HYDROGEN EUROPE
CLEAN HYDROGEN MONITOR 2020

LAUNCH EVENT

8 October 2020
15:30 - 17:00
Online
WELCOME & INTRODUCTION

JORGO CHATZIMARKAKIS,
SECRETARY-GENERAL,
HYDROGEN EUROPE
Green Hydrogen for a European Green Deal
A 2x40 GW Initiative

Prof. Dr. Ad van Wijk
Jorgo Chatzimarkakis
Position of Hydrogen Europe has changed

8th JULY

- ENERGY SYSTEM INTEGRATION
- EU HYDROGEN STRATEGY
- EU CLEAN HYDROGEN ALLIANCE

European Clean Hydrogen Alliance
At EU level

“At EU level, the European Union is committed to hydrogen as a key element of its green transition. "H2 rocks, and I am committed to making it a success!" — Frans Timmermans, Executive Vice-President for the European Green Deal.

Historical momentum

16 billion euros from France and Germany!
Historical position for H2 in EU politics
### Billions to be invested in the EU

EU governments propose hydrogen strategies with dedicated 2030 investment plans:

<table>
<thead>
<tr>
<th>Country</th>
<th>Investment</th>
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<tbody>
<tr>
<td>Germany</td>
<td>€7bn (+ €2bn external partnerships)</td>
</tr>
<tr>
<td>Spain</td>
<td>€8.9bn</td>
</tr>
<tr>
<td>France</td>
<td>€7.2bn</td>
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<tr>
<td>Portugal</td>
<td>€1bn</td>
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<tr>
<td>Italy</td>
<td>€4bn</td>
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<tr>
<td>Austria</td>
<td>€2bn</td>
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Coherent strategy

**VISION**

Produce 40GW in Europe and 40GW in neighbouring countries by 2030.

**COST**

€430bn in funds are needed to kick start the hydrogen economy.

**COMMITMENT**

90+ Hydrogen Europe CEOs ready to support Clean Hydrogen Alliance

**RECOMMENDATIONS**

Input to the Hydrogen Strategy: providing an enabling regulatory framework at EU level.
Clean Hydrogen Monitor 2020
OPENING SPEECH

JENS GEIER, MEP, EUROPEAN PARLIAMENT
PURPOSE AND AMBITION OF THE YEARLY REPORT

ALEXANDRU FLORISTEAN, HYDROGEN EUROPE
Our Vision
Hydrogen enabling a zero emission society

Our Mission: NO EMISSION
We bring together diverse industry players, large companies and SMEs, 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.
What we want

Enable clean hydrogen to:
- replace all unabated fossil hydrogen consumption,
- replace fossil fuels and feedstocks in other sectors where hydrogen can play a role.

By 2024 Clean Hydrogen Production should be 13x times that of today and by 2030, it should be 130 times larger.

Source: Hydrogen Europe
Objective facts and figures

Policy Makers
• Policies need to reflect reality
• Policy Makers should be able to evaluate the effectiveness of the measures they take
• Baselines need to be clear and rooted in facts

Project Developers and Promoters
• Building business cases requires in-depth understanding of
  • the market and the economics of your product
  • Policies and incentives

General public and Non-Governmental Organisation
• Transparency is key for public acceptance

Growing workforce
• New workforce needs to be brought up to speed quickly
Monitor the development of the
Clean Hydrogen Sector

Hydrogen production and consumption

• Share of clean vs other pathways
• Figures / country / technology, etc.

Levelized Cost of Hydrogen

• Competitive disadvantage of clean hydrogen as opposed to fossil alternatives

Policies

• National strategies and plans
• EU legislation and policies
• Funding and incentives schemes
CURRENT PRODUCTION AND CONSUMPTION OF HYDROGEN IN EUROPE

GRZEGORZ PAWELEC, HYDROGEN EUROPE
Chapter 1 – Hydrogen demand and supply in the EU:

1.1. Hydrogen generation capacity
1.2. Hydrogen demand
1.3. International hydrogen trade by EU countries
Where is the demand for hydrogen coming from?

Total demand in the EU: 8.3 Mt

Source: Hydrogen Europe
Where is hydrogen produced today?

- Large portion of Hydrogen industrial demand sources (and captive production sites) are located in ports or in close proximity to ports.

- Just five industrial hubs in Belgium and Netherlands (Antwerp, Zeeland, Rotterdam, IJmond and Delfzij) have a combined local hydrogen demand of 1.7 Mt per year, which is equal to around 20% of total EU consumption today.
How is hydrogen produced today?

- **Fossil hydrogen**: 90.6%
- **Renewable hydrogen**: 0.1%
- **Low-carbon hydrogen (CCS)**: 0.7%
- **By-product**: 7.1%
- **Electricity mix electrolysis**: 1.6%

Source: Hydrogen Europe
Hydrogen prices today

Source: Hydrogen Europe, based on international trade database
LEVELIZED COST OF RENEWABLE AND GRID ELECTRICITY HYDROGEN IN EUROPE

GRZEGORZ PAWELEC, HYDROGEN EUROPE
Chapter 2 – Levelized hydrogen production costs in the EU:

2.1. Grid connected electrolysis
2.2. Direct connection to renewable energy source
How much does renewable hydrogen cost now in the EU?

- In most EU countries we are still some way off target when it comes to average renewable hydrogen production costs ...

Source: Hydrogen Europe
How much does renewable hydrogen cost now in the EU?

Levelized cost of hydrogen (EUR/kg) from utility scale PV

- **Source**: Hydrogen Europe

Levelized cost of hydrogen (EUR/kg) from onshore and offshore wind

- **Average wind conditions**
- **Top 10% wind resource in a country**

SMR hydrogen (without CCS) cost range

- **Source**: Hydrogen Europe
Further optimization by scaling electrolyser power

At 1:1 ratio, the electrolyser CF equals that of RES

At 1:2 ratio, the electrolyser CF + onshore wind grows to almost 4,200h for onshore wind

At 1:10 ratio, the electrolyser CF + onshore wind grows to almost 8,000h for onshore wind

Source: Hydrogen Europe
Further optimization by scaling electrolyser power

Onshore wind

Solar PV

At 1:2 ELY:RES ratio, LCOH from onshore wind falls down to 3,0 EUR/kg for Solar PV and 2,3 EUR/kg for onshore wind.

At 1:10 ELY:RES ratio, LCOH from onshore wind falls down to around 1,6-1,7 EUR/kg.

At 1:1 ratio with average wind conditions, green H2 from onshore wind costs 5.4 EUR/kg.

Grey hydrogen production costs range

Source: Hydrogen Europe
PLANS FOR PRODUCTION OF CLEAN HYDROGEN

MATUS MURON,
HYDROGEN EUROPE
Chapter 3 – Planned Hydrogen Production and Infrastructure:

3.1. ★ Planned power-to-hydrogen projects
3.2. Low-carbon hydrogen projects overview
3.3. Hydrogen transmission and distribution infrastructure
3.4. Important Projects of Common European Interest (IPCEI) on hydrogen
Planned projects amount to 36% of EU’s 2024 6 GW goal

Cumulative planned PtH projects by year 2020 - 2040 (MW and # of projects)

Comments

- **20,011 MW by 2040** (additional 1,278 MW with Date N/A)
- Annual 2020 – 2030 capacity growth rate at **63%**
- 2,131 MW by 2024 compared to 6 GW EU target, **36%**
- 9,101 MW by 2030 compared to 40 GW EU target, **23%**
- The currently announced projects amount to at least ~**€10.6 billion worth of investments in electrolyzer technology**
- Sizeable new PtH facilities are being announced regularly
- The effect of new policies and incentives stemming from strategies

Source: Hydrogen Europe
Six countries have planned additions above 1 GW by 2030

Map of PtH additions by country 2020 – 2040 (MW)

- Above 3,000 MW
- 1,000–3,000 MW
- 200–1,000 MW
- 50–200 MW
- Up to 50 MW
- Existing project/s with undisclosed capacity
- Not included in the analysis
- No known projects

Pth projects in ten countries 2020 – 2030 (MW and # of projects)

Source: Hydrogen Europe
Wind electricity and alkaline electrolysis lead planned capacity

Electrolyzer technology

- ALK leads by providing 76% of the tracked capacity, PEMs share is at 21% and SO at 3%
- More than two thirds of those projects plan to use PEM technology, with 27% choosing ALK and the remaining 4.4% will involve SO

Electricity source

- 77% of announced PtH capacity will be supplied by wind power
- Solar generation constitutes 14% of the announced capacity and 18% of the number of projects

Comments

- 45 out of the 151 tracked projects have already announced their electrolyser technology
- ALK leads by providing 76% of the tracked capacity, PEMs share is at 21% and SO at 3%
- More than two thirds of those projects plan to use PEM technology, with 27% choosing ALK and the remaining 4.4% will involve SO
- The electricity source for new PtH capacity has been announced for 82 of the 151 projects
- 77% of announced PtH capacity and 39% of projects will be supplied by wind power
- Solar generation constitutes 14% of the announced capacity and 18% of the number of project
Low-carbon H2 projects are being developed across Europe

Selection of low-carbon hydrogen projects

1. Acorn CCS / H2
2. Aramis (Blue H2 Den Helder)
3. H21 North of England
4. H2morrow
5. H-Vision
6. HyDemo
7. H2H Saltend
8. HyNet
9. Porthos
10. Preem CCS
11. CCS Ravenna Hub
12. Humber Zero

Source: Hydrogen Europe

Comments

- Five projects in the United Kingdom, three in the Netherlands, and one each in Germany, Sweden, Italy, and Norway
- The H-Vision aims to produce low-carbon hydrogen in Rotterdam by mid-2020 and continue to scale up by 2030 abating around 2.2 million tonnes of CO2 by 2026 and 4.3 million tonnes by 2031
- H21 North of England includes construction of a new 12.15 GW auto-thermal reforming hydrogen generation based on natural gas coupled with CCS in an effort to “convert the North of England to hydrogen between 2028 and 2035”
- H2H Saltend, decarbonization of a chemicals park (including H2 production)
- Humber zero plans to develop a regional hydrogen production hub and decarbonize a refinery
European Hydrogen Backbone as proposed by a group of gas TSOs

- Feasibility study (across 10 EU-countries) from 11 European gas TSOs about integrating hydrogen into the European gas network
- **Rationale**: First connecting industrial clusters, ports and cities in the north of the continent (Belgium, Netherlands, North-West Germany)
- **Instrument**: ¾ as retrofitted natural gas infrastructure (only around 25% of the cost of new dedicated hydrogen infrastructure)
- **Network**: 6,800 km hydrogen network by 2030 and 22,900 km hydrogen network by 2040
- **Cost**: €27-62bn by 2040
- Levelized cost of transporting hydrogen of 0.09-0.17€/kg per 1000km

Source: European Hydrogen Backbone Initiative
Gasunie, Tennet, Dutch Ministry of Economic affairs and Climate are creating a study on the development of a **national hydrogen infrastructure** under the name **HyWay 27**

- In addition, Gasunie continues to work on its hydrogen backbone plans

**Rationale:** Connection of 5 industrial clusters (Zeeland, Rotterdam, Amsterdam, Limburg, North of NL) by 2025 (trans-national expansion planned subsequently)

**Network:** 1,100 km hydrogen network (90% retrofitted gas infrastructure)

**Capacity:** 55 – 120 TWh of hydrogen per year by 2030

**Pressure:** 10 – 30 bar (initial stage) to 30 – 50 bar (later stage)

**Investment:** €1.5 – 2bn

**Current stage:** Market participants query to estimate concrete demand requirements by industry
EU POLICIES IMPACTING THE DEVELOPMENT OF CLEAN HYDROGEN

ALEXANDRU FLORISTEAN, HYDROGEN EUROPE
EU Policies impacting the development of a clean hydrogen economy

Chapter 4 – EU Policies, Legislation, and Incentives:

4.1. ★ The EU’s contemporary energy policy framework
    4.1.1. Laying down the basis: Energy Union, Clean Energy Package, and the EU ETS
    4.1.2. Enhanced climate ambitious: The European Green Deal and its follow-up actions
    4.1.3. The EU Recovery Plan
    4.1.4. Conclusion

4.2. ★ Expectation for future policy developments
    4.2.1. Non-legislative policy initiatives
    4.2.2. Legislative revisions
Evolution of EU Policies on Energy

**ENERGY UNION**
Five fundamental pillars for the EU’s energy system:
- energy security,
- internal energy market,
- energy efficiency,
- decarbonisation, and
- research & innovation

**CLEAN ENERGY PACKAGE**
Implementation of the Energy Union strategy
- Governance Regulation (EU) 2018/1999
- And 6 additional legislations

**EU GREEN DEAL**
“The EU’s new growth strategy”
- Carbon neutrality by 2050
- Upgraded targets
- Revised legislations

**EU RECOVERY PLAN**
• Additional funding opportunities via new schemes or the upgrade of existing ones.
The EU’s contemporary energy policy framework

Clean Energy Package Adoption (2019)


Governance Regulation (EU) 2018/1999


(+ 6 additional legislations)

The basis of the EU’s contemporary energy policy framework (June 2019 and anterior)

The new MFF and the EU Recovery Plan

EU’s Recovery Plan
(updated MFF and Next Generation EU) – Commission’s proposal

EU’s Recovery Plan – Council’s agreement

2019
Dec

2020
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sept

EU Green Deal – Commission’s Communication

European Climate Law – Commission’s proposal

Just Transition Fund – Commission’s proposal

New Industrial Strategy for Europe – Commission’s Communication

The European Green Deal and its derived initiatives

EU’s Hydrogen Strategy and European Clean Hydrogen Alliance – Commission’s Communication

2030 Target Plan – Commission’s Impact Assessment

Source: Hydrogen Europe
Expectation for future policy development

Source: Hydrogen Europe
Expectation for future policy development

Source: Hydrogen Europe
NATIONAL POLICIES AND INCENTIVES FOR DEVELOPMENT OF A CLEAN HYDROGEN ECONOMY

BASTIEN BONNET-CANTALLOUBE, HYDROGEN EUROPE
Chapter 5 – National policies and Incentives:

5.1. ⭐ National hydrogen strategies
   5.1.1. European national hydrogen strategies
   5.1.2. Non-European national hydrogen strategies
   5.1.3. Comparative analysis of national hydrogen strategies

5.2. ⭐ National Energy and Climate Plans (NECPs)
   5.2.1. How prominently is hydrogen featured in NECPs?
   5.2.2. Role of hydrogen across sectoral applications in NECPs
   5.2.3. Conclusion

5.3. National Policies and Incentives on Hydrogen technologies
   5.3.1. Mobility
   5.3.2. Stationary power
   5.3.3. Hydrogen and the gas grid
   5.3.4. Industry
National hydrogen strategies

Publication dates of national hydrogen strategies across the world per country

State of publication of National Hydrogen Strategies in EU/EEA Member States

Hydrogen deployment plan for the energy transition

National strategy for the development of decarbonised hydrogen in France

In preparation:
National hydrogen strategies

How far are we from the 2030 EU target for electrolyser capacity (GW)?

Source: Hydrogen Europe
National Energy and Climate Plans (NECPs)

Where EU Member States lay out the strategies and measures they plan to implement for the period 2021-2030 in order to comply with 2030 energy and climate targets at EU and national levels.

Number of EU MS that mentioned hydrogen in relation with a specific application

Source: Hydrogen Europe
National Energy and Climate Plans (NECPs)

Main applications
where a decarbonisation role is foreseen for hydrogen

‘H2 ambitions’ per country groups
(strictly based on the analysis of NECPs and the place and role they give to hydrogen):
• A ‘leading group’: Austria, France, Germany, the Netherlands, and Portugal.
• A ‘fast follower group’: Belgium, Czechia, Hungary, Poland, Slovakia, and Slovenia.
• A ‘laggard group’ of the others.

The period tackled by NECPs – i.e. 2021 to 2030 – is mainly seen as a phase for:
• the definition of a clear and incentivising legal framework, and
• research and development of the technology (not least with the launch of demonstrators and through increased public funding)

Some NECPs put more emphasis on deployment (e.g. leading group), others on continued research and development.
CLOSING REMARKS

NICOLAS BRAHY, DIRECTOR, HYDROGEN EUROPE
THANK YOU FOR YOUR ATTENTION!

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