END OF LIFE SOLUTIONS FOR BIOMATERIALS
JTI-CS2-2019-CFP10-AIR-03-07

Project started: 1st July 2020
Project will finish: 1st March 2023

Nora Lardiés Miazza
Chemical recycling area
nlardies@aimplas.es

This project has received funding from the European Union's Horizon 2020 research and innovation programme for the Clean Sky Joint Technology Initiative under grant agreement No 886416.
This publication reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.

ELIOT

Clean Sky 2 JOINT UNDERTAKING

Index:

- What is AIMPLAS?
- ELIOT project objectives
- WPs
- Recycling technologies
  - Pyrolysis
  - Solvolysis
  - Biological degradation
- Looking for stakeholders

AIMPLAS PLASTICS TECHNOLOGY CENTRE

TNO innovation for life

Excellence in Plastics

AIMPLAS

FEBRUARY 2021

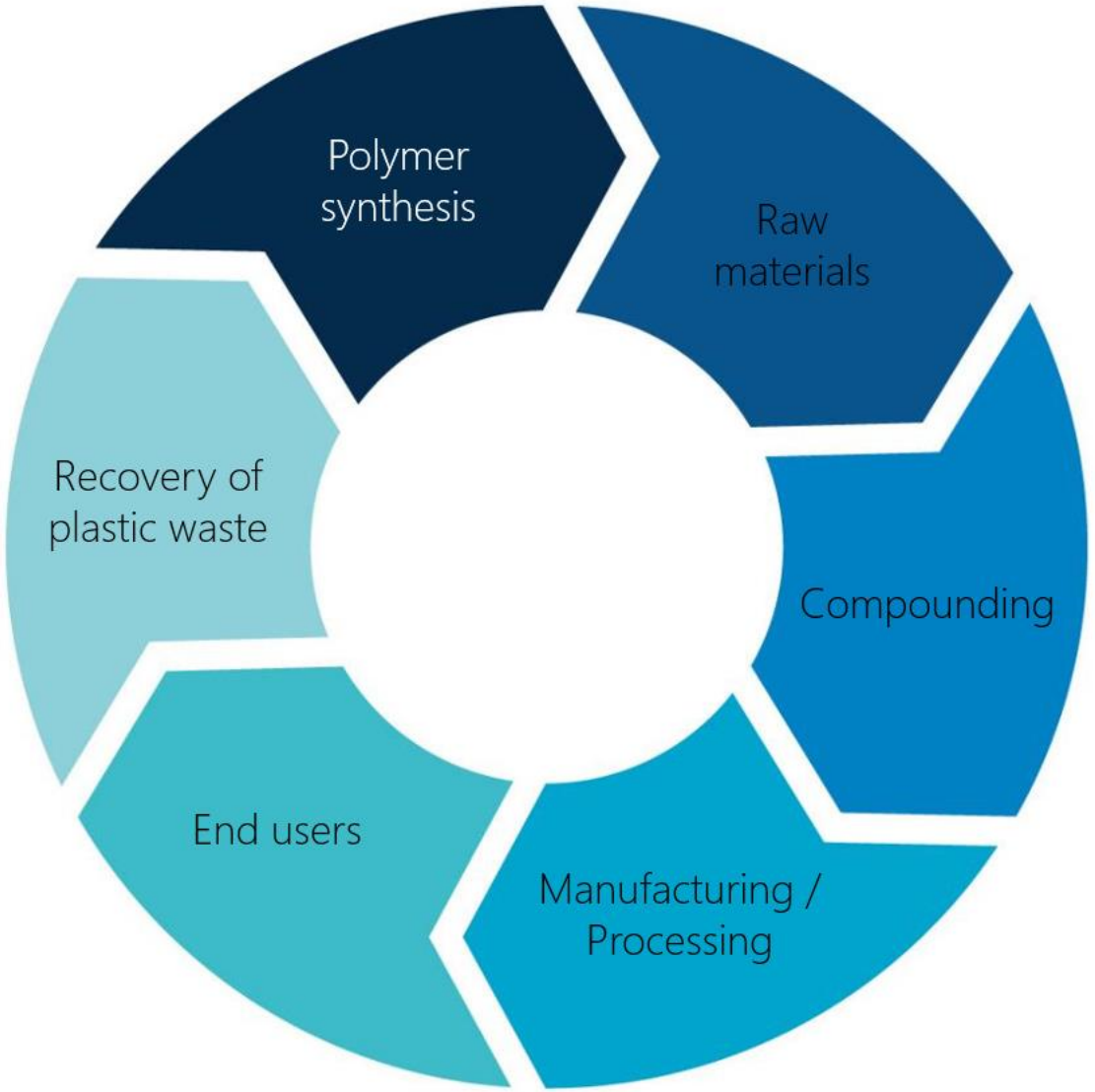
What is AIMPLAS?

A **technology centre** with more than 30 years' experience in the plastic sector.

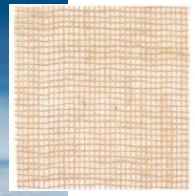
More than **10,500 m²** of cutting-edge facilities

- Pilot plants (6,000 m²)
- Laboratories (4,500 m²)

Expertise across the entire plastics value chain



Main technical objective: full-scale demonstration of the most promising EoL methods for biocomposite waste:



- ❑ Definition and development of potential recovery solutions for biocomposite waste from EoL aircraft
- ❑ Selection of the best EoL methods for biocomposite waste
- ❑ Testing of the EoL methods for biocomposite waste at laboratory scale
- ❑ Full-scale demonstration of the EoL methods for biocomposite waste

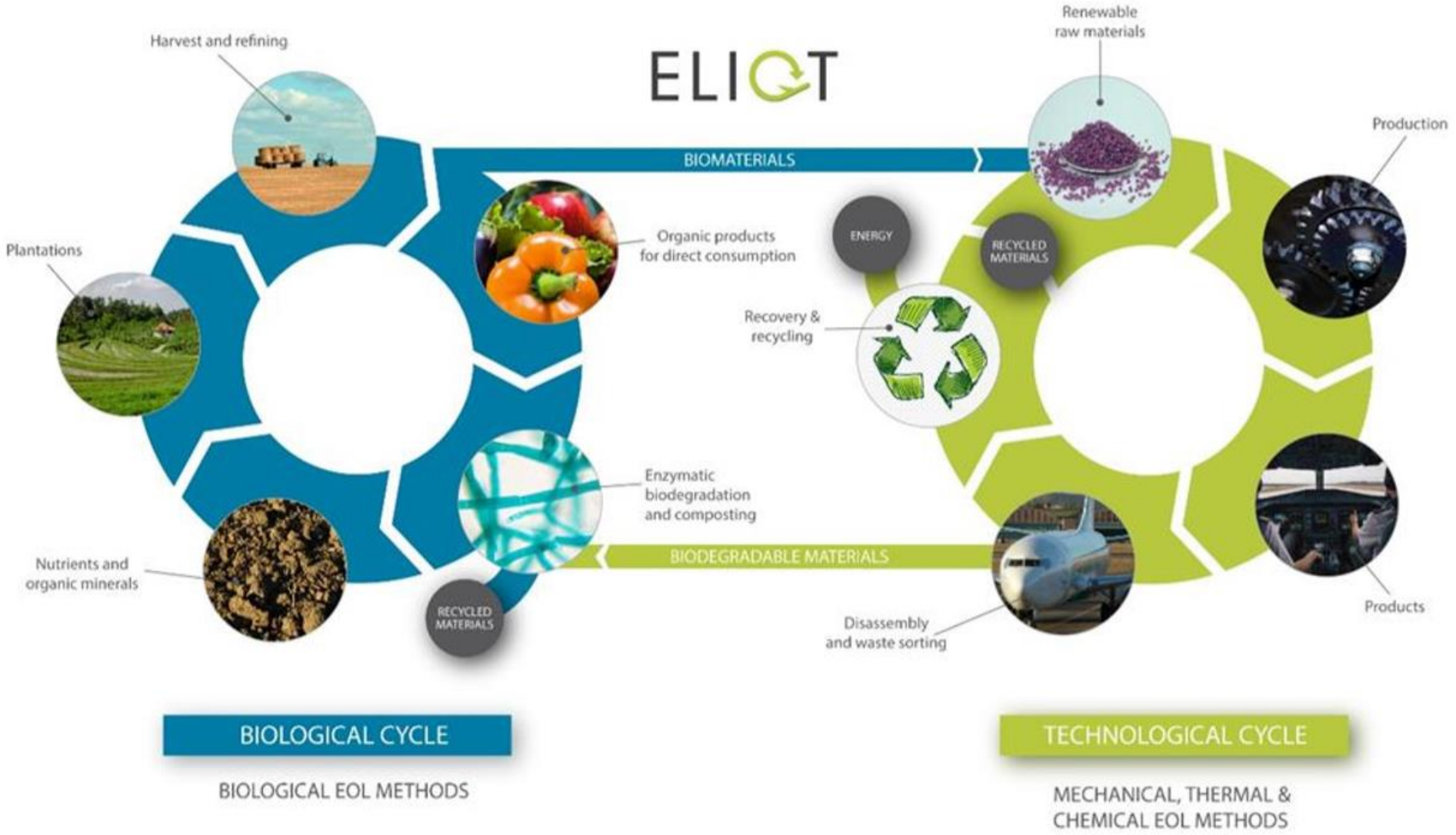
Different EoL methods for waste recovery and recycling will be evaluated:

- ✓ Mechanical
- ✓ Thermal
- ✓ Chemical
- ✓ Biological

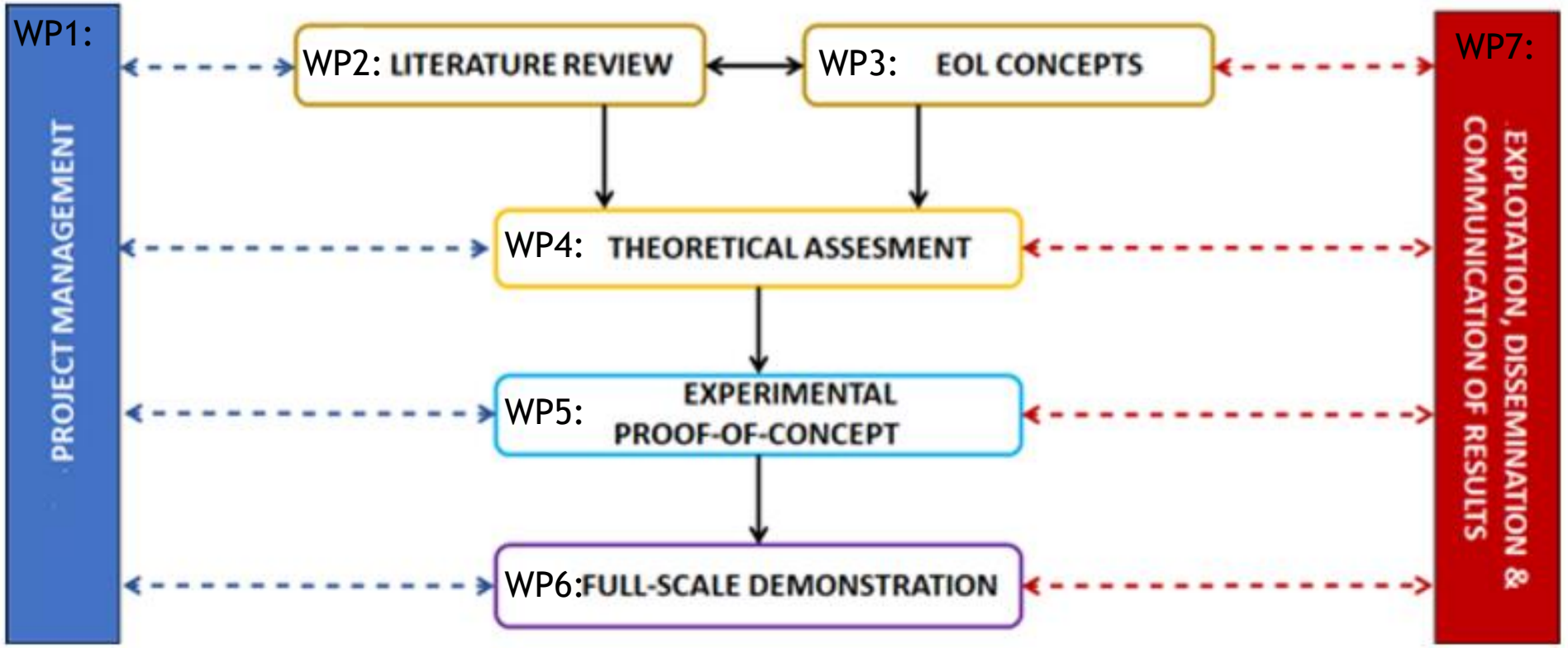
A comparison of the advantages and disadvantages of the EoL methods in terms of cost and environmental sustainability will be conducted

Objectives

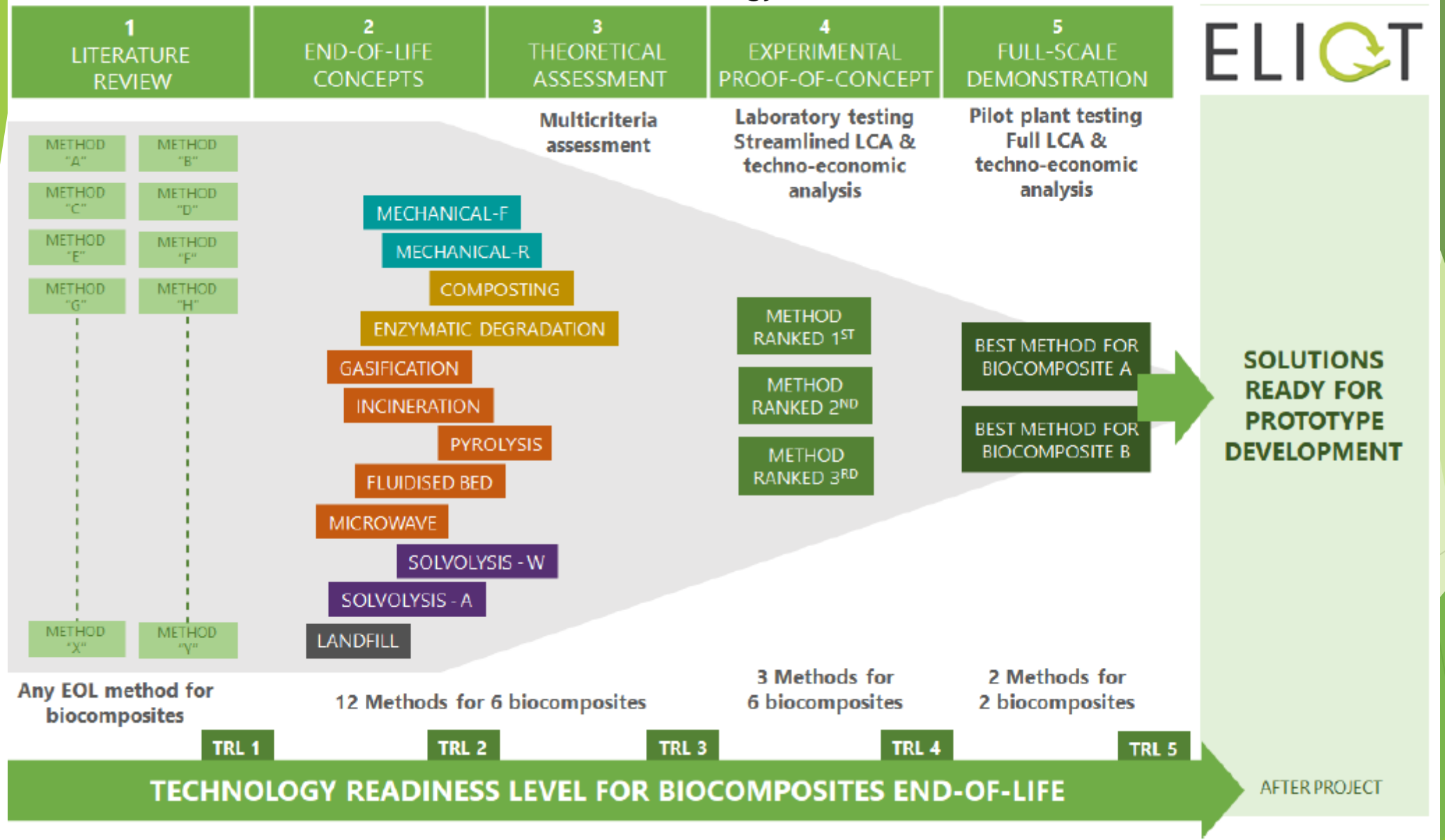
Circular economy model in aircraft industry aimed at ELIOT



WPs


WP1:
PROJECT MANAGEMENT
WP2: LITERATURE REVIEW
WP3: EOL CONCEPTS
WP4: THEORETICAL ASSESMENT
WP5: EXPERIMENTAL PROOF-OF-CONCEPT
WP6: FULL-SCALE DEMONSTRATION
WP7:
EXPLOTATION, DISSEMINATION & COMMUNICATION OF RESULTS

Funnel methodology followed in ELIOT



AIMPLAS INSTITUTO TECNOLÓGICO DEL PLÁSTICO

Clean Sky 2 JOINT UNDERTAKING

TRLs of ELIOT solutions

	TECHNOLOGY READINESS LEVEL	CURRENT STATE OF EOL METHOD FOR CONVENTIONAL COMPOSITES	ELIOT EOL METHODS FOR BIOCOMPOSITES
9	ACTUAL SYSTEM "FLIGHT PROVEN" THROUGH SUCCESFUL MISSION OPERATIONS	INCINERATION; LANDFILL	SOLUTIONS READY FOR PROTOTYPE DEVELOPMENT
8	ACTUAL SYSTEM COMPLETED AND "FLIGHT QUALIFIED" THROUGH TEST AND DEMONSTRATION (GROUND OR SPACE)	PYROLYSIS (CF); MECHANICAL RECYCLING (GF)	
7	SYSTEM/SUBSYSTEM DEMONSTRATION IN A SPACE ENVIRONMENT	PYROLYSIS (GF); MECHANICAL RECYCLING (CF)	
6	SYSTEM/SUBSYSTEM MODEL OR PROTOTYPE DEMONSTRATION IN A RELEVANT ENVIRONMENT (GROUND OR SPACE)		
5	COMPONENT AND/OR BREADBOARD VALIDATION IN RELEVANT ENVIRONMENT		BEST METHOD BIOCOMPOSITE A; BEST METHOD BIOCOMPOSITE B
4	COMPONENT AND/OR BREADBOARD VALIDATION IN LABORATORY ENVIRONMENT	FLUIDISED BED PYROLYSIS; SOLVOLYSIS	METHOD RANKED 1ST; METHOD RANKED 2ND; METHOD RANKED 3RD
3	ANALYTICAL AND EXPERIMENTAL CRITICAL FUNCTION AND/OR CHARACTERISTIC PROOF-OF-CONCEPT	MICROWAVE-ASSITED PYROLYSIS	3 SELECTED EOL METHODS
2	TECHNOLOGY CONCEPT AND/OR APPLICATION FORMULATED		12 EOL METHODS EVALUATED
1	BASIC PRINCIPLES OBSERVED/REPORTED		ANY EOL METHOD FOR BIOCOMPOSITES

AFTER PROJECT

PROJECT PROGRESS

M. 30

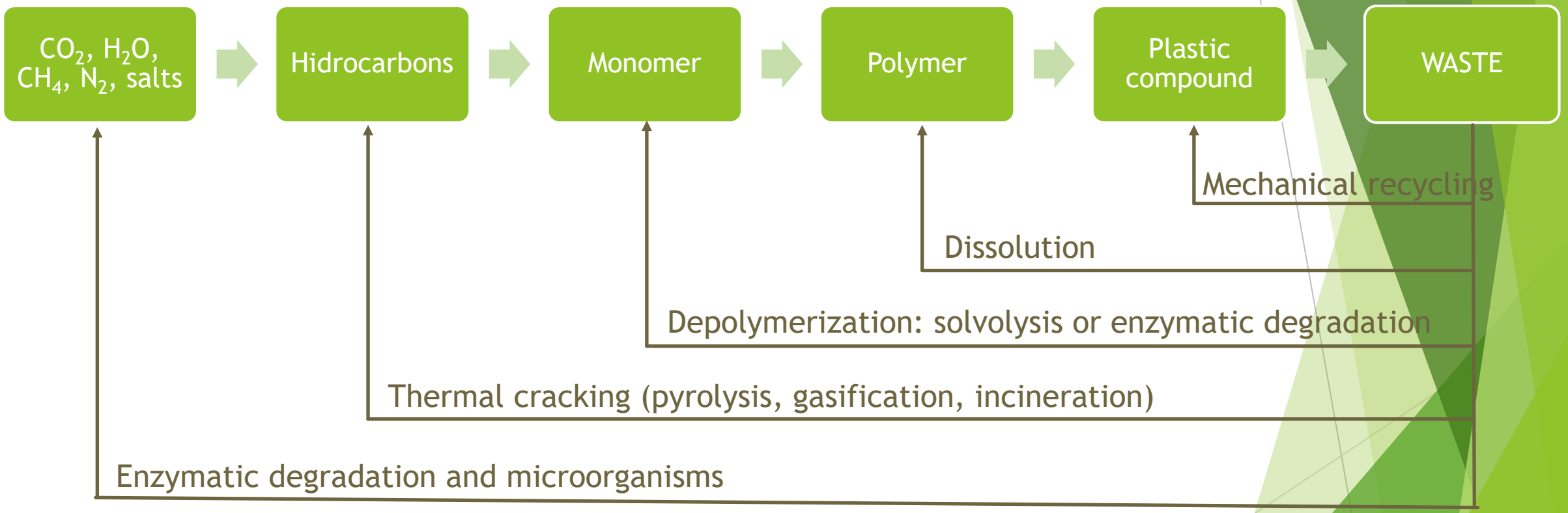
M. 24

M. 18

M. 12

M. 0

Recycling technologies



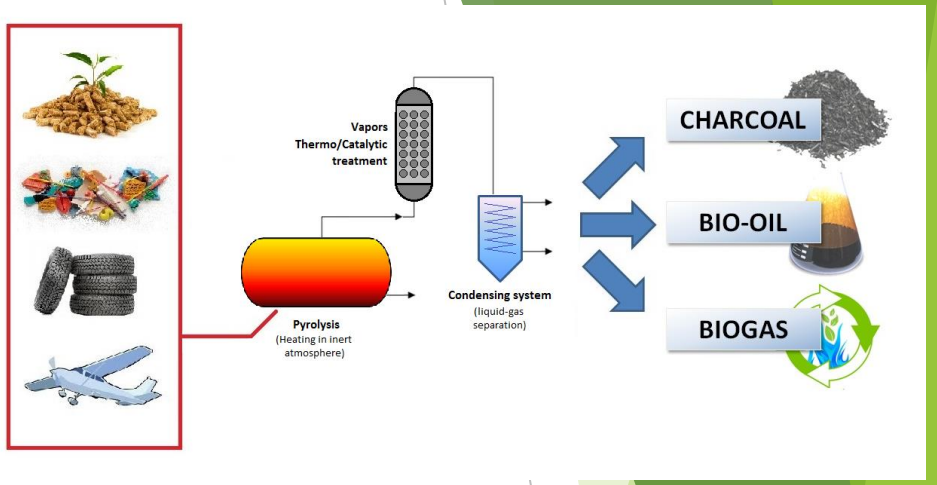
Chemical Recycling

TEMPERATURE

Technology Readiness Level

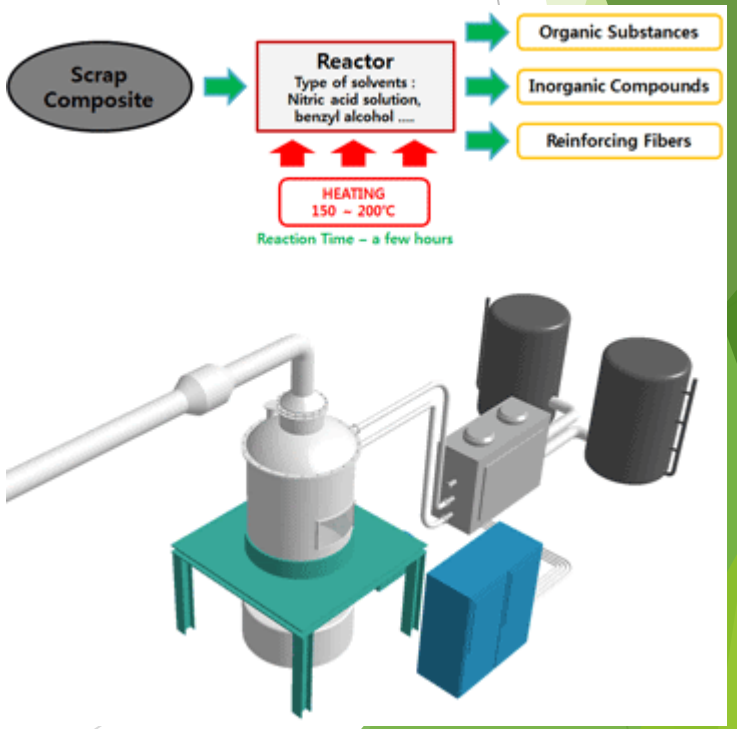
Pyrolysis

Temperature (>400 degrees)
Inert atmosphere
Waste mixtures
Products: 3 fractions



Solvolysis

Temperature, pressure and solvents
supercritical or subcritical conditions



Biological/enzymatic degradation

Applicability of enzymes as biocatalyzers
Lower temperatures
Bioplastics and conventional plastics

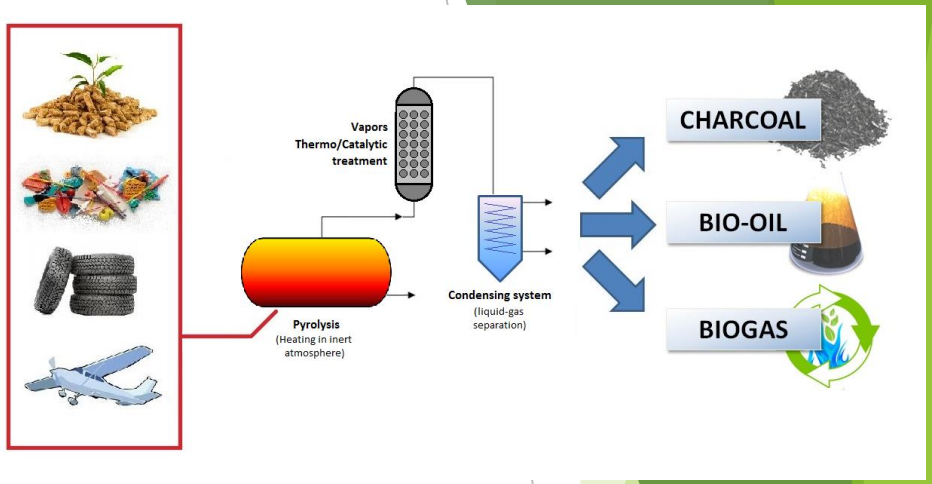
Chemical Recycling

TEMPERATURE

Technology Readiness Level

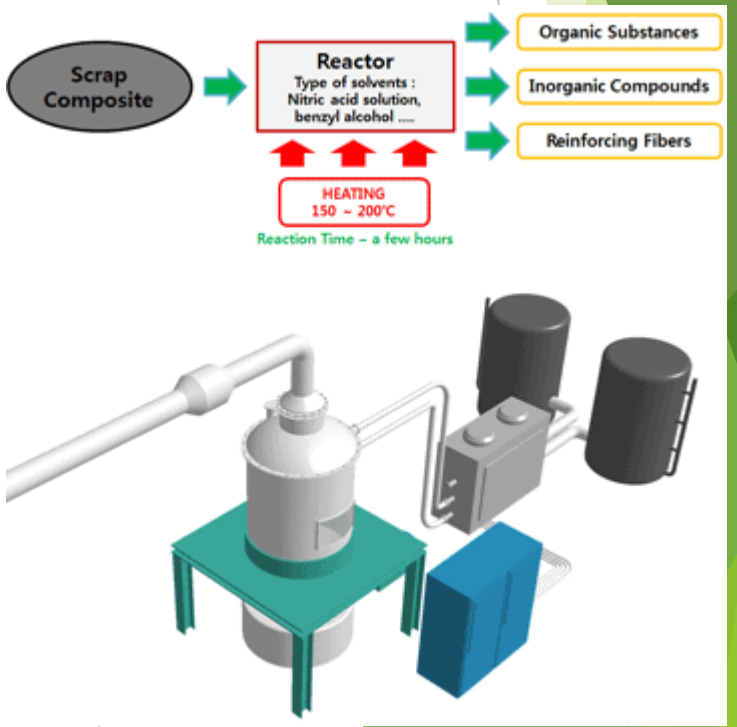
Pyrolysis

Temperature (>400 degrees)
Inert atmosphere
Waste mixtures
Products: 3 fractions



Solvolysis

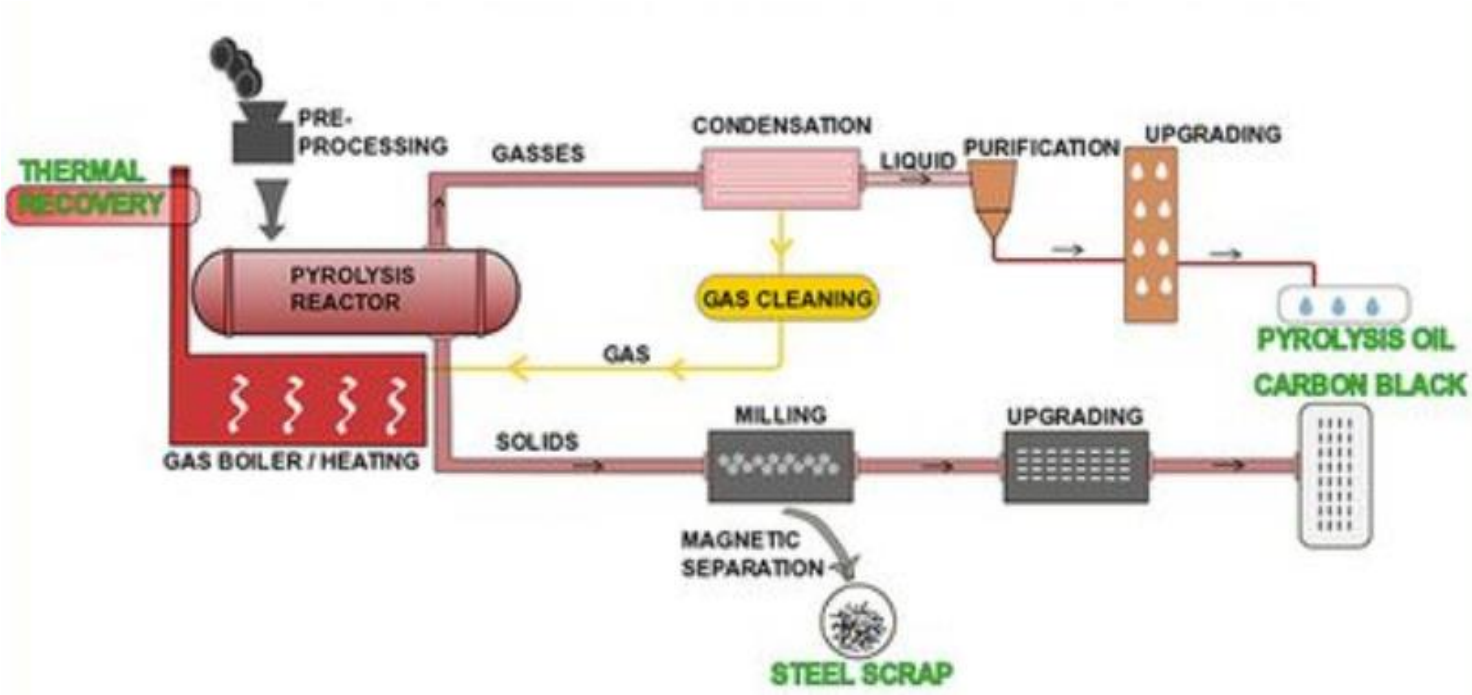
Temperature, pressure and solvents
supercritical or subcritical conditions



Biological/enzymatic degradation

Aplicability of enzymes as biocatalyzers
Lower temperaturas
Bioplastics and conventional plastics

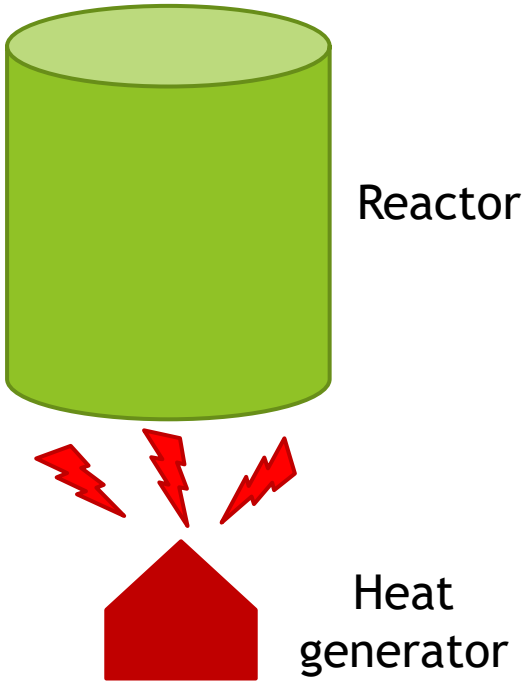
Pyrolysis



AIMPLAS´s Pilot plant

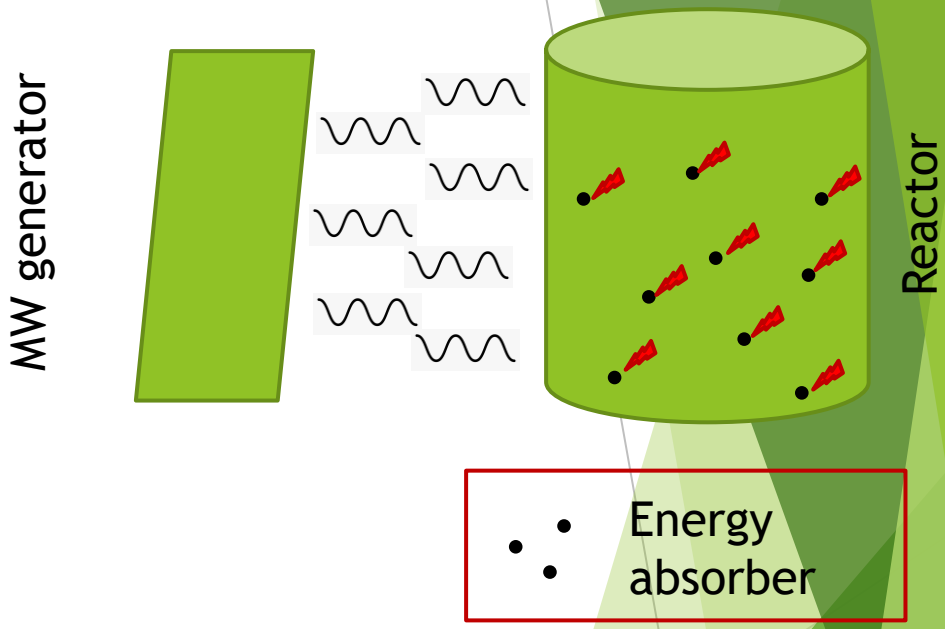
MW assisted pyrolysis

Conventional pyrolysis



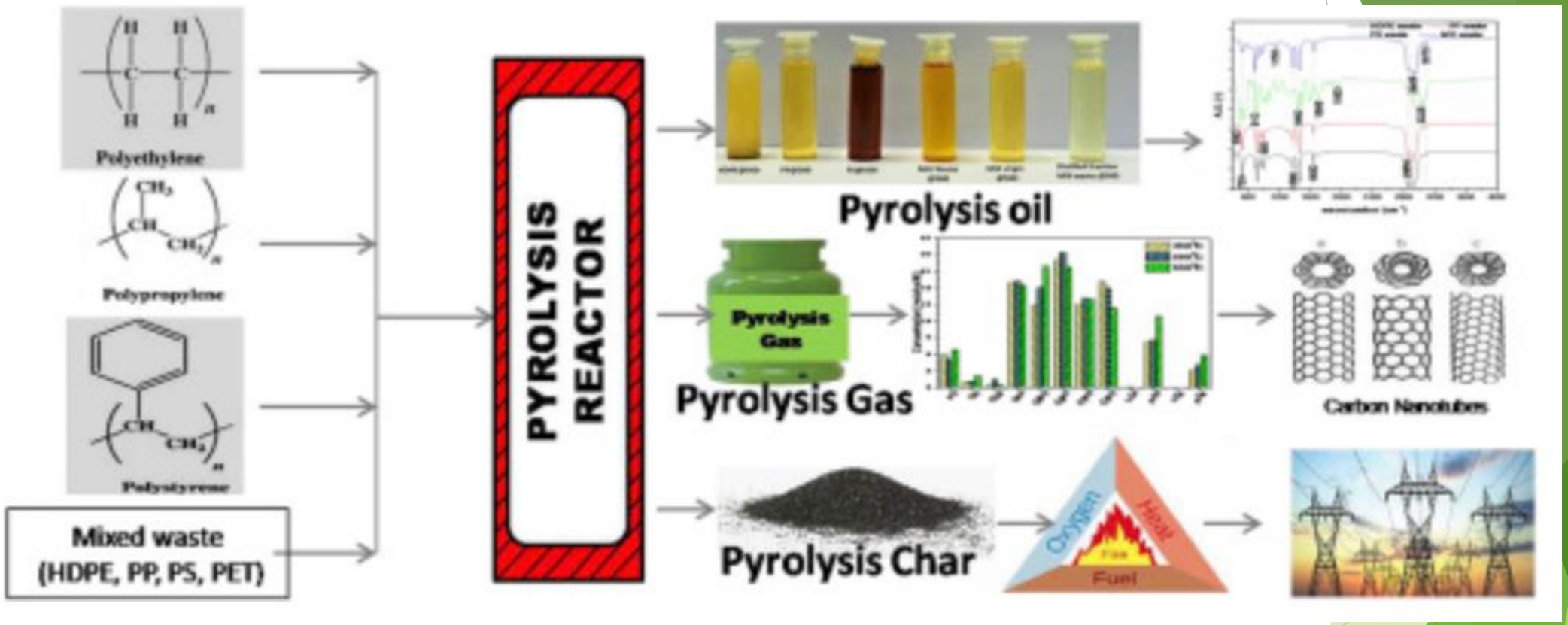
- The heat is generated outside the reactor
- Low efficiency: energy transfer

MW assisted pyrolysis



- The heat is generated inside the reactor
- High efficiency: Good energy transfer

Pyrolysis


Polyethylene
Polypropylene
Polystyrene
Mixed waste
(HDPE, PP, PS, PET)
PYROLYSIS REACTOR
Pyrolysis oil
Pyrolysis Gas
Pyrolysis Gas
Pyrolysis Char
Carbon Nanotubes
Oxygen
Heat
Fuel

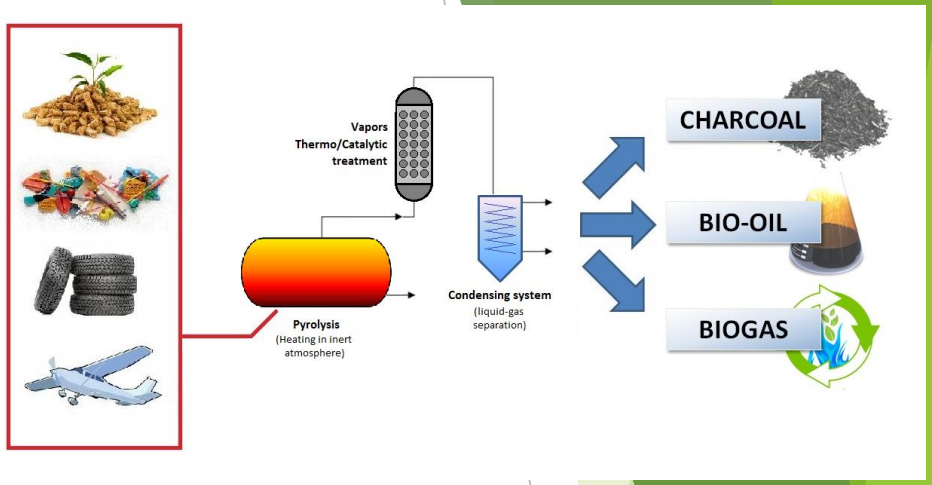
Chemical Recycling

TEMPERATURE

Technology Readiness Level

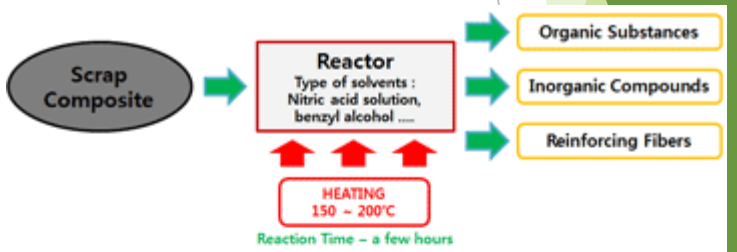
Pyrolysis

Temperature (>400 degrees)
Inert atmosphere
Waste mixtures
Products: 3 fractions



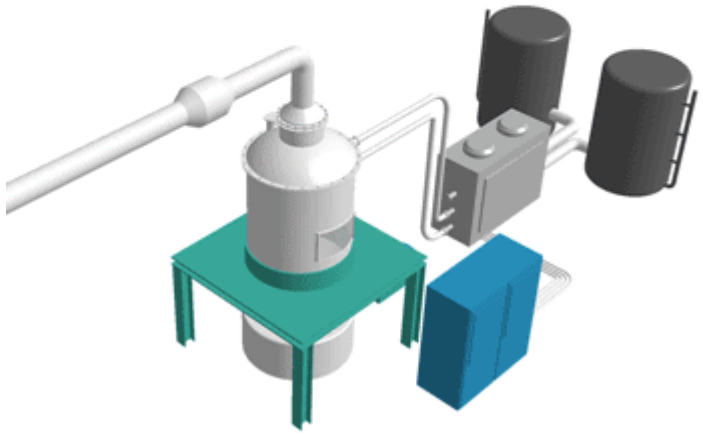
Solvolysis

Temperature, pressure and solvents supercritical or subcritical conditions



Biological/enzymatic degradation

Applicability of enzymes as biocatalyzers
Lower temperatures
Bioplastics and conventional plastics



Solvolysis

Use of solvents, temperature and pressure to carry out the reverse reaction of polymer formation

Depending on the used solvent
Methanolysis → Methanol
Glycolysis → Glycol
Hydrolysis → Water

Different monomer or oligomers are obtained depending on the chemical agent used for the polymer excision

AIMPLAS

Solvolysis reactor

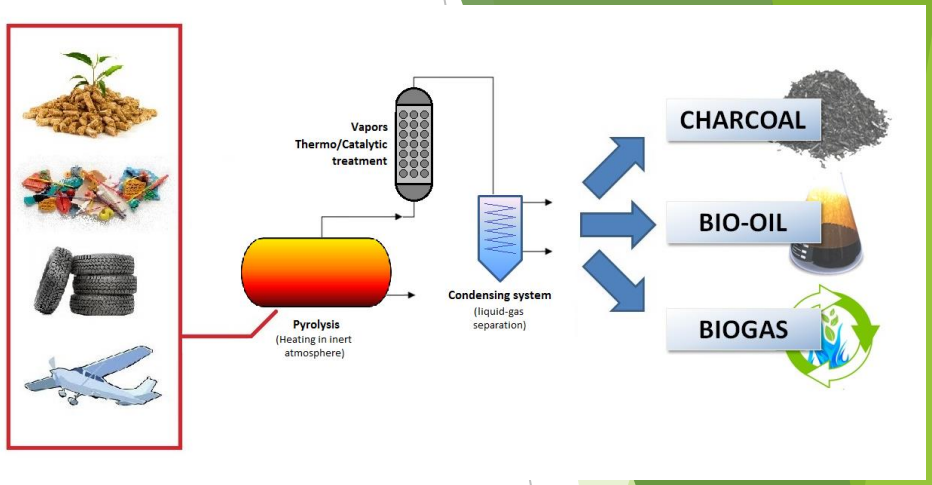
Chemical Recycling

TEMPERATURE

Technology Readiness Level

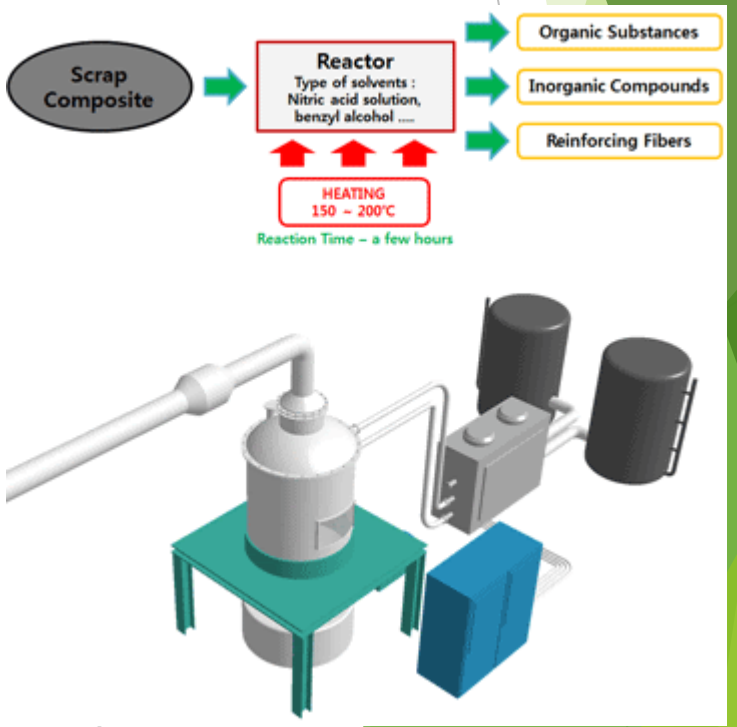
Pyrolysis

Temperature (>400 degrees)
Inert atmosphere
Waste mixtures
Products: 3 fractions



Solvolysis

Temperature, preasure and solvents
supercrítical or subcrítical conditions



Biological/enzymatic degradation

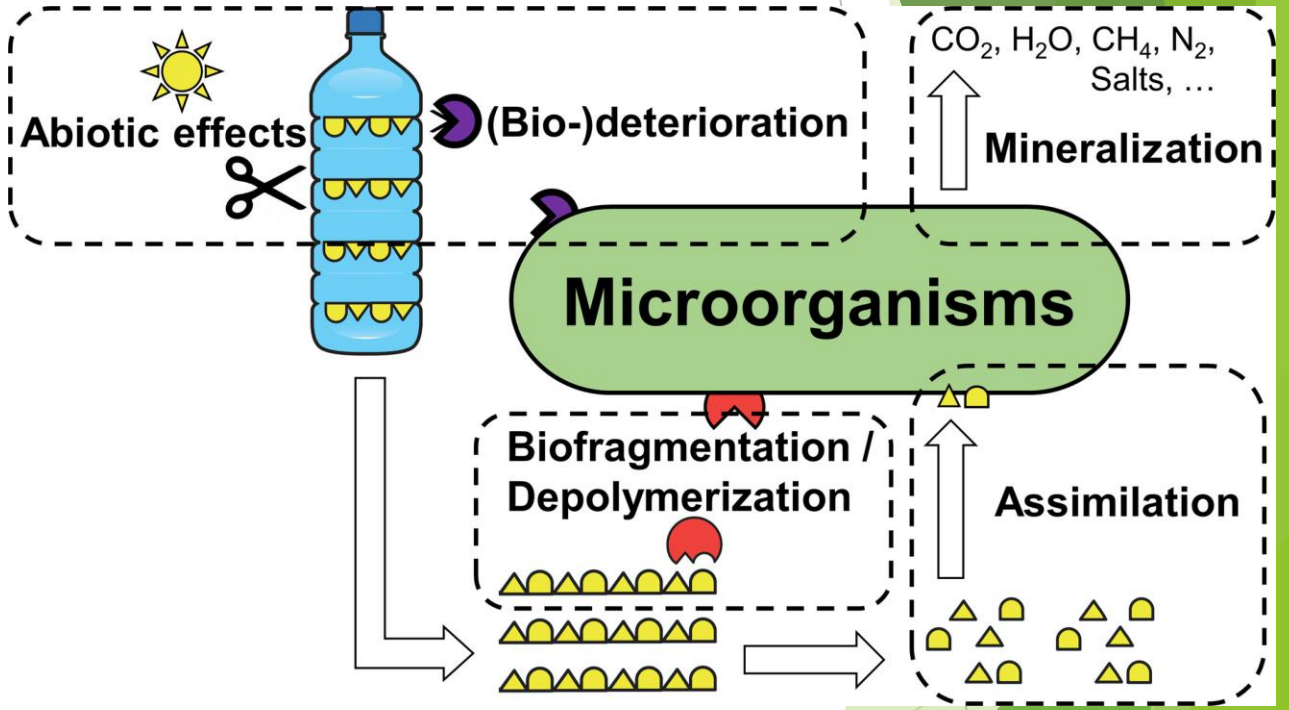
Applicability of enzymes as biocatalyzers
Lower temperatures
Bioplastics and conventional plastics

Biological/enzymatic degradation

Use of enzymes (biocatalyzers) to degrade polymers to monomers or oligomers

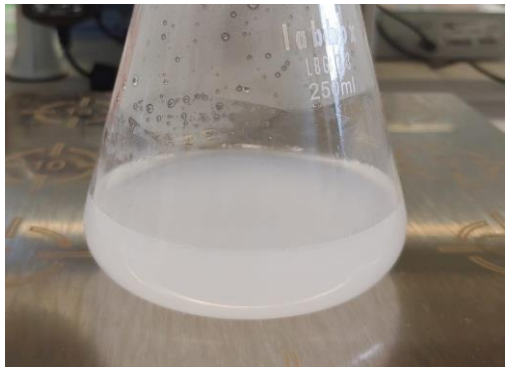
Depending on the enzyme used different monomers or oligomers are obtained

Use of **microorganisms** to mineralize polymers to CO_2 and water or biogas

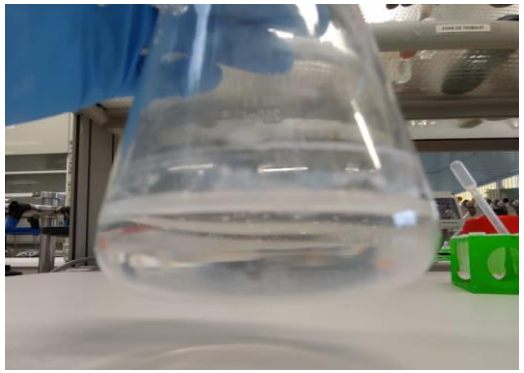


Biological degradation

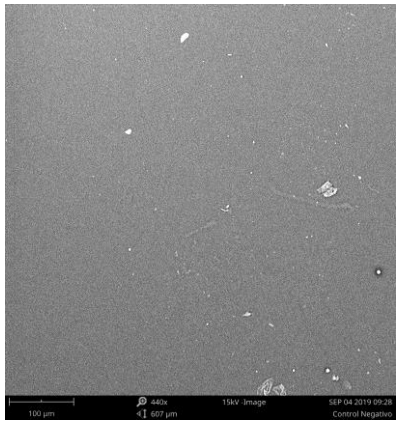
Initial polyester resin



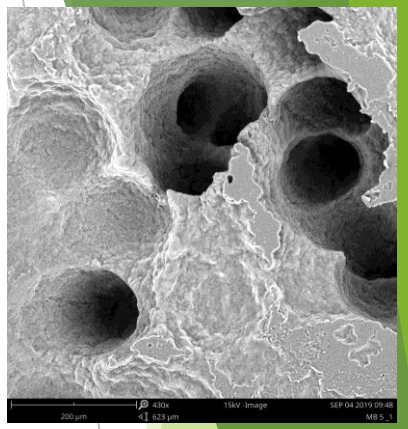
Polyester resin after degradation



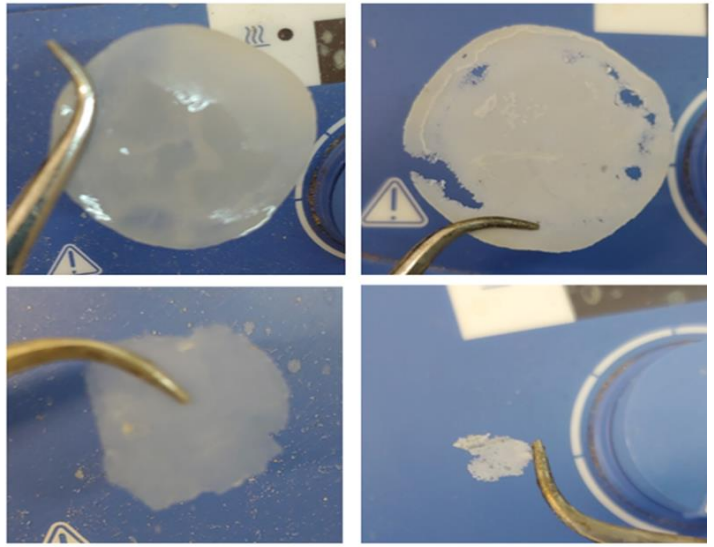
Polyurethane film

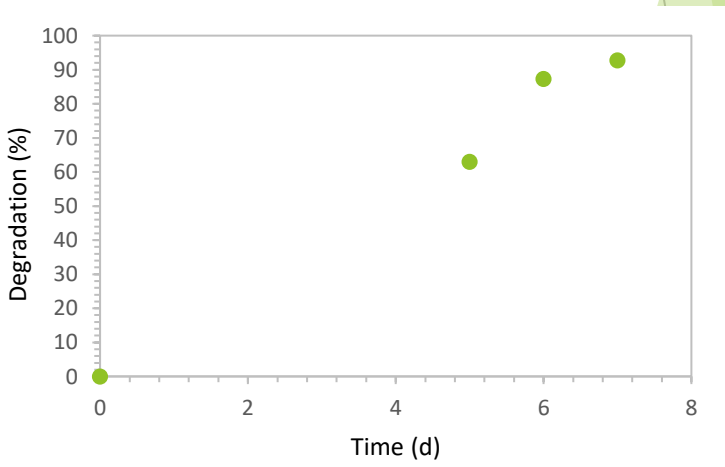


Polyurethane film after degradation



Degradation of a PHB film





STAKEHOLDERS

The ELIOT team is looking for stakeholders interested in the results of the project:

- We are interested in companies from the composites value chain, including **waste managers, recyclers, end users in different sectors, as well as policy makers, sectoral associations and other relevant bodies.**

- ELIOT solutions will generate **additional market opportunities** for the different stakeholders and other sectors interested in green technologies for EoL of natural fibres and bio-resins.

- The stakeholders interested in the project will be invited to a **specific workshop** to promote the project findings. The workshop will offer the chance to come into discussion with researchers and relevant industry stakeholders.

Thank you!

Nora Lardiés Miazza
Chemical recycling area
nlardies@aimplas.es

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 760884.
This publication reflects only the author's view and that the Commission is not responsible for any use that may be made of the information it contains.