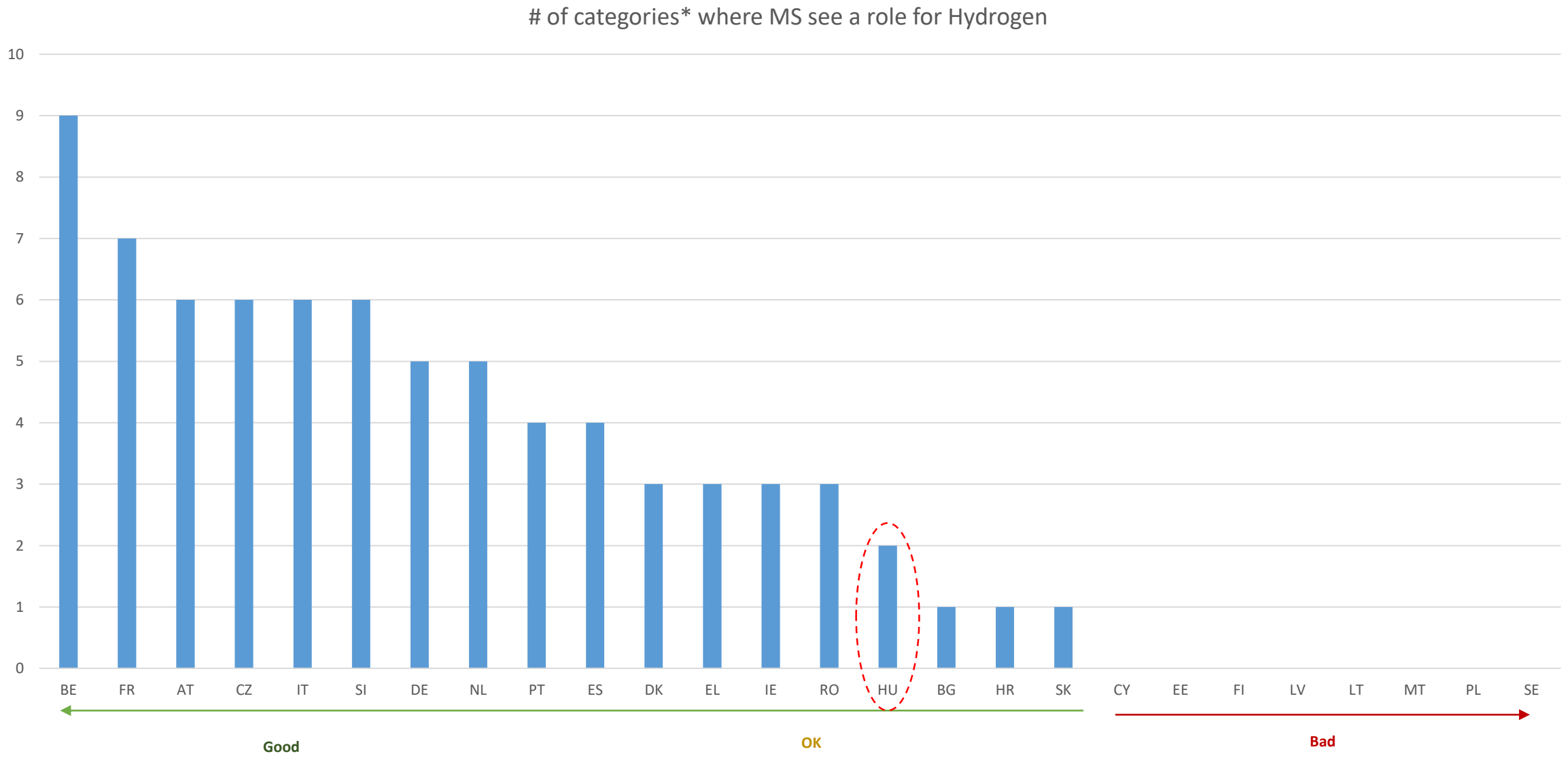
National Energy and Climate Plans

Do they mention Hydrogen?

National Climate and Energy Plans & Hydrogen



National Climate and Energy Plans & Hydrogen



National Energy and Climate Plans

What does the Commission think?

GHG Reduction - almost achieved

Under current plans: Overall GHG reduction by 40% vs 1990 to be achieved

28 % achievement (vs 30% target) reduction in non-ETS sectors by 2030

Recommendations from EU Commission:

- Transport to be put at the center of the NECPs (main source of GHG emission in non-ETS sectors)
  - **Set out emission reduction measures** in the transport sector
    - Combine quantified emission reduction objectives with planned measures
      - Member States **can encourage renewable Hydrogen** in production of conventional fuels
  - "*Measures to increase electromobility* ***not described in a very detailed manner***"
    - **Countries can consider the added benefit of FCEVs in Mobility,** especially towards decarbonizing captive fleets (taxies; vans), long-haul transport, buses and coaches and the waterborne sectors
  - ***"Planning and investing in alternative fuel infrastructure*** *not sufficiently detailed"*
    - **HRS development plans** can be placed in national NECPs
  - **Good practice** examples given by EC: AT; ES, IT, SI (quantified emission reduction + policies and measures).
    - All four explicitly reference H2 (with a clear role for H2 in transport)
    - Good practices in referencing FCEVs in transport from these countries can be "copied" by other MS

- **Industry not sufficiently addressed** in the draft NECPs
  - Reference made to state aid rules **(IPCEI)**

Hydrogen for energy-intensive industry

Nouryon, Tata Steel, and Port of Amsterdam partner to develop the largest green hydrogen cluster in Europe

Press release 18-10-2018

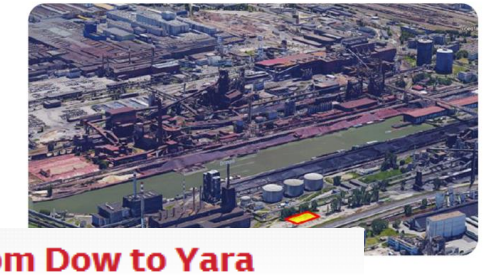
Nouryon (formerly AkzoNobel Specialty Chemicals), Tata Steel and the Port of Amsterdam have joined together to study the feasibility of a large green hydrogen cluster in the Amsterdam region. The three parties consider green hydrogen as vital for reaching climate targets and building a more circular economy, for example by combining it with emissions from steel manufacture to make new products.

REFHYNE
CLEAN REFINERY HYDROGEN FOR EUROPE

H2FUTURE Project: Green Hydrogen for Steel Industry

H2FUTURE
Green Hydrogen

- **6 MW Siemens PEM electrolyser system** at the voestalpine steel plant in Linz, Austria
- **Industrial integration of renewable hydrogen production** in the steelmaking process
- **26-month demonstration** of the electrolyser system, in particular
  - Prequalification for power reserve markets (primary, secondary and tertiary control)
  - Integration of the electrolyser system into the steelworks operation
  - Commercial operation on the power reserve and spot markets
  - Quasi-commercial operation with revenue streams from both hydrogen and power
- **Accompanying analysis** of different operation modes, impact in the steel and fertilizer industries



http://www.h2future-project.eu

Gasunie hydrogen pipeline from Dow to Yara brought into operation

Tuesday 27-11-2018

Terneuzen | press release

- **Transport of hydrogen between Dow Benelux and Yara has commenced**
- **First Gasunie transport pipeline modified for hydrogen transport**
- **Decrease in energy consumption: 0.15 PJ per year; comparable to annual gas consumption of 3,000 households. CO2 savings of 10,000 tons**

And many more…

GHG Reduction - almost achieved

- **Power sector**:
  - Focus on the **increased use of renewable electricity** and on the phase out of coal from electricity generation
    - **Hydrogen can support higher RES integration in the power sector**
  - Ambitious objectives and timelines to phase out coal for electricity generation.
    - France (2022).
    - Italy and Ireland (2025).
    - Denmark, Spain, Netherlands, Portugal and Finland (2030).
    - Germany (2038)
  - Measures to assist workers and families affected by coal phase out should also be addressed.
    - **Hydrogen economy creates jobs and new opportunities**

- **Other**
  - Climate adaptation goals (e.g. IE, LT, PL, SK, SI)

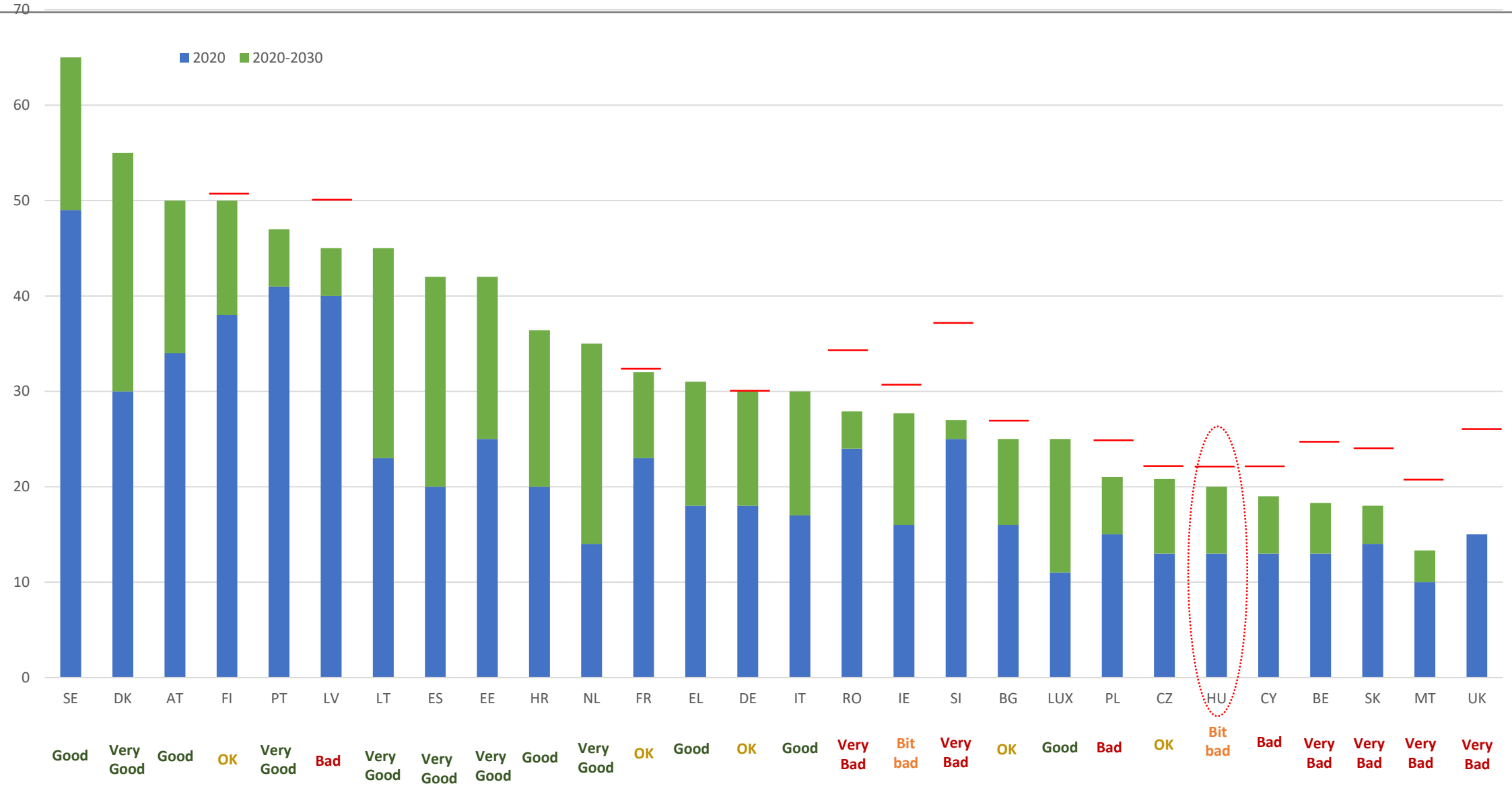
Gap analysis: (RES share not achieved)

RES integration in 2017: 17.5%

Under current plans: **Achievement is between 30.4% and 31.9% in 2030**; Highly dependent on achievement in a few (ambitious) countries:. (e.g. Sweden; Denmark, Estonia, Spain, Lithuania and Portugal)

If MS committing less than expected would put their ambition in line with the formula shares (Governance Regulation), the **EU level share will be 33%**

Renewable share – Commission not impressed



Gap analysis: RES Target – work to do

Recommendations by Commission:

- Emphasis on Heating and cooling (50% of energy consumption, but only 19.5% RES) – NECPs to show how RES in heating in cooling increased based on RED II obligations!
  - 13 countries* explicitly mention H2 in gas grids,
  - Countries could consider H2 in gas grids as means to decarbonise heating and cooling!

- More emphasis to be placed in NECPs on Transport to **explain how the 14% obligation on fuel suppliers will work** *"This will provide the industry with certainty about future market demand"*
- Good practice examples given by commission: CZ, IE, IT. (All 3 have strong emphasis on H2 in transport)
  - **Compliance with 14% obligation via renewable H2 in refineries results in 2,5 times more CO2 abatement than compliance via ethanol**
  - HE can provide MS with support in implementing the 14% obligation via H2

Gap analysis: Research and Innovation

Recommendations:

- Additional efforts to integrate research, innovation and competitiveness into NECPs required
  - 16 countries* explicitly mention H2 in research
  - MS should explicitly mention continued research in H2 technology, especially for scale-up and demonstration
  - NECPs should acknowledge and show support for a continued EU partnership on hydrogen (e.g. FCH JU 3)

- *"NECPs should consider how planned national public investments can support market uptake of available technologies and large-scale deployment of new breakthrough technologies and their integration into the energy system."* **This sentence is tailored for hydrogen!**

- "*The contribution of the national innovation/industrial ecosystems to building European strategic sustainable value chains (e.g. batteries, hydrogen, […]) should also be developed.*" – Hydrogen explicitly mentioned by the EC

- *"European research should focus on transformational carbon-neutral solutions in areas such as energy and transport,* ***hydrogen and fuel cells****, energy storage, carbon-neutral transformation of energy intensive industries,* […]*"* - Hydrogen explicitly mentioned by the EC

National Energy and Climate Plans

Formal Recommendations issued by the Commission to individual Member states

(National Recommendations)

National level Recommendations

Step up efforts in heating and cooling (more information)

Belgium
Bulgaria
Croatia
Czechia
(Estonia)
Hungary
(Ireland)
Italy
(Latvia)
Malta
(NL)
Poland
Portugal
Romania
Slovakia
Slovenia

***"Member States to assess the need to extend existing gas network infrastructure to facilitate the integration of gas from renewable sources."* (Art 20.1)**

- The role of low-carbon hydrogen in decarbonizing the gas grid should be recognized in revised NECP's
- Ensure a remuneration mechanisms for renewable hydrogen
- Support the EU efforts to harmonize fragmented regulation to inject hydrogen into the natural gas network
- Consider fair measures to facilitate the connection of gas from renewable sources to existing grids

The European Gas Grid – cheap transport of H_2

SOURCES: ENTSO-G

Hydrogen Roadmap for Europe

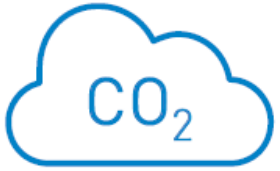
Hydrogen Europe

BESIDES CO_2 ABATEMENT, DEPLOYMENT OF THE HYDROGEN ROADMAP ALSO CUTS LOCAL EMISSIONS, CREATES NEW MARKETS AND SECURES SUSTAINABLE EMPLOYMENT IN EUROPE

2050 hydrogen vision

~24%

of final energy demand[1]



~560 Mt

annual CO_2 abatement[2]

~EUR 820bn

annual revenue (hydrogen and equipment)

~15%

reduction of local emissions (NO_x) relative to road transport

~5.4m

jobs (hydrogen, equipment, supplier industries)[3]

Hydrogen Europe

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