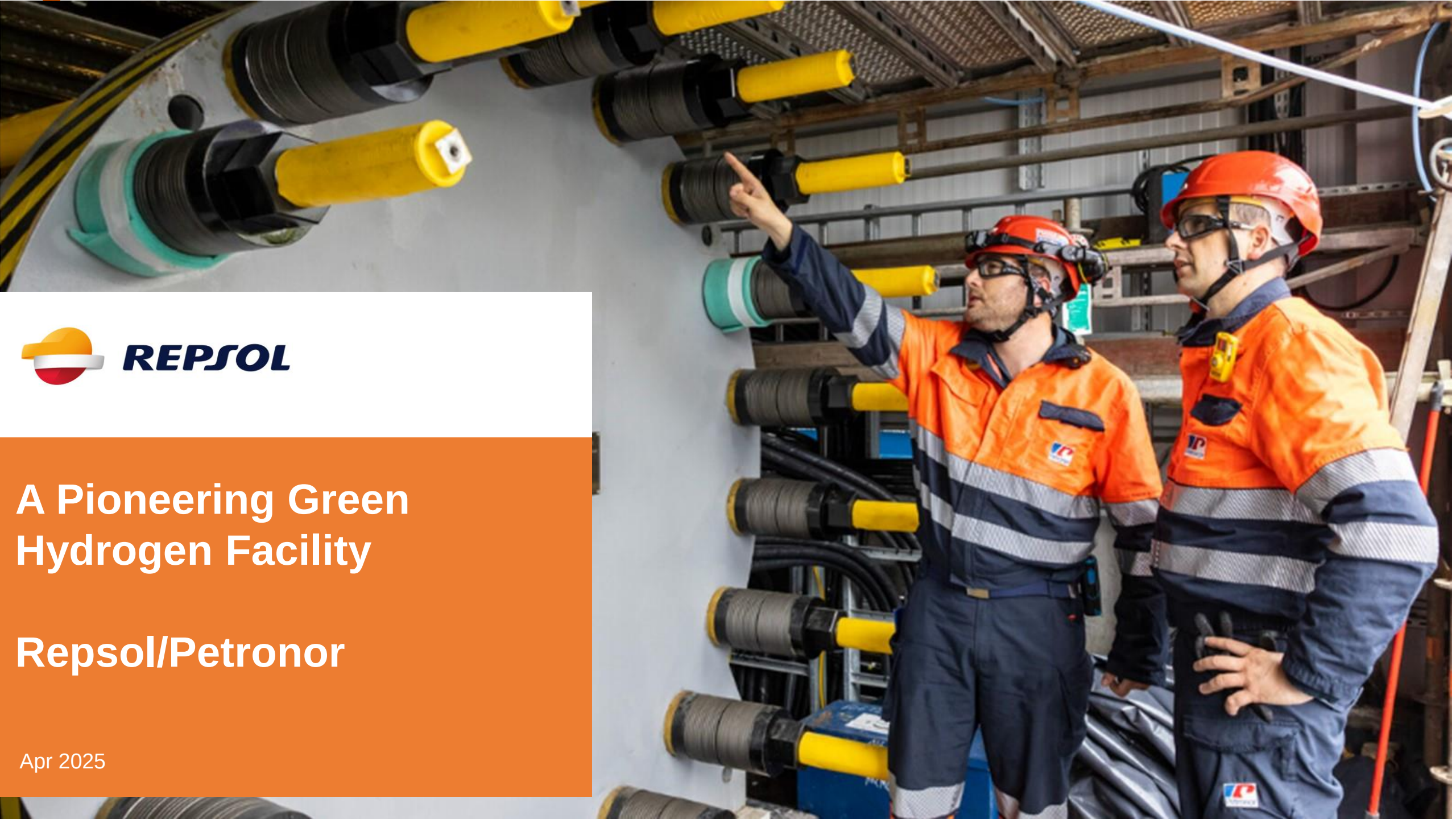

A Pioneering Green Hydrogen Facility

Repsol/Petronor

Apr 2025

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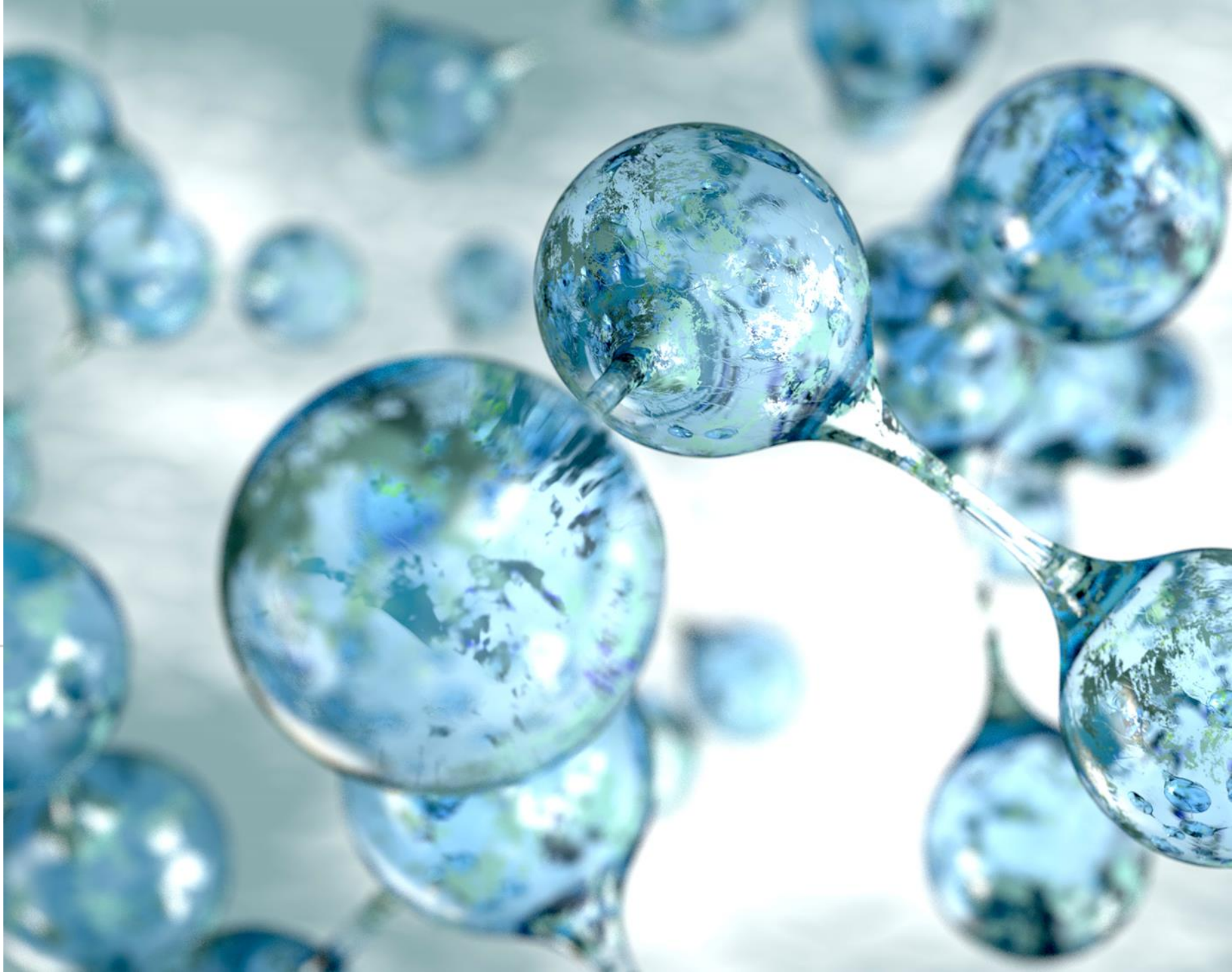
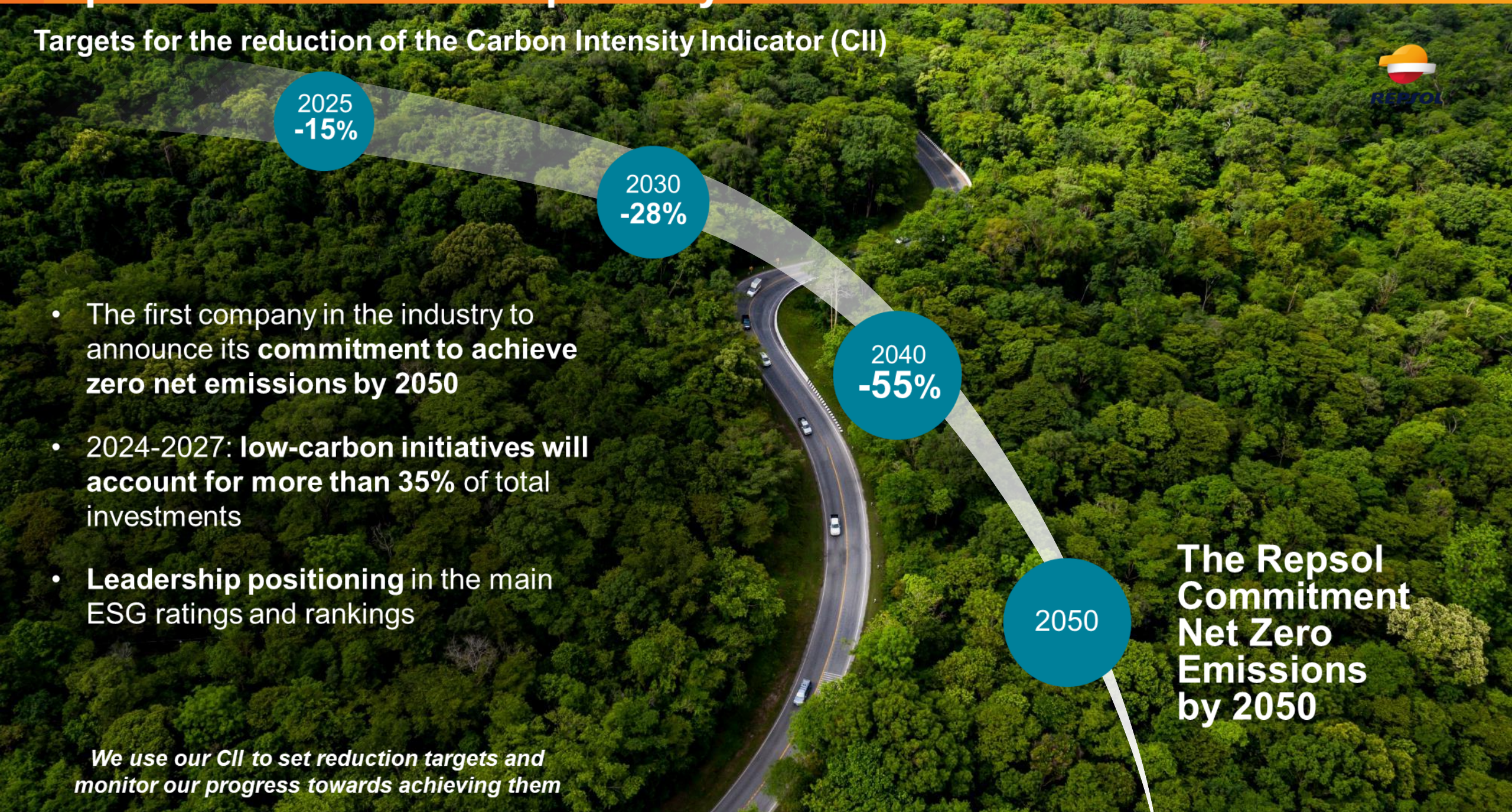
Repsol Strategic Path in Hydrogen



Repsol decarbonization pathway

Targets for the reduction of the Carbon Intensity Indicator (CII)

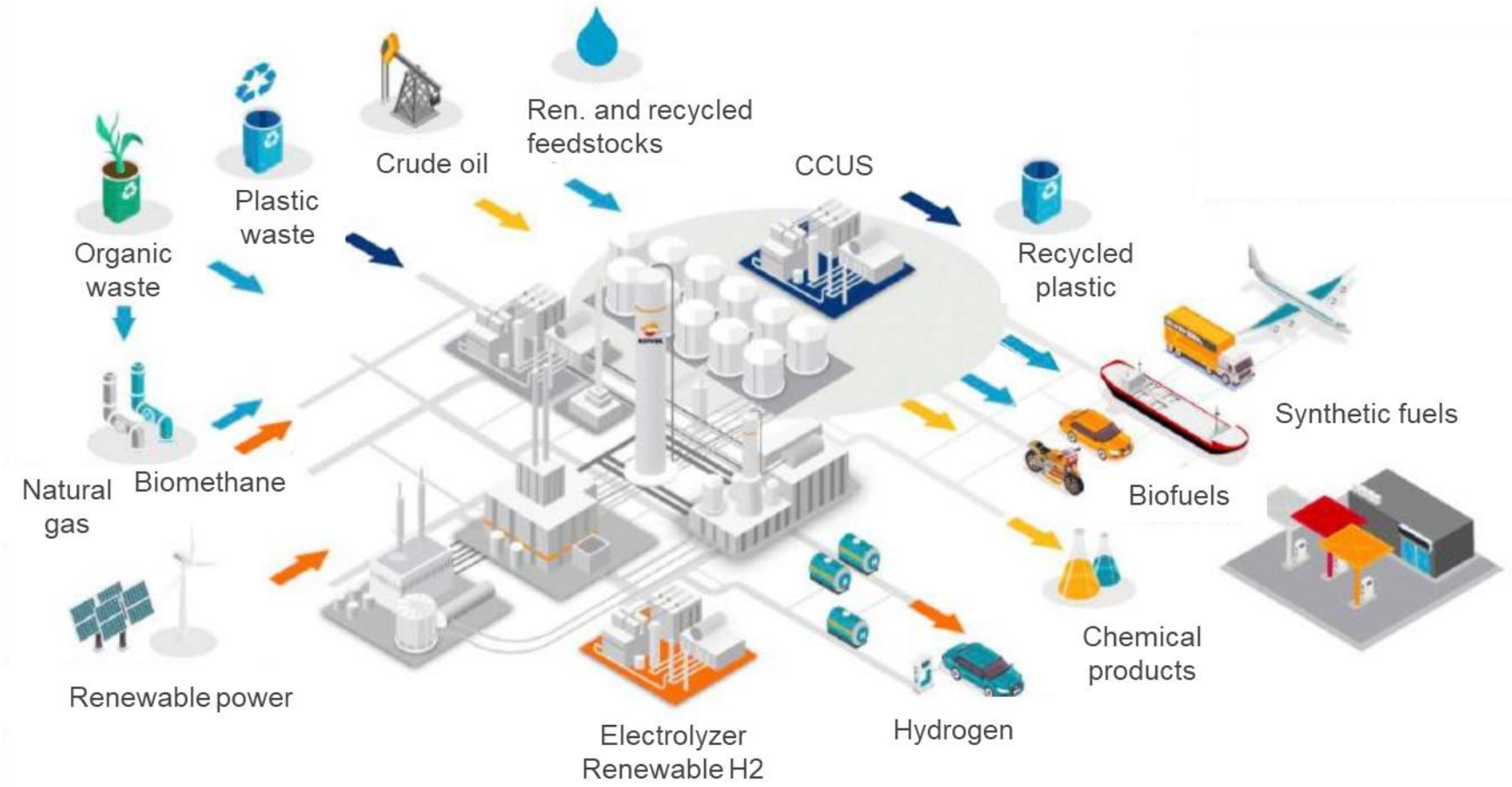


- The first company in the industry to announce its **commitment to achieve zero net emissions by 2050**
- 2024-2027: **low-carbon initiatives will account for more than 35%** of total investments
- **Leadership positioning** in the main ESG ratings and rankings

We use our CII to set reduction targets and monitor our progress towards achieving them

Integrated in the value chain

Transforming Repsol's sites in Iberia into renewable fuel platforms



1 **Renewable hydrogen** from electrolysis or biogas for the production of low-carbon liquid fuels or direct use as fuel gas.

2 Urban, forestry, agricultural and industrial wastes and plastics used as feedstock for **advanced biofuels** or circular plastics.

3 CO2 captured from existing processes used as feedstock with renewable hydrogen for **synthetic fuels.**

4 Renewable electricity and low carbon fuels as a dual platform for **decarbonized mobility.**

- Conventional
- Renewable energy, Renewable H_2 & Biomethane
- Renewable fuels
- Circular materials

Renewable hydrogen ambition

Leveraging Repsol's industrial and partnership capabilities

Repsol is developing new opportunities, building new business, according to policy and market trends

E-fuels plant to strengthen Repsol H2 position and increase market share in a highly synergetic long-term business

Participation in **pilots with third parties** to develop positioning and know-how in new applications

Deployment of **electrolyzer capacity in own refineries to develop experience and scale**. The ambition is under review to consider legislative updates

Portfolio balancing of alternative fuel options, to comply with regulation to reduce carbon footprint

Third party volumes to cover additional industrial needs

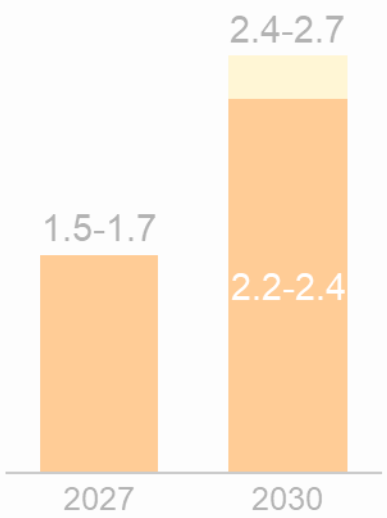
As the largest hydrogen producer and consumer in Spain, utilizing its extensive experience gained from its refineries and petrochemical facilities, Repsol maintains more than 4% of the European Union's hydrogen quota.

Renewable hydrogen deep dive

Growth of low carbon business and progress in sustainability

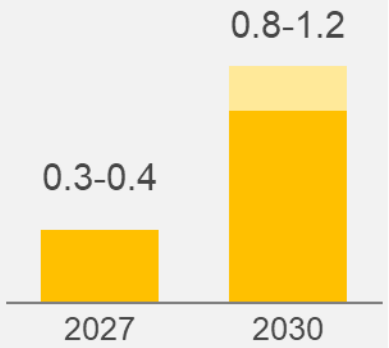
Renewable fuels[1]

Mta

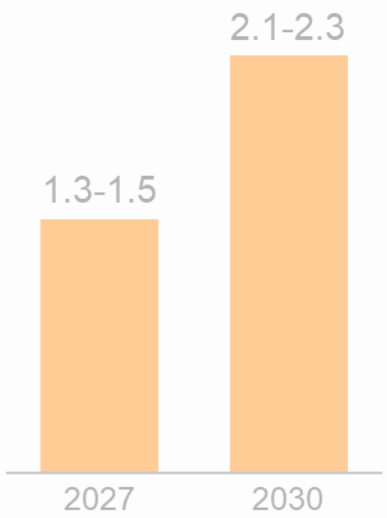


Renewable H_2 & Biomethane

GWeq renewable H_2 [2]

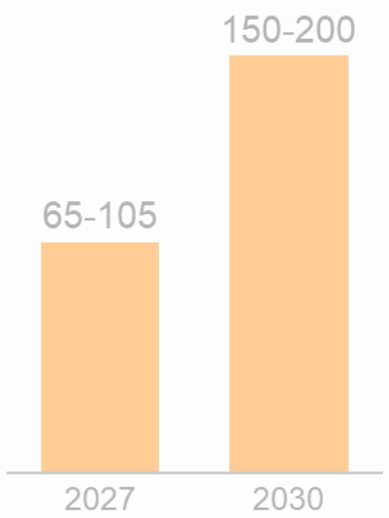


TWh biomethane



Circular + Ren. chemicals[3]

kta[3]



Emissions reduction (Scope 1 & 2)[4]

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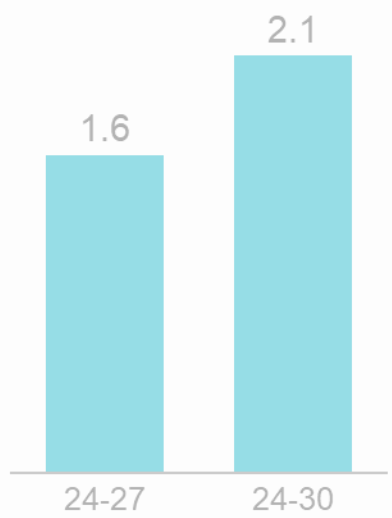


Iberia International (US)

Targets and Capex to be adapted according to opportunities driven by regulation and market development

1. Includes bioETBE and H2 as intermediate 2. Includes 0.35 GW equivalent capacify of biomethane SMR from 2025 3. Range between production and sales 4. Includes refining and chemicals facilities

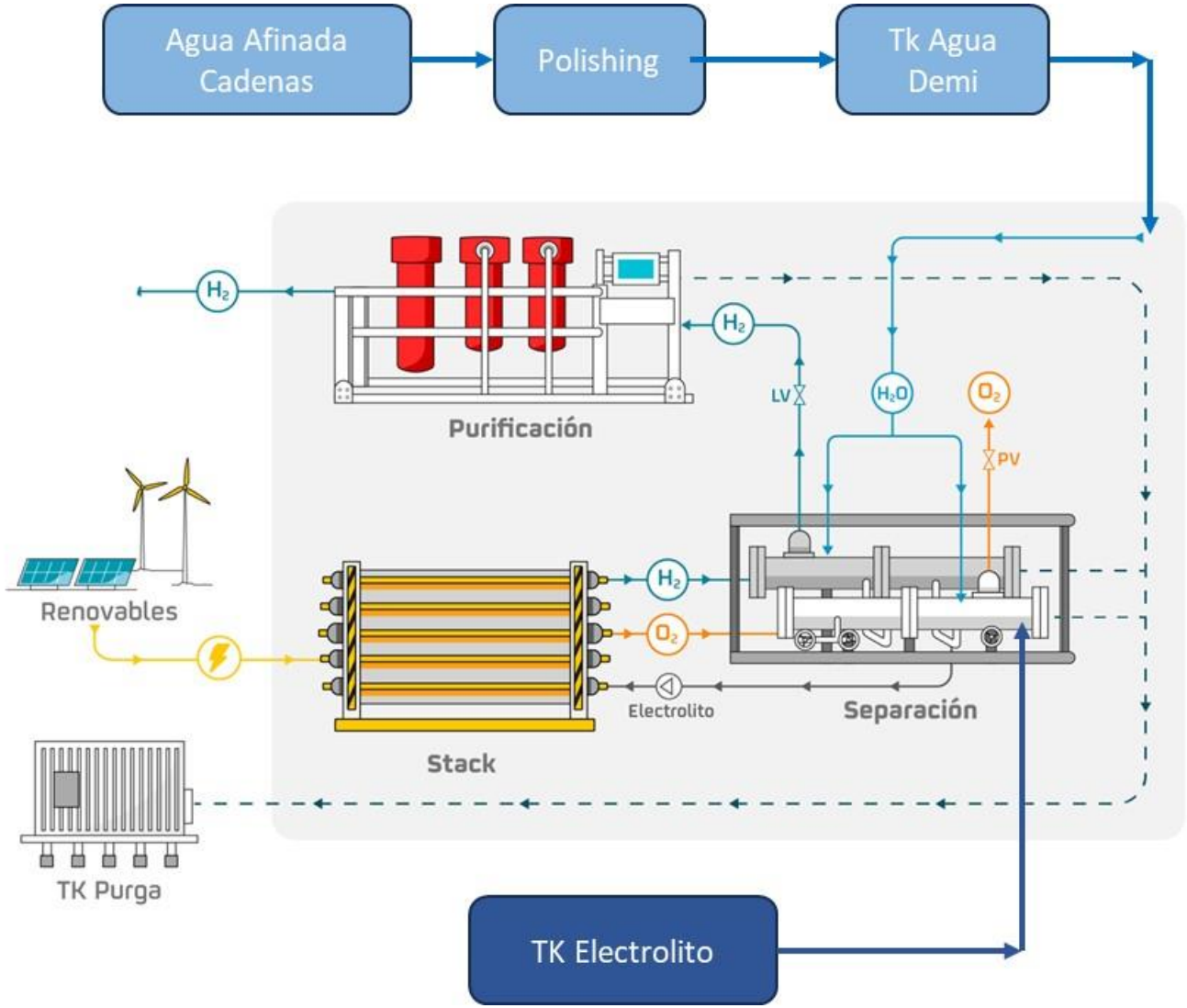
Bilbao Petronor

The Petronor refinery in Muskiz is the largest industrial consumer of hydrogen in northern Spain, with an annual consumption of 50,000 tons. The refinery's hydrogen production currently generates approximately 400,000 tons of CO_2 emissions per year.

Petronor 2.5 MW

The 2.5 MW electrolyzer project at Petronor is Repsol's first to produce renewable hydrogen on a demonstration scale in an industrial complex.

Petronor 2.5 MW Electrolyzer



- **Technology**: Low-temperature alkaline
- **Technologist**: John Cockerill. Model DQ 500
- **Plant Capacity**: 2.5 MW
- **Stack**: 2.5 MW
- **Production**: 500 Nm3/h / 45 kg/hr / 375 tons/year
- **Efficiency BOL**: 4.66 Kwh/Nm3 / 52 MWh/ton / 65% (LHV)
- **Purity after purification**: 99.999%
- **H2 outlet pressure**: 30-31 barg
- **H2 outlet temperature**: <50ºC
- **Operating temperature**: 85 ±5ºC

Technological Choices

Repsol's technology neutrality emphasizes mitigating supply chain risks, assessing development potential, and maintaining flexibility to adapt to technological advances.

The choice of alkaline technology based on

- Technological development potential

  ✓ Both alkaline and PEM technologies have similarities in efficiency and operating range, but in 2021, alkaline technology had more production benchmarks and lower capital costs.

- Mitigate risks associated with the supply of critical metals.

- Supply chain security based on European Manufacturing.

Project Objectives

The project aims to integrate various hydrogen applications, develop internal expertise, and initiate the deployment of the hydrogen network and mobility infrastructure.

Integration of hydrogen uses and initial phase to start deployment of hydrogen pipeline and mobility infrastructure

To integrate, at an appropriate initial scale, different uses of H_2, as a test bed to help leverage regulation and as a basis for future larger-scale projects.

- Refinery.
- Mobility logistics
- Residential sector in the Abanto Technology Park
- Hydrogen distribution by pipeline

Internal knowledge and skill development.

To generate internal knowledge and experience within Repsol in the engineering, commissioning, process integration, and operation of hydrogen assets, and their integration into industrial hydrogen networks.

Develop digital tools.

The project aims to develop digital molecular traceability tools to certify the renewable origin of hydrogen and issue Guarantees of Origin (GOs), as well as tools to optimize the use of renewable resources.

Petronor 2.5 MW Electrolyzer journey

The journey began in March 2021, and it took two years until obtain the first molecule of hydrogen

March 2021
Approval of Conceptual Engineering

September 2021
Investment Approval

January 2022
Positive resolution MNS AAI

July 2022
Construction Permit

August 2022
Start of Works

September 2022
AAP & Project Authorization

Oct 2022
Start installation of equipment.

April 2023
Stack Installation

October 2023
First Energization Test

Opening

October 2024
Plant ready for stable operation

Petronor 2.5 MW Electrolyzer lessons learned

Lessons learned during execution and commissioning

Effective coordination among various disciplines

To ensured that all aspects of the project were aligned and potential issues were addressed promptly.

Clearly defining the critical stages of the project

Essential for the successful execution of simultaneous work on different tasks by multiple teams, while maintaining safety and efficiency.

Adaptation to new services not previously available at the refinery, such as oxygen lines

Specific installation procedures and thorough cleaning of the circuit are required.

Compact design considerations versus complicated operational and maintenance activities

Need to balance compact design with practical operability and maintainability.

Programming and Synchronization between the PLC (Programmable Logic Controller) and the transformer-rectifier

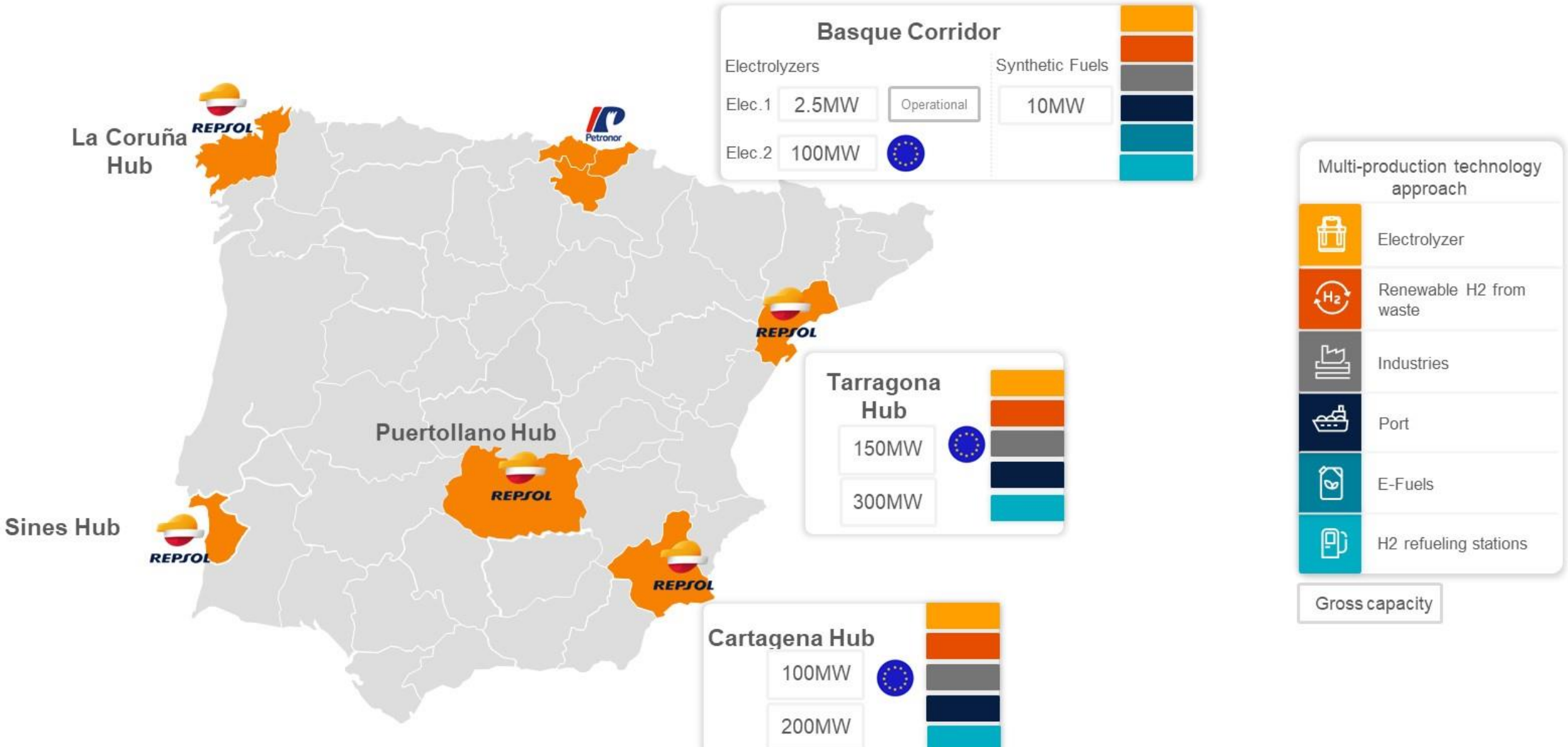
To ensure proper communication and startup sequence.

Stabilization of internal components of the stack

Small particles from the component of stack clogging the filters. Robust filtration systems and initial cleaning protocols are required.

Next steps: industrial scaling

Repsol is ready to develop the next renewable hydrogen projects at all Repsol's industrial facilities in Iberia




2,5MW
Electrolizador
Elektrolizagailua
REPSOL
¡Thank you!