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Ecoplanta Project: a technology-driven business opportunity

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ESG Day 2022
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02. Gasification technology and Repsol

03. Enerkem and Repsol fit

04. Ecoplanta Project
01. Repsol’s ambition and context
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Renewable fuels and circular economy targets

**Renewable fuels**: Increase our Low Carbon Fuels Production Capacity to 2Mty by 2030

**Hydrogen**: Goal to reach a H₂ capacity of 552 MW equivalent in 2025 and 1.9 GW in 2030

**Circularity**: Recycling equivalent to 20% of our polyolefins production by 2030

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**H₂ net capacity objective (GW)**

- Ambition 25: 0.6
- Repsol H₂ in own-assets: 1.0
- E-fuels: 0.4
- 3rd-party assets: 0.5
- Ambition 30: 1.9

**Recycled Products (Mt/y)**

- Total: 20%
- 0.36 Mt/y
- Mechanical Recycling: 0.004 Mt/y
- Chemical Recycling (Pyrolysis): 0.14 Mt/y
- Chemical Recycling (Gasification): 0.17 Mt/y

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**Biofuels**
- 2020: 0.7 Mt/y
- 2025: 1.0 Mt/y
- 2030: 1.1 Mt/y

**Synthetic fuels**
- 2020: 0.3 Mt/y
- 2025: 0.1 Mt/y

**Other renewable fuels**
- 2020: 0.6 Mt/y
- 2025: 1.0 Mt/y
- 2030: 1.1 Mt/y

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**Hydrogen in own-assets**

- 2020: 0.006 Mt/y
- 2025: 0.08 Mt/y
- 2030: 0.17 Mt/y

**Ambition**

- 2020: 0.006 Mt/y
- 2025: 0.08 Mt/y
- 2030: 0.17 Mt/y

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**ESG Day 2022**
In the current context, four main trends are encouraging the development of sustainability fuels and materials for Europe and Spain:

**Energy transition and independence**
- Decarbonization: Fit for 55 sets targets to reduce greenhouse gas emissions by at least 55% through different regulatory proposals, including:
  - RED II revision (RED III)
  - ReFuelEU aviation
  - FuelEU maritime
  - Energy Taxation Directive (Directive 2003/96/EC)
- European energy independence: REPowerEU accelerates energy transition to decrease dependency of fossil fuels coming from Russia

**Circular economy regulatory push**
- Circular economy regulatory measures will stimulate a feedstock market to be recycled or recovered:
  - Waste Framework Directive (under revision) to ban landfilling
  - Packaging and Packaging Waste Directive (under revision)

**Client demand**
- Relevant companies in airlines and chemicals sectors are pledging to become net zero and demanding sustainable products such as renewable fuels (i.e. SAF, methanol) and sustainable chemicals in response to customer demands and to shareholders' pressure
- Circular plastics have a low impact on final end customer manufactured goods prices

**Commodity prices**
- Natural gas prices could remain structurally higher than historical values in the long term due to substitution of Russian pipelined natural gas by LNG
- CO2 emission prices have also significantly increased and will increasingly play a relevant role in production costs and make profitable technologies to reduce emissions (that were not viable with historical prices)
02. Gasification Technology and Repsol
Gasification Technology and Repsol

Gasification role in Repsol's Industrial decarbonization roadmap

**Feedstock**
- MSW (Municipal solid waste)
- Mixed plastic waste
- Biomass (forestry and agricultural waste)

**Gasification process**
1. Pre-treatment
2. Gasification
3. Reforming & Quenching
4. Syngas conditioning and cleaning

**End products**
- Renewable / Circular syngas
- Chemicals
- Biofuels
- E-fuels

Gasification technology is fundamental in Repsol's Industrial businesses decarbonization roadmap.

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1. **Flexibility**
High flexibility to process heterogeneous feedstocks (e.g. MSW low purity requirements and contaminants).

2. **Versatility**
Syngas production from waste has a large potential to decarbonize industrial processes as well as transportation and chemical applications due its flexibility.

3. **Efficiency**
Key in the hybridization pathway as the most efficient way to produce E-fuels, and synergies with renewable H2 for chemicals production.

4. **Maturity**
Higher maturity and utilization of the technology for greater short-term value capture.

5. **Scalability**

6. **Sustainability**
EU Green Deal and Fitfor55 goals.
- Transportation → (advanced bios)
- Chemicals → (circularity/bios)
03.
Enerkem and Repsol fit
Enerkem and Repsol fit

Enerkem is the preferred gasification technology

**Feedstock**
- Municipal solid Waste (MSW)
- Mixed Plastic Waste
- Biomass Residues

**Primary transformation**
- Waste Pretreatment
- Gasification (syngas)

**Secondary transformation**
- Fisher Tropsch
- Enerkem Alcohol to Olefins
- Olefins to Jet
- Syngas to Methanol
- Under development

**Products**
- SAF/Fuels
- Olefins
- SAF
- Methanol
- Ethanol

Enerkem technology is highly flexible and compatible with other post-syngas technologies

- Own technologies available – syngas to methanol – and under development – alcohol to olefins
- Flexible to integrate with 3rd parties

Enerkem’s value chain

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Enerkem and Repsol fit

Enerkem as the preferred gasification technology

Most mature gasification technology
- 6 years of experience operating and developing technology at large scale
- High waste pre-treatment flexibility and process stability

Large experience in adapting the feedstock to maximize yields

Demonstrated capacity to improve syngas production and integrate new downstream technologies

Strong recognition by several agencies and partners – e.g. selected for European Commission Innovation Fund (Ecoplanta project)

Commercial deployment roadmap in place, with a strong project pipeline. Partnering with top players for plants development
Enerkem and Repsol fit

In April 2022 Repsol invested C$170 million in Enerkem (C$75 million in equity and C$95 million in convertible debt) becoming a strategic shareholder.

What did Enerkem seek in Repsol?
Repsol can speed up Enerkem’s project rollout in Iberia.

- Repsol is the main H2 producer and Iberia has competitive renewable energy for green H2
- Well positioned in the waste ecosystem
- Industrial asset base and operation
- Offtake integration → leader in trading and marketing
- Experience licensing proprietary Technology to third parties
- Strong track-record of world-scale projects

What did Repsol seek in Enerkem?
Enerkem, a good partner to meet Repsol’s decarbonization goals.

- Preferential access to advantageous technology
- Access to new projects in Iberia
- Early investment in a technology company with value upside potential
- Opportunity to develop competitive advantages in a new technology
- Technologist of choice for joint developments
04. Ecoplanta Project
Highly innovative waste-to-methanol process (I/II)

The project

Located in El Morell, Tarragona. It would be the first plant in Spain to transform non-recyclable municipal solid waste into renewable/circular methanol to be used in the manufacturing of new materials and advanced biofuels.

This plant, which is expected to be in operation by 2026, will process around 400,000 tons of non-recyclable municipal solid waste from "ecoparks" — waste recovery and treatment plants — from surrounding regions.

The waste will be used to produce around 240,000 tons of renewable/circular methanol, a compound that serves as a raw material for the production of circular chemical products and advanced biofuels.

The technology

By subjecting non-recyclable municipal solid waste to specific pressure and temperature conditions, the molecules are broken down into their essential compounds. This process transforms it into a synthetic gas (syngas) that, once cleaned, can be transformed into renewable/circular methanol.

It is a highly innovative technology and will be a first of a kind plant. The process will allow to treat high volumes of waste (~400kt/y) with high flexibility in terms of composition.

GHG emissions reduction

- Achieve a reduction of 3.4 Mt CO2eq of greenhouse gas (GHG) emissions during the first ten years of operation.
- Recycle more than 70% of the carbon present in the waste.
Highly innovative waste-to-methanol process (II/II)

Ecoplanta will process the non recyclable waste from Ecoparks that currently end up in landfills.

The project is aligned with the EU and national directives in terms of reduction of waste to landfill and increasing recycling rates. The EU Waste Directive (2008/98/CE amended by 2018/581) sets ambitious goals:

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<th>2030</th>
<th>2035</th>
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<tr>
<td>% waste to landfill reduction</td>
<td>20 %</td>
<td>10 %</td>
</tr>
<tr>
<td>% material recycling</td>
<td>60 %</td>
<td>65 %</td>
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The process will produce around 240,000 tons of renewable/circular methanol, that can be used for:

- Production of circular chemical products: material valorization to manufacture chemical products (paints, resins…) and circular plastics (through the production of circular ethylene)

- Advanced biofuels: according to the EU REDII directive, the biomethanol produced will be considered an advanced biofuel used initially for road transport. Additionally, methanol can be used to decarbonize “hard-to-abate” sectors such as maritime transport and aviation with further processing.
03. Ecoplanta

**Project summary**

- **Municipal solid waste (MSW) ECOPLANTA**
  - ~400 kt

- **Syngas**

- **Hydrogen** ~24 kt

- **Renewable and circular METHANOL** ~240 kt

- **Recycling over 70%** of the carbon present in the residual waste.

- **Startup in 2026**

- **Investment of ~800 M€** including the electrolyzer

- **3.4 Mt CO2eq of greenhouse gas (GHG) emissions reductions** over the first ten years of operation.

**Circular Chemicals**

**Advanced biofuels**

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03. Ecoplanta

Calendar

- **2011**: Urban planning report
- **Q2 2022**: Presentation of IEA (Integrated Environmental Authorization)
- **2023**: Administrative authorization
- **2023-2025**: Works and construction
- **2026**: Commissioning
Ecoplanta is aligned with EU policies

**Innovation Fund Program**

Ecoplanta has been selected by the European Union commission to be funded through the Innovation Fund program.

It is one of the seven projects chosen out of more than 300 applicants.

Ecoplanta is the only large-scale project awarded in Spain.

The Commission has highlighted the innovative technology, the decarbonization obtained with the process and the possibility of scalability.

**EU Taxonomy eligibility**

Advanced bio methanol production and material recovery of non-hazardous waste are Ecoplanta’s eligible activities for climate change mitigation.
Repsol, partner of choice due to Enerkem & Ecoplanta

- Early positioning in Renewable/Circular syngas and secondary transformation products of syngas (marketing of Low Carbon products)
- Shareholder of the most advanced gasification technologist
- A better and more complete proposal for waste managers, integrating with the waste requirements of other internally developed technologies such as pyrolysis
- First EU project, first MeOH beta in the EU
- Early player with operational capabilities on this route

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October 4th, 2022