Hydrogen production in the context of a just energy transition and regional diversification

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Director of H2 regulatory affairs
8 May 2024
The demand for clean H2 is expected to grow exponentially...

End-use of energy in Europe
2015 – 2050, Mtoe

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>1086</td>
<td>684</td>
</tr>
<tr>
<td>Fossil fuels</td>
<td>66%</td>
<td>20%</td>
</tr>
<tr>
<td>Hydrogen and e-fuels</td>
<td>0%</td>
<td>7%</td>
</tr>
<tr>
<td>Others</td>
<td>22%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Source: European Commission

...as it is necessary to meet strategic goals

- **DECARBONIZE** non-electrifiable energy uses
- Increase penetration of **RENEWABLE** energies
- **INDEPENDENCE** from fossil fuels:
  - Energy Uses
  - Storage
  - Use as raw material
  - Directly or through its derivatives
- Economic and environmental **SUSTAINABILITY**
- Strengthen the **ELECTRICITY** market
Using electricity that comes from fossils is more polluting than producing conventional grey H2, so strict rules for defining renewable H2 are needed.

Without these rules, there would be an increase in the consumption of marginal energy sources on the market, i.e. fossil fuels.

Sources: US Gov, Argonne, Delegated Act 2023/1184
For the adoption of renewable hydrogen today, it is necessary to reduce the "funding gap"... which can be reduced by different types of measures that are being developed by Governments.

<table>
<thead>
<tr>
<th>H2 Production Cost (LCOH)</th>
<th>Price of the fossil alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>€/kg H₂</td>
<td></td>
</tr>
<tr>
<td>~70%</td>
<td></td>
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</tbody>
</table>

- Renewable Electricity and Grid Charges
- Electrolysis CAPEX and other costs
- CO₂
- Transport cost
- Fossil fuel

- "Carrots"
  - Direct subsidies, CAPEX and/or OPEX
  - Regulatory Incentives

- "Sticks"
  - Environmental charges (CO₂,...)
  - Creating Demand Through Obligations
There are already ambitious goals and binding targets already in place in Europe for adoption of renewable hydrogen.

EU has a goal of 20 Mt/yr by 2030...

...but the binding targets are lower

<table>
<thead>
<tr>
<th>Industry sector</th>
<th>Targets approved</th>
<th>RH2 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>2030</td>
<td>42%</td>
<td>~ 2–3 Mt</td>
</tr>
<tr>
<td>2035</td>
<td>60%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transport sector</th>
<th>2030 – General</th>
<th>2030 – Maritime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.5%</td>
<td>1.0%</td>
</tr>
<tr>
<td></td>
<td>1.2%</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

*RFNBO: Renewable Fuels of Non-Biological Origin (=Renewable H2 and its derivatives)

Additionally, there are other EU regulations recently approved that include measures for incentivizing local production of renewable H2 or its derivatives (CO2 free allowances and CO2 indirect costs in ETS, Fuel EU Maritime, Refuel EU Aviation, Carbon Border Adjustment Mechanism CBAM)

EU has a goal of 20 Mt/yr by 2030...

- General industry sector: Target in 2021 ~ 5.6 Mt, Target in 2022 ~ 20 Mt
- Transport sector: Target in 2021 ~ 5.6 Mt, Target in 2022 ~ 20 Mt

Spain has increased ambition in the recent draft National Energy and Climate Plan (NECP) and has funding available in the Recovery Plan (RRP).

**Target installed capacity (GW) of electrolyzers in 2030**

<table>
<thead>
<tr>
<th>Target 2030 roadmap (2020)</th>
<th>Target 2030 NECP Review (2023)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 GW</td>
<td>11 GW</td>
</tr>
</tbody>
</table>

**Commitments made by Spain in the 2026 Recovery Plan regarding renewable H2**

<table>
<thead>
<tr>
<th>#Target RRP</th>
<th>Target</th>
<th>Source: Ministry for the Ecological Transition (Spain)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>136</td>
<td>Authorized electrolysis 500 MW</td>
</tr>
<tr>
<td></td>
<td>134</td>
<td>Singular small projects funded 10</td>
</tr>
<tr>
<td></td>
<td>133</td>
<td>H2 Clusters or valleys funded 2</td>
</tr>
</tbody>
</table>

**Funding for renewable hydrogen**

- 3,000 M€
There are several public funding mechanisms in Europe that are increasing budget progressively, like Innovation Fund, H2 Bank, H2 Global or national instruments.

### Regular grants of Innovation Fund

<table>
<thead>
<tr>
<th>Year</th>
<th>B€</th>
<th>Projects Funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020</td>
<td>1.1</td>
<td>7</td>
</tr>
<tr>
<td>2021</td>
<td>1.8</td>
<td>16</td>
</tr>
<tr>
<td>2022</td>
<td>3.6</td>
<td>41</td>
</tr>
<tr>
<td>2023</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

### H2 Bank (auctions with funds of IF)

- First pilot auction with budget of 800 M€ ended on Feb 8th:
  - Fixed premium €/kg 10 years (max 4.5 €/kg)
  - Not stackable with other funding
  - Germany allocated extra 350 M€ (“auction as a service”)
- Results: less than 0.48 €/kg!!
- Next auction this year budget of 2.200 M€

### H2 Global

- The intermediary company (“Hintco”) carries a double-sided auction of suppliers (Power-to-X projects) and buyers
- The funds from the granting authority cover the difference in price of PtX product between the HPAs and HSAs
- 900 M€ for importing PtX to Germany announced in 2022
- Joint tender Netherlands and Germany announced in 2023 with 300 M€ each
- 3530 M€ announced by Germany in 2024

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Source: European Commission, CINEA, H2 Global
At the national level, there is much that could be done in Spain in terms of incentives and public funds.

**Regulatory Incentives**

- Ambitious roadmap
- Waiver for policy charges in electricity consumption
- Guarantees of origin for renewable H2
- Free CO2 emission allowances
- Compensation for indirect CO2 costs
- Renewable H2 use targets
- Clarity for participating in grid services
- Clarity for injecting H2 into the network
- Temporary grid tariffs exemptions for network use
- Facilitate connection of electrolysis and renewables

**Direct Subsidies**

- PERTE EHRA (aid to H2 producers)
- Define the aid scheme for IPCEI projects
- Increased aid intensity in PERTE (allowed by EU)
- PERTE decarbonisation (aid to H2 consumers)
- Support electrolysis OPEX, e.g. via European H2 bank
Coal plants have the conditions to be repurposed to become strategic H2 export hubs

- Port and potential for **export and bunkering**.
- **Electrical** infrastructures
- Great long-term **renewable** potential (off-shore)
- Potential industrial **offtakers** of the steel, refining, chemical, fertilizer, cement industries,...
- Next to **urban** nodes
- In the planned **hydrogen backbone network**
- Sites of industries **affected by decarbonization** (just transition policies,...)
- Presence of engineering companies, manufacturing of raw materials and capital goods, and R+D
- And **People** skilled in operating industrial plants
EDP has 5 Just Transition projects for each one of its coal thermal sites in 3 regions of Iberia...

Soto de Ribera - Asturias
Aboño
Puente Nuevo - Andalucia
Sines - Alentejo
Los Barrios

...developed around 4 strategic priorities/technologies

- **RENEWABLE ENERGIES**
  - Onshore & offshore wind and PV

- **STORAGE**
  - Liquid air,
  - Melted Salts and batteries

- **GREEN H2**
  - Production, Storage and Supply

- **FLEXIBILITY**
  - Synchronous compensator
EDP’s dedicated hydrogen business unit (H2BU) ensures a consistent and integrated approach to the supply of renewable H2

EDP’s capabilities

- **Renewables**
- **Engineering**
- **Clients**

**Build operational experience**
- 1 project in operation in Brazil (COD Q4 2022)
- 1 project currently under construction in Portugal (COD Q2 2024)

**Demonstrate EDP’s competitiveness**
- 6 Recovery & Resilience Plan projects
- 2 Innovation Funds
- 3 IPCEI Important Project of Common European Interest
- 1 PCI Project of Common Interest

**Create growth opportunities**
- Projects of up to 150 MW being developed, with potential to scale up to >500 MW in some cases
- Integrated planning of different phases
EDP’s projects will promote an integrated renewable H2 value chain in regions like Asturias, Andalucía and Alentejo.

EDP’s projects are at the center of the value chain, in the renewable production, electrolysis and recharging segments.

To complete the chain, collaboration with upstream and downstream companies is necessary.