Low Carbon Day
Hydrogen business strategy

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01. Hydrogen market vision
01. Market Vision

Strong hydrogen market growth

1. Demand growth driven by low carbon H₂
   - EU hydrogen demand – Market forecasts (M tons/yr)

2. Ambitious H₂ development targets in the EU and Spain, supported by public and private funding

3. Recently launched "Fit for 55" regulatory package with ambitious targets supporting H₂ development
   - Strong 2030 penetration targets
     - Min. 50% share of renewable H₂ consumption in industry
     - 2.6% minimum quota of RFNBO³ in transport
     - 0.7% e-fuels share in the aviation fuel mix (5% in 2035)
    - Discount tax rates for the use of renewable and low-carbon hydrogen for end-consumers (based on energy content)

4. Further regulatory support still in progress
   - Economic incentives to ensure low carbon H₂ competitiveness
   - Secondary regulation for H₂ and the 3rd Gas Package review including the contribution of H₂ to decarbonization of gas markets to be launched in December.
   - Technical requirements for production of H₂ and derivatives (e.g. renewable energy feed criteria, requirements on CO₂ for e-fuel production, etc.)

EU - FCHJU¹

€8.5 B

H₂ production market size²

7

20

44

2020

2030

2040

40 GW

Electrolyzer capacity by 2030

89-107 B€

Public & private investment by 2030 (electrolyzers, storage, distribution)

4 GW

Electrolyzer capacity by 2030

9 B€

Public & private Investment by 2030 in H₂-related projects

Spanish government supports deployment of low carbon H₂ under EU funds, with €1.55 B before 2024

1. EU-FCHJU forecast (Fuel Cell and Hydrogen Join Undertaking)
2. Market size estimated with 1.3 €/kg full grey (incl. capex) H₂ production cost (assuming natural gas cost of 20 €/MWh and excluding CO₂ price)
3. Renewable Fuel of Non Biological Origin – H₂ and H₂ derivatives (e.g. e-fuels)
Industry & transport lead market for renewable H₂

Industrial processes and heavy vehicles are the most promising short-term applications

Market development driven by low carbon H₂ competitiveness and lack of alternatives – 2030 view

Legend
- Industry
- Transport
- Power & Heat

Bubble size is proportional to application's CO₂ emissions

H₂ more competitive

Long-term H₂ penetration to be driven by regulation and technology

H₂ in Heavy Vehicles (Incl. RED II)

Ammonia - process

Chemicals - process

Aviation

Marine

Industrial heat

Residential/commercial

Power generation

Power storage

Competitiveness vs incumbent (2030)

Minimum H₂ presence

Medium H₂ presence

Cost parity vs incumbent

H₂ less competitive

Large cost gap vs. incumbent

Steel

Power & Heat

Grid blending

Residential/commercial

Power generation

Power storage

Competitiveness vs incumbent (2030)

Marginal use

Lead H₂ development in the short term supported by regulation

H₂ in Light / commercial vehicles (Incl. RED II)

Refining (Incl. RED II)
01. Market Vision

Regulatory support & Refining competitiveness

EU regulation (RED II&III) can bring competitiveness to renewable $H_2$ produced for refineries

Industrial processes: competitiveness achieved in refining due to $H_2$ for fuel production being included as part of renewable targets in transport

- **Hydrogen cost (€/kg $H_2$)**
  - Full grey $H_2$ production cost: 1.8
  - Green $H_2$ cost 2020: 3.4
  - Green $H_2$ (incl. capex subsidies): 3.1

**CO$_2$ price @ 60 €/ton**

1. Natural gas price 20 €/MWh; range corresponds to CO$_2$ price (from 0 to 60€/ton)
2. 100 MW electrolyser, 1200€/kW of CapEx (full project costs incl. electrical connection, civil, intermediate storage, project costs), 65% electrolyser efficiency, ~70% load factor, range corresponds to power price between 32 and 50€/MWh; additionally considers 6.4€/MWh grid toll.
3. $H_2$ capex subsidies 25% : effective capex 900 €/kw (Total capex 1200 €/kw)
Hydrogen competitiveness

**01. Market Vision**

**Low-carbon H₂ expected to become competitive vs incumbent by 2030-35**

<table>
<thead>
<tr>
<th></th>
<th>Conventional H₂</th>
<th>Low carbon H₂</th>
<th>Renewable H₂</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EU</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>H₂ production cost</strong></td>
<td>1.0-1.5</td>
<td><strong>1.6-2.1</strong></td>
<td>3.4</td>
</tr>
<tr>
<td><strong>Cost excl. capex</strong></td>
<td>1.3-1.8</td>
<td><strong>2.2</strong></td>
<td>1.3</td>
</tr>
<tr>
<td><strong>(€/kg)</strong></td>
<td></td>
<td><strong>1.9-2.4</strong></td>
<td>&lt;2.0</td>
</tr>
<tr>
<td><strong>CO₂ price</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>high range</strong></td>
<td>25-75</td>
<td><strong>2.5</strong></td>
<td>Capex &amp; Opex</td>
</tr>
<tr>
<td><strong>Prod. cost</strong></td>
<td></td>
<td><strong>1.9-2.0</strong></td>
<td><strong>Power</strong></td>
</tr>
<tr>
<td>(incl. low price range CO₂)</td>
<td></td>
<td><strong>1.9-2.0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>1.3-1.8</td>
<td>1.6-1.7</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>2030</strong></td>
<td>1.7-2.2</td>
<td>1.9-2.0</td>
<td>1.6 - 1.8</td>
</tr>
<tr>
<td><strong>2035</strong></td>
<td>1.9-2.4</td>
<td>1.9-2.0</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>CO₂ price (€/ton)</strong></td>
<td>50-100</td>
<td><strong>1.9-2.0</strong></td>
<td>1.3</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>1.4-1.9</td>
<td>1.6-1.7</td>
<td></td>
</tr>
<tr>
<td><strong>2030</strong></td>
<td>850-900</td>
<td><strong>1.9-2.0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>2035</strong></td>
<td>75-125</td>
<td><strong>1.9-2.0</strong></td>
<td></td>
</tr>
</tbody>
</table>

1. 20 €/MWh natural gas price
2. Considers carbon capture of 90% of total CO₂ produced
3. 100 MW electrolyser, 1200€/kW of CapEx (full project costs incl. electrical connection, civil, H₂ intermediate storage, project costs), 65% electrolyser efficiency, ~70% load factor, electricity price 32€/MWh, 6.4€/MWh grid toll.
4. Low range: 100 MW electrolyser, 5796€/kW CapEx, 68% efficiency, ~70% LF, electricity price 25 €/MWh, 6.4€/MWh toll; high range: 100 MW electrolyser, 760€/kW CapEx, 68% efficiency, 70% LF, electricity price 30 €/MWh, 6.4€/MWh toll.
5. CapEx 400 €/kw, 68% efficiency, LF ~70%; electricity price 20 €/MWh, 6.4€/MWh toll, OpEx 24 €/kW
02. Repsol position
Repsol competitive advantages

Leveraging sources of competitive advantage...

- Main H₂ consumer (largest in Spain, and >5% share in the EU)
- Early entry @ scale
- Large potential scale
- Industrial asset base and capabilities
- Integrated position
  - Renewables
  - Commercial
- Iberian location – access to lower cost renewable
- Focused organization

... driving a differentiated market position

- Lower costs for H₂ and e-fuels
- Unique value proposition to end-customers
  - H₂ solutions
  - E-fuels
- Ability to attract partners
  - National
  - International
  - Technology
- Regulatory clout and presence
- Attractive equity story
**02. Repsol Position**

**Hydrogen consumption in Europe & Spain**

**Europe's H₂ market (~6.6 M tons/yr, €8.5 B)** represents c.9% of world market and is concentrated on ammonia and refinery uses.

Hydrogen demand in Europe, 2020 (M tons/yr)

- Refining: 2.7 (41%)
- Ammonia: 0.8 (13%)
- Chemicals - Methanol: 0.7 (11%)
- Others: 6.6

**Spain’s H₂ market driven by refinery end-use, which accounts for 79% of total demand; market size ~ €0.8 B**

Hydrogen demand in Spain, 2019 (ktons/yr)

- Refining: 498 (360 ktpa)
- Ammonia: 116
- Chemicals - Methanol: 13
- Other: 627

**Equivalent electrolyzer capacity (GW)**

- Refining: 41 (CF 95%)
- Ammonia: 56 (CF 70%)
- Chemicals - Methanol: 79 (CF 50%)

Source: IEA; Nexant

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1. Capacity factor; Electrolyzer efficiency ~65%
2. Market size estimated with 1.3 €/kg full grey (incl. capex) H₂ production cost (assuming natural gas cost of 20 €/MWh and excluding CO₂ price)

The Repsol Commitment: Net Zero Emissions by 2050
02. Repsol Position

Present throughout the value chain

1,942 MW Renewable generation

299 MW Storage

552 MWeq H₂ Production

Geological storage

Biomethane production (steam reforming SBR)

Electrolysis

Photoelectrocatalysis

Energy storage

Hydrogen Refueling Station

2,7 MM l/year of e-fuels

INDUSTRY:
refinery, ammonia, methanol, iron/steel industry

H₂ for power/heat

Power storage, injection into grid, residential and commercial, industrial heat and power generation

1. Note: figures as of 2025
03. Ambition
03. Ambition

Current ambition aligned with “Fit for 55” targets

**2025 objective**

<table>
<thead>
<tr>
<th>H₂ capacity objective, 2025 (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repsol H₂ in owns assets¹</td>
</tr>
<tr>
<td>3rd-party assets</td>
</tr>
<tr>
<td>Total ambition (updated)</td>
</tr>
<tr>
<td>Ambition in Strategic Plan</td>
</tr>
</tbody>
</table>

**2030 ambition**

<table>
<thead>
<tr>
<th>Required H₂ capacity vs. ambition, 2030 (GW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repsol min. regulatory requirement</td>
</tr>
<tr>
<td>Repsol H₂ in own assets</td>
</tr>
<tr>
<td>3rd-party assets</td>
</tr>
<tr>
<td>E-fuels</td>
</tr>
<tr>
<td>Total ambition (updated)</td>
</tr>
<tr>
<td>Ambition in Strategic Plan</td>
</tr>
</tbody>
</table>

- **Deployment of electrolyzer capacity in own refineries to develop experience and scale**
  - Developing H₂ hubs around own sites
- **Participation in pilots with 3rd-parties to develop positioning and know-how in new applications**

- **Fit for 55 proposal strongly support renewable H₂ development in Europe:**
  - **Transport:** 2.6% minimum quota of RFNBO² for all transport modes and minimum quota of 0.7% of e-fuels used in aviation by 2030 (5% by 2035)
  - **Industry:** 50% minimum share of renewable H₂ used for final energy and non-energy purposes in industry
  - **Current H₂ ambition in own-assets achieves minimum regulatory targets**
  - **E-fuels plant to strengthen Repsol H₂ position** and increase market share in a highly synergetic long-term business line
  - **Third party volumes to cover additional industrial needs**

1. Including the e-fuel pilot plant in Petronor
2. SBR: Steam biomethane Reforming, renewable hydrogen production from biomethane
3. Renewable Fuel of Non Biological Origin – H₂ and H₂ derivatives (e.g. e-fuels)
04.
Business roadmap
04. Business roadmap

Key financial metrics

Cumulative EBITDA (M€)

-14
1.244
2.369

2022-2025
2026-2030
2031-2035

Cumulative CAPEX (M€)

967
1.582
72

2022-2025
2026-2030
2031-2035

Capacity, End-of-year (GW)
0.5
1.9
1.9

Capex for stack replacement

Note: Considers 20 years lifetime for each project since commissioning, and no terminal value; does not include overhead costs; H₂ price estimated as cost of grey H₂ production alternative (steam reforming) + CO₂ cost + RED II green premium; e-fuel price estimated as diesel price alternative (including hydrocarbon taxes) + RED II green premium; amortization for projects with commissioning date before 2027 of 5 years, for other projects of 20 years; PPAs established before 2027 with high cost (+22€/MWh compared to the base cost of the PPAs signed afterwards)
04. Business roadmap

Pipeline of projects up to 2025

Capex (M€)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Capex (M€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolyzers in Petronor, Cartagena &amp; Tarragona</td>
<td>232</td>
</tr>
<tr>
<td>Biogas in SMR plants across refineries (2025)</td>
<td>273</td>
</tr>
<tr>
<td>E-fuel pilot plant in Bilbao (2024)</td>
<td>32</td>
</tr>
<tr>
<td>Photoelec. in Puertollano (2025)</td>
<td>25</td>
</tr>
<tr>
<td>Pilots in mobility &amp; other industries (2023-25)</td>
<td>48</td>
</tr>
<tr>
<td>Electrolyzers with local partners (2025)</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>611</td>
</tr>
</tbody>
</table>

Capacity (MW)

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Capacity (MW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolyzers in Petronor, Cartagena &amp; Tarragona</td>
<td>200</td>
</tr>
<tr>
<td>Biogas in SMR plants across refineries (2025)</td>
<td>10</td>
</tr>
<tr>
<td>E-fuel pilot plant in Bilbao (2024)</td>
<td>0.2</td>
</tr>
<tr>
<td>Photoelec. in Puertollano (2025)</td>
<td>50</td>
</tr>
<tr>
<td>Pilots in mobility &amp; other industries (2023-25)</td>
<td>60</td>
</tr>
<tr>
<td>Electrolyzers with local partners (2025)</td>
<td>110</td>
</tr>
<tr>
<td>Total</td>
<td>552</td>
</tr>
</tbody>
</table>

1. Assumes sizing of 3.25 MW renewable generation capacity per MW of electrolyzer (70% of Renewables power generation is dedicated H2 production, with the rest fed to the grid); Gross capacity assumes 100% of renewables development in projects in which Repsol's stake is >=50%.
Note 1: Capacities assume a 95% capacity factor;
Note 2: Equity share between 50% and 100% in projects deployed in Repsol refineries before 2025. Equity share for projects deployed in third-party assets in Spain of 50%. Equity share for international projects of 30%;
04. Business roadmap

Production of e-fuels in Petronor

Development of worldwide reference plant to achieve commercial level and leading position in production of synthetic fuels

Investments:
Wind generation, electrolysis, e-fuels plant: €74 M

Production: 50 bbl/d

Partners
04. Business roadmap

SUNRGYZE – Renewable H₂ production technology

Repsol - Enagas partnership: technological development of disruptive and photoelectrocatalytic process for production of cost-competitive renewable hydrogen

- 100% renewable
- 100% CO₂ reduction vs conventional hydrogen.
- Based on the direct conversion of solar energy into chemical energy
- Collaboration with different public and private entities

Co-funded by European Regional Development Funds (FEDER) and EU Innovation Fund

100% renewable
100% CO₂ reduction vs conventional hydrogen.
Based on the direct conversion of solar energy into chemical energy
Collaboration with different public and private entities

Co-funded by European Regional Development Funds (FEDER) and EU Innovation Fund

The Repsol Commitment
Net Zero Emissions by 2050
04. Business roadmap

**Spanish Hydrogen Network (SHYNE) Project**

Repsol with great strengths to be the backbone of the Renewable Hydrogen roadmap and its sectoral integration, together with growing demand for H₂ in the coming years, and the role played by the European Funds, will lead Spanish national project.

Repsol's objective is to **develop a national project** for the deployment of the renewable hydrogen vector, supported by public-private collaboration, which will take the form of the creation/boosting of:

<table>
<thead>
<tr>
<th>1</th>
<th>Multi-sectoral vision</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 hydrogen valleys where they will develop specific renewable H₂ production projects and end uses in industry and transport, in addition to renewable Electricity Generation and Storage Projects.</td>
<td>• Impacts in terms of ecology, job creation, knowledge and technological sovereignty</td>
</tr>
<tr>
<td>2 Transversal Innovation Hubs and 1 Digitalisation and Knowledge Management Hub with R&amp;D&amp;I and technological development, Knowledge Management and Digitalisation projects that guarantee a sustainable economy based on this energy vector.</td>
<td>• Presence in 10 Autonomous Regions</td>
</tr>
</tbody>
</table>

**Project aligned with both the EEFF and the Spain Can Plan**, especially with component 9, based on **technological and sectoral diversification and a coherent systemic approach**

**Tractor effect of SMEs**, with 40 partners involved in the project and will be conveyed through **two relationship models**, strategic agreements and declarations of interest, to **facilitate the governance** of the project and **unify interests** of entities from different sectors and along the value chain.

*Total CAPEX. Repsol's CAPEX is approximately 2,250 M€*
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