iCAREPLAST: Integrated Catalytic Recycling of Plastic Residues Into Added-Value Chemicals

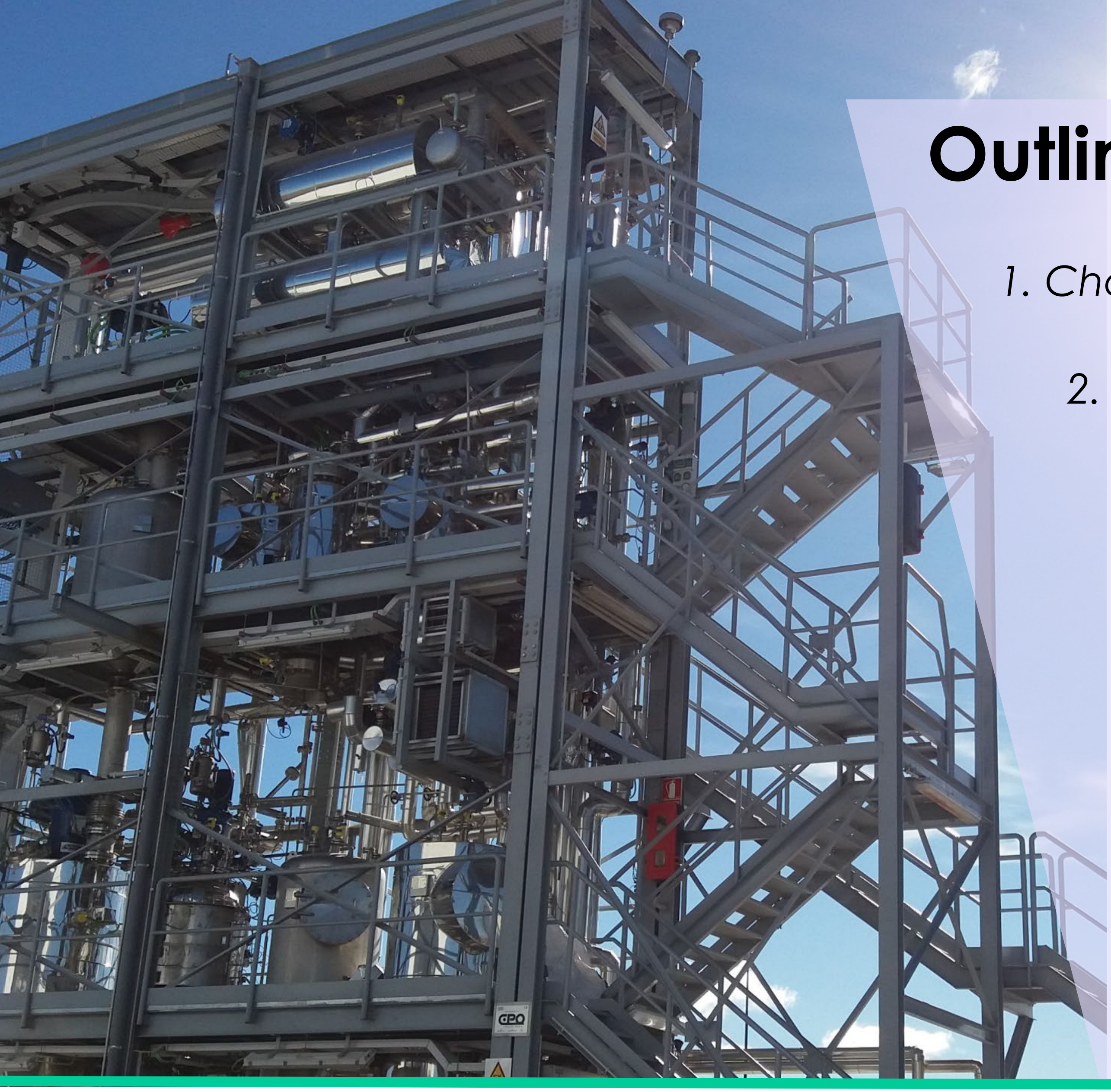
BlackCycle Workshop

L. Almar

22nd November 2021

This project has received European Union’s Horizon 2020 research and innovation funding under grant agreement N° 820770.

Sustainable Process Industry through Resource and Energy Efficiency

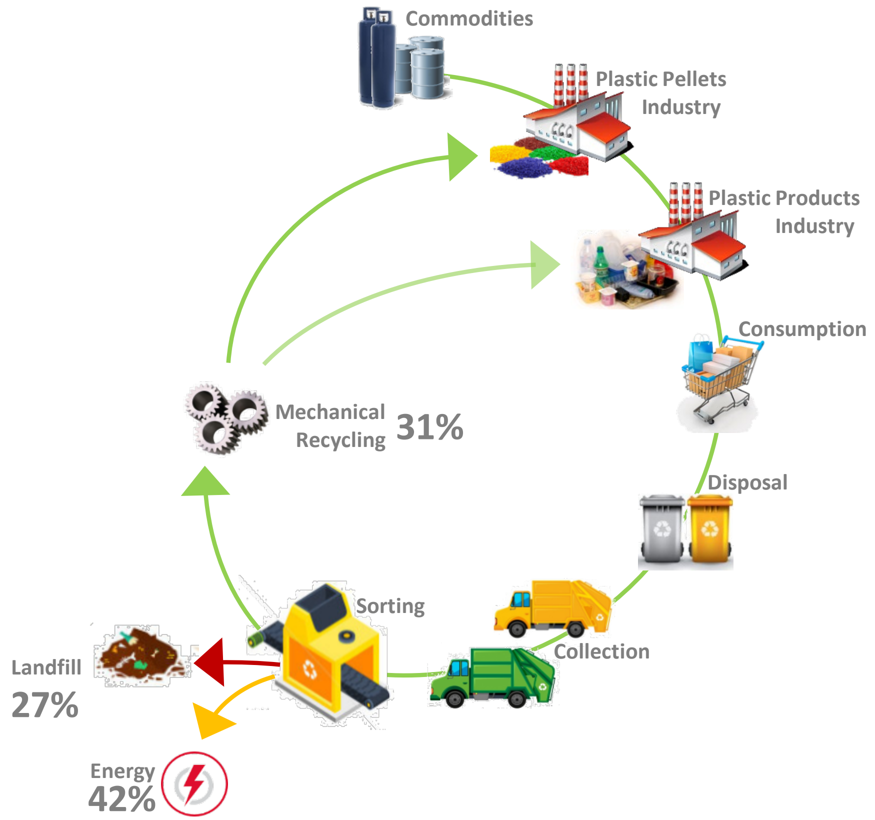


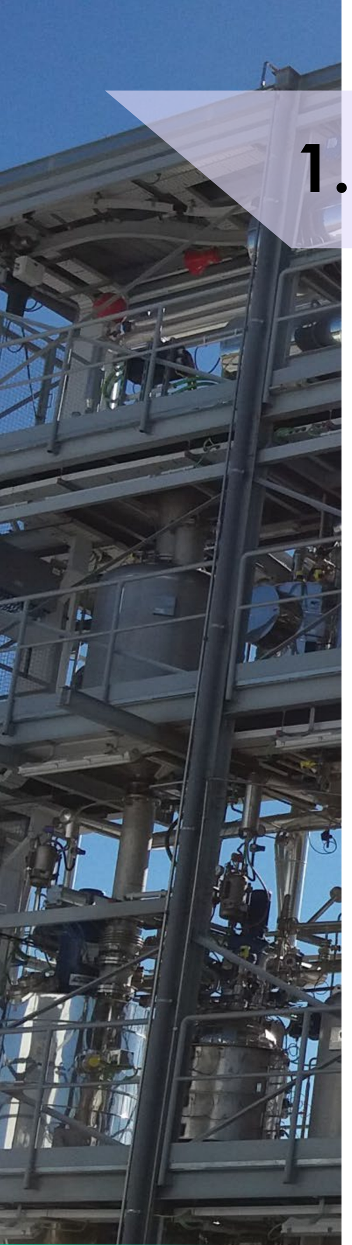
Outline

This project has received European Union's Horizon 2020 research and innovation funding under grant agreement N° 820770.

1. Challenge: Closing the Plastic Recycling Loop

- 27.1 Mt/year Plastic waste recovered in EU
- Only ca. 31% is efficiently recycled
- 70 % ≅ **18.5 Mt/year NOT RECYCLED**
  - ⇢ 42% Incineration
  - ⇢ 27% Landfill





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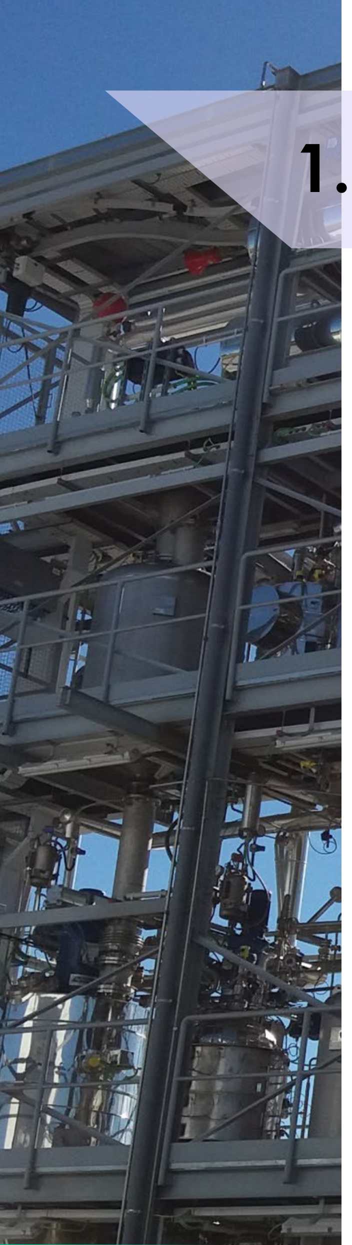
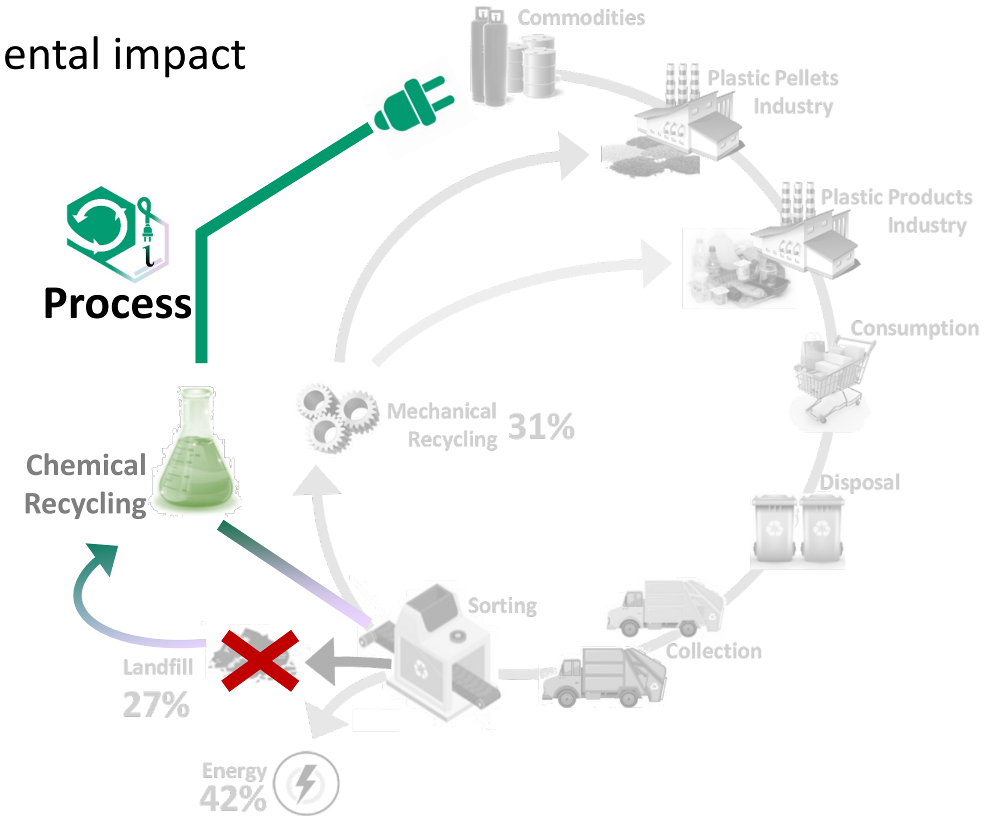


1. Challenge: Closing the Plastic Recycling Loop

EFFICIENT & SUSTAINABLE
in terms of products, energy-cost and environmental impact
integrate use of renewable energy resources

FLEXIBLE
suitable for treating heterogeneous plastic materials operation flexible

INTEGRATED
with current value chains



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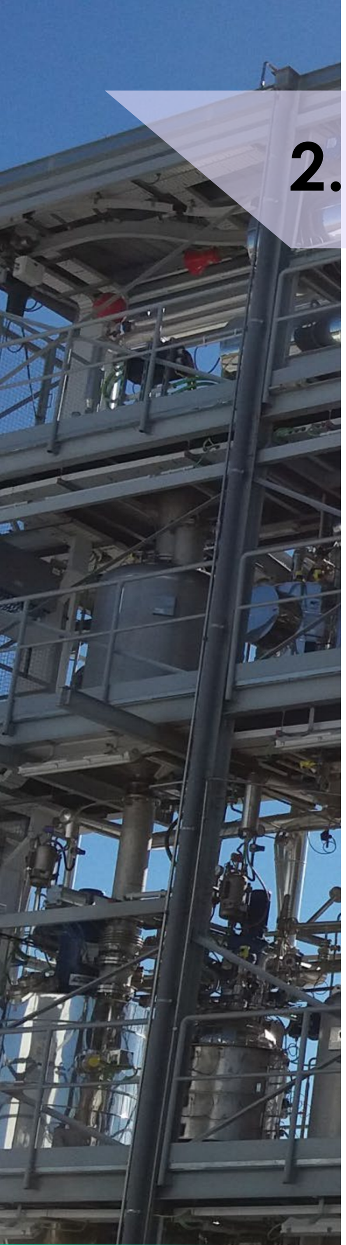
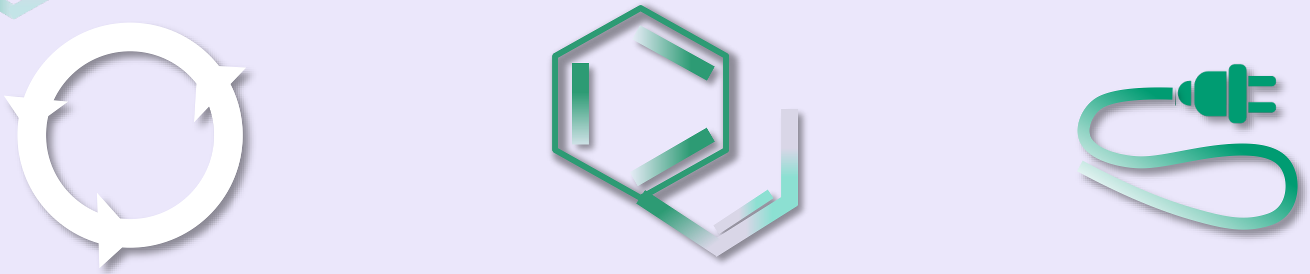


2. Mission



Plastic Recycling and Valorisation

Added-Value Chemicals (alkyl-aromatics)

Energy efficiency Sustainability

iCAREPLAST addresses the **cost and energy-efficient recycling** of a large fraction of today's non-recyclable plastics and composites. The process combines **chemical routes** (catalytic and separation steps) to produce **valuable chemicals**.

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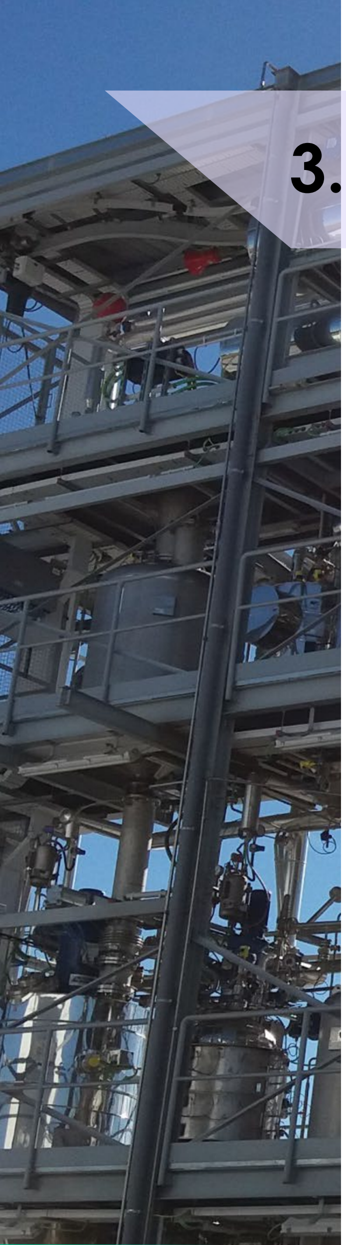


3. Consortium

10 Partners from 5 countries – interdisciplinary and across sector

Leading experts teaming up for an excellent consortium

Advisory Board

- Air Liquide
- Shell
- P&G Procter & Gamble
- Fundación Comunidad Valenciana Región Europea

Imperial College London

- ITQ
- CSIC Consejo Superior de Investigaciones Científicas
- ai2 Instituto de Automática e Informática Industrial
- urbaser
- Universitat Politècnica de València
- KERIONICS

LNEG

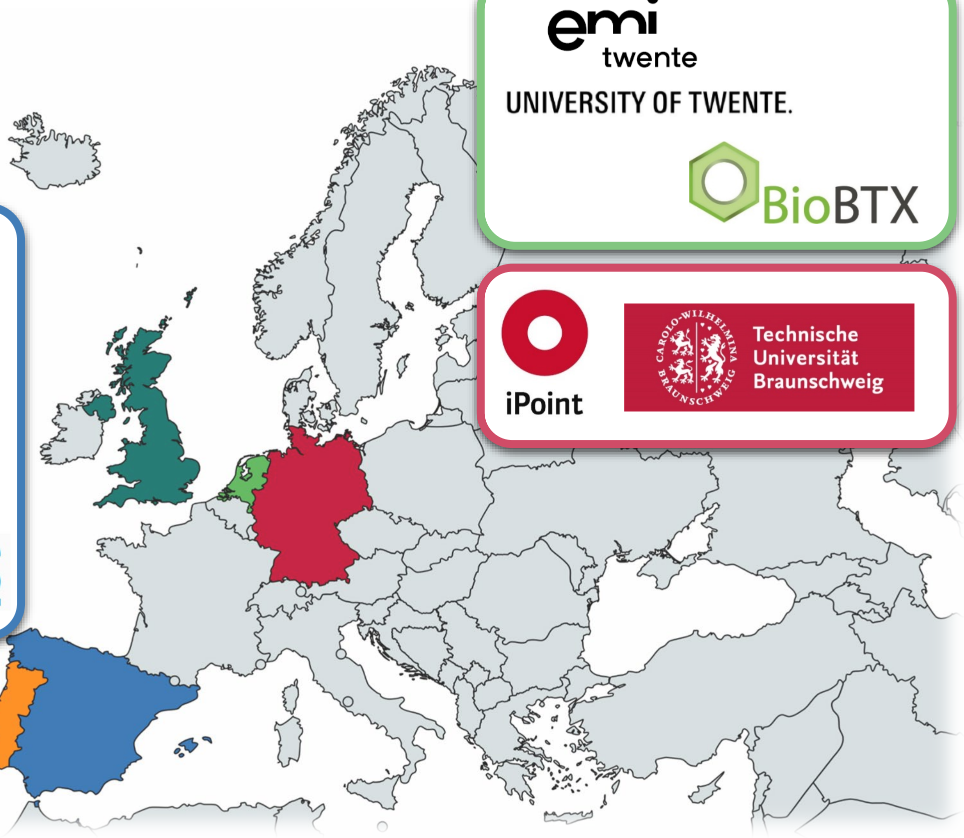
emi twente

University of Twente

BioBTX

iPoint

Technische Universität Braunschweig



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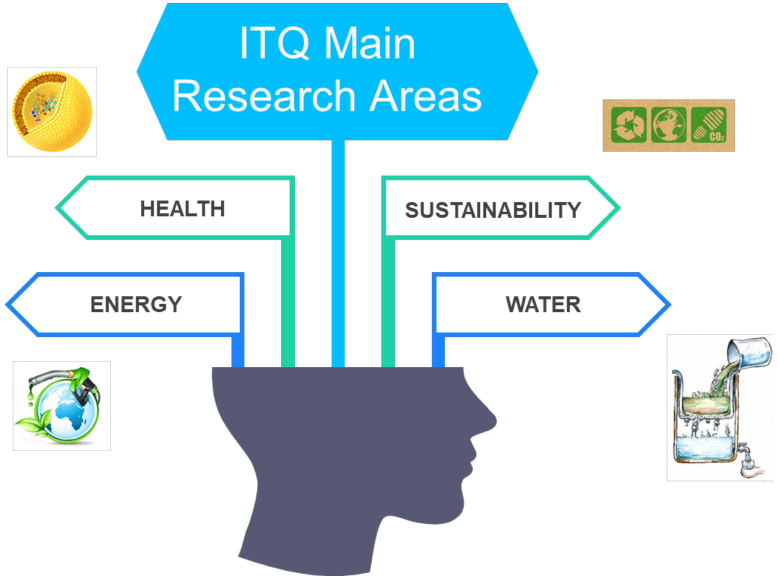
3. Consortium – Project Coordinator ITQ (UPV-CSIC)

The Instituto de Tecnología Química (ITQ) is a joint research center created in 1990 by the Universitat Politècnica de València (UPV) and the Consejo Superior de Investigaciones Científicas (CSIC) located at the UPV Campus. It is an international reference centre in the area of **catalysis and new materials** (specially zeolites).



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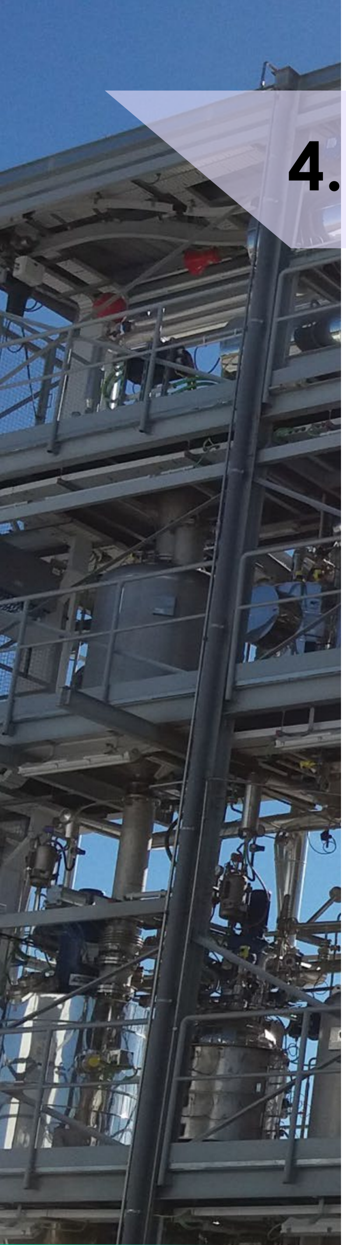
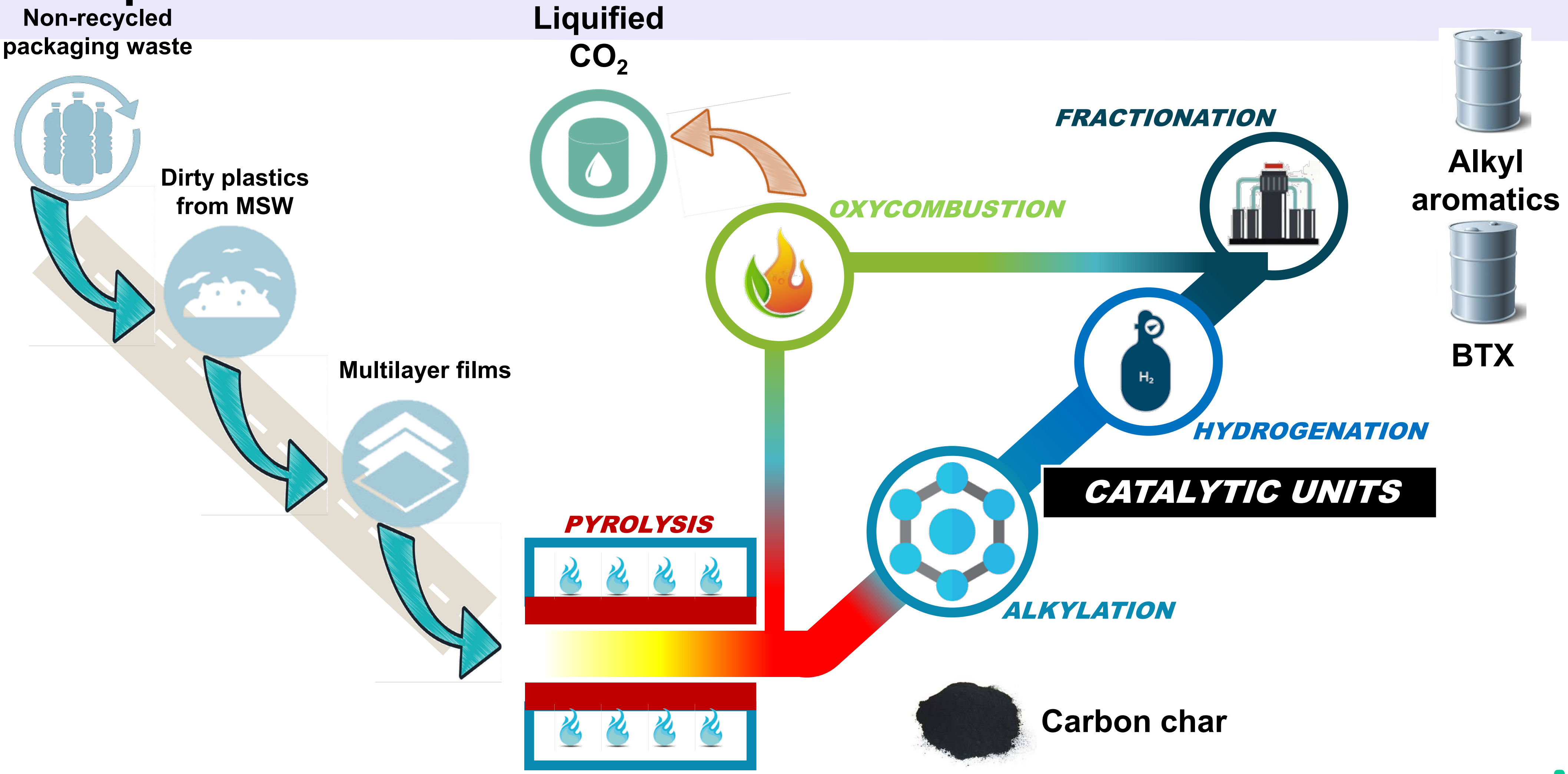
4. Concept





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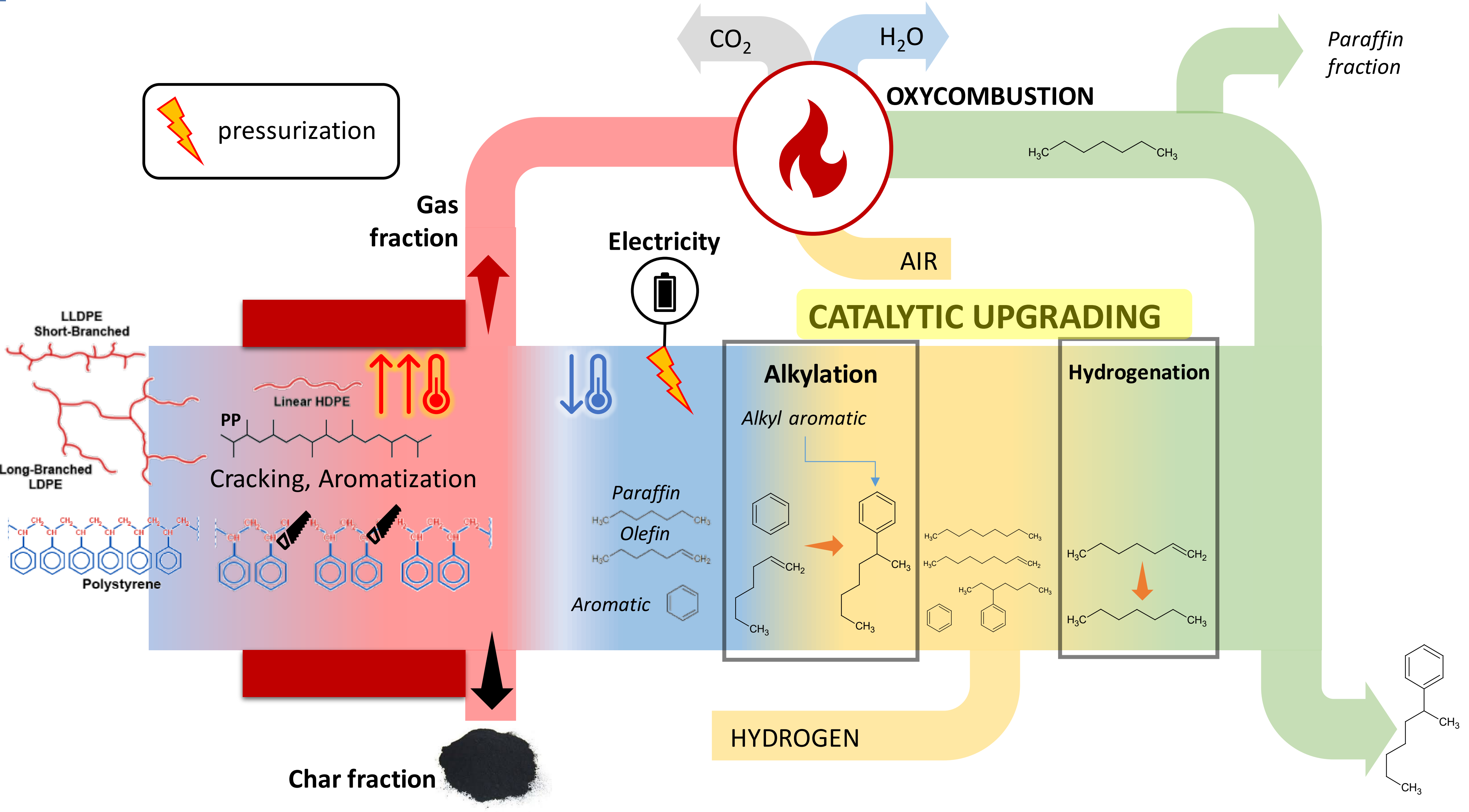

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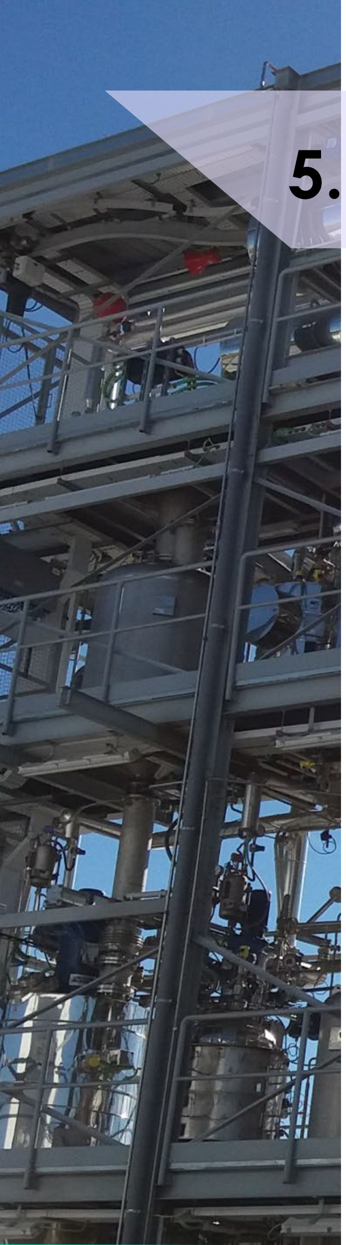
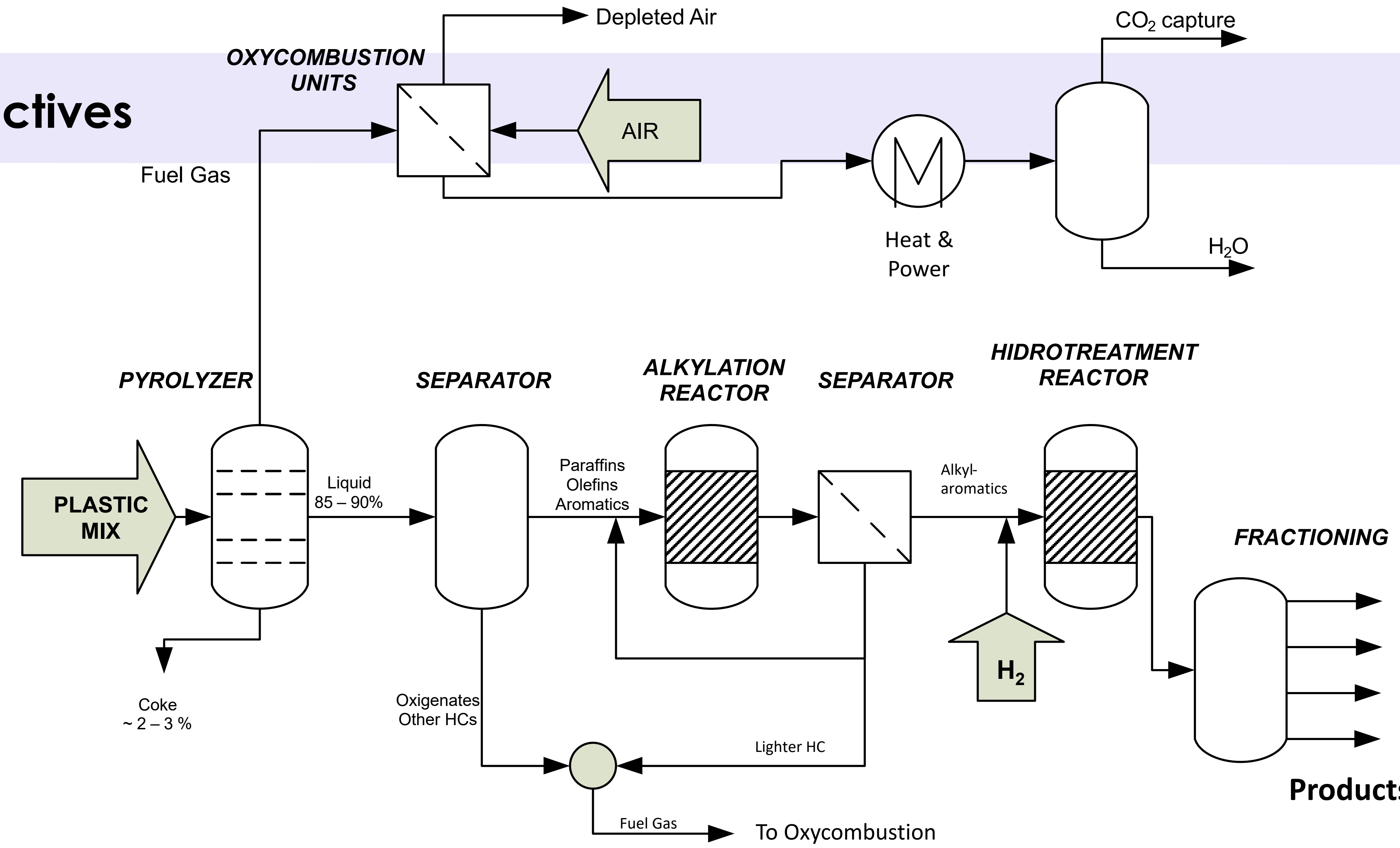
5. Objectives





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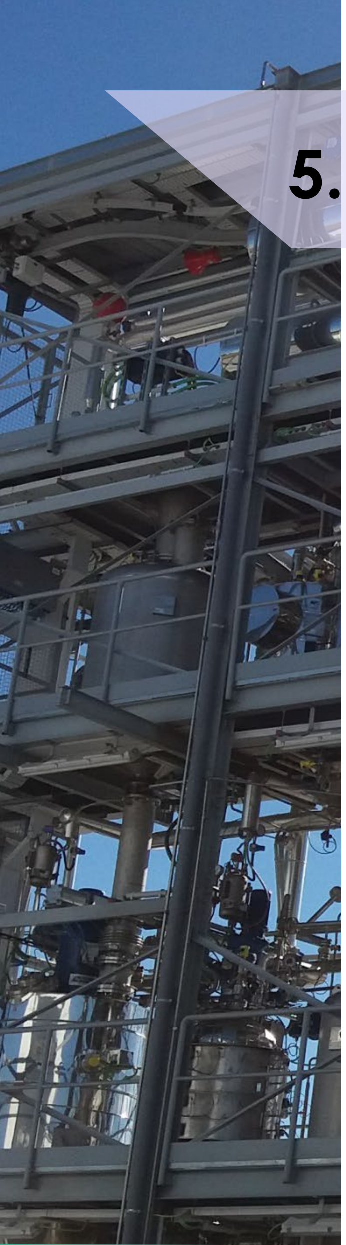

5. Objectives

1. Characterisation of plastic waste streams
2. Identification of pre-treatment operations
3. Optimisation of feeding mixtures
4. Optimisation of operational parameters of pyrolysis reactor
5. Design of separation processes to selectively remove impurities and bulky hydrocarbons from pyrolysis products
6. Optimisation of operational parameters of alkylation reactor

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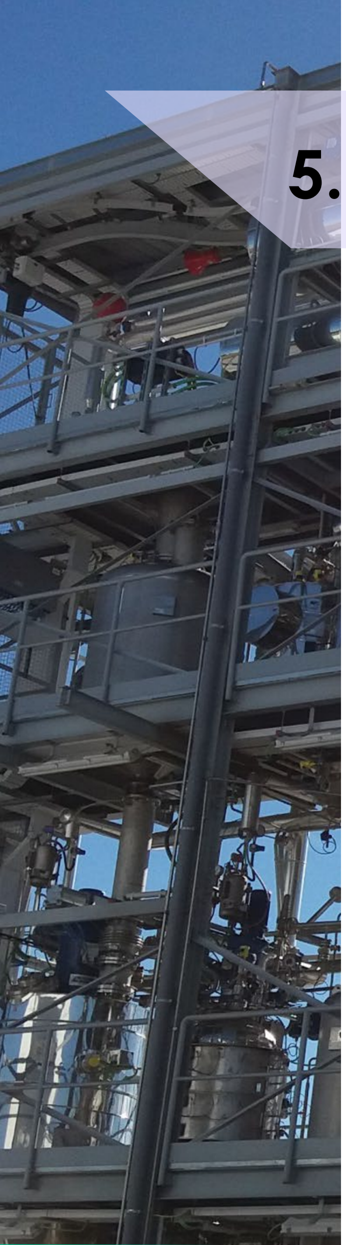

5. Objectives

7 **Design of membranes to separate alkyl-aromatics from mixtures obtained after the alkylation reaction**

8 **Optimisation of operational parameters in hydrotreatment**

9 **Optimisation of operational parameters of the distillation column**

10 **Design of oxyfuel combustion units with CO_2 capture**

11 **Identification of efficiency and sustainability indicators, and real-time optimisation and control of integrated operation**

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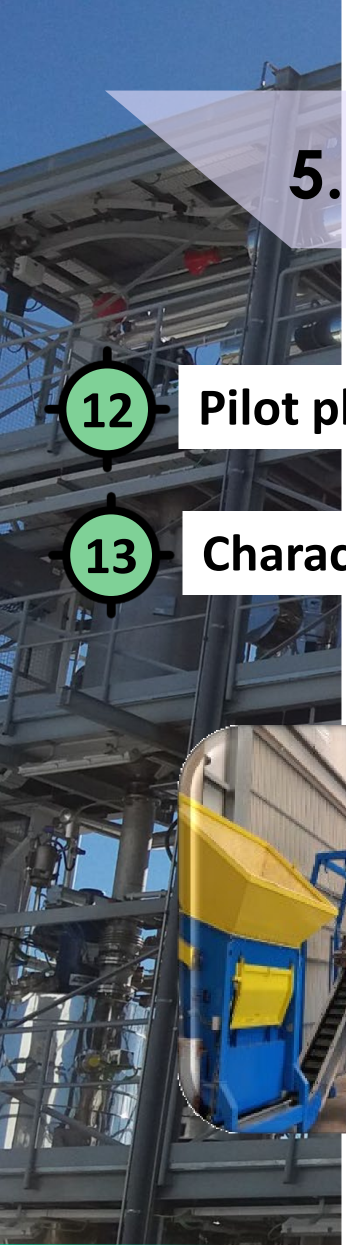

5. Objectives

12 **Pilot plant demonstration and integration of individual processes**

13 **Characterisation of products and valorisation of by-products**

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6. Project Implementation

Ex-situ piloting of selected units

Validation of Key Enabling Technologies → Lab/bench scale studies → Process units design and fabrication → Pilot Plant Engineering, Integration, Installation and Commissioning → **Pilot Plant Testing** → **INDUSTRIAL EXPLOITATION**

Plastic Mix PE+PP+PS	Pyrolysis → T, P, t	Liquid Yield MW distribution P-O-A ratio Energy needs	Catalysis → Alkylation Aromatization	Separation → Membranes	Target products BTX vs. Alkylaromatics Data for OPEX (CAPEX)

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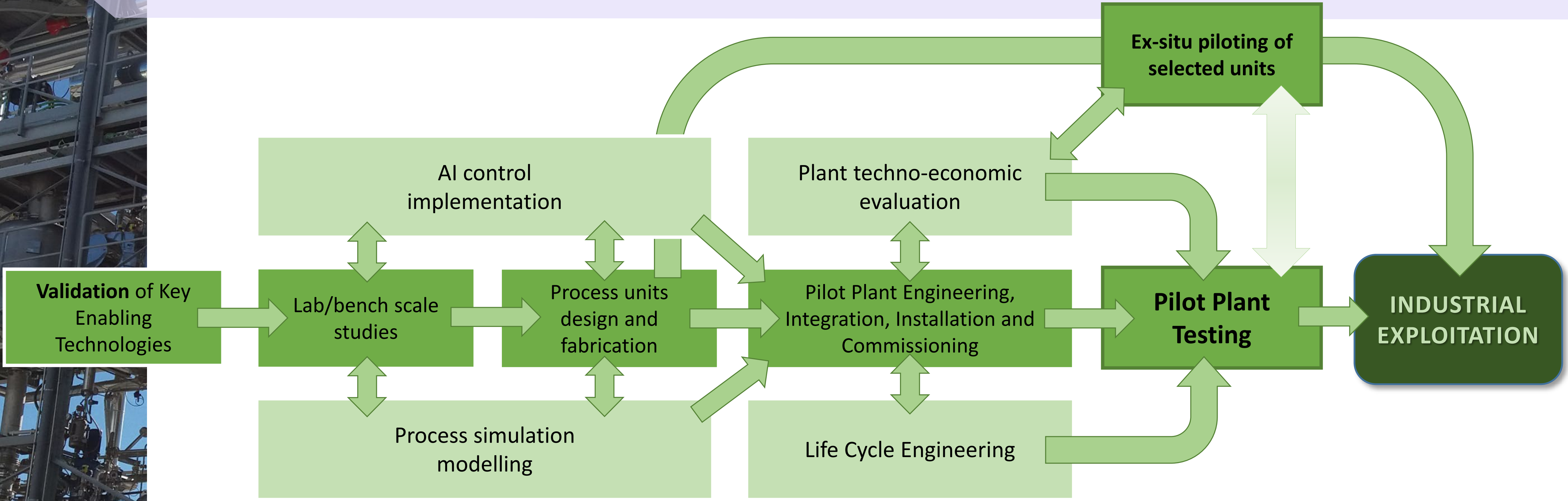
6. Project Implementation



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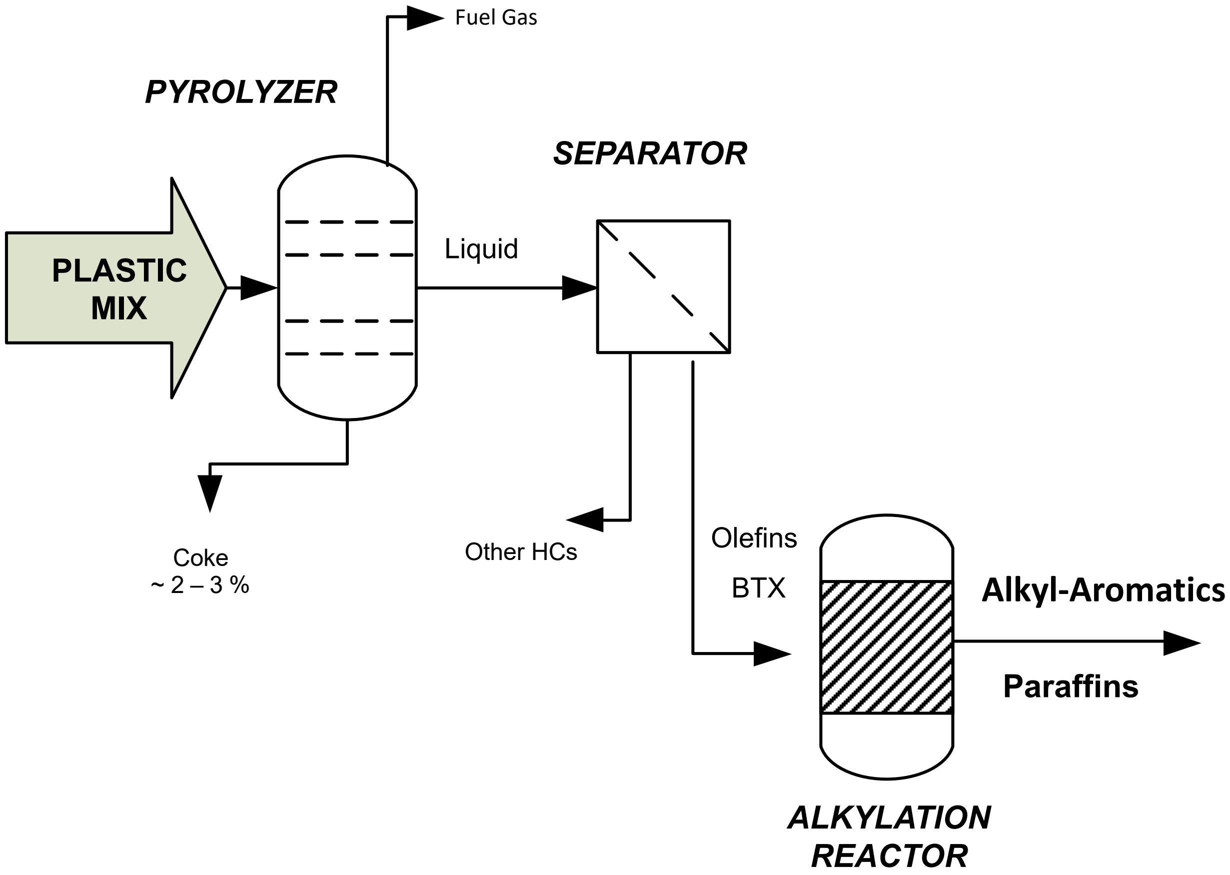
7. Where are we at M37?

Aromatics products and Plant flexibility



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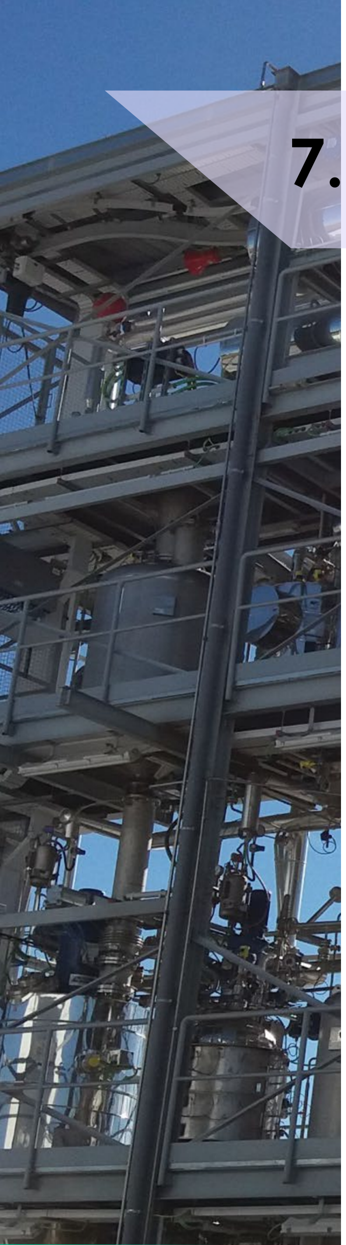

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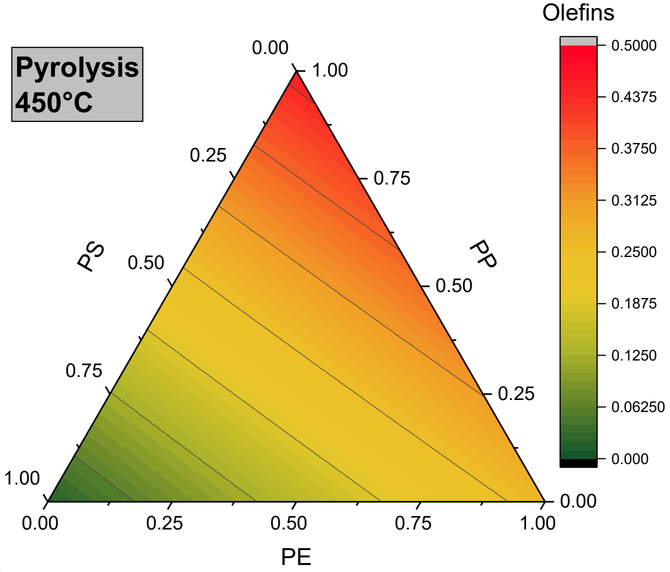

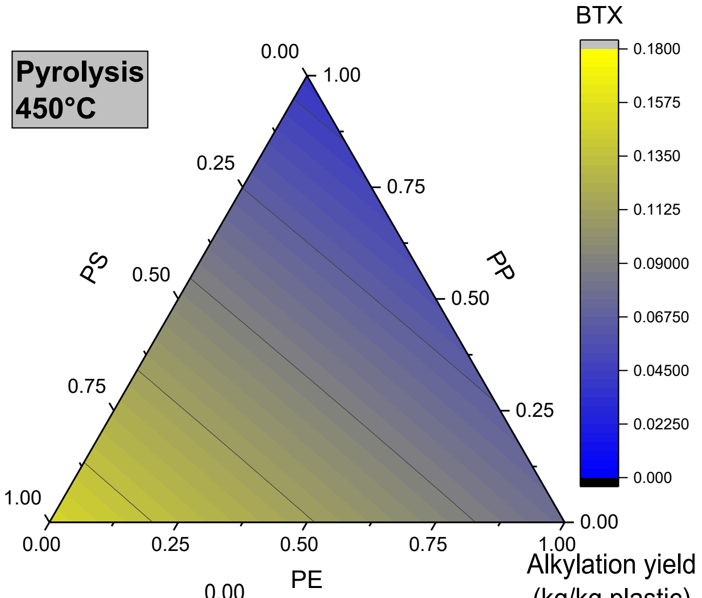

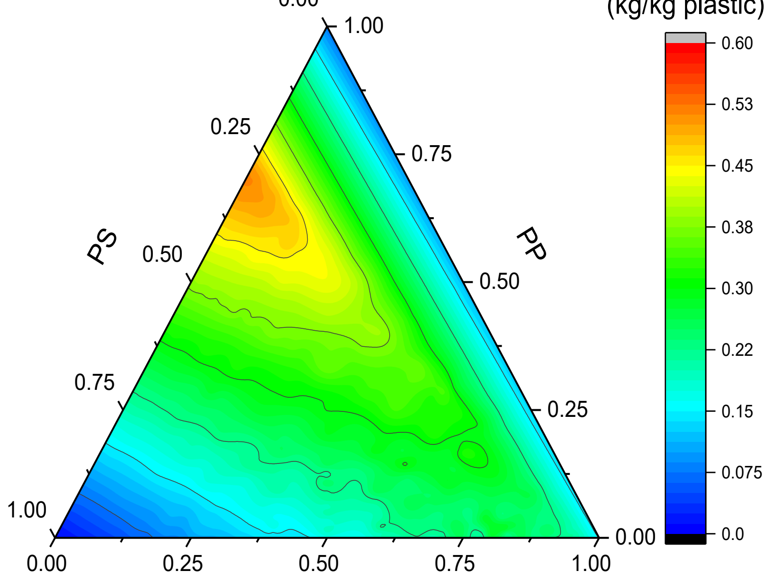

Key Data and Models for:
Process design. Units Design
Real-time plant control
→ Optimization of techno-economics
→ Environmental Impacts
→ Business plan

This project has received European Union's Horizon 2020 rese
innovation funding under grant agreement N° 82077

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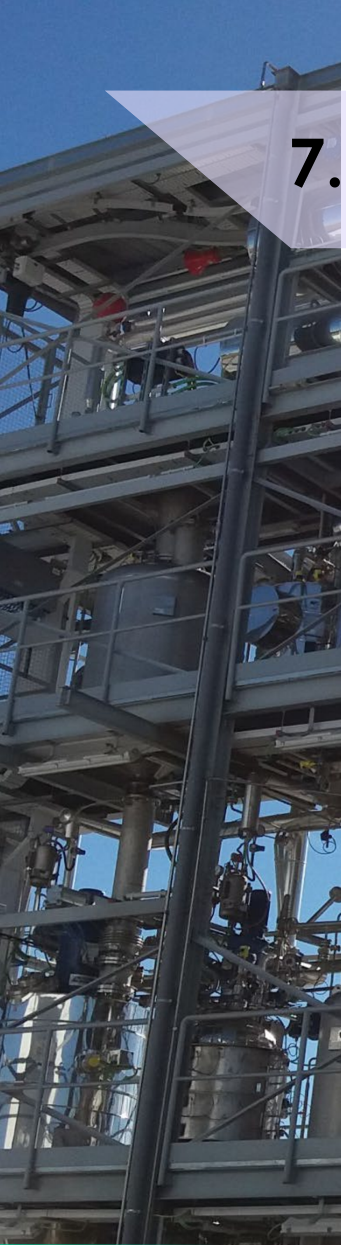
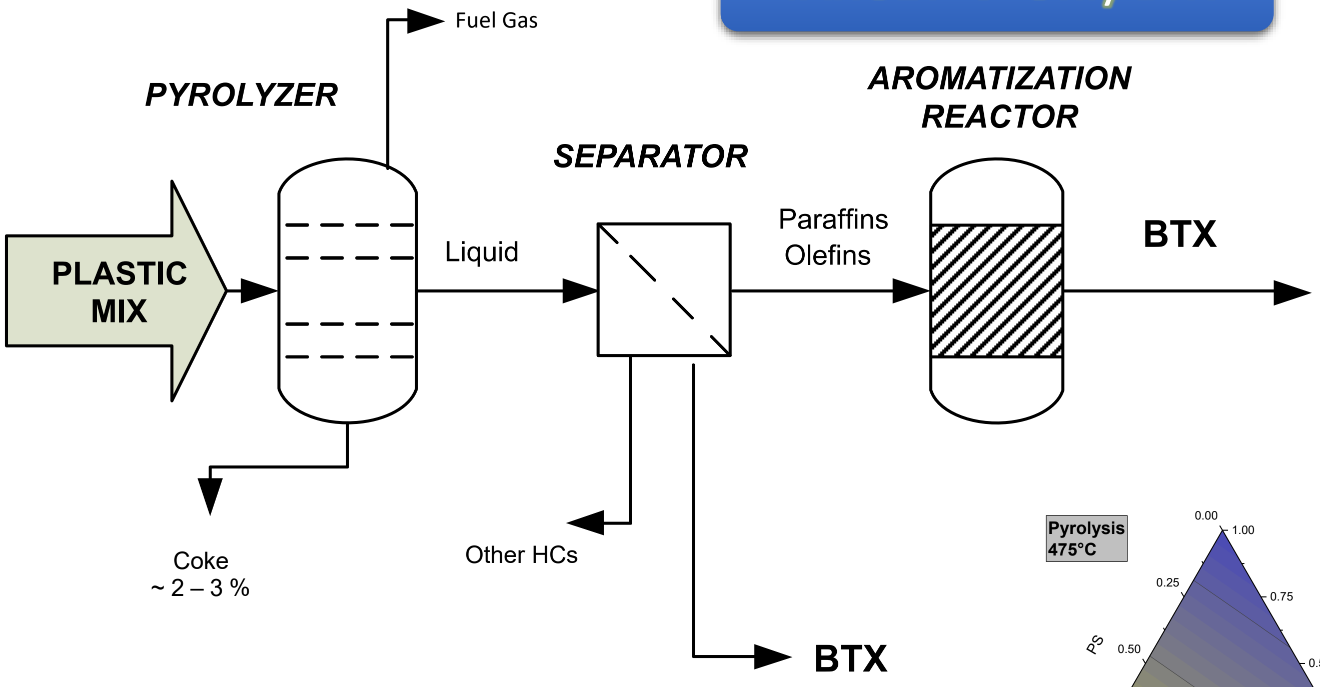
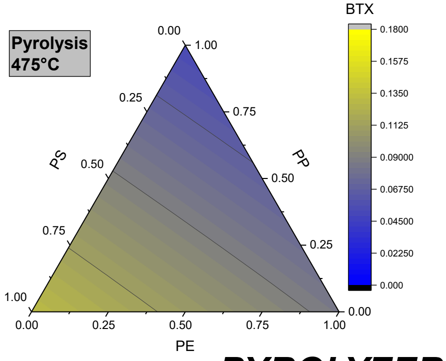


TARGET → Only BTX





PYROLYZER

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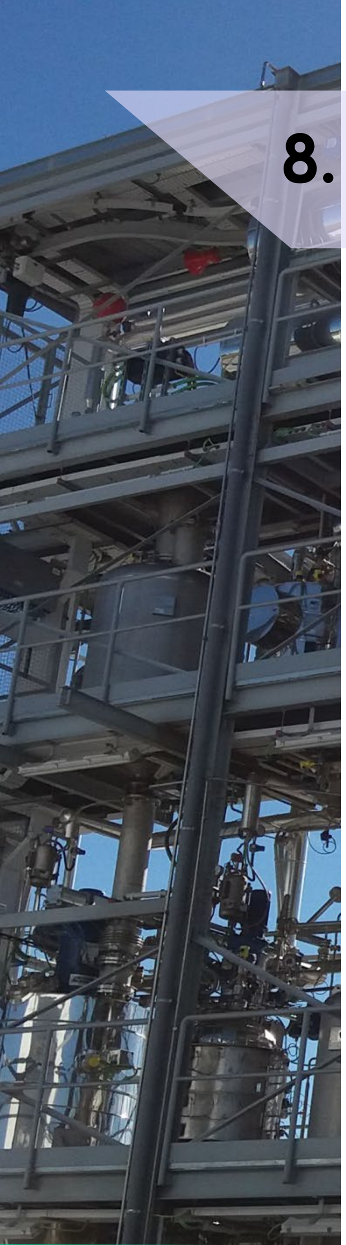

8. Expected impact*

Indicator	Impact
Pyrolysis Liquid Yield	↑12%
Energy Required (MJ/kg plastic)	↓45%
Residues Production	↓95%
Economic Yield (€/kg plastic)	↑200%
Raw Material	Up-cycling of nowadays non-recycled plastics
Products	Virgin-like commodities
Plant Capacity	**Over 140,000 ton of plastic waste in 5 years**
Number of Installation	**29 plants around Europe in 5 years**
CO_2 emissions	↓40%

**Compared to benchmark recycling processes applying thermal conversions.*

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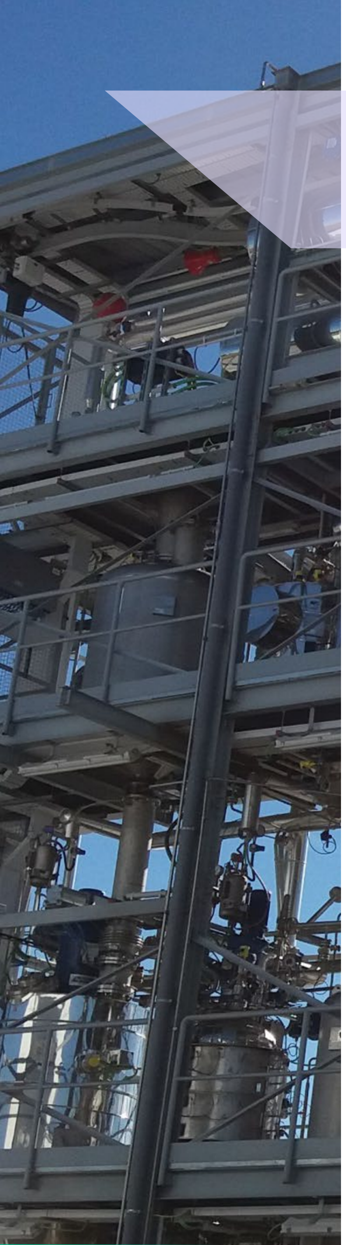

Thank you for your attention

Watch the video made with collaboration from all partners!

https://youtu.be/1sSNRRSldTY

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