Waste plastics
Mechanical Recycling, Chemical Recycling and Energy Recovery

Background data collection for waste plastic recycling and recovery pathways

Thursday, 4th March 2021

Project carried out for the European Commission-JRC

Main objectives

Analyse the three main recovery pathways / technologies for waste plastics in Europe: mechanical and chemical recycling as well as energy recovery, using a LCA approach

WHAT WE NEED

Collect real data from your side for the different pathways.

WHY WE NEED IT

To cover as many types of polymers (e.g. including EPS) and products from different sectors (automotive, WEEE, ….)

Identified pathways

All potential pathways have been identified taking into account different data (Technology Readiness Level, geographic representativeness, market size, etc.).

The most relevant pathways have been chosen from those identified in the mapping by means of multicriteria decision analysis (MCDA).

1st stage → we were able to identify pathways as follows

Mechanical & Chemical Recycling and Energy Recovery pathways: Identified pathways

MECHANICAL RECYCLING

Pathway/stream	Main materials
Packaging Film	LDPE. PP
Food Trays Containers	PET. PP
PET Bottles	PET
PO Bottles	HDPE. PP
Drum Crate Box	HDPE. PP
EPS Packaging	EPS
PVC Building Profiles	PVC
Building Pipe	PE. PP. PVC
Agricultural Film	LDPE
Agricultural Chemical Containers	HDPE. PP
Agricultural Plant Containers	HDPE. PP
Automotive ELV	PP. ABS. other
Automotive Bumper	PP. ABS
Automotive Interior Trim	PP. ABS. other
Automotive Battery	PP
Automotive Fuel Tank	HDPE
Automotive Cable	PE. PVC
WEEE	PP. PS. ABS. other
WEEE Large Appliance	PP. PS. ABS. other
WEEE Small Appliance	PP. PS. ABS. other
WEEE IT Electronic	PP. PS. ABS. other
Textile Fibre Filament	PET. PA
Textile Woven	PP
Textile Non Woven	PP
Other Moulded Parts	PE. PP. PS. ABS. other
Toys Sports Leisure	ABS. PS. PP

Mechanical & Chemical Recycling and Energy Recovery pathways: Identified pathways

CHEMICAL RECYCLING

Waste pathway/stream	Main product
PET_Bottles (Glycolysis)	BHET
PET_Bottles (Glycolysis)	Polyols (insulation)
PET_Bottles (Hydrolysis)	PTA+MEG
PET_Bottles (Enzimatic hydrolysis)	PTA+MEG
PET packaging (opaque, multi-layered or fully welded PET bottles and trays) (Glycolysis)	Polyols (PET)
PET_Trays & Sheet (solvent/separation)	PET
PA/PE_Sheet & (solvent separation)	PA
Textile (carpet.net, furniture) (Depolymerisation)	Caprolactam (PA6)
Mixed plastic waste (Pyrolysis)	Feedstock for the petrochemical industry
Mixed plastic waste (Microwave induced Pyrolysis)	synthetic refinery feedstock
Agricultural film (Pyrolisis)	synthetic refinery feedstock/Fuel
Municipal Solid Waste/Mixed plastics (Catalytic Tribochemical Conversion (CTC))	Hydrocarbon mixture
ASR (Gasification)	Methanol
Mixed plastics (Gasification)	Methanol
Thermoset CF Reinforced (Pyrolysis)	Carbon fibres
Shoe soles (Single phase glycolysis)	Polyols
Rigid PU foams (Single phase glycolysis)	Polyols
RIM PU (single phase glycolysis)	Polyols
PU elastomer (single phase glycolysis)	Polyols

Mechanical & Chemical Recycling and Energy Recovery pathways: Identified pathways

ENERGY RECOVERY

Waste stream/pathway	Main materials
Packaging Film	LDPE, PP
PET_Bottles	PET
EPS_Packaging	EPS
Agricultural Film	LDPE
PO_Bottles	HDPE, PP
Food_Trays Containers	PET, PP
WEEE Large_Appliance	PP, PS, ABS, other
Automotive ELV	PP, ABS, other
Textile Woven	PP
Building pipe	PE, PP, PVC
WEEE	PP, PS, ABS, other
Mixed plastic	PP, PS
MSW rejections	PP, PS, LDPE

Main Energy Recovery technologies
Incineration
Gasification
Pyrolysis
Co-incineration

Mechanical & Chemical Recycling and Energy Recovery pathways: Identified pathways

PATHWAY	MR/CR	INPUT	OUTPUT	MARKET
PET-Bottles	MR			
		Selective packaging waste facility	Flakes	Non-food packaging
		Waste treatment facility	Pellets	Food packaging
		Deposit Return Systems (DRS)		Strip
		Pre-consumer stream		Fiber
				Chemical recycling (rejections)
PET-Bottles	CR			
		Mechanical recycling	BHET (glycolysis)	PET_food contact
		Waste manager (industrial_shredding)	TPA+MEG (hydrolysis)	Polyester resin (construction)
			Polyols (glycolysis)	Textile
			TPA+MEG (enzimatic-hydrolysis)	Polyurethane (insulation/construction)
				Others
PET-Tray	MR			
		Selective packaging waste facility	Flakes	Non-food packaging
		Waste treatment facility		Cleaning products (broom, dustpan)
		Pre-consumer stream		Others
				Chemical recycling (rejections)
PET-Tray	CR			
		Mechanical recycling	PET (Solvent separation)	PET_food contact
		Waste manager (industrial_shredding)	BHET (glycolysis)	Polyester resin (construction)
		Rejection MR_Bottle fraction	TPA+MEG (hydrolysis)	Textile
		Industrial scrap		Others
Textile	MR			
		Industrial	Shredded material	Acoustic panels
		Treatment plants		Chemical recycling
				Yarn/textile
Textile	CR	RM		
		Mechanical recycling	Caprolactama (Solvolysis)	PA (textile)
				PA (others)

Mechanical & Chemical Recycling and Energy Recovery pathways: Identified pathways

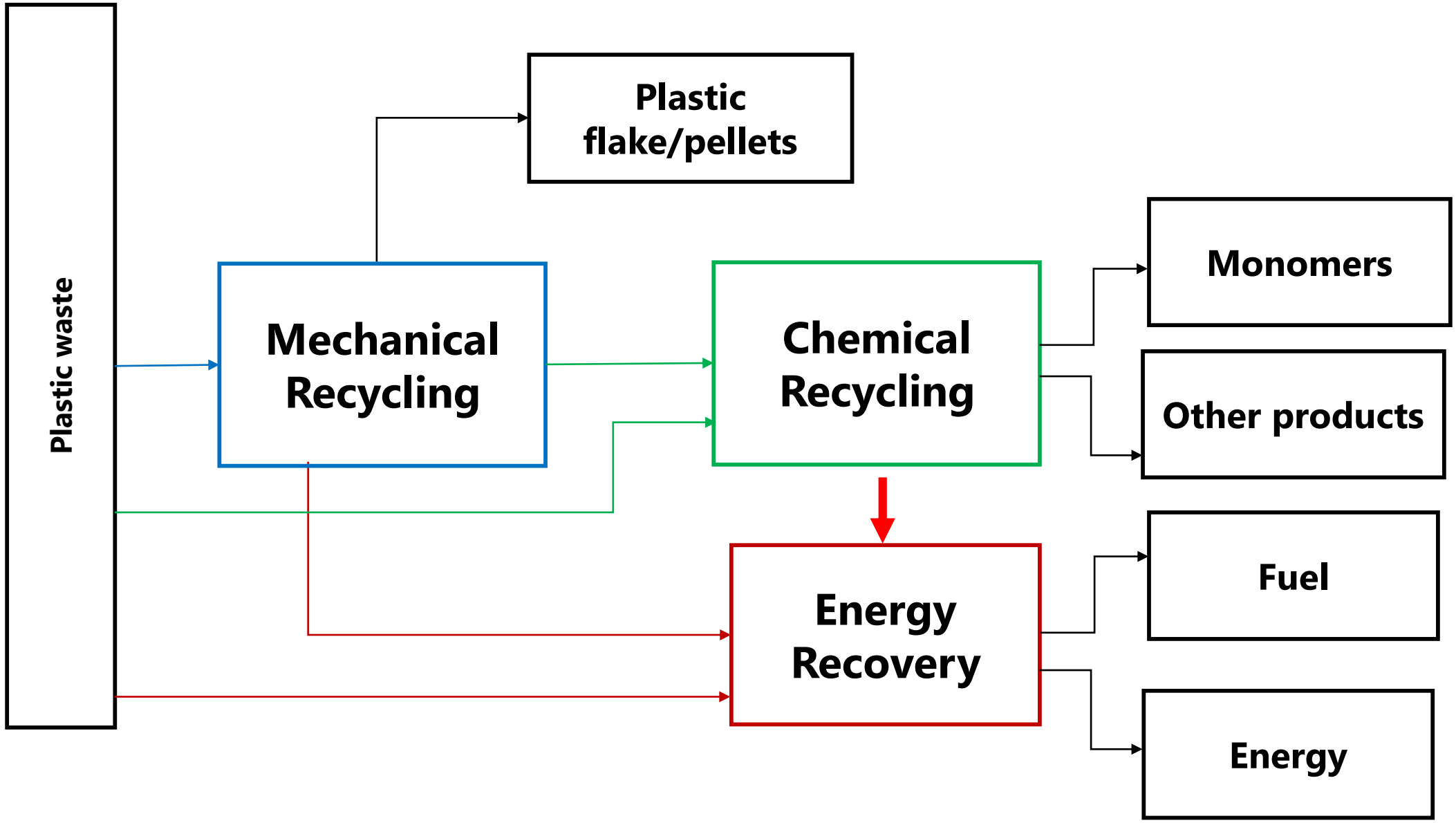
NET	MR			
		Discarded nets	PP pellets	Urban furniture
		Collection on specific points (ports)	PE pellets	Non-food packaging
				Others
NET	CR			Textil (PA)
		Mechanical recycling	Caprolactama (Solvolysis)	PA (textile)
				PA (others)
Agricultural film (PE)	MR			
		Recycling facilities	PE pellets	Agricultural film / pipeline
				bags
				Chemical recycling
Agricultural film (PE)	CR			
		Mechanical recycling	Hydrocarbon mixture(Pyrolysis)	
ELV	MR			
		Authorised treatment facilities	Shredded material	PP market
		Shredding plants	PE pellets	PE market
		Industrial	PP pellets	ASR
				Chemical recycling
ASR_ELV	CR			
		Gasification	Methanol	Industry

Conclusion → We would like stakeholders to help us identify pathways that include mechanical recycling AND chemical recycling AND energy recovery for which they can provide us life cycle and techno-economic data

WHY?

Because **without involvement** from the stakeholders, we will need to **possibly outdated literature data** and/or **conservative assumptions** that may not well reflect the state-of-the-art of the current technology in use

Mechanical & Chemical Recycling and Energy Recovery pathways: Example



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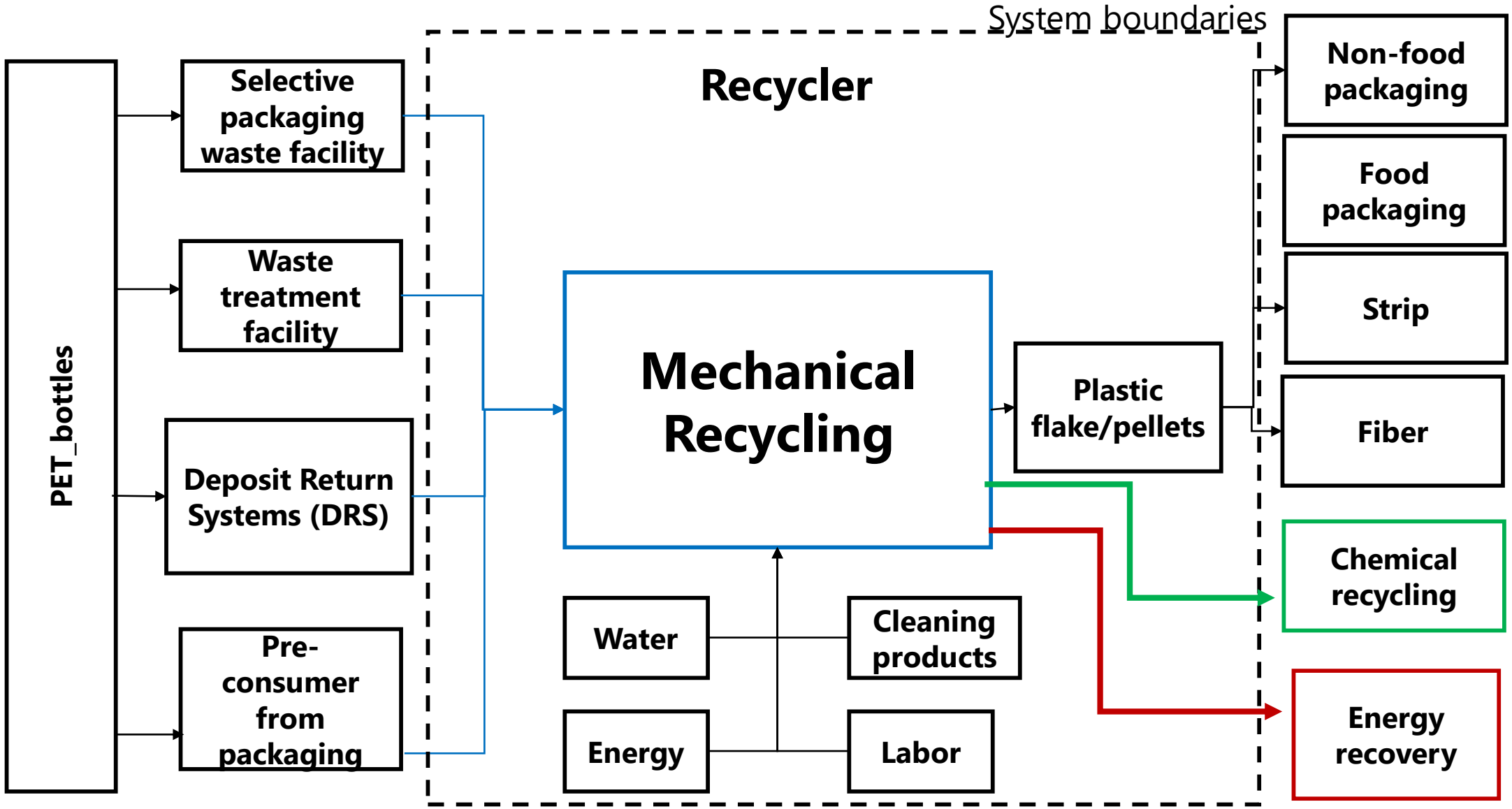
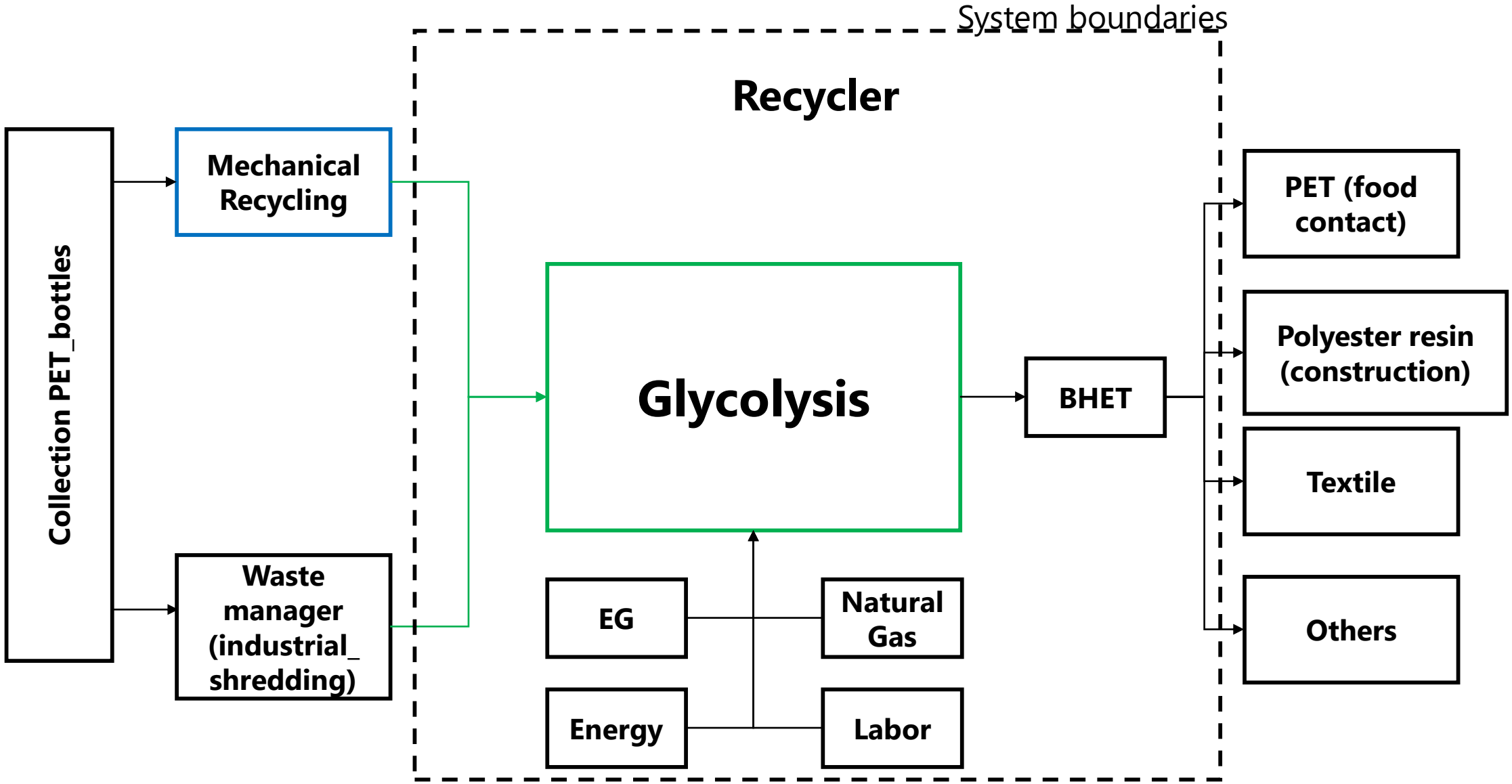
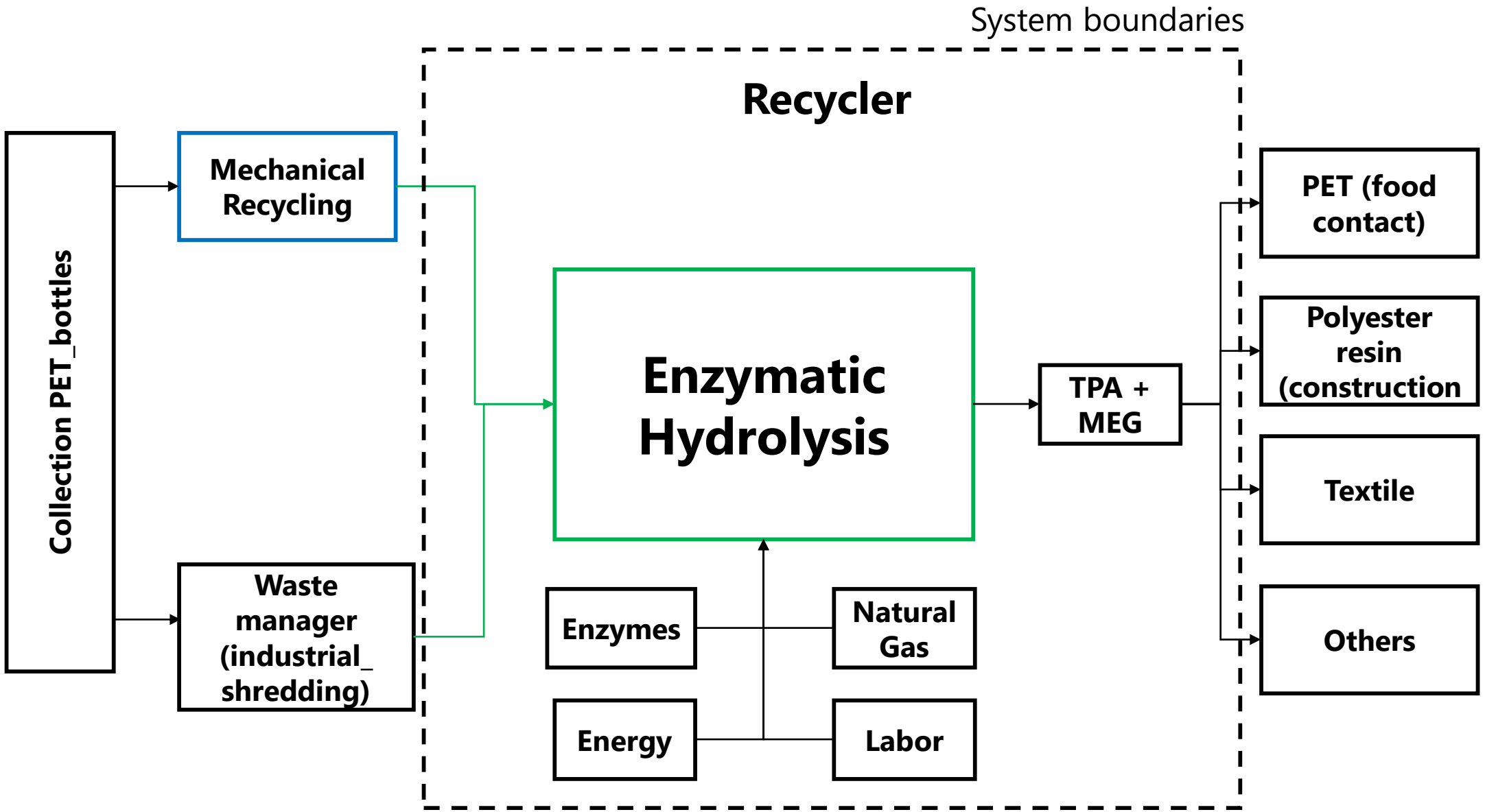


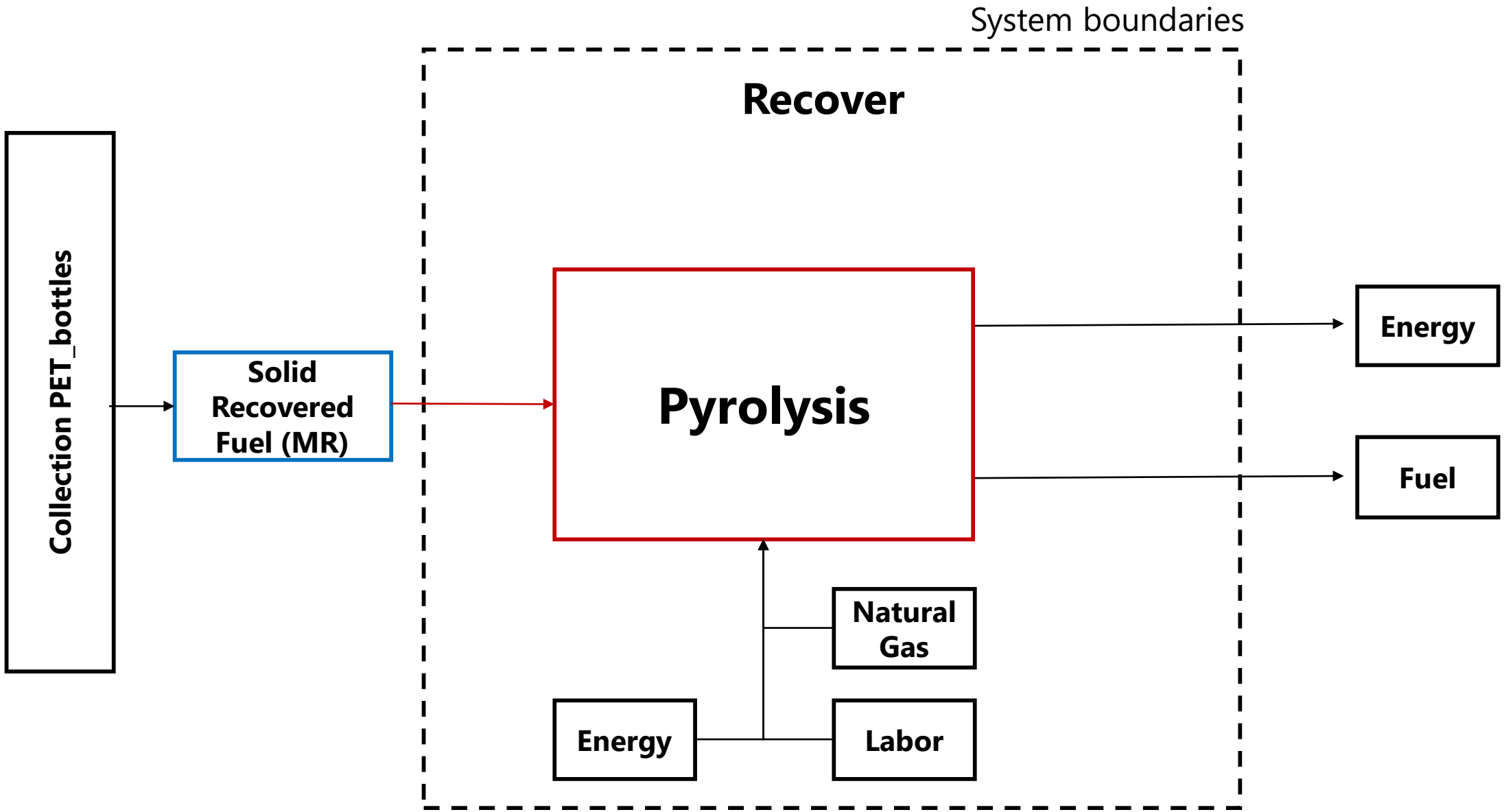
Mechanical & Chemical Recycling and Energy Recovery pathways: Example



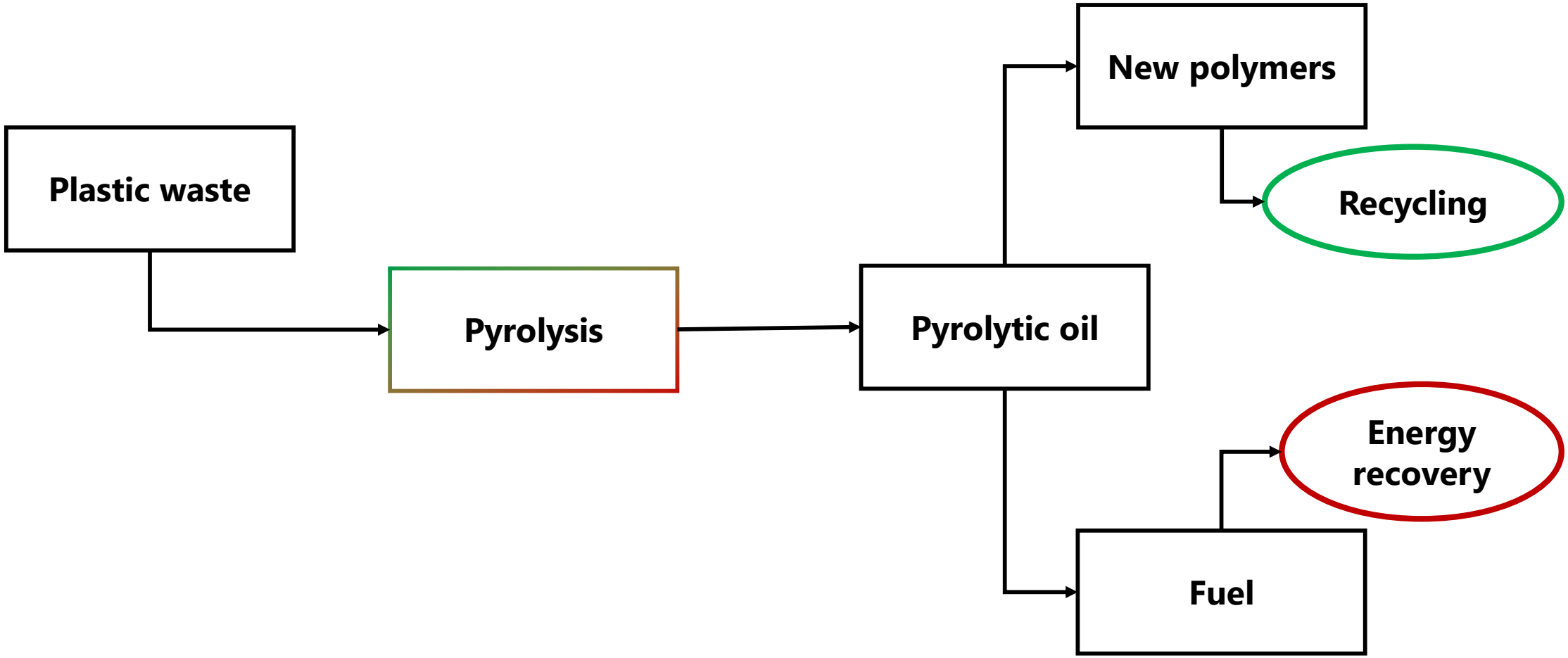
Mechanical & Chemical Recycling and Energy Recovery pathways: Example



Mechanical & Chemical Recycling and Energy Recovery pathways: Example



Methodology to calculate recycling and recovery rates for chemical recycling



Data collection

Direct contact to companies

- Collect the data (input / output) of the processes.

Website developed for the study

- Platform in which all participant will store their data in a defined data base.

Collaboration with main European associations

- Are a primary source of information about companies
- Facilitating communication in the case of languages other than English, French or Spanish

Mechanical & Chemical Recycling and Energy Recovery pathways:

MINI-SURVEY

Company data:

Name	
City (country)	
Website	
Contact person	
e-mail address	

What type of Chemical recycling process do you use?

	Solvolysis
	Delamination
	Dissolution / extraction
	Gasification
	Pyrolysis
	Enzymatic

Do you have other process? Please, specify.

If you use more than one process from the above, please repeat the following questions for each one.

1. Indicate your production capacity (t/year; t/month):
2. Treated waste.

   What kind of waste are you treating?

   What is your main source (raw material)?

   Are you using specific waste (*bottle, piece, film, etc*)?

   Could you indicate the waste polymer type?

	Single polymer (indicate)
	Mixed

- Origin of the treated waste:

	Packaging: Food/Non-food
	Building
	Vehicles
	Agricultural
	Electric-electronic
	Others (indicate)

3. What kind of products are you obtained?
4. Are you aware of the market of the products obtained?

	Packaging: Food/Non-food
	Building
	Vehicles
	Agricultural
	Electric-electronic
	Others (indicate)

5. What do you consider important elements to calculate the rate of recycling and energy recovery for certain chemical processing pathways?

Mechanical & Chemical Recycling and Energy Recovery pathways: Companies and stakeholders involvement

Glycolysis of PET				
Polymer (*): (select and indicate percentage) • PET • Other (indicate)				
Waste type: (select and indicate percentage) • Bottle • Sheet • Textile • Industrial • Other (indicate)				
Scale of the operation (**): TRL 9: Actual system proven in operational environment. TRL 8: System complete and qualified TRL: 7: System prototype demonstration in operational environment TRL 6: Technology demonstrated in relevant industrially environment. TRL:5: Technology validated in relevant industrially environment. Other TRL: to indicate.				
Unit	**Inventory (per t)**	**Unit**	**Inventory (per a)**	**Distribution (per t)**
Capacity				
Annual usage rate				
Lifetime				
Inputs				
Feedstock-type				
Feedstock quantity				
Electricity				
Natural gas				
Ethylene glycol				
Water				
Labour: non-skilled				
Labour: skilled				

Outputs				
Output products				
Product 1 (BHET)				
Other product				
Air emissions				
CO_2				
CO				

Air emissions				
CO_2				
CO				
NO_x				
SO_x				
HCl				
Dust				
Dioxins				
N_2O				
NH_3				
Pb				
As				
Cd				
Cr				
Cu				
Hg				
Ni				
VOCs				
Other 1				
Other 2				

Mechanical & Chemical Recycling and Energy Recovery pathways: Companies and stakeholders involvement

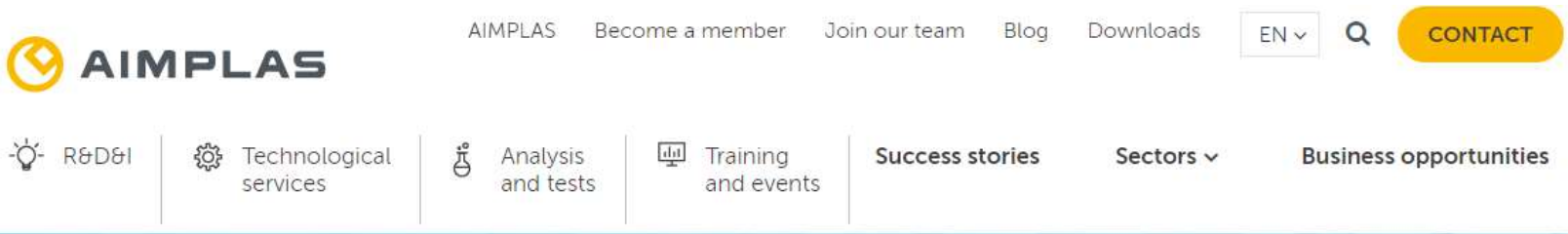
Costs				
Unit				
Electricity	M€/a			
Natural gas	M€/a			
Ethylene glycol	M€/a			
Water	M€/a			
Other inputs	M€/a			
CAPEX	M€			
OPEX	€/ton			
OPEX: Insurance	%CAPEX			
OPEX: Maintenance	%CAPEX			
OPEX: labour involved (skilled)	Person-hours			
OPEX: labour involved (non-skilled)	Person-hours			
OELEX	M€			

Prices				
Unit				
BHET	€/t			
Other product	€/t			
Operational data				
Unit				
Temperature	K			
Pressure	Pa			
BHET yield	%			
Ethylene glycol yield	%			
Other outputs yield	%			

Product Purity (Indicate if there are different purities, what they are and the percentage of each of the products globally

- BHET
- Others (indicate)

Website



https://www.datarecycling.aimplas.net/

Timeline

Mini-survey send to the stakeholders

- Monday 8th of March

Return of mini-survey completed

- Monday 15th of March

Send Detailed questionnaire to stakeholders

- Monday 5th of April

Return completed detailed questionnaire

- Deadline: Monday 17th of May.

THANKS FOR YOUR ATTENTION

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