Opportunities from the inclusion of Hydrogen in NECPs

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PROJECT OBJECTIVE and SCOPE

Objective:

Based on **information in NECPs and other sources**, identify and **evaluate national opportunities for hydrogen deployment** and perform **analysis for 2 hydrogen deployment scenarios**.

Scope:

- EU27 (+ UK), with Member State focus
- Up to 2030
- Renewable & low-carbon (= clean) hydrogen

Study team:

Trinomics

ludwig bölkow systemtechnik

Client:

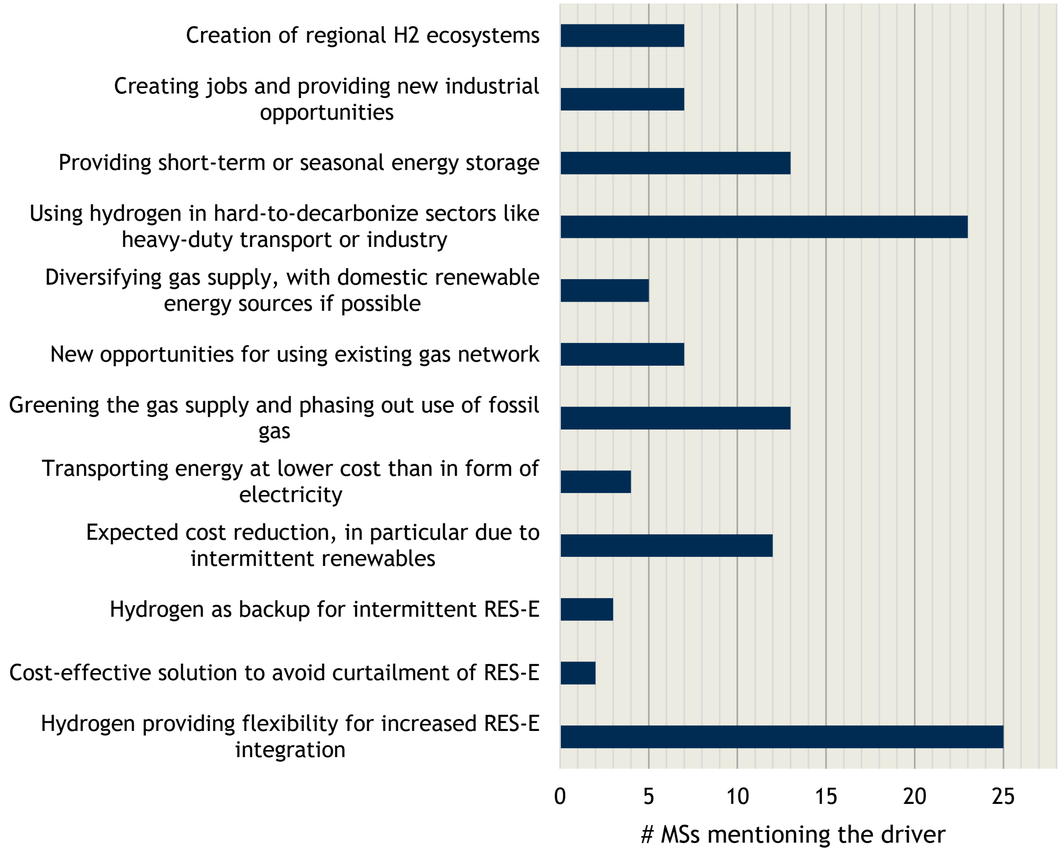
FCH FUEL CELLS AND HYDROGEN JOINT UNDERTAKING

1. Hydrogen in NECPs (1/2)

Hydrogen is explicitly addressed in most NECPs

- Nearly all NECPs explicitly refer to hydrogen, but effective coverage is quite different
- MSs consider hydrogen as medium or long-term option, and focus in NECP on preparatory actions
- Main drivers/benefits mentioned in NECPs: facilitate increasing penetration of intermittent RES-E - reduce GHG emissions by substituting fossil fuel

Main drivers/benefits referred to in NECPs



1. Hydrogen in NECPs (2/2)

Main end-user sectors targeted in NECPs

Transport

Transport is considered in the NECP as **first market segment to deploy hydrogen:**

- Several NECPs mention 2030 targets or estimates for H_2 fuelled vehicles and/or refuelling stations (BE, CZ, FR)
- Other MSs include absolute targets for renewable energy and/or H_2 in transport (BG, HR, PT, SI)
- Or targets for the share of H_2/renewable energy in total transport fuel consumption (BE, DE, HU, IT, SK)
- Or explicitly refer to use of H_2 in heavy-duty transport (IT, DK)

Industry

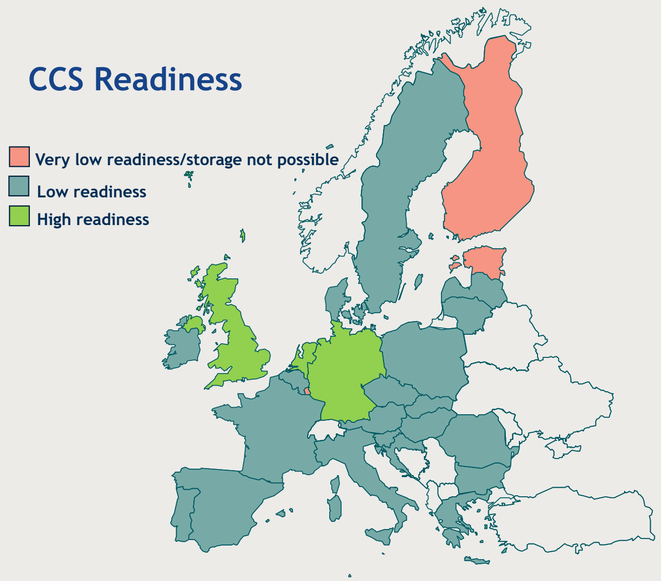
Several MSs mention that clean hydrogen is expected to gradually **replace conventional hydrogen or natural gas as feedstock or for high temperature processes**, mainly in oil refining, steel, ammonia, fertilisers and pharmaceutical sectors.

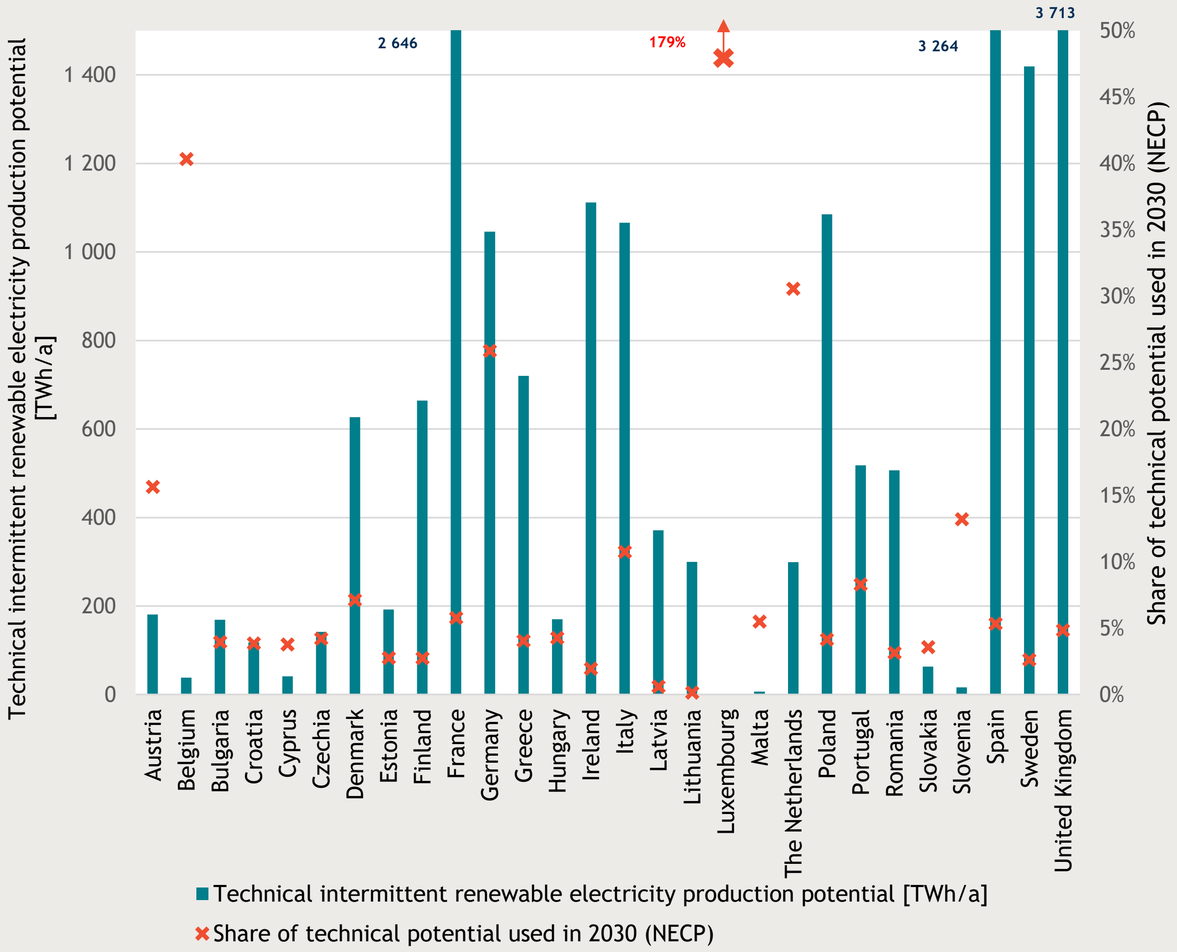
- Iron and steel sector is strong focus for clean H_2 (e.g. AT, DE, FI, SE)
- France mentions objective to switch 20 to 40% of conventional to clean H_2 in industry by 2028.

2. Opportunities for hydrogen deployment (1/4)

Hydrogen production potential and its role in energy system flexibility

- Planned RES-E capacity in 2030 represents small fraction of technical RES-E potential => technically feasible to build additional RES-E capacity for conversion into hydrogen
- Increasing flexibility needs are opportunity in most MSs
- Potential for low-carbon hydrogen production is low: limited progress in CSS technologies and lack of CO_2 transport and storage facilities in most MSs



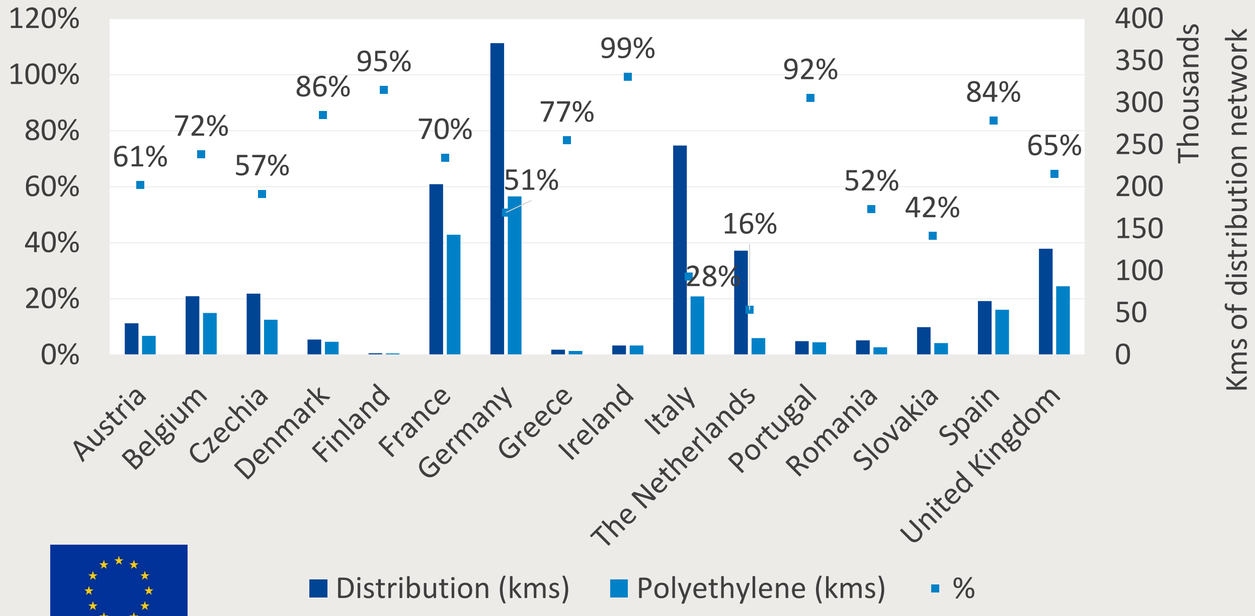


2. Opportunities for hydrogen deployment (2/4)

Potential for hydrogen transport and storage by using existing methane infrastructure

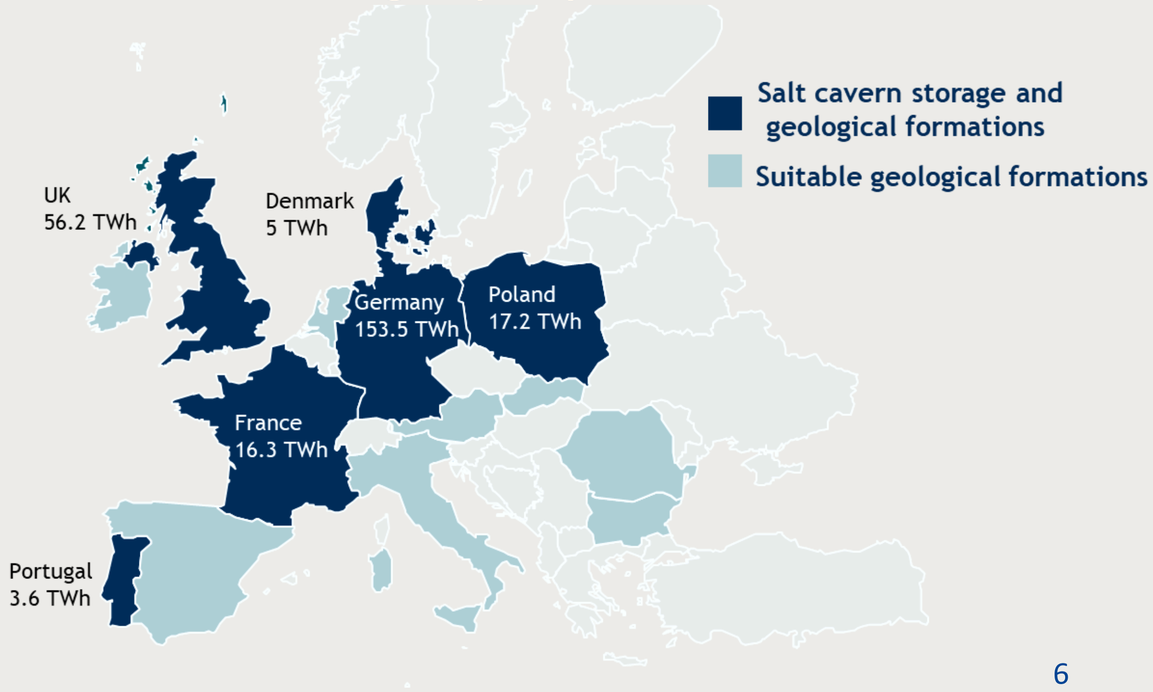
- Most MSs can use **existing methane infrastructure** as basis for H_2 transport and distribution
  - 6 MSs are effectively considering H_2 admixture into methane network
  - Gas TSOs (e.g. DE, HU, NL) have announced plans to use existing pipelines for H_2 transport

Share of polyethylene pipelines in distribution system



- 6 MSs have **salt cavern natural gas storage sites** that could be used for H_2 storage.
- 8 MSs have **underground salt layers** that provide further H_2 storage opportunities

Salt cavern storage capacity



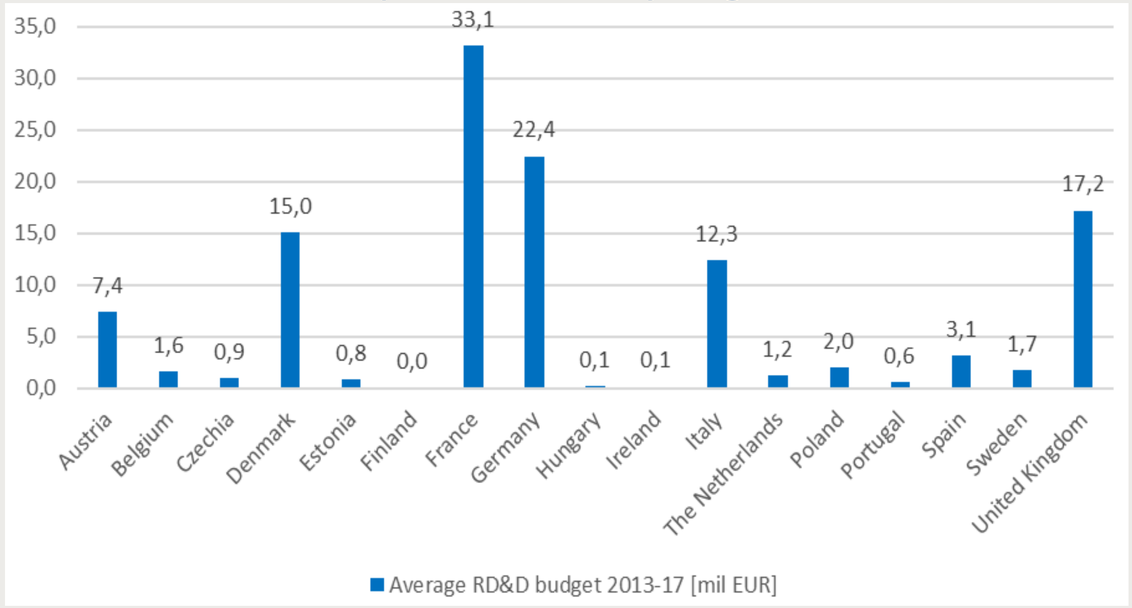
2. Opportunities for hydrogen deployment (3/4)

Enabling political and industrial environment for hydrogen development

MSs have implemented **several instruments** to address potential and challenges of hydrogen :

- National hydrogen association or working group
- National hydrogen roadmaps and strategies
- Integrating hydrogen in other policies (e.g. industrial policy)
- Sector specific hydrogen strategies
- Hydrogen RD&I programmes
- Industrial initiatives/projects, etc.

National RD&I expenditure on hydrogen & fuel cells



Strategies and roadmaps related to hydrogen development

Source: IEA RD&D budget expenditures database. www.iea.org/statistics/rdd

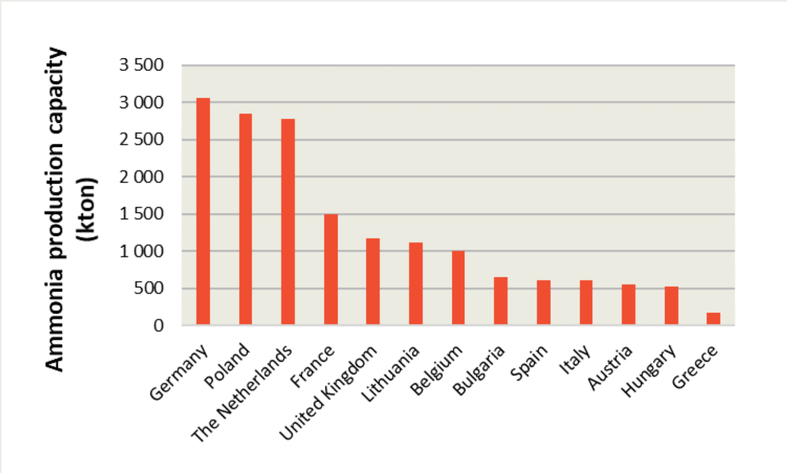
2. Opportunities for hydrogen deployment (4/4)

Current and potential hydrogen demand (1/2)

Industry

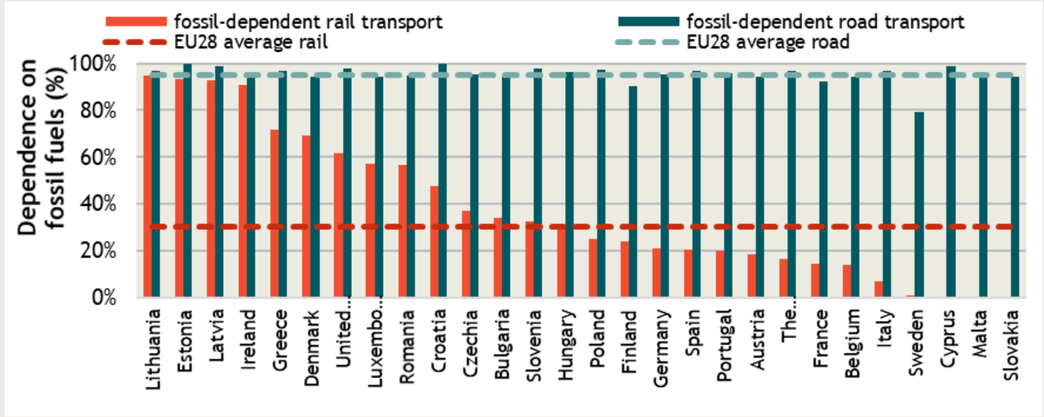
- Opportunities for renewable or low-carbon H_2 in industry affected by :
  - Level of existing conventional hydrogen use;
  - Share of natural gas in industrial energy mix;
  - Demand for high-temperature process heat.

- Decarbonising existing use of conventional hydrogen and natural gas
  - H_2 use in ammonia production, refining, and methanol production represents 91% of current H_2 demand;
  - Natural gas represents 32% of industry's fuel mix;
  - 63% of energy use in industry relates to generation of high-temperature process heat.



Transport

- Transport sector is heavily dependent on fossil fuels;
- H_2 has role in decarbonising heavy duty road transport, diesel trains, shipping and aviation



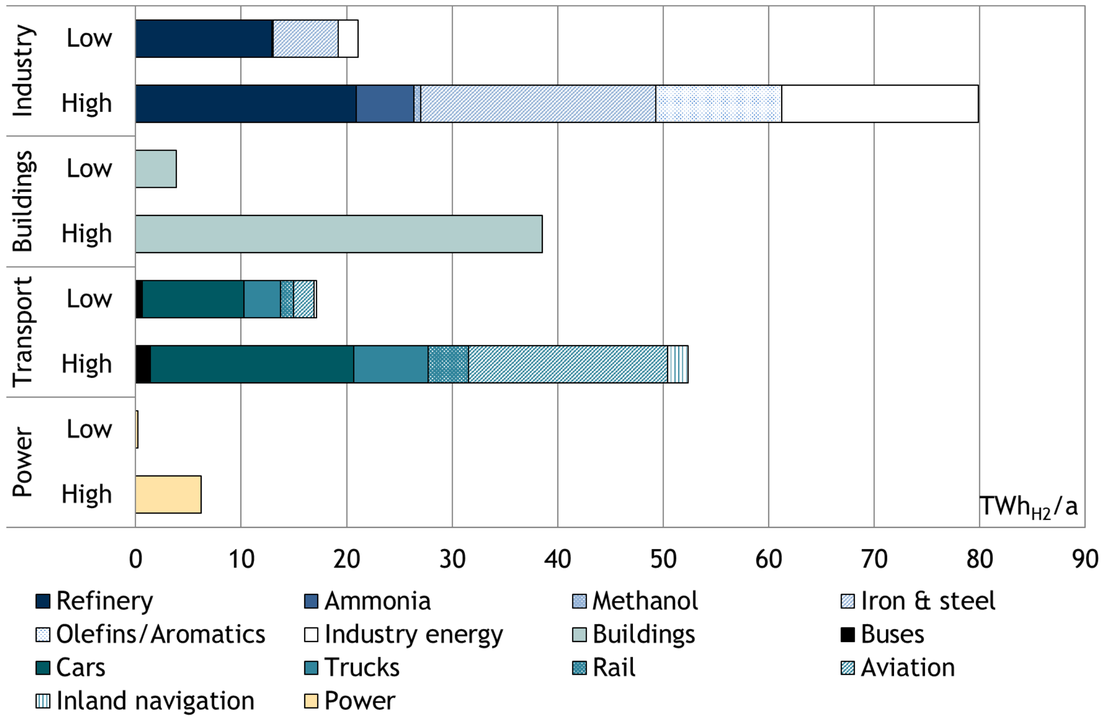
Buildings

- Heating of buildings relies on fossil fuels to large extent;
- Renewable and low-carbon H_2 can play role in decarbonisation of neighbourhoods connected to natural gas or heating networks.

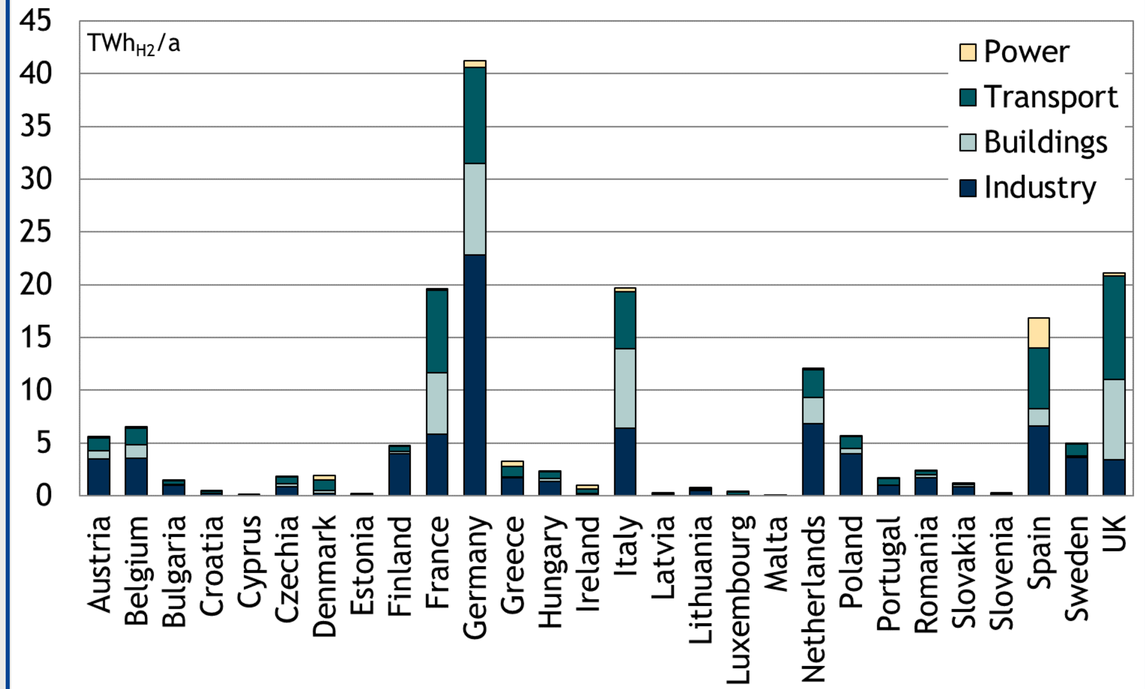
3. Estimated impact of hydrogen deployment (1/5)

Demand for hydrogen in EU-28 by 2030: 40-180 TWh_{H2}/a mainly in industry and transport

Renewable H_2 per sector in EU-28



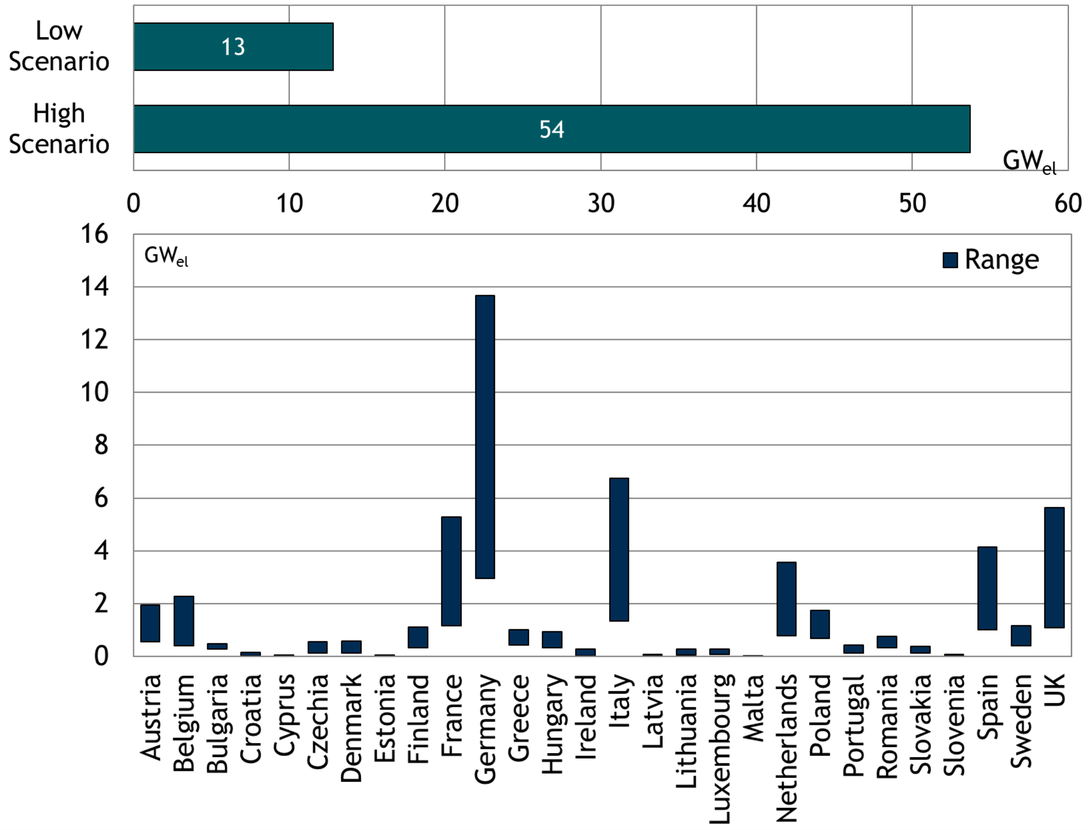
Renewable H_2 per MS (high scenario)



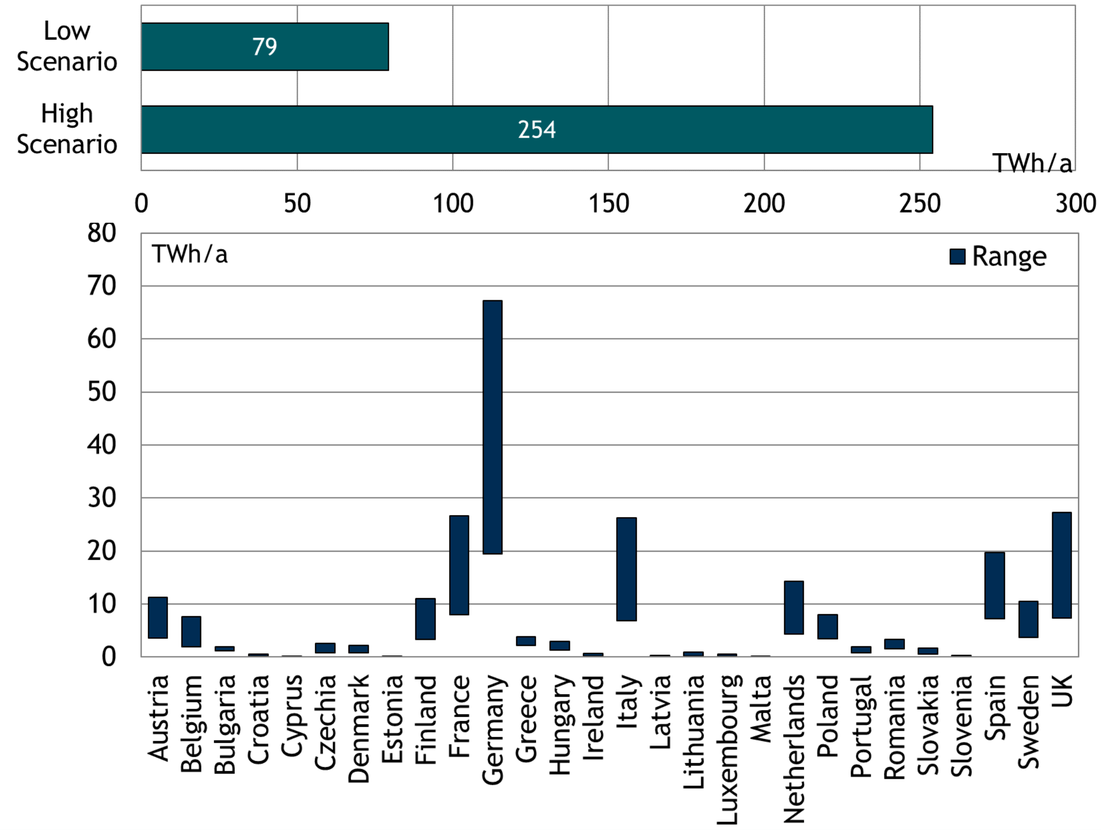
3. Estimated impact of hydrogen deployment (2/5)

Electrolysis capacity 13-54 GW_{el} with average utilisation of 4 800 full load hours
Avoided fossil fuel imports by 2030: 80-250 TWh/a improving security of energy supply

Electrolysis capacity in EU-28 and per MS



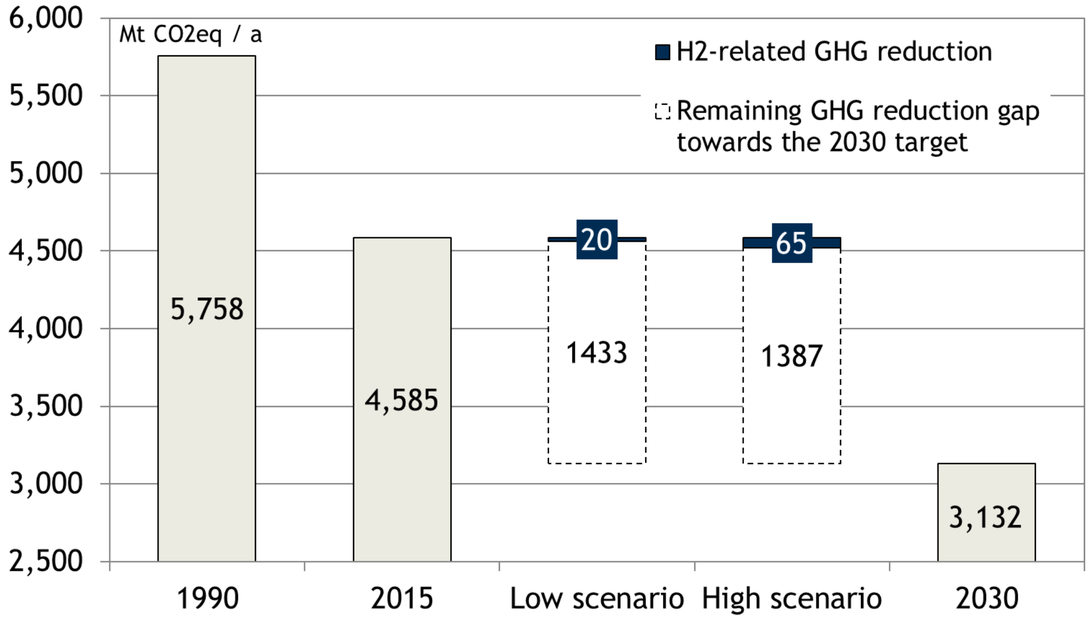
Avoided fossil fuel imports EU-28 / per MS



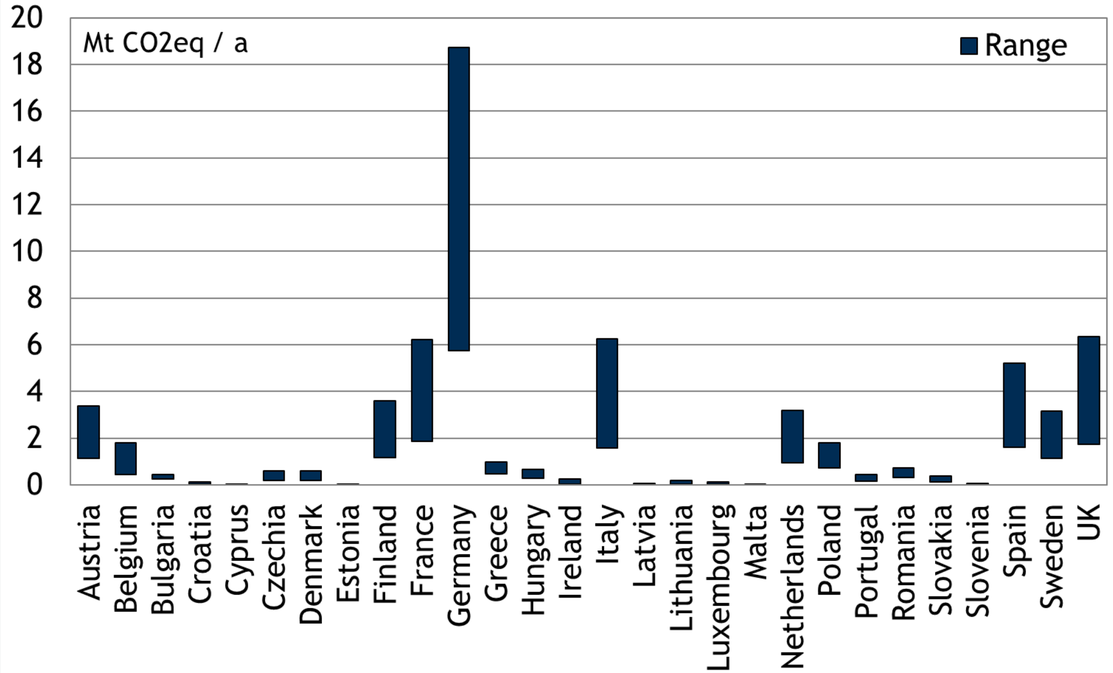
3. Estimated impact of hydrogen deployment (3/5)

20-65 Mt_{CO2}/a GHG emission reduction at EU-28 level

H_2-related GHG emission reduction in EU-28



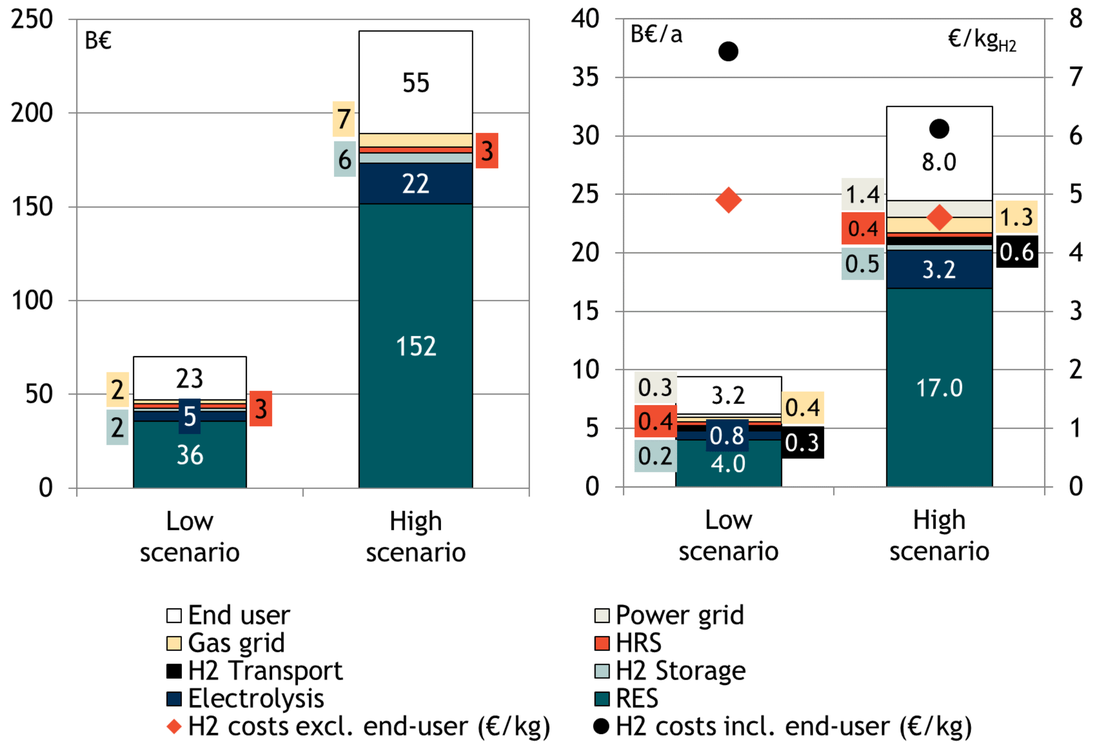
H_2-related GHG emission reduction per MS



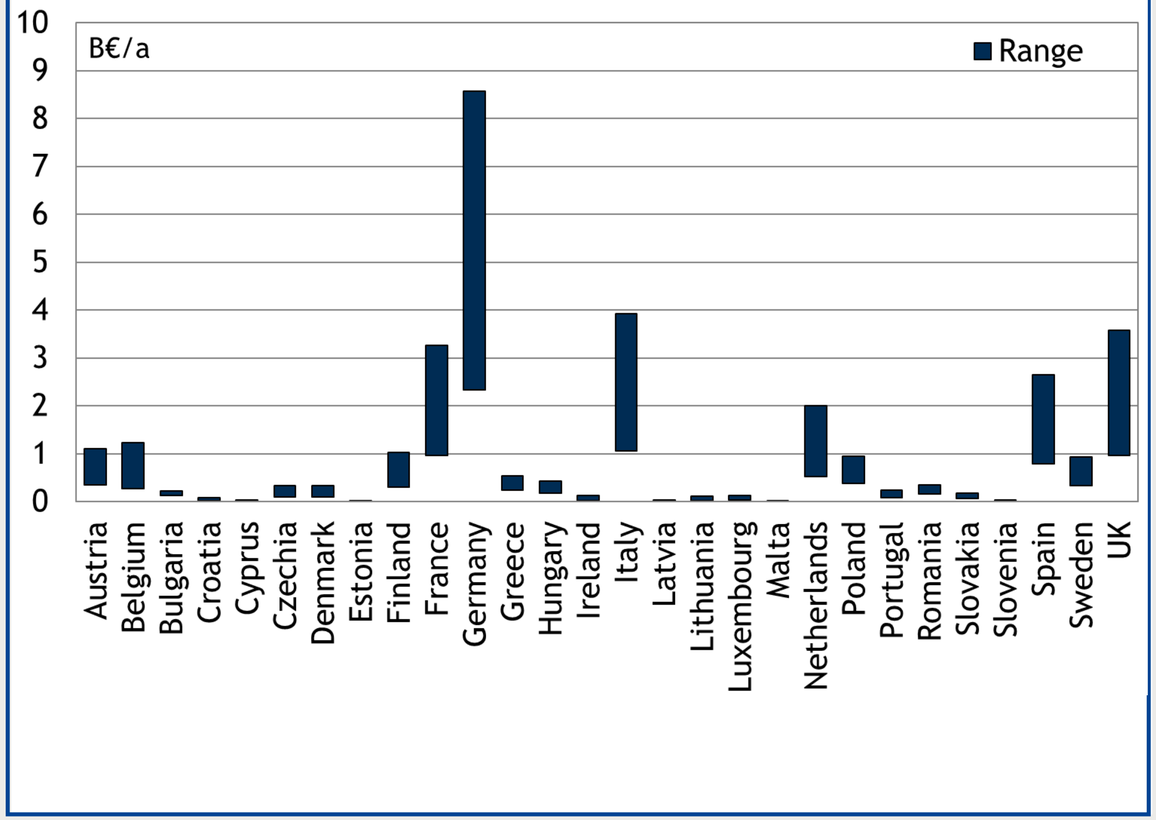
3. Estimated impact of hydrogen deployment (4/5)

Annual costs of 9-33 billion EUR/a including end-user related technologies

Cumulative investments and annual costs in EU-28



Gross annual costs per MS

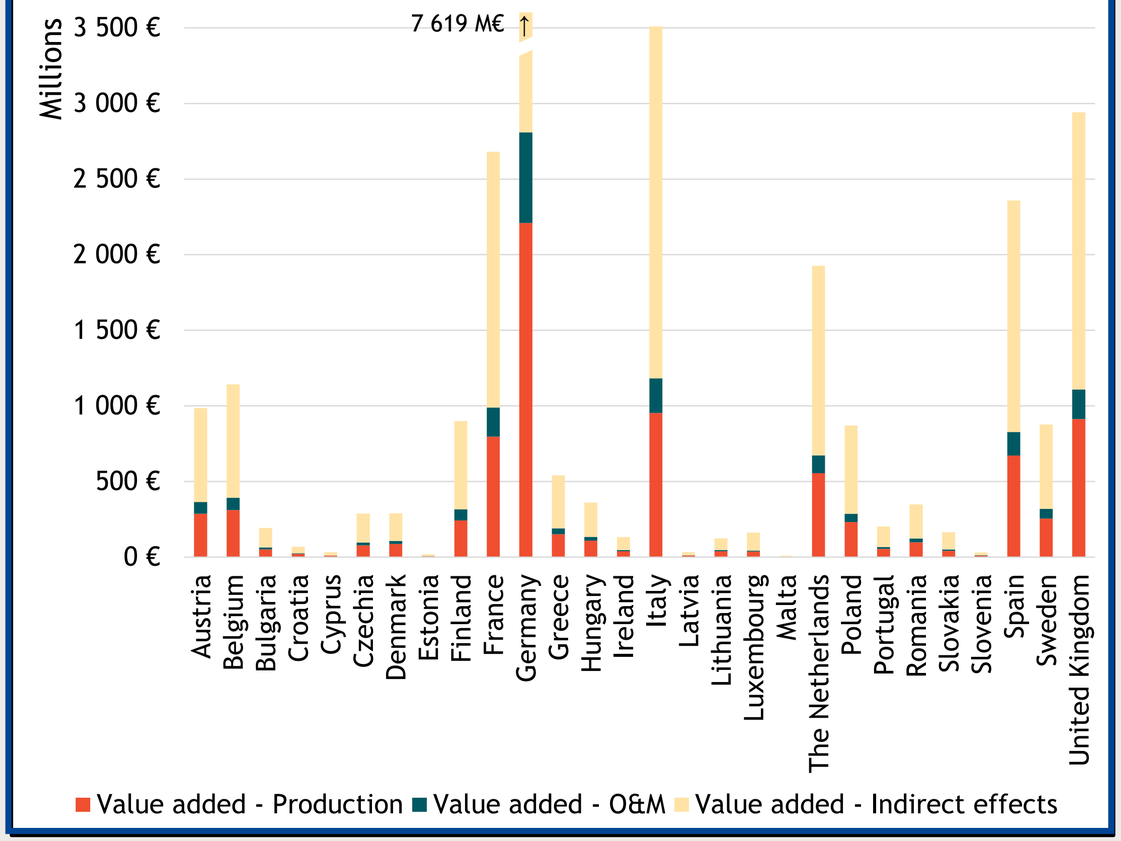


Note: Annual costs include CAPEX & OPEX

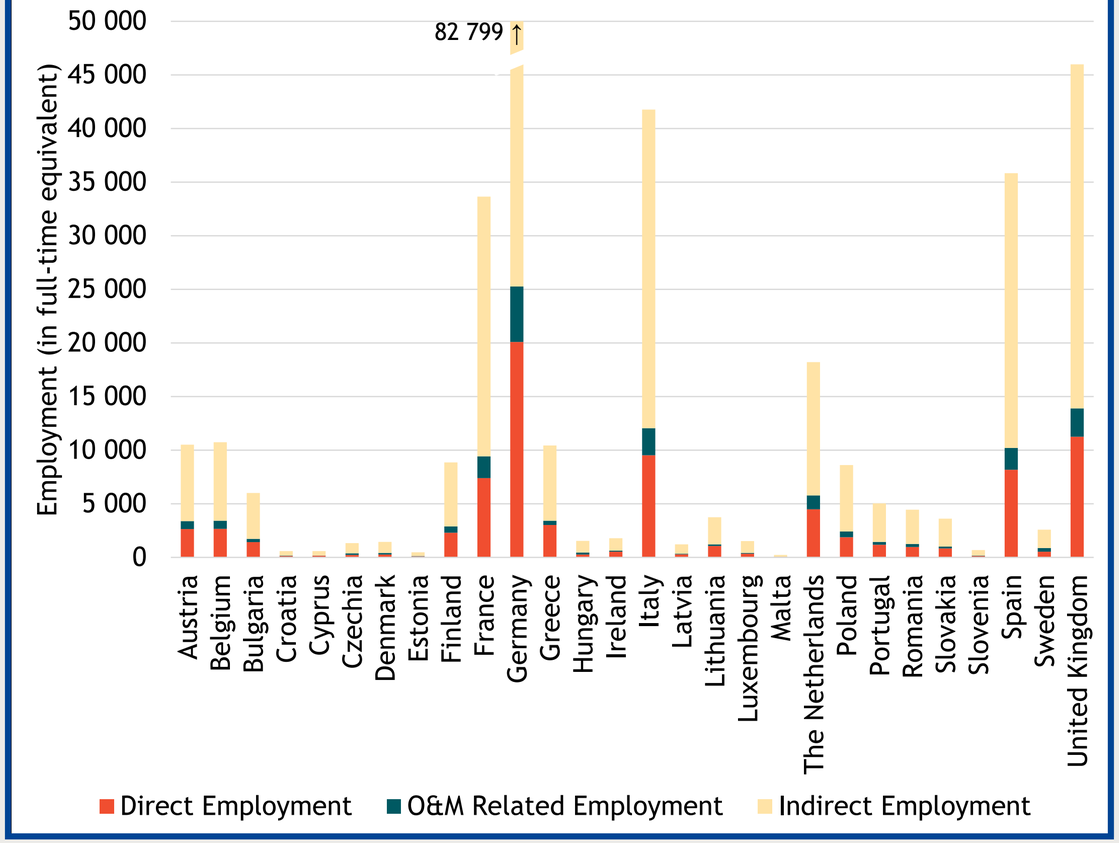
3. Estimated impact of hydrogen deployment (5/5)

High Scenario would at EU-28 level generate annually 29 billion EUR of Value Added and create 103 100 direct + 241 150 indirect jobs

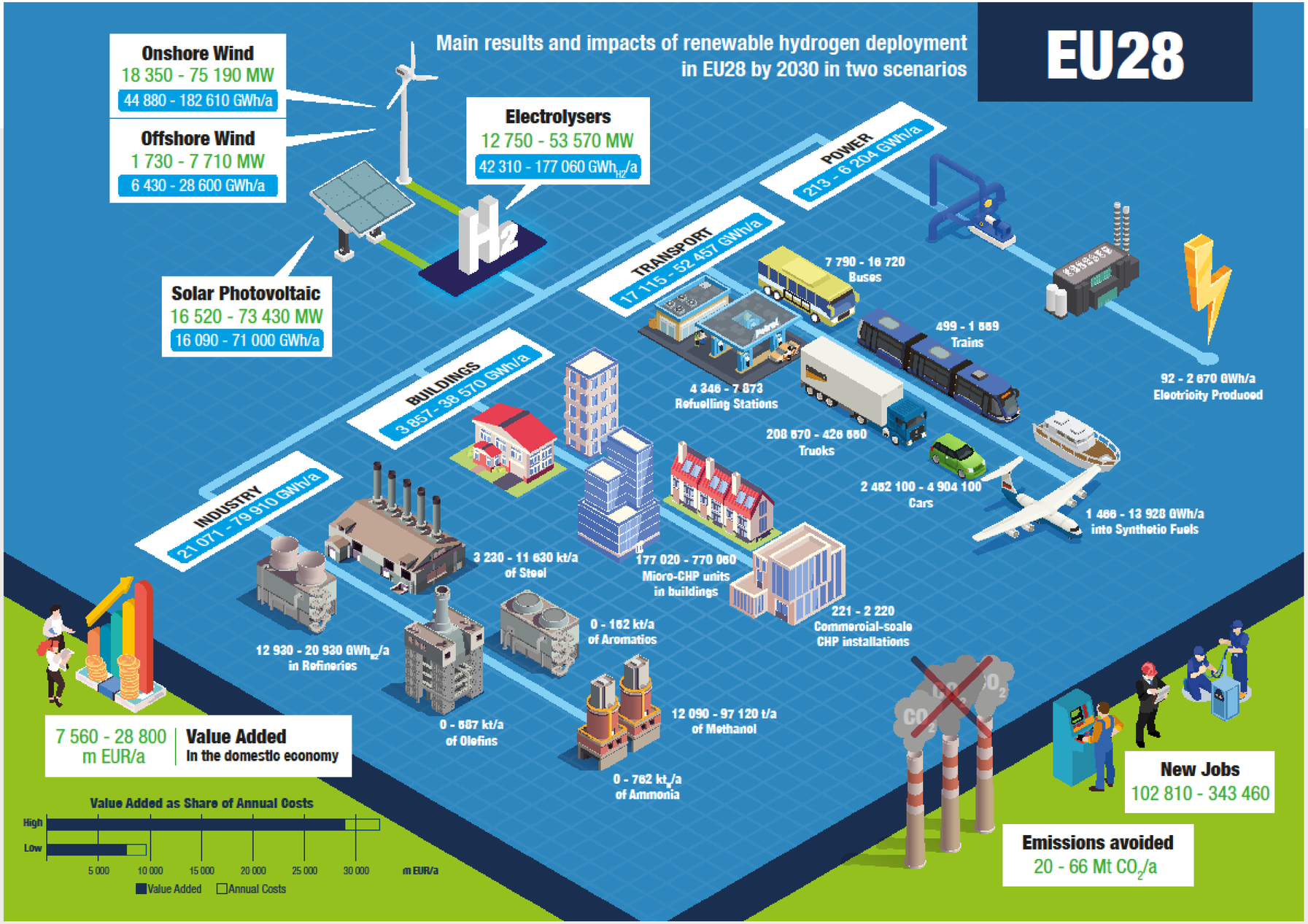
Value Added – High Scenario



Employment – High Scenario



4. Conclusions (1/2)



4. Conclusions (2/2)

Hydrogen in NECPs

- Nearly all NECPs mention hydrogen, but minority comprises concrete targets for hydrogen production/consumption
- Final NECPs pay much more attention to hydrogen than draft versions => increasing interest and awareness of MSs
- Focus on hydrogen as short term and seasonal flexibility provider, greening fossil energy use in industry and transport
- Due to NECP structure, info on hydrogen is scattered in different parts of NECP

National opportunities for hydrogen deployment

- Technical potential for producing green hydrogen through RES-E is available
- Hydrogen can cover short term and seasonal flexibility needs
- Existing methane infrastructure is stepping stone for hydrogen deployment (as admixture or in dedicated networks)
- Significant demand opportunity in hard-to-decarbonise industrial processes and heavy-duty transport

Estimated impact of 2 hydrogen deployment scenarios

- Demand for hydrogen in EU-28 by 2030: 40-180 TWhH2/a with industry and transport focus
- Electrolysis capacity 13-54 GW_{el} with average utilization of 4 800 full load hours
- H2-related GHG emission reduction: 20-65 $MtCO_2/a$, corresponding to 1.4%-4.5% of reduction gap at EU-28 level towards 2030 targets
- Annual cost of 9-33 billion EUR/a taking into account end-user related technologies
- 7.5-29 billion EUR of value added created in EU economy annually, creating 103-344 thousand jobs