Energy Community

HYDROGEN POTENTIAL IN THE CONTRACTING PARTIES ... with reality check

National Hydrogen Strategies
Implementation pathways and modelling results
Webinar
8 December 2021

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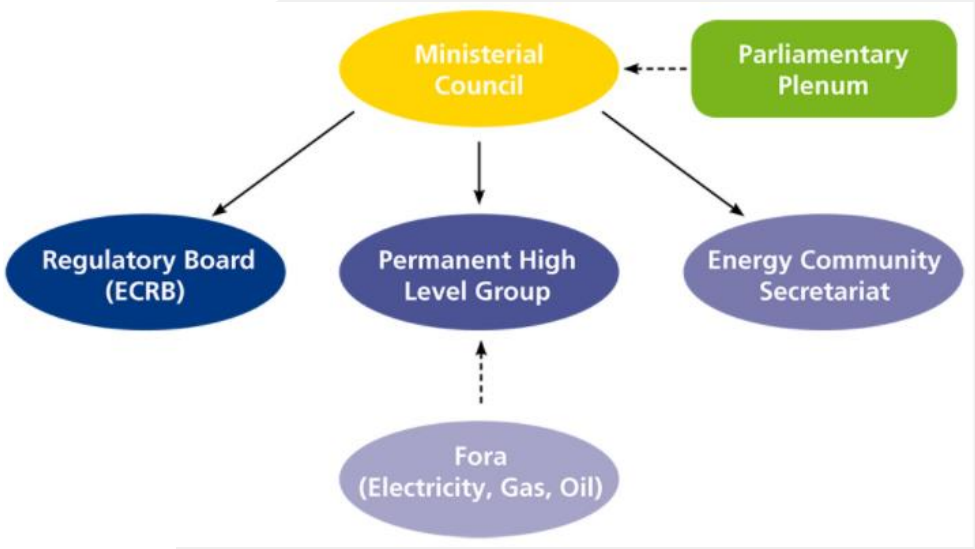
Energy Community



www.Energy-Community.org
https://www.energy-community.org/dam/jcr:737d594d-e541-4c0e-975b-b7fc937cfad1/EnC_Factsheet_122021.pdf

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The entire study is publicly available here:
https://www.energy-community.org/news/Energy-Community-News/2021/06/17a.html or
https://www.energy-community.org/documents/studies.html under Gas section

Introduction

EU H2 consumption is ca.: 10,2 Mt/yr

- ca. 30% thereof is used by refineries
- production - 9,7 Mt/yr, approximately equals consumption
- vast majority thereof is produced by fossil-based production - SMR technology

SMR-based H2 costs ca. 1,35 EUR/kg in Europe

- AEL technology 10 MW electrolyser in 2020 with HUPEX prices – ca 4 EUR/kg (REKK)
- PEM technology 10 MW electrolyser in 2020 with HUPEX prices – ca 3,3 EUR/kg (REKK)
- Cost reduction potential exists – learning curve: economies of scale, efficiency increase

Global SMR and coal gasification-based H2 production is responsible for 2,3% of total global CO2 emission

I. H_2 and the Contracting Parties - Drivers

Figure 2 Carbon intensity (CO_2 emissions as a proportion of primary energy supply), 2018

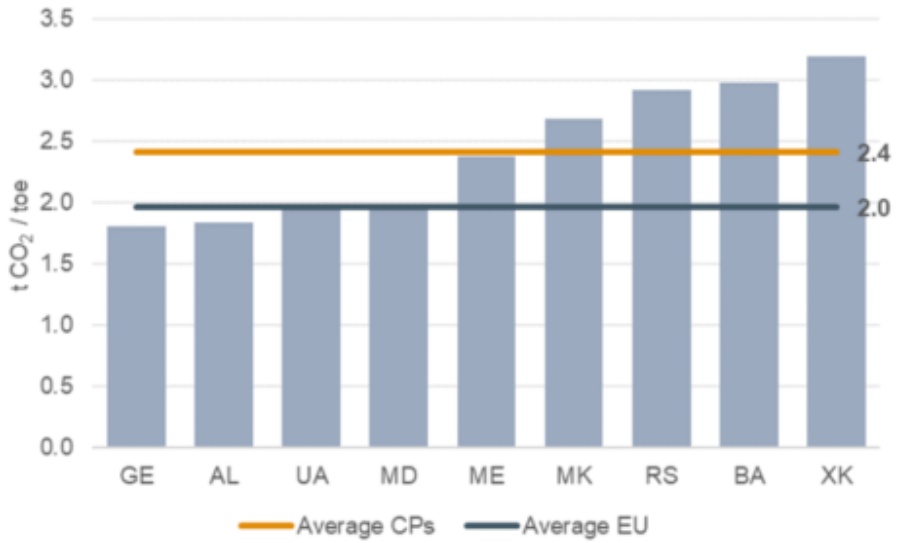


Figure 4 Fossil fuel share in power generation, 2018

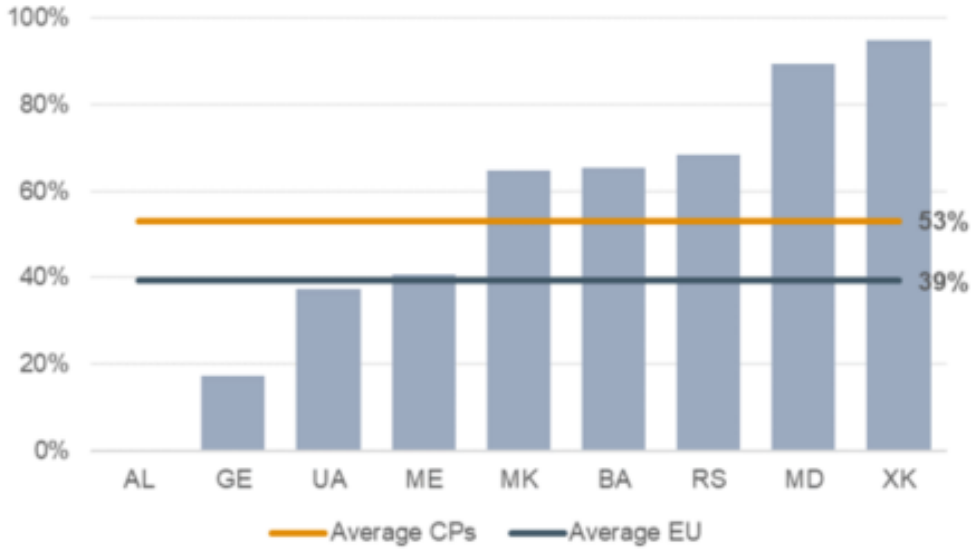


Figure 6 Renewable energy technical potential (MW capacity per km² of country surface area)

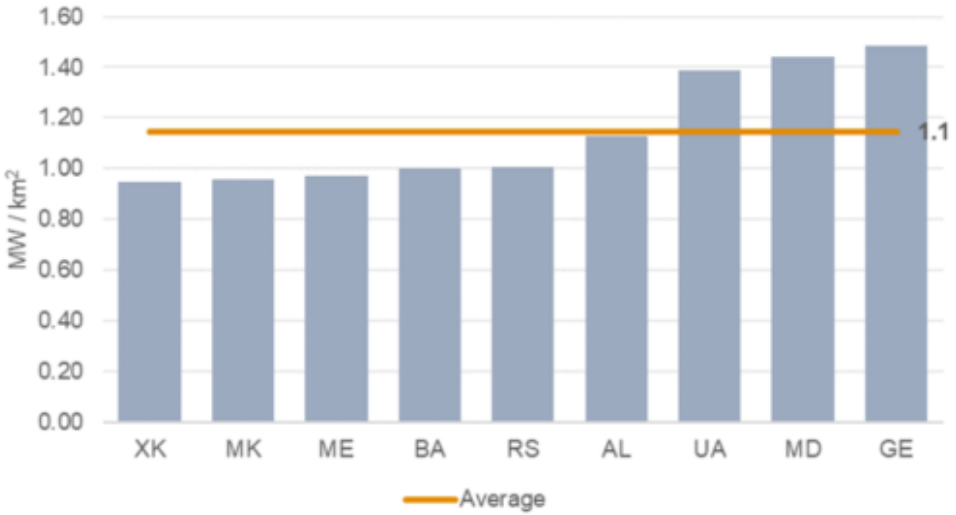
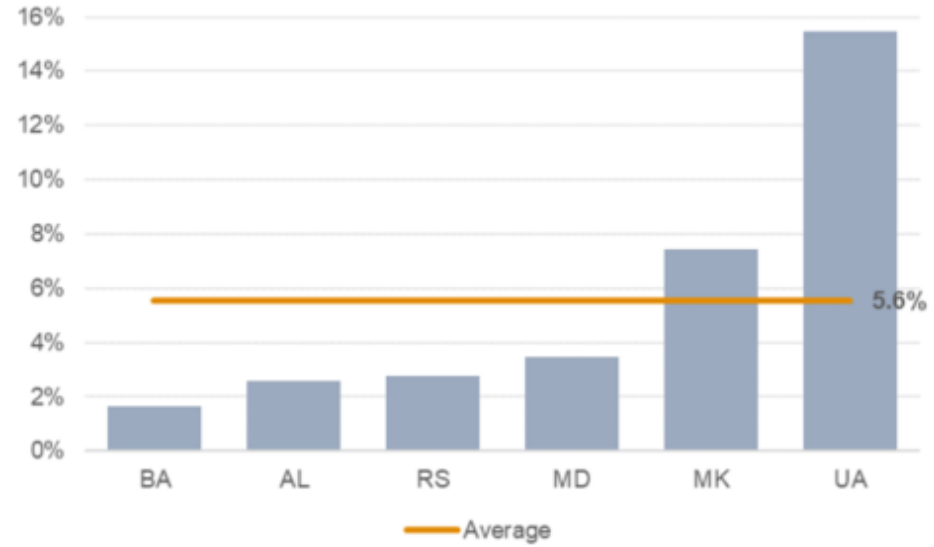


Figure 8 Share of key industrial applications in total output[10] (2018)



I. H_2 and the Contracting Parties – Use cases

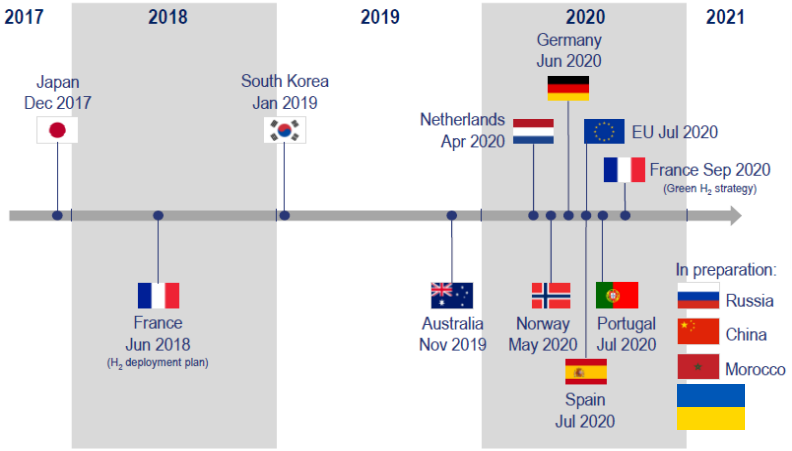
Energy Sector
Flexibility and Storage

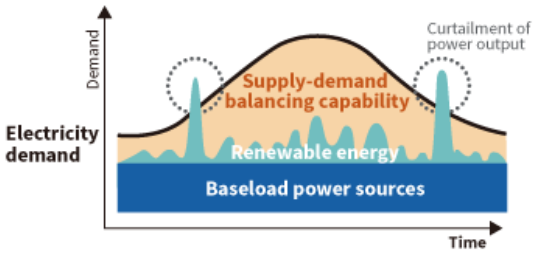
Industry
Feedstock and Energy

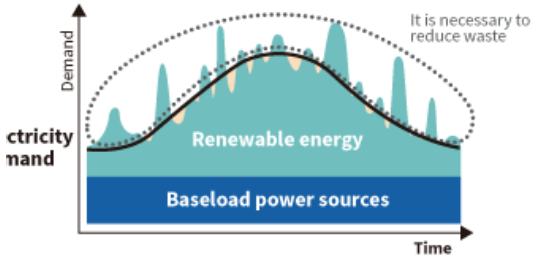
Transport
Road, Freight, Fixed Track, Marine, Synthetic Fuel

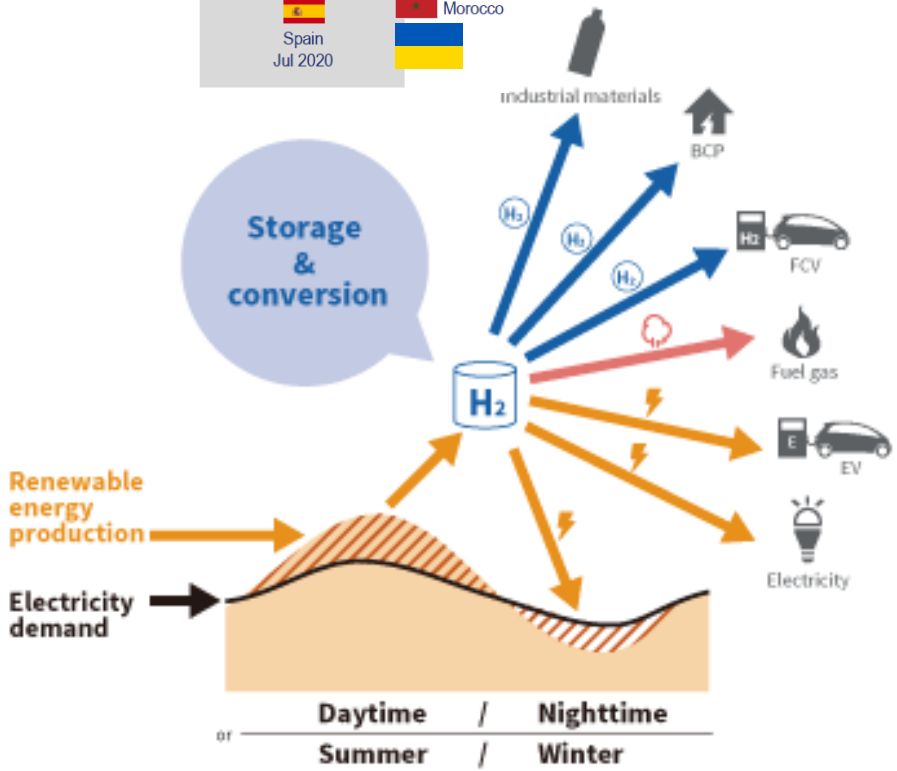
Commercial and Household
Space Heating

Potential H_2 applications are diverse
Countries have to find their competitive edge and focus on high potential sectors



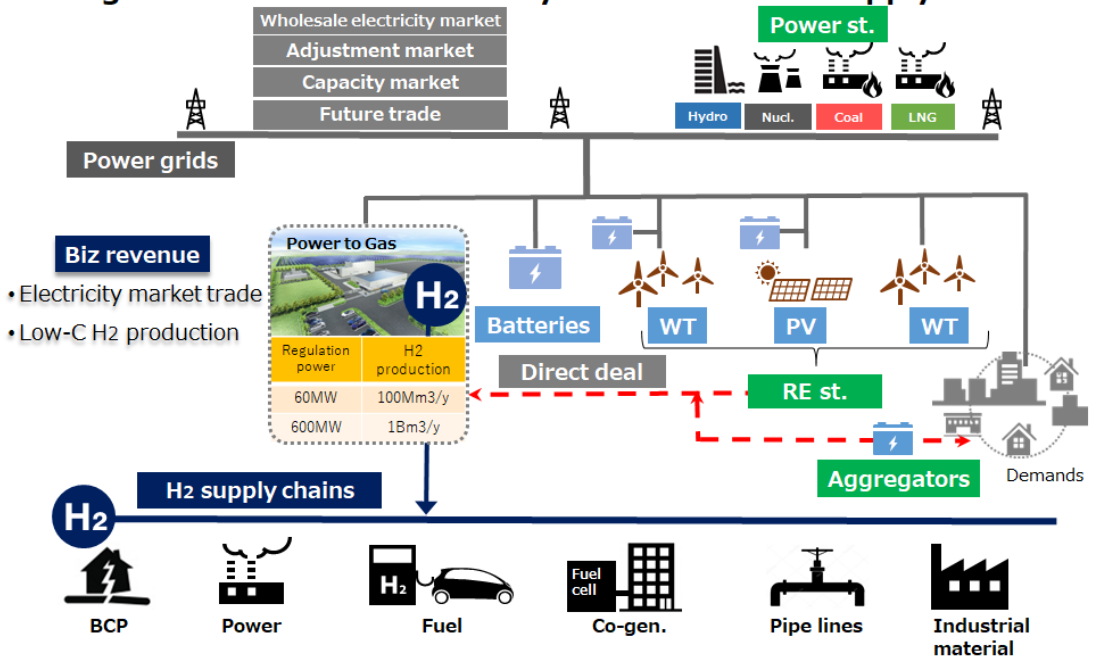






P2G business concept in 2030's

Enlarge and connect to electricity markets and H2 supply chains



Source: Toshiba-energy.com

II. The Energy Community Study

To assist CPs in assessing their potential to

1) **produce, transport and use hydrogen in different sectors;**
2) **to raise awareness and initiate discussion;**
3) **to draw a realistic picture and ascertain the potential way forward for each CP and**
4) **to provide a "menu" of options and ideas for the policy makers, project owners, developers and investors**

the ECS has initiated the "H_2 potential in the CPs study".

Synthesis Document

- **Observations**
- **Recommendations**
- **Projects**

International Review

- **H2 value chain, Drivers for H_2 use, Support policies and instruments, Country and project case studies**

Contracting Parties' Review

- **Comparative assessment, CP reviews**

Economic Analysis

- **Feasibility review of H2 applications in the transport, industry, power and storage, and domestic heating sectors**

III. Findings – focus on green and low carbon H2

Source: ECA-E4Tech – ECS Study

1) H_2 potential in the CPs was evaluated based on five categories:

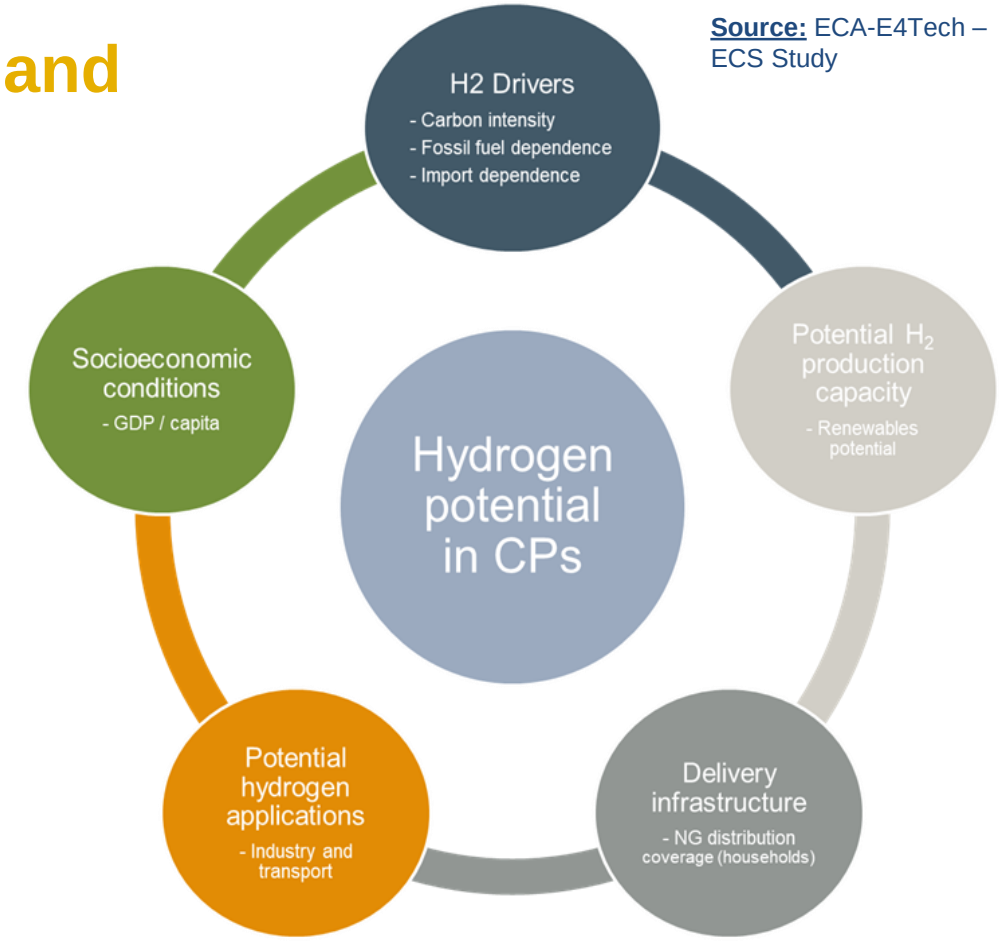
2) Relative potentials were aggregated:

Figure 1 Relative assessment of CP prospects of introducing hydrogen

Assessment parameters	AL	BA	GE	MD	ME	MK	RS	UA	XK
Hydrogen drivers									
Potential H_2 production capacity									
Delivery infrastructure									
Potential hydrogen applications									
Socioeconomic conditions									

Most conducive to promoting H2
Reasonably conducive to promoting H2
Relatively less conducive to promoting H2
Least conducive to promoting H2

Source: ECA and E4tech



3) Based on the:

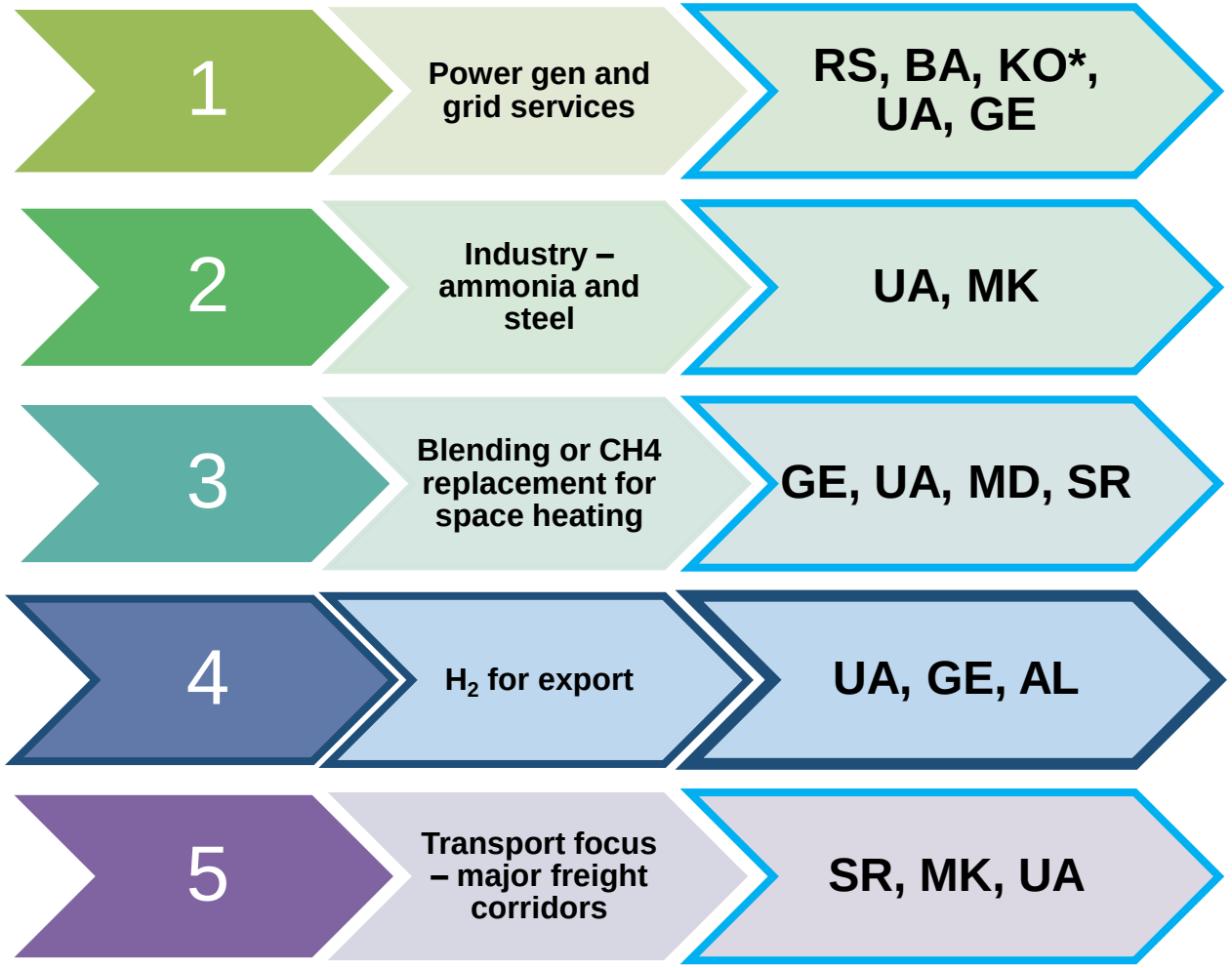
- current and forecasted cost-base of H_2 applications (Economic Analysis),
- CP profiles (Contracting Party Review) and
- international experience (International Review)

five country groups (cohorts) were identified, where there is *potential/need* for H_2 applications in specific sectors.

4) Potential pilot-projects were scoped for each cohort.

III. Findings

The Study identified the highest potential in the *long-term* for the following applications.
In the short term, large scale applications do not seem to be economically feasible – support is needed



NO "ONE SIZE FITS ALL" H_2 SOLUTION

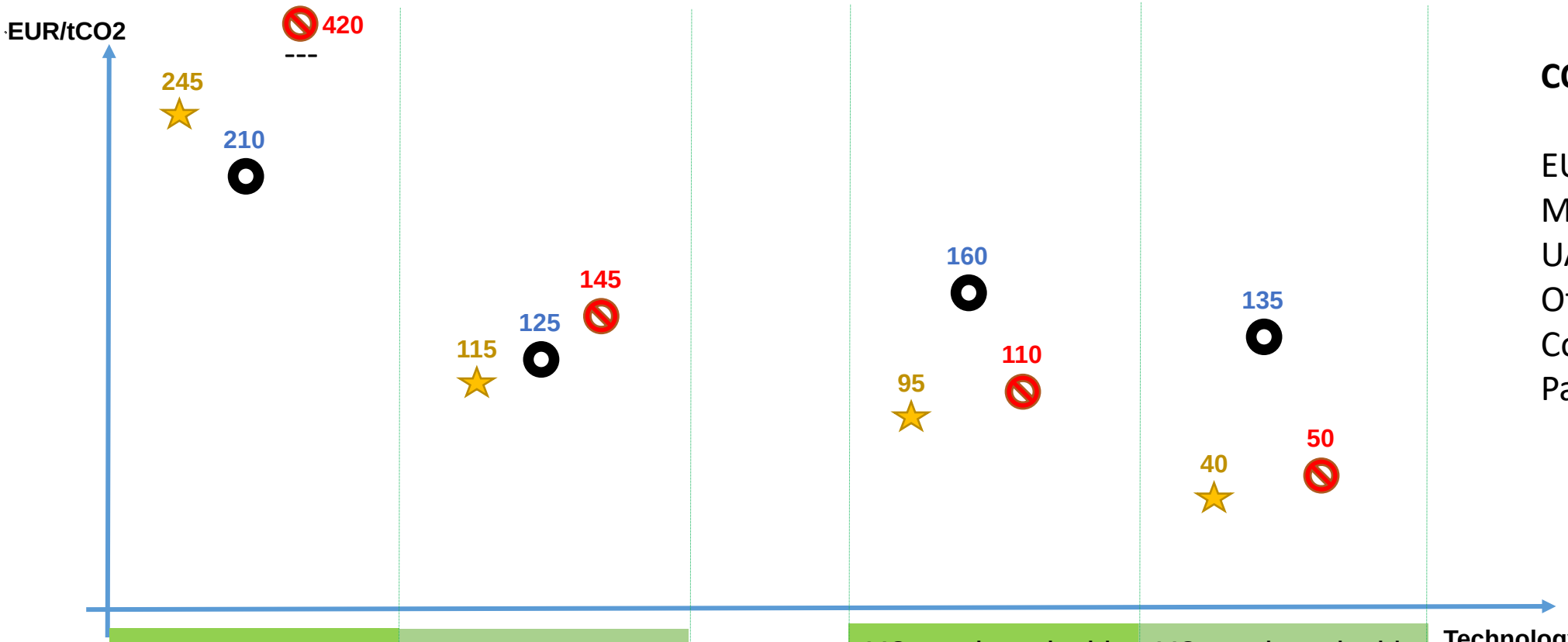
"Which application could become sufficiently economic in each Contracting Party depends on the local context, but a wide range of plausible applications are considered to be potentially viable in the long-term (2035-2050) at carbon prices of ***€200/tCO$_2$*** *or more"*

ECS Study

Small scale pilot and demonstration projects with support can be realized – perfect ground for CB cooperation

1	Power Gen and Grid Services	**Combine grid flexibility demonstration of electrolysers with other trials to demonstrate grid flexibility impact and learn about regulatory and legislative barriers in generating feasible revenue streams (e.g. flexibility market)**
2	Industry – Ammonia and Steel	**Small-scale/demonstrational project where green H_2 is injected alongside fossil hydrogen as feedstock** **Small-scale/demonstrational blending of green H_2 with methane in a closed gas grid/industrial site**
3	Blending or CH4 replacement for space heating	**Research and demonstration projects to encompassing the gas system and households to research and demonstrate viability – similarly to projects in UA.** **Small scale Power2H_2 demonstration projects involving injection to local/closed grid**
4	H_2 for export	**Demonstration of the gas grid's viability to blend H_2/dedicate routes to pure H_2, in cooperation with int. partners.** **Demonstrate long distance transport by road/rail/waterborne transport of cryogenic H_2 or H_2 contained in a carrier e.g. ammonia or other liquid organic H_2 carriers (LOHC)**
5	Transport focus – major freight corridors	**Introduction of H_2 in a captive fleet with electrolysis-based hydrogen refueling stations (HRS) – city buses, taxis, delivery vehicles-corporate fleets (in large urban areas) with HRS open to the public**

III. Long-term, break-even CO2 prices for some industrial applications



CO_2 prices today:

EU – ETS	60-65 EUR/t
MN	24,0 EUR/t
UA	0,03 EUR/t
Other Contracting Parties	0 EUR/t

Ammonia
Iron&Steel
Methanol

IV. Export? Reality Check

ca. 50 kWh Electrolyzer electricity input produces

Assumed efficiency 80%

→ **1 kg or 11,13 Nm3 Hydrogen**

Total installed wind and solar capacity in UA is around 8650 MW (including household PV)

Assuming an average 23% Load Factor (2.000 Full Load Hours/yr)

ca. 2,0 GW Electrolytic Capacity

@ 100% Load Factor

→ **ca. 0,35 Mt or 3,9 bNcm H_2 /yr could be produced**

→ ***Current* EU H_2 consumption is ca.: 10,2 Mt/yr**

If total current wind and PV capacity of UA would be dedicated for H2 generation, ca. 0,35 Mt of H2 could be produced in a year, which is about 3,5 % of EU's H2 consumption.

With similar calculation, 230 GW dedicated RES (PV, wind) capacity would be needed to replace the current EU demand H2 demand. EU has ca. 150 GW installed PV and 220 GW installed wind capacity

IV. EXPORT? The Infrastructure

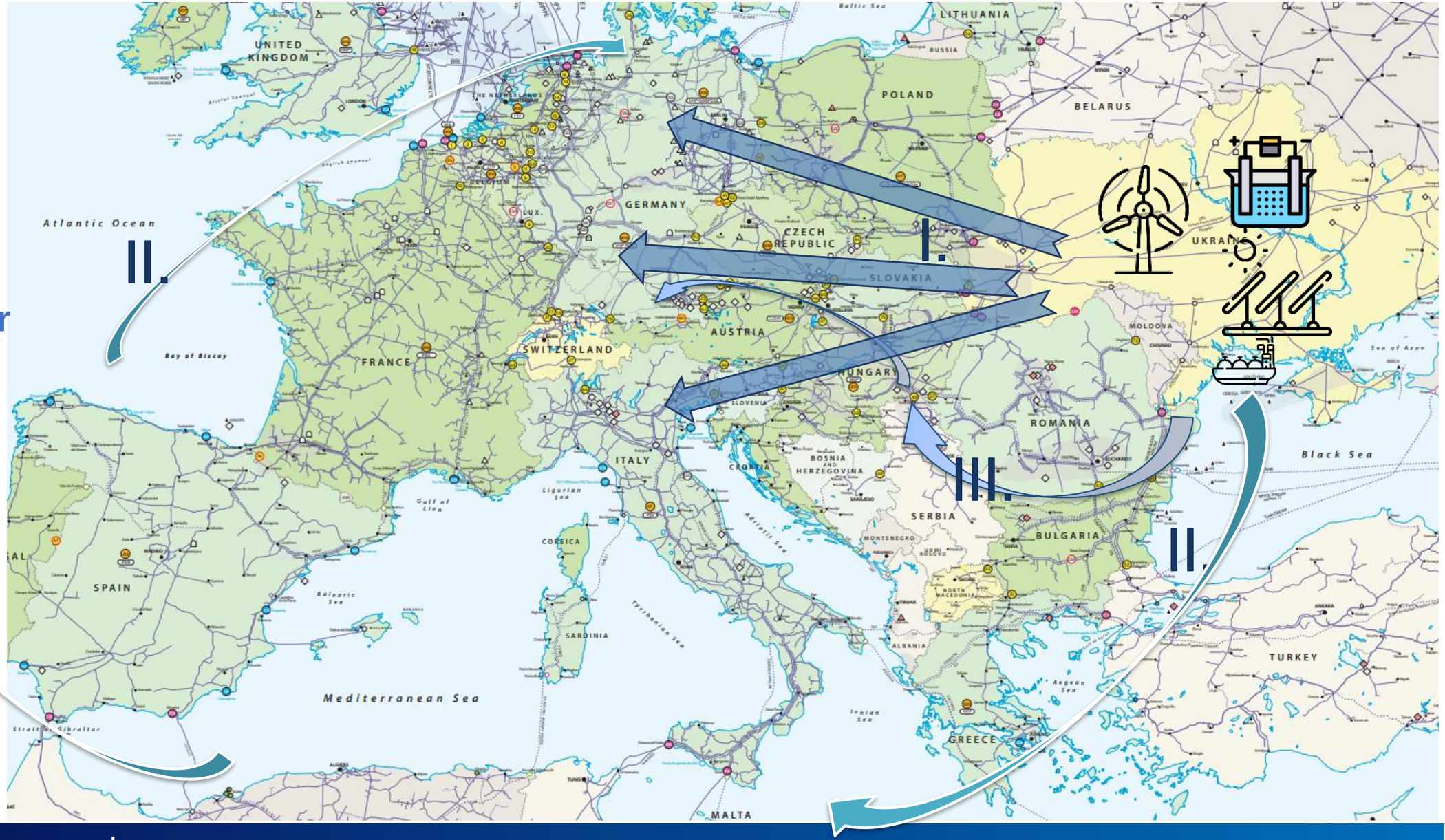
I. Pipeline Route

or

II. Sea Route for Ammonia or other H_2 carriers

or

III. Danube route



IV. RISKS & NEXT STEPS, COOPERATION

EU interest is to enable cost efficient, green H2 import into the EU, along with security of supply and decarbonisation of Contracting Parties' economies.

LEGAL

FINANCIAL

TECHNICAL

POLITICAL

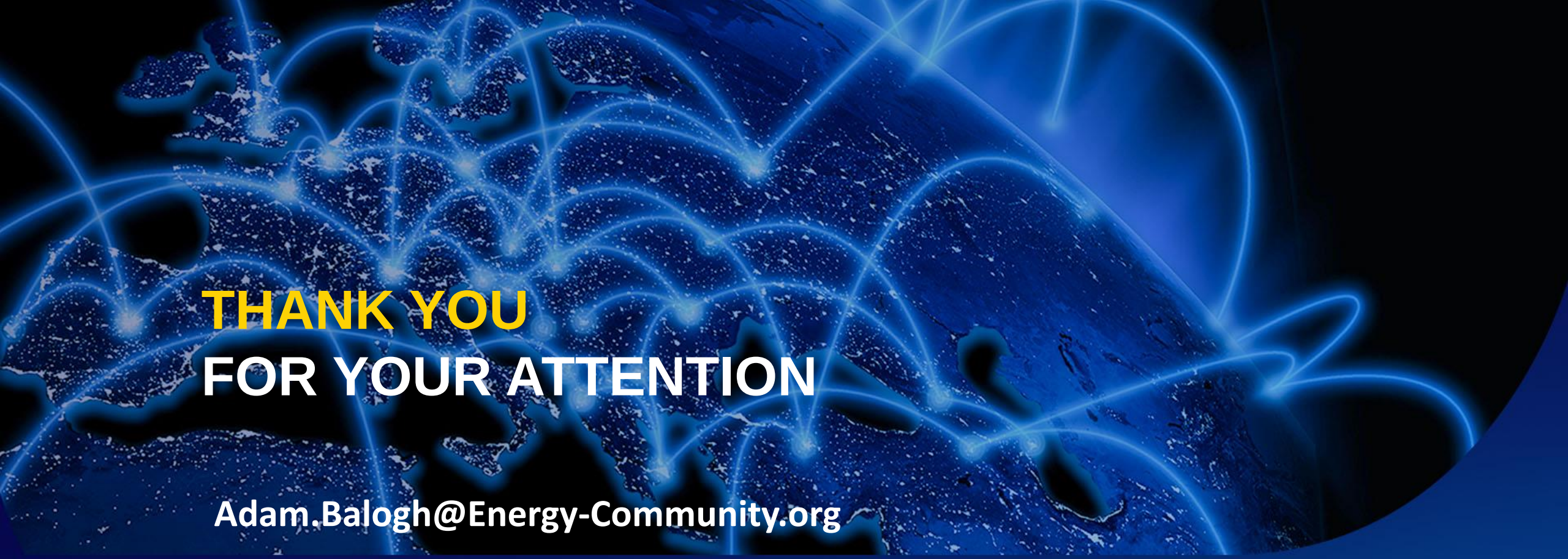
New TEN-E Regulation is on the way:

- **New, H2 project categories – Electrolysers**
- **Projects of Mutual Interest – V4-CP cooperation**

ECS to assist countries with project identification and preparation for the new Regulation:

Planned "Roadshow" on New. Reg. 347/2013 and H2 projects

Important Projects of Common European Interest – allowing state aid for H2 projects – possibility for V4-CP cooperation



THANK YOU
FOR YOUR ATTENTION

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