

Study on the potential for implementation of hydrogen technologies and its utilisation in the Energy Community

Potential in EnC Contracting Parties – preliminary study outcomes

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Potential in EnC Contracting Parties –
preliminary study outcomes

Objectives of assignment and structure of tasks

Key findings from supporting reports
Bringing it all together – the synthesis report

The study's purpose is to assess the potential of hydrogen production, transport and use in the Contracting Parties*

- ▶ Document and evaluate the **state of play** in more developed markets and in the CPs
- ▶ Draw on **findings and lessons** from international experience and identify **enabling** mechanisms for using hydrogen
- ▶ Identify **barriers and risks** to hydrogen deployment and mechanisms for addressing or mitigating against them
- ▶ Develop a set of **tiered recommendations** across project, national and Energy Community levels



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Key findings – international review

▶ Hydrogen drivers

- Demand pull – net zero targets
- Supply push – increasing commerciality

▶ High potential or promising end use sectors

- Heavy duty transport
- Heavy industry
- Heating (where there is a natural gas grid)

▶ Hydrogen policy frameworks and instruments

- Strategies and targets (commitment and direction)
- No “silver bullet” (combination of policies)

▶ Regional / country tailoring

- Renewable hydrogen / decarbonise heat / maximise wind potential
- Hydrogen exports to substitute for LNG and coal
- Hydrogen in transport / fuel cell vehicle industry

▶ Opportunities for CPs

- Increasing demand for hydrogen in Europe
- Global or regional trade in hydrogen
- Existing demand sectors (fossil-based hydrogen)
- EU policy and funding support

▶ Risks of inaction by the CPs

- Uncompetitive industry (given increasingly tight decarbonisation requirements)
- Lack of interconnectivity (eg in transport)
- High import dependence

Key findings – economic analysis

▶ Transport

- Feasibility of **long-haul hydrogen trucking along dedicated routes** should be explored through pilot studies (eg in Serbia which has high diesel prices)

▶ Industry

- For CPs with **coal-based ammonia production and without access to natural gas supply**, a combination of electrolysers with dedicated renewables and/or carbon prices could make renewable-based ammonia production economically competitive
- In the **steel** sector, while more costly than traditional blast furnace production, direct reduction iron-electric arc furnace (DRI-EAF) using hydrogen offers **the prospect of supplying carbon-free steel**

▶ Power and storage

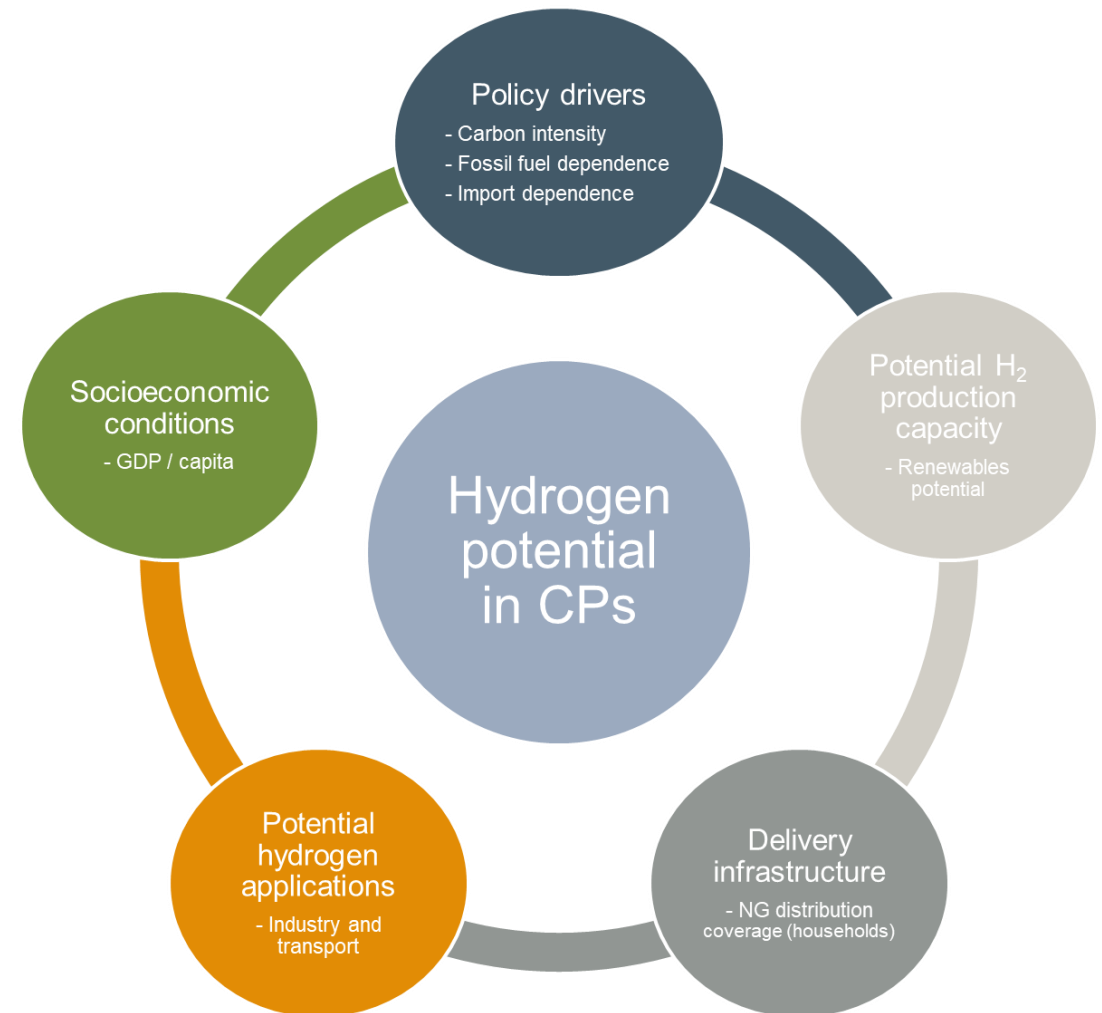
- Hydrogen in future (~ by 2035) could offer a **lower LCOE than BESS at discharge durations above eight hours**
- For lower capacity factors (under 15%), hydrogen storage is expected to be cost competitive with CCUS-fitted OCGT / CCGT units following full commercialisation
 - More favourable conditions (higher natural gas prices and lower hydrogen production costs) could see **hydrogen competitive for capacity factors up to around 30%**

▶ Heating

- Low probability that hydrogen can be an economically competitive heating option, but **could be favoured where there is an existing gas distribution network**

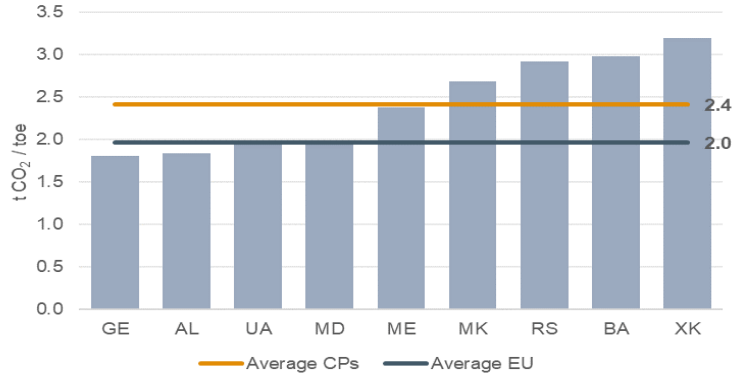
Comparative assessment - our evaluation approach identifies some critical factors that could underpin hydrogen adoption

1. **Policy drivers** – the higher the carbon intensity and fossil fuel dependence, the greater the imperative to examine decarbonisation options
2. **Potential hydrogen production capacity** – renewables remain largely untapped in the CPs and could potentially be harnessed to produce hydrogen
3. **Delivery infrastructure** – natural gas pipelines likely to be the lowest cost option for delivering hydrogen to end users
4. **Potential hydrogen applications** – existing industries such as refining, ammonia and steel and new applications such as transport
5. **Socioeconomic conditions** – ability to adopt and/or support the development of newer technologies

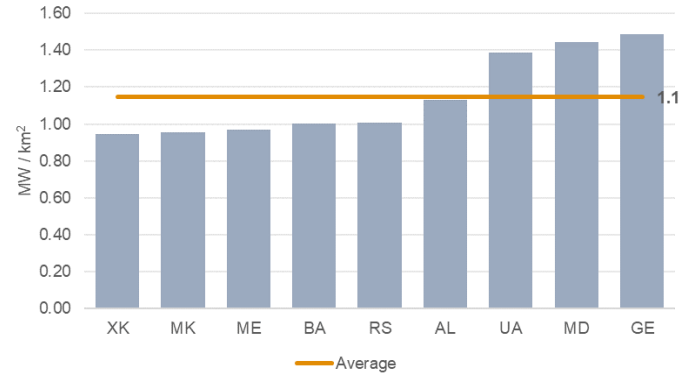


Comparative assessment – none of the CPs scores unambiguously higher against all the assessment parameters

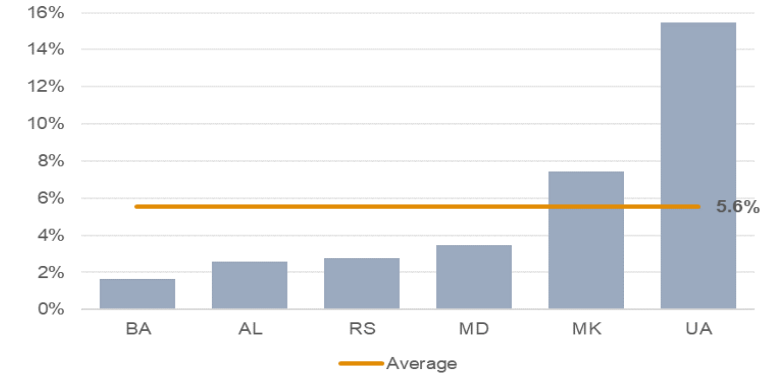
Carbon intensity



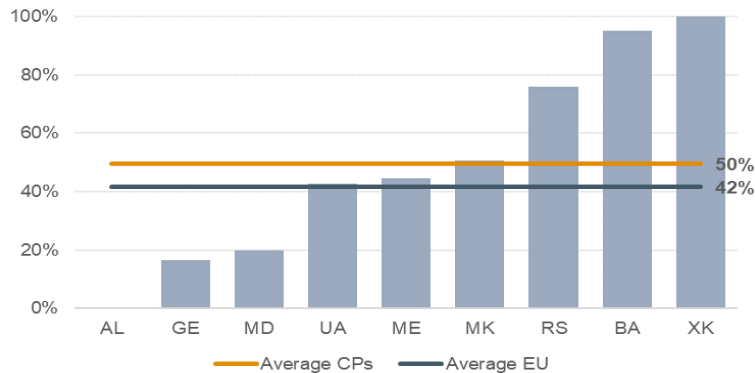
Renewable energy technical potential



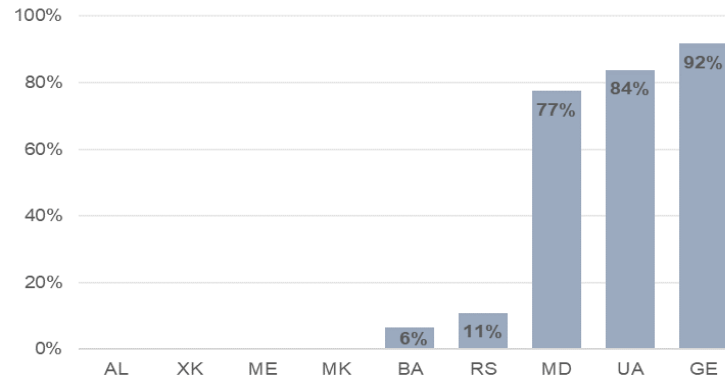
Share of key industrial applications in total output



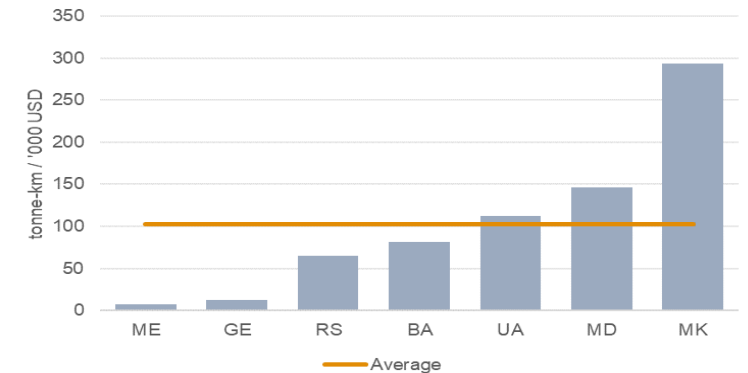
Fossil fuel share in electricity demand



Households connected to gas network



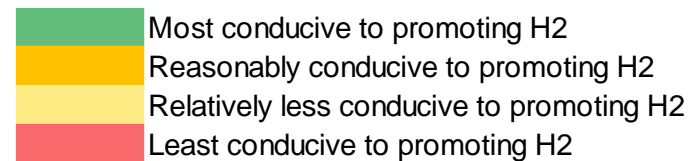
Road freight transport per unit of output



Comparative assessment - relative appraisal of CP prospects of introducing hydrogen

- ▶ Decarbonisation should be featuring as a **priority** for the CPs
- ▶ The theoretical **potential for producing hydrogen** from renewables appears to be medium to high in most CPs
- ▶ Matching producers and users of hydrogen is likely to be the largest challenge for most of the CPs given the **lack of existing infrastructure**
- ▶ Many of the CPs have a **significant share** in their total output **of industrial applications** favouring the use of hydrogen **and freight transportation**

Assessment parameters	AL	BA	GE	MD	ME	MK	RS	UA	XK
Policy drivers	Red	Green	Orange	Yellow	Orange	Green	Green	Orange	Green
Potential H ₂ production capacity	Orange	Red	Green	Green	Red	Red	Red	Green	Red
Delivery infrastructure	Red	Red	Green	Yellow	Red	Red	Red	Yellow	Red
Potential hydrogen applications	Red	Orange	Red	Orange	Red	Green	Orange	Green	Red
Socioeconomic conditions	Red	Orange	Orange	Red	Green	Yellow	Yellow	Red	Red



- ▶ The relatively limited economic capacity of the CPs could act as a constraint on promoting hydrogen

Potential in EnC Contracting Parties – preliminary study outcomes

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Key findings from supporting reports

Bringing it all together – the synthesis report

Summary of preliminary findings and interlinkages

International review

- ▶ **Decarbonisation** agenda creating policy in support and increased demand
- ▶ **Industrialisation advances** bringing down costs but future levels remain uncertain
- ▶ **Storage is critical** and cheaper where underground options are available
- ▶ **Several end-uses of interest** with industry, transport, power and heating leading the way
- ▶ Range of ongoing **pilot projects** in EU across the full value chain

Economic analysis

- ▶ **Transport** interest led by **long-distance freight**
- ▶ **Industry** focused on **ammonia, steel and methanol** (especially where competing with **coal**)
- ▶ **Power generation** is most competitive as **peaking plant** and discharge durations needed of **>8 hours**
- ▶ **Heating** of potential interest to CPs with existing/planned **gas distribution grid**
- ▶ **Significant carbon price** still needed (directly or indirectly via other support)

Comparative assessment

- ▶ **Transport corridors** open opportunities for long-distance freight → **UA, RS>XK>MK**
- ▶ **Industrial base** in relevant sectors → **UA, MK**
- ▶ **Policy drivers** strongest where coal use greatest → **RS, BA, XK**, but also import dependency → **GE**
- ▶ **Delivery infrastructure** for distribution → **GE, UA, MD** (but others joining)
- ▶ **Economic RES** potential for competitive production → **GE, UA, MD, AL**

Draw on three studies to develop “cohorts” of most attractive end-use and CP combinations

Cohort 1 – Transport corridors for long distance freight

International review

- ▶ **Example countries:** Norway and Japan
- ▶ **Pilot project:** heavy duty vehicles with filling stations → carbon free e-mobility system in Switzerland

Economic analysis

- ▶ **Transport** interest led by **long-distance freight**

Comparative assessment

- ▶ **Transport corridors** open opportunities for long-distance freight → **UA, RS>XK>MK**

Cohort 1

- ▶ Examines the most attractive transport corridors for long-distance freight
- ▶ Analysis remains underway → to assess freight volumes and long-term potential
- ▶ Expected to include UA and corridor from RS to MK
- ▶ Potential for cooperation on pilot project between CPs where corridors extend across jurisdictions

Draw on three studies to de

Cohort 2A – Industrial use for ammonia, steel and methanol

International review

- ▶ **Example country:** Germany
- ▶ **Pilot project:** H2Future in Austria focusing on Voestalpine steel manufacturing site but also providing grid services

Economic analysis

Comparative assessment

Cohort 2A

- ▶ **Industry** focused on **ammonia, steel and methanol** (especially where competing with **coal**)

- ▶ **Industrial base** in relevant industries → **UA, MK**

- ▶ Looks at where most promising industries are most heavily concentrated
- ▶ UA and MK are stand-out CPs for relevant industries, although steel making is widespread in the region
- ▶ Hydrogen more competitive where coal is the counterfactual (RS, BA, XK)

Draw on three studies to de

Cohort 2B – Power generation and grid services

International Review

- ▶ **Example country:** Netherlands
- ▶ **Example project:** the proposed conversion of the 1.32 GW Magnum CCGT plant in Netherlands to 100% hydrogen

Draw on three studies to de

Economic analysis

Comparative assessment

Cohort 2B

- ▶ Lack of low carbon flexible generation options (particularly hydro but also natural gas)
- ▶ **Power generation** is most competitive as **peaking plant** and discharge durations needed of **>8 hours**
- ▶ **Policy drivers** strongest where coal use greatest → **RS, BA, XK**, but also import dependency → **GE**
- ▶ High CO₂ emissions
- ▶ Coal dependency in RS, BA and XK elevates
- ▶ Import dependency for power also concern → GE (hydro very seasonal resulting in spillage and import cycles)

Cohort 3 – Blending or replacing natural gas for heating

International review

- ▶ **Example country:** United Kingdom
- ▶ **Example pilot projects:** HyDeploy in UK (delivery to homes) and White Dragon in Greece (district heating)

Economic analysis

Comparative assessment

Cohort 3

- ▶ Adoption of hydrogen space heating boilers a consideration with gas distribution infrastructure
- ▶ GE, UA and MD have networks in place while others (notably MK) have them in development or planning

▶ **Heating** of most interest where existing or planned **gas distribution grid** exists

▶ **Delivery infrastructure** for distribution → **GE, UA, MD** (but others joining)

- ▶ Consider integrating dual fuel capability during development stage, as marginal cost is low
- ▶ District heating an additional consideration → may be stacked with industrial off-take

Draw on three studies to de

Cohort 4 – hydrogen production for export

International review

- ▶ **Example country:** Morocco
- ▶ Has signed an MoU with Germany for exports

Draw on three studies to de

Economic analysis

Comparative assessment

Cohort 4

- ▶ Low cost and extensive RES potential clearest in GE, UA, MD and AL
- ▶ Export of hydrogen from GE (at least to EU) is relatively complex due to locality
- ▶ Pipeline delivery from UA, MD or AL will require studies on capability and upgrade requirements

- ▶ **Significant carbon price** still needed (directly or indirectly via other support)

- ▶ **Economic RES** potential for competitive production → **GE, UA, MD, AL**

- ▶ Internal trading between CPs also a potential consideration (eg UA sales to RS)

Potential policy pathways (preliminary examples)

	Cohort 1 (transport)	Cohort 2A (industry)	Cohort 2B (power)	Cohort 3 (heating)	Cohort 4 (export)
Strategies & targets	National hydrogen strategies to 2050 identifying applications of greatest interest				
	RES-T target	Industry decarb targets	RES-E target	RES-H target	
Standards & regulation	Vehicle emission regulations		Market design	Price & ownership regulation	
	Safety standards and product standards				
Supporting demand	Carbon pricing				
	Subsidies		Time-of-use pricing	Subsidised boilers	RES target trading
Supporting supply	De-risking investments through concessional loans and guarantees				
	Providing non-financial support through streamlined permitting				
Promoting R&D	Part-funding and support for pilot or demonstration projects				
	Innovation programmes with academia and industry				

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