EDP Leading the Energy Transition through Innovation
About us

11.6k employees

19 countries

27GW capacity installed

72TWh electricity produced

11.6m clients

4th world wind player
Leading the energy transition to create superior value

**EDP 2030 Vision**

- **Decarbonization**
  - >90% renewables generation
  - Reduce 90% specific emissions (vs 2005 levels)
  - Become coal-free

- **Digitalization**
  - >4 Mn decentralized solar PV panels installed

- **Decentralization**
  - >1 Mn clients with e-mobility solutions

100% smart grids (in Iberia)
Green positioning

Our Decarbonization Commitments

<table>
<thead>
<tr>
<th>% renewables generation</th>
<th>Specific emissions (vs 2005 levels)</th>
<th>Become coal-free before 2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005 20%</td>
<td>2005 628 gCO₂ / kWh</td>
<td>Aboño 1 will be converted to gas (CDD 2022); Aboño 2 as a backup</td>
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<tr>
<td>2019 66%</td>
<td>2019 -66%</td>
<td>No production since Jun-19</td>
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<tr>
<td>2025 &gt;80%</td>
<td>2025 -85%</td>
<td>* Aboño 1 &amp; 2 (0.9 GW)</td>
</tr>
<tr>
<td>2030 &gt;90%</td>
<td>2030 -90%</td>
<td>* Soto 3 (0.3 GW); Sines (1.2 GW)</td>
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**2019 Performance:** Penalized by weak hydro resources in Portugal

**Coal production in Iberia 2019:** -49% YoY

2050: Net zero emissions commitment
EDP Innovation
INNOVATION WORK GROUPS
PROJECTS 2019
About edp innovation

Tech groups
Cleaner Energy
Smarter Grids
Client focus solutions
Energy Storage and Flexibility
Data Leap

Innovation Tools
EDP Ventures
Startup Engagement
Business Transformation
Different Time Frames.

Different Focus

- **EDP Innov**
  - New Markets
  - Emerging Markets
  - Existing Markets

- **BU/CFs**

**Horizon 1**
- Exploration into New Markets
- Adjacent growth
- Sustain

- iPhone 6 => iPhone 6s
- Improvements, extensions, variants, cost reduction, n°1

**Horizon 2**
- Next generation product/service/x for core markets
- iPhone => Apple watch

**Horizon 3**
- New categories that are visionary, transformative and new to the world
- iPhone 6 => Autonomous vehicles

Mature Technology
Emerging Technology
New Technology
The power sector is changing at a swift pace...

... We need to anticipate the trends
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Renewable Energy sources will increase significantly in the next decades leading to excess of energy in certain periods of time
Renewable Energy is driving a new energy vector!
There are some obstacles to worldwide electrification that can lead to the development of a hydrogen economy

AVIATION 100%

SHIPPING 100%

INDUSTRY > 75%
Hydrogen produced today has origins in carbon-intensive sources. As a decarbonization vector, Blue and Green H2 technologies have to reach maturity.

**Black/Grey Hydrogen**

Uses fossil fuels to produce hydrogen using thermochemical processes:
- Coal or biomass gasification
- Steam methane reforming (SMR)

**Blue Hydrogen (Low Carbon H2)**

Produced using the same energy source and process as grey hydrogen but adding CCS to reduce emissions.
- CO2 reduction can reach up to 90%
- CCS remains to be fully proven and can add a significant cost to the process
- Value chain for CO2 need to be developed

**Green Hydrogen (Zero Carbon H2)**

Electrical energy is used to dissociate water into hydrogen and oxygen through electrolysis process.
- Alkaline electrolysis (AEC)
- Proton exchange membrane electrolysis (PEM) – Preferred for RES coupling due to dynamic response time and wider load ranges
- Solid Oxide Electrolysis (SOEC)

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**Production of H2 today**

**CCS**

Share of energy sources used globally to produce hydrogen [2018, %]

- Coal: 18%
- Electricity: 48%
- Natural Gas: 4%
- Oil: 30%

*2 400 TWh

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[1] CCS: Capture and Storage

Source: NREL, Shell, Hydrogen Council, IRENA, H21 North of England, National Hydrogen Roadmap Australia
Hydrogen supply is expected to reach \(~1\ 800\ TWh_{HHV}\) by 2050. Electrolysers capacity is expected to reach 300 GW mostly located in Northwest Europe.

- Currently in Europe, more than 200 TWh_{HHV} of grey H\(_2\) is produced, increasing to \(~1800\ TWh_{HHV}\) in 2050.
- In the next decade, grey H\(_2\) is expected to be converted to blue. As we move towards 2050, green H\(_2\) will assume a greater generation share (>50%).
- Dedicated green H\(_2\) will reach 250 GW, mostly using offshore wind. Production of green H\(_2\) from curtailed electricity is limited.
- 59% of green H\(_2\) will be produced in Northwest EU and 20% in Southern EU.

Source: IHS Markit, Hydrogen: The missing piece of the zero-carbon puzzle
Hydrogen will be a fundamental piece to achieve carbon neutrality and can account up to 16% of final energy demand in 2050

Consumption of hydrogen by sector and H2 percentage of final energy demand in EU 2050 [TWh, %]

- Power sector (storage)
- Residential & services
- Transport
- Industry
- Feedstock

Hydrogen plays an increasingly important role with the growing ambition of decarbonizing the economy

Hydrogen deployment is intrinsically related to the strategy adopted to achieve the decarbonization targets

IHS Markit low decarbonization through $\text{H}_2$ is justified by a high share of oil fuels for transportation sector, specifically for aviation and marine demand

Heating is pointed as the first sector to be converted to $\text{H}_2$ through blending with natural gas

Decarbonization % GHG

- ELEC – Electrification in all sectors
- H2 – Hydrogen in industry, transport and buildings
- COMBO – Cost-efficient combination of options
- 1.SLIFE – Based on COMBO, with lifestyle changes and increased resource and material efficiency

*These scenarios do not include feedstock

Source: EC – A Clean Planet for All, IHS Markit
Exploring New Business Opportunities

Rationale

- Decarbonisation puzzle piece | Address hard-to-decarbonise downstream sectors
- Empowering renewables | Handle renewables’ intermittency and stabilize renewables’ revenue
- Storage and flexibility | Can serve as an energy buffer and a strategic energy reserve

EDP Action Plan

- Power-to-hydrogen in CCGT
  Test the power-to-H2-to-power concept to enhance CCGT’s flexibility
- Offshore hydrogen-wind coupling
  Study a solution to produce hydrogen from offshore wind
- Hydrogen exporting hub and industrial cluster
  Promote a national hydrogen industry and export renewable energy

16% H₂ in final energy demand. Europe, 2050
Innovation is not a lone affair. Open to new ideas.
Promoting a Portfolio

Diversified and Efficient

EDP’s Approach

- Proof-of-concept
- Validate technology
  - Identify and quantify benefits
- Technology to reach commercial stage
  - Address specific supply chain issues
- Reduce LCOE
- Improve data and asset management strategies

Wave Energy/HAVE/Other energies
New Solar Technologies
Offshore wind
Onshore wind/Solar PV Conventional generation
Diversified and Efficient

**WindFloat 1**
- WF1, with a 2 MW wind turbine, completed 5 years of high-availability operation.
- The prototype was successfully decommissioned in July 2016, completing a succeeded proof of concept.
- 2011 - 2016

**WindFloat Atlantic**
- Precommercial floating wind park
- 25MW (3 x 8.4MW)
- Location: Viana do Castelo
- Bankability demonstration
- 2019 COD

**Les éoliennes flottantes du golfe du Lion**
- Pre-commercial project awarded by the French Government
- 30MW (3 x 10MW)
- Location: Leucate Mediterranean
- 2020-21 COD

**Wind offshore project Redwood Coast**
- Public-private partnership with Redwood Coast Energy Authority awarded in March 2018
- 150MW with 8+MW turbines
- 2024 COD
Knowledge-Driven

Solar PV – SunLab I/II
Project focused in increasing the knowledge about solar PV panels but also its O&M (including soiling, degradation and longstanding shadowing) and its impact in the business case of solar farms.

Floating Solar PV
EDPP is testing a Floating PV plant, with potential for places where the available land is scarce, sharing costs of grid connection and potential for increased efficiency.

Solar CPV – CPVLab
Test concentrated solar PV technologies with potential in the medium term to acquire knowledge on performance and O&M of this technology.

Solar Glass-Glass and Bifacial
Test and demonstrate new PV solar technologies that can improve efficiency of solar plants and change radically the business model.

O&M

New Technology