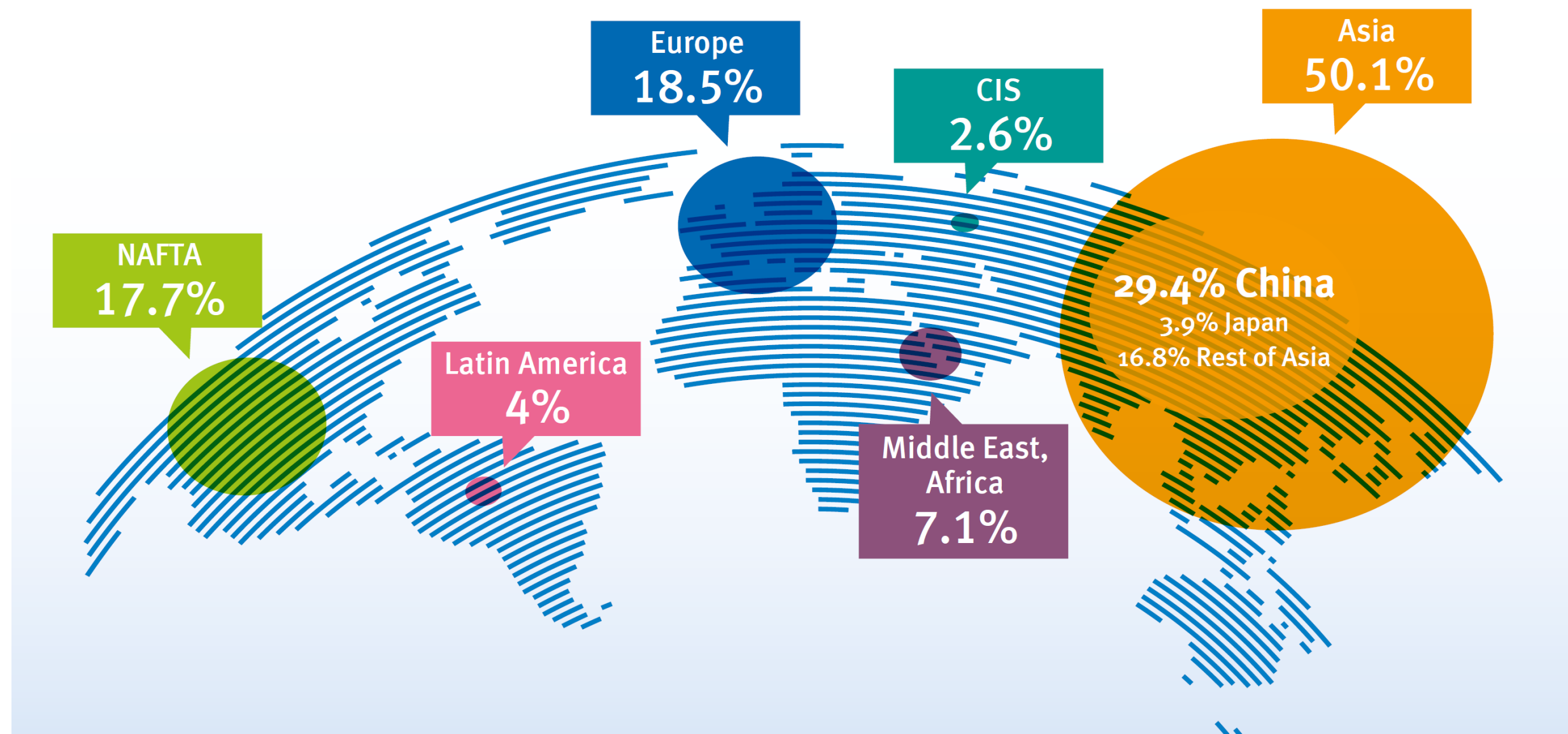


# PSYCHE Project

Prof. Dr. Ir. Kevin Van Geem, 08/05/2019

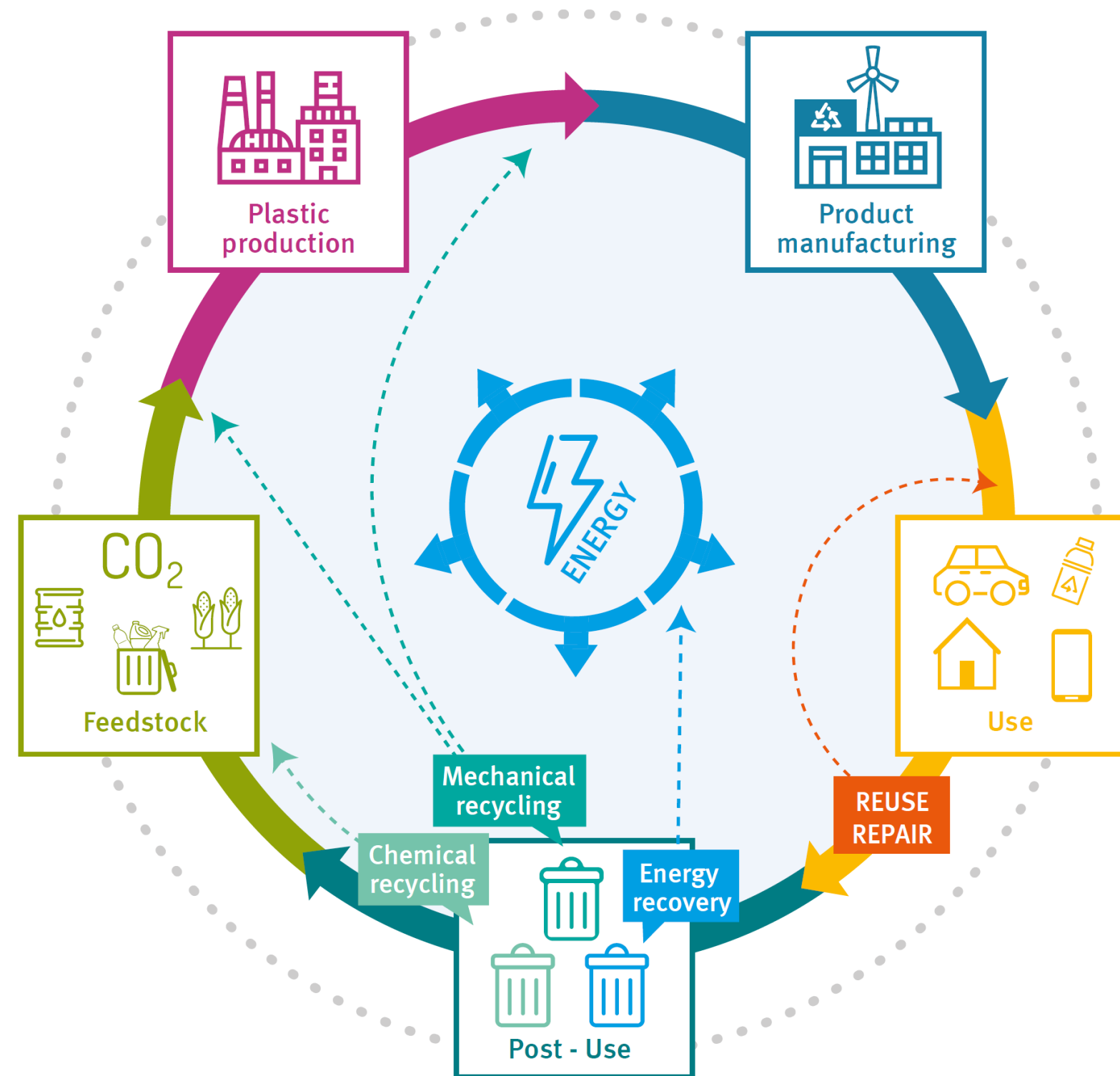
# Plastics

- World Plastics Production (MT) in 2016 → 2017: 335 → 348
- EU Plastics Production (MT) in 2016 → 2017: 60 → 64.4



PlasticsEurope, 2018. Plastics – the Facts 2018: An analysis of European plastics production, demand and waste data, PlasticsEurope Brussels, Belgium.

# Circular Economy

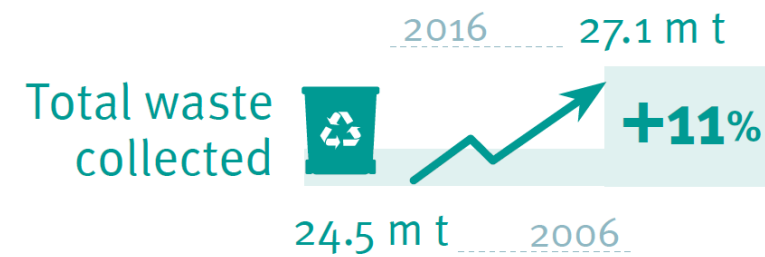
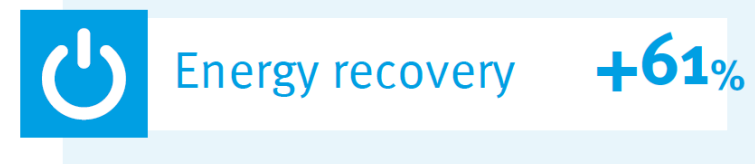
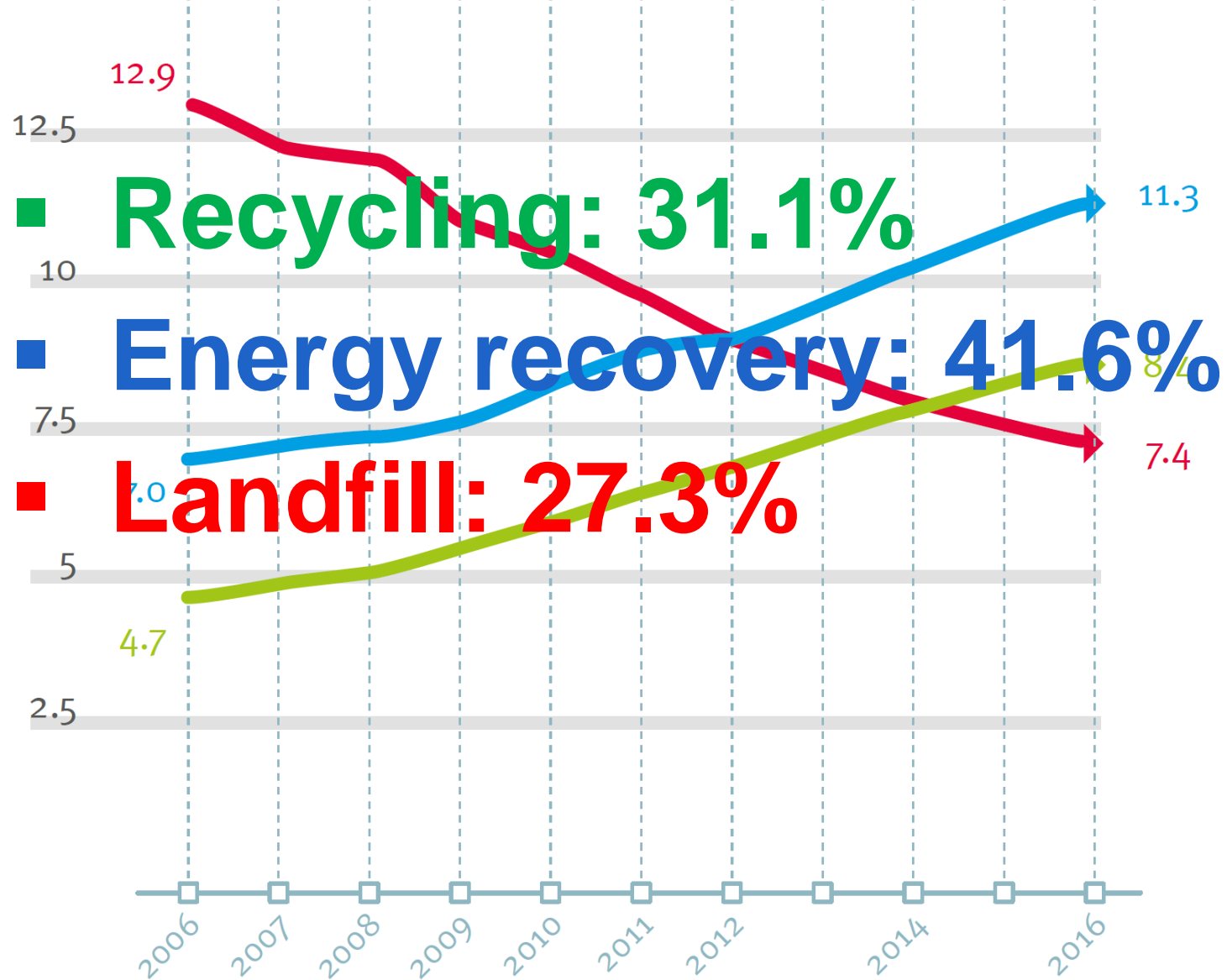


PlasticsEurope, 2018. Plastics – the Facts 2018: An analysis of European plastics production, demand and waste data, PlasticsEurope Brussels, Belgium.

# Increased plastic waste recycling

– EU plastic waste treatment from 2006 to 2016

– First time, in 2016, landfill became lower than recycling



PlasticsEurope, 2018. Plastics – the Facts 2018: An analysis of European plastics production, demand and waste data, PlasticsEurope Brussels, Belgium.

# PSYCHE Project

- Conversion of plastic waste to base chemicals via gasification and subsequent Fischer-Tropsch synthesis



**PSYCHE**

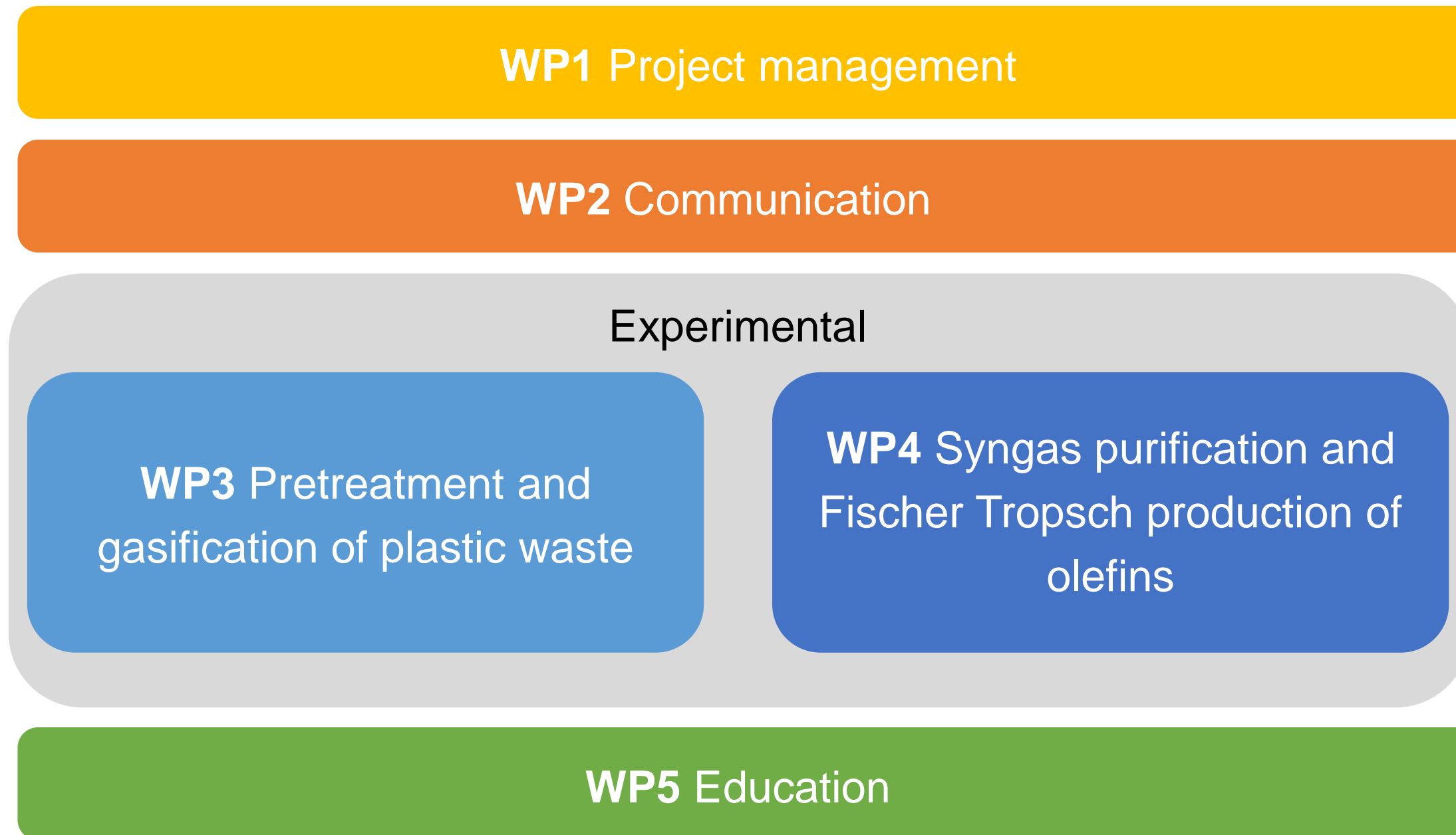


**€ 2.6 Million**



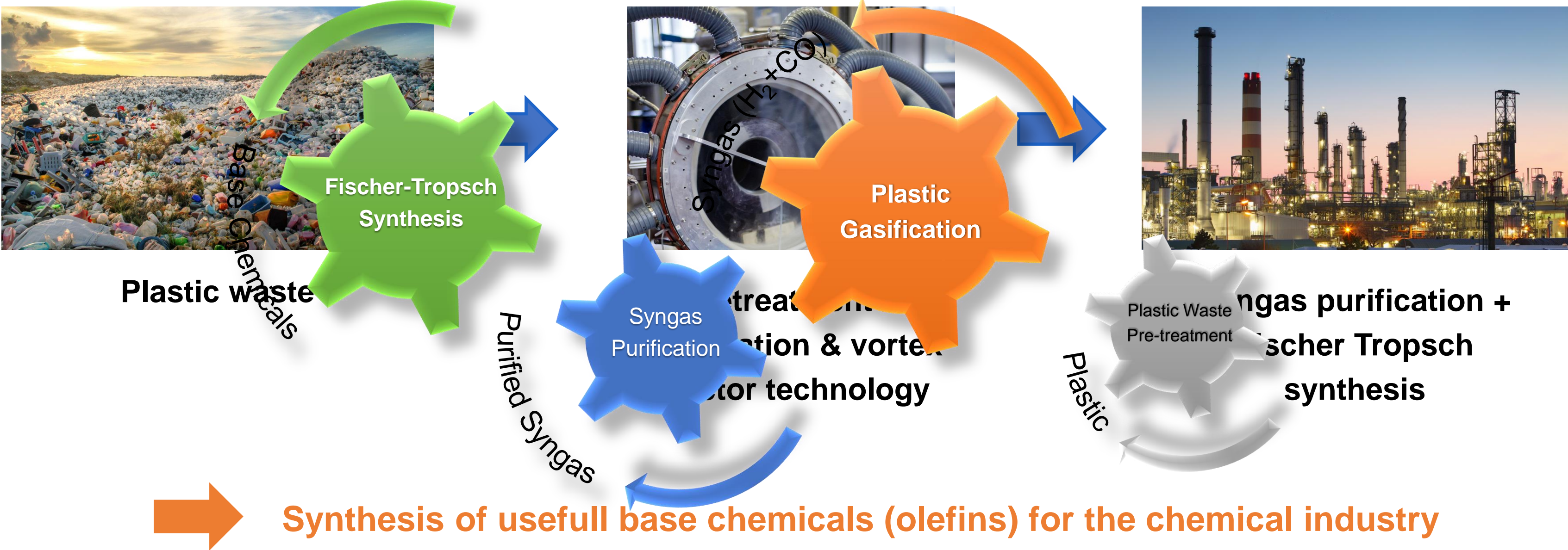
**PSYCHE**

# Work Packages





# PSYCHE Objective



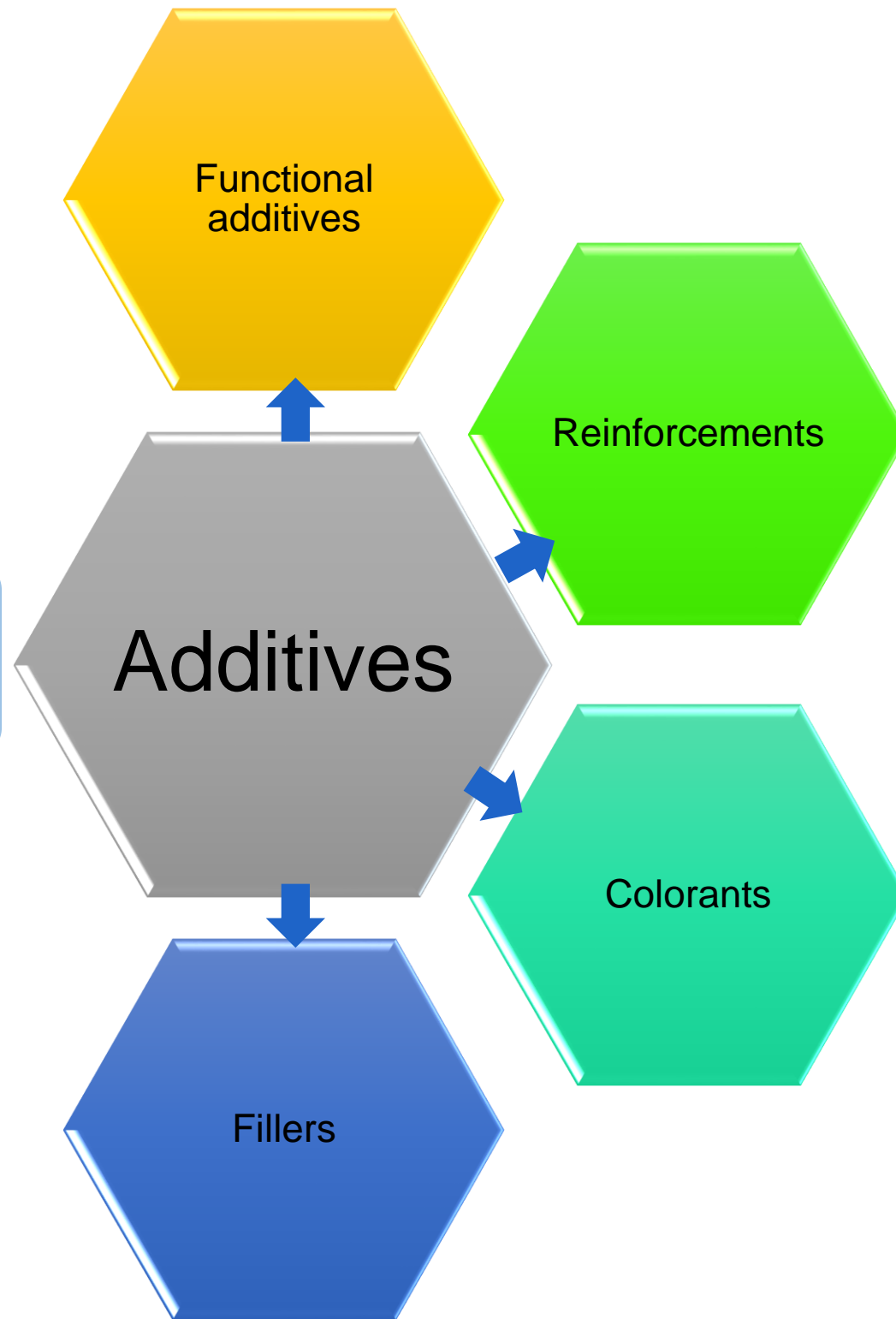
# Pre-treatment



# Challenge in plastic processing: Additives



Additives improve physicochemical properties of plastics

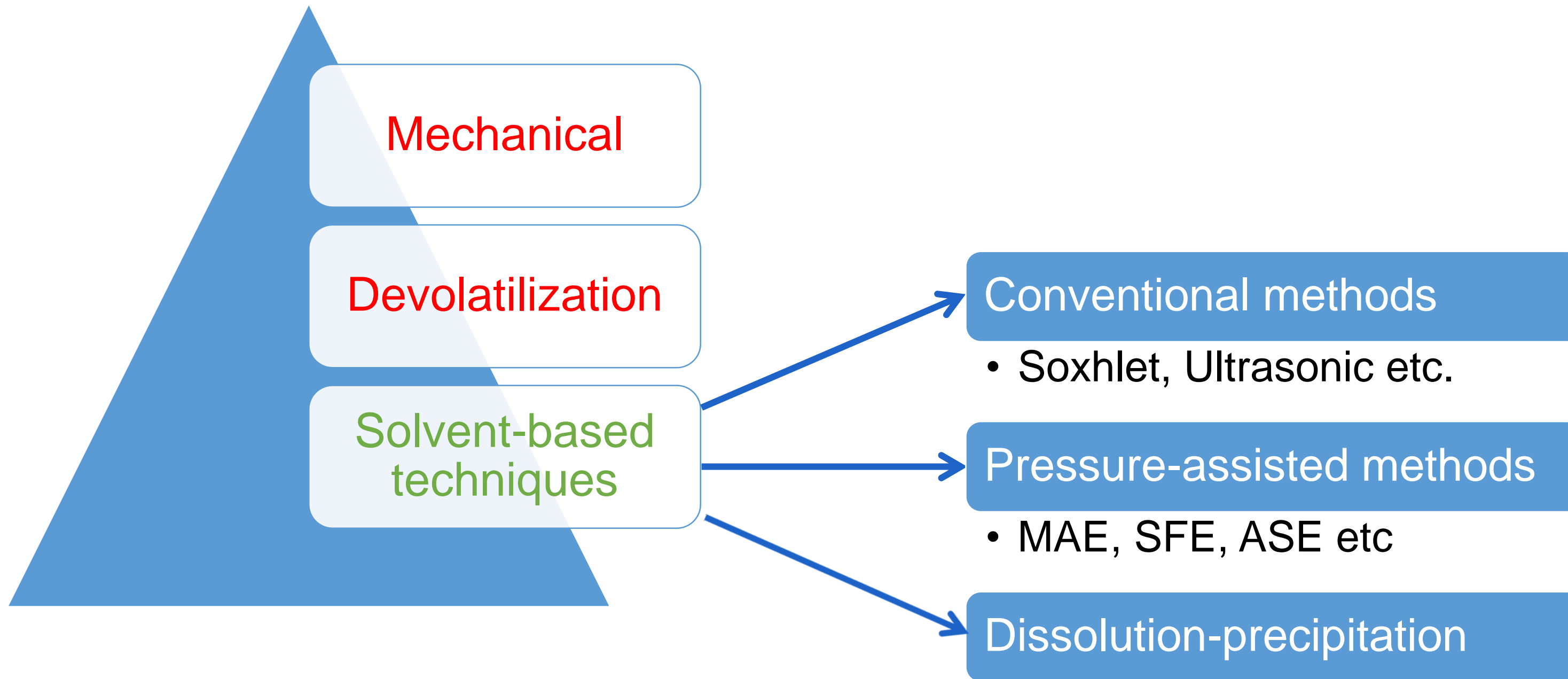


HOWEVER

During processing they cause:

- Migration
- Emissions
- Leaching
- Degradation
- Release

# Techniques for pre-treatment



- ✓ Start with a review of scientific literature based on extraction of various additives via solvent-based extraction techniques

# Objectives

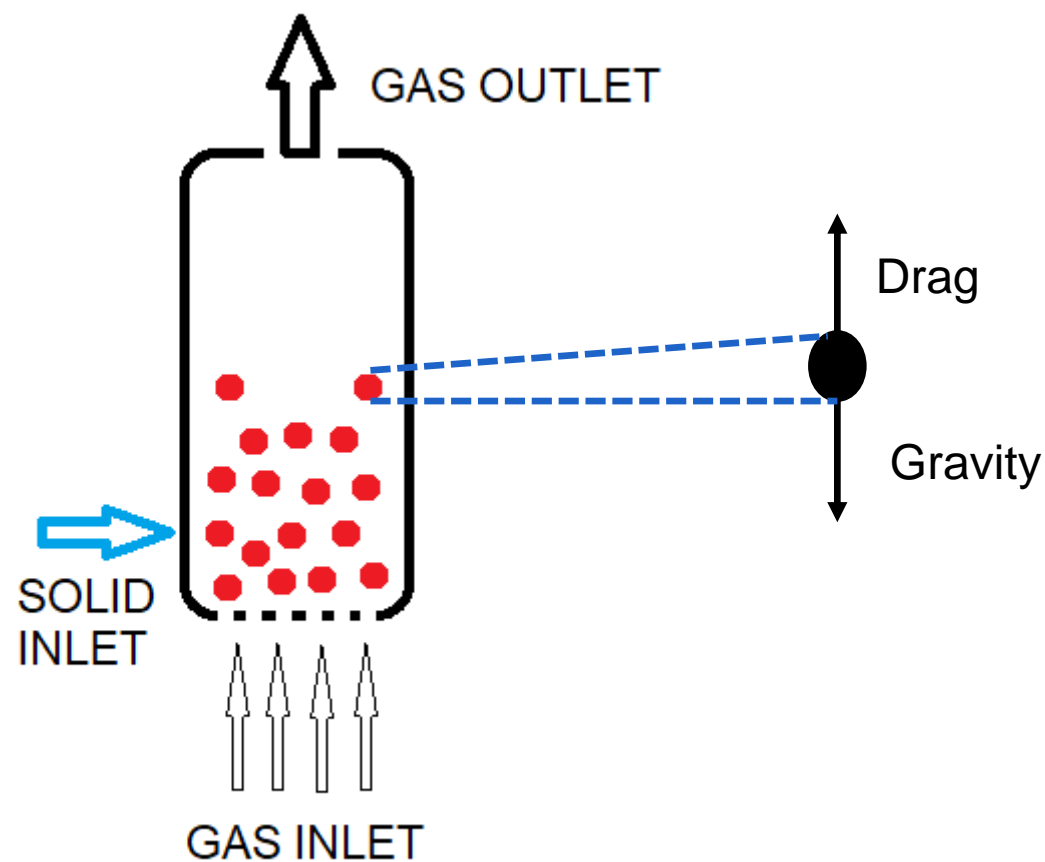
- Physicochemical pre-treatment of plastic waste via various extraction methods
- Assessment of various extraction methods on the removal of different type of additives from plastic waste
- Optimization of pre-treatment conditions for a broad range of plastics



# Gasification in vortex reactor

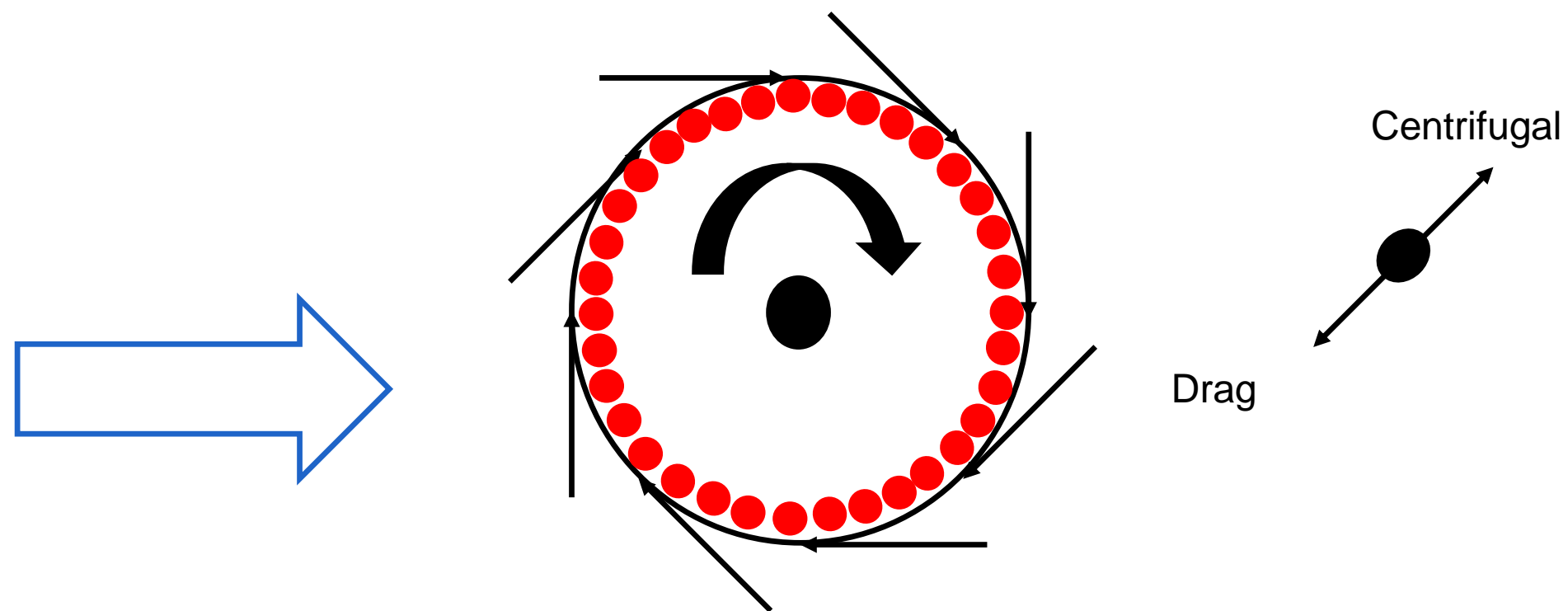
# Gas-Solid reactors

## Fluidized bed reactor



- Gas velocity limitation.
- Diluted bed.

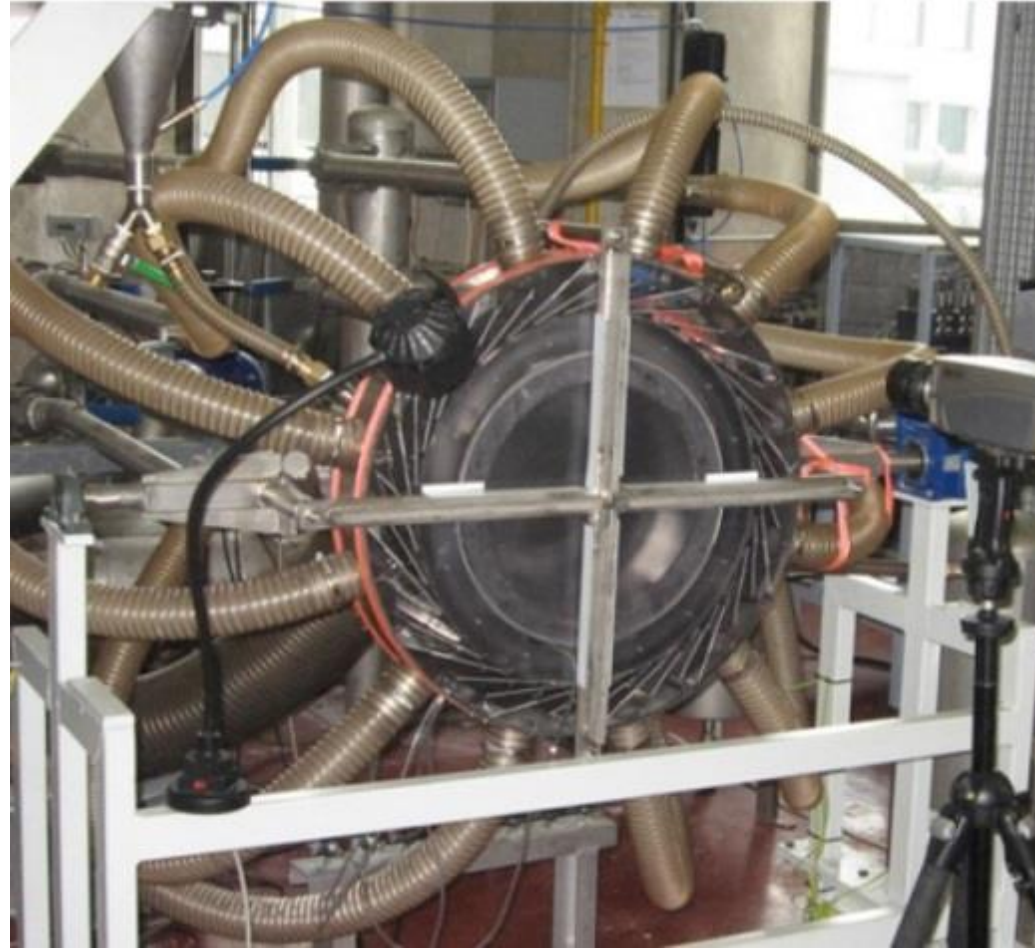
## Gas Solid Vortex Reactor (GSVR)



- Extended gas velocity limitations.
- High gas-solid slip velocity.
- Packed bed.
- Short gas space time.



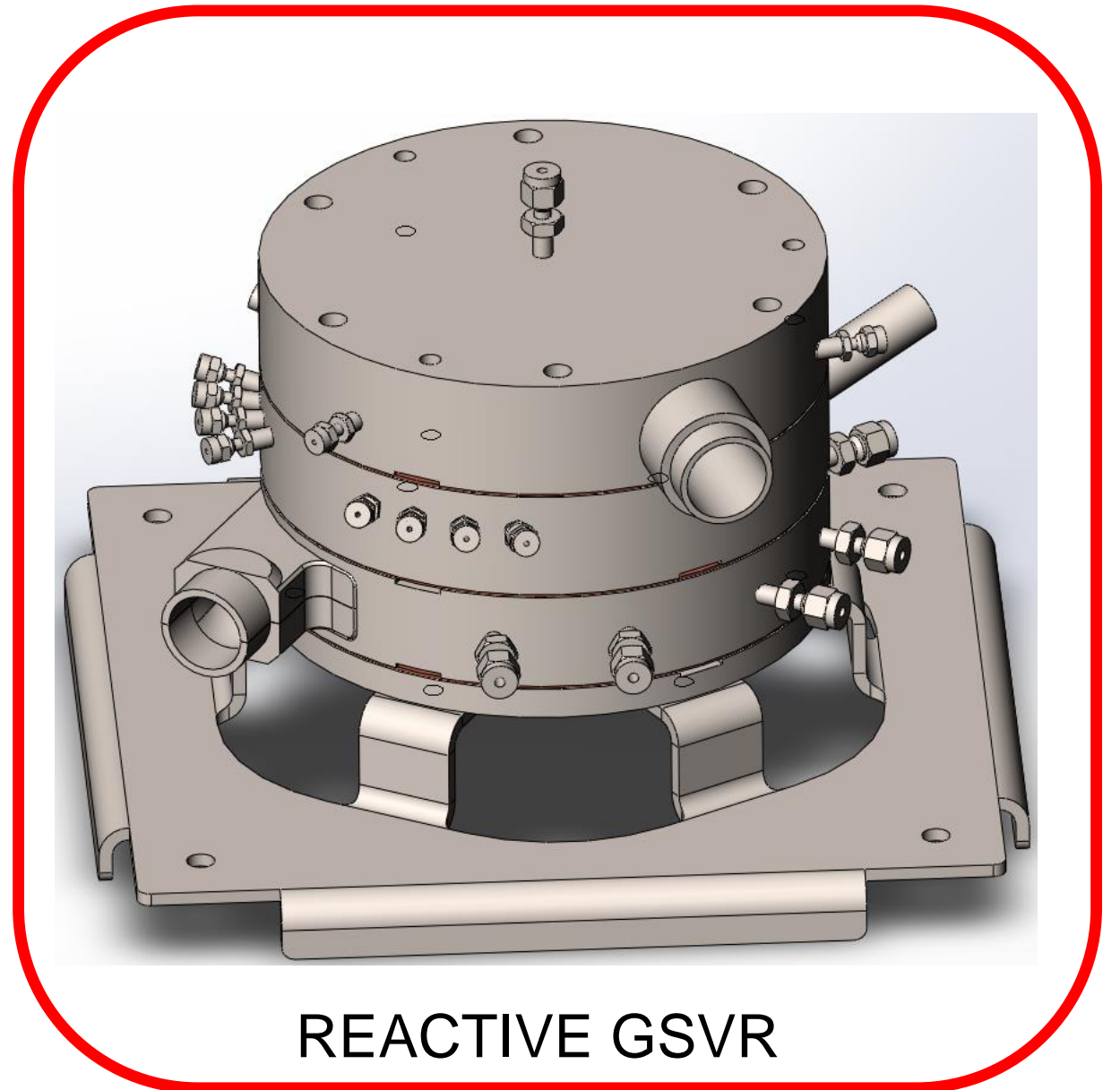
# GSVR research at LCT



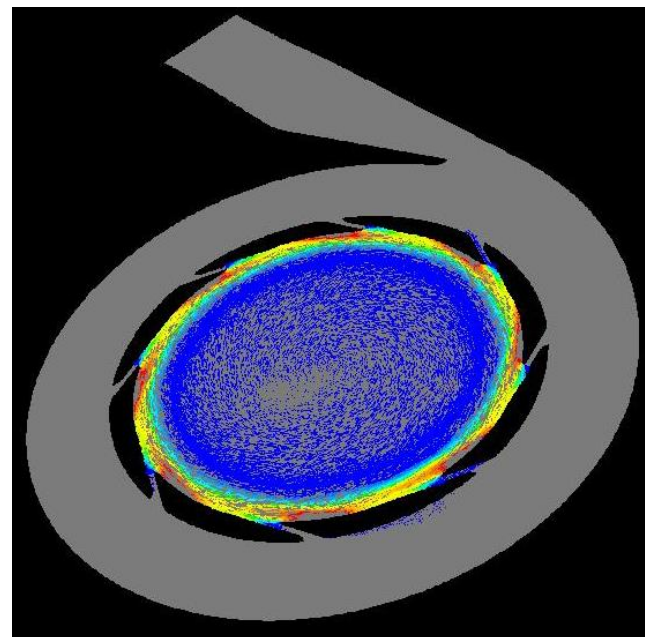
COLD FLOW GSVR



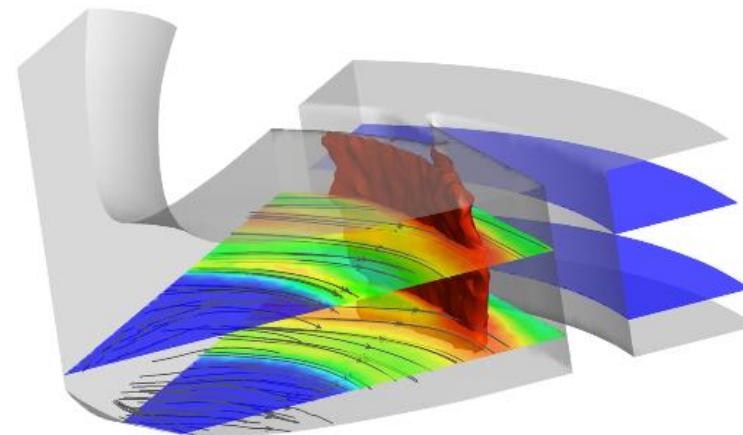
HOT FLOW GSVR



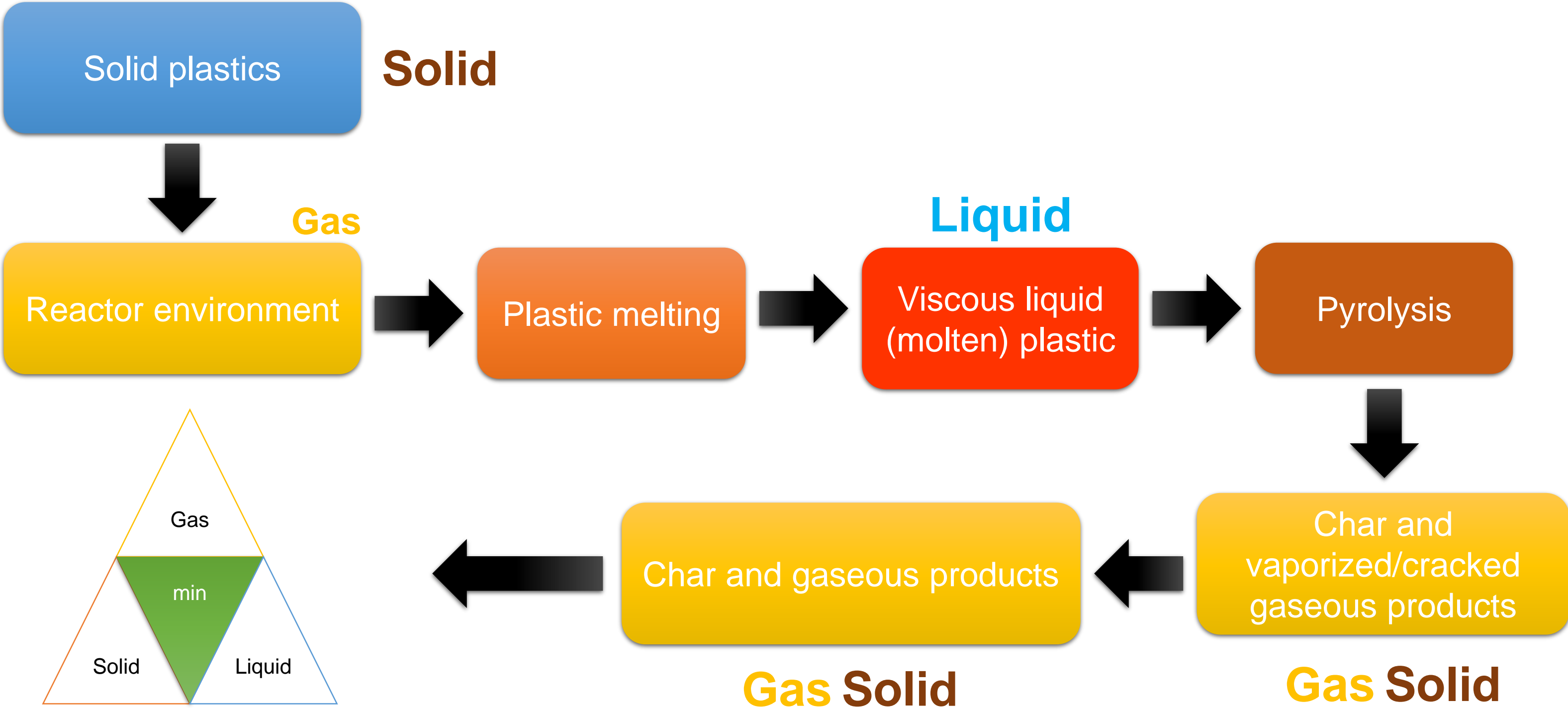
REACTIVE GSVR



CFD



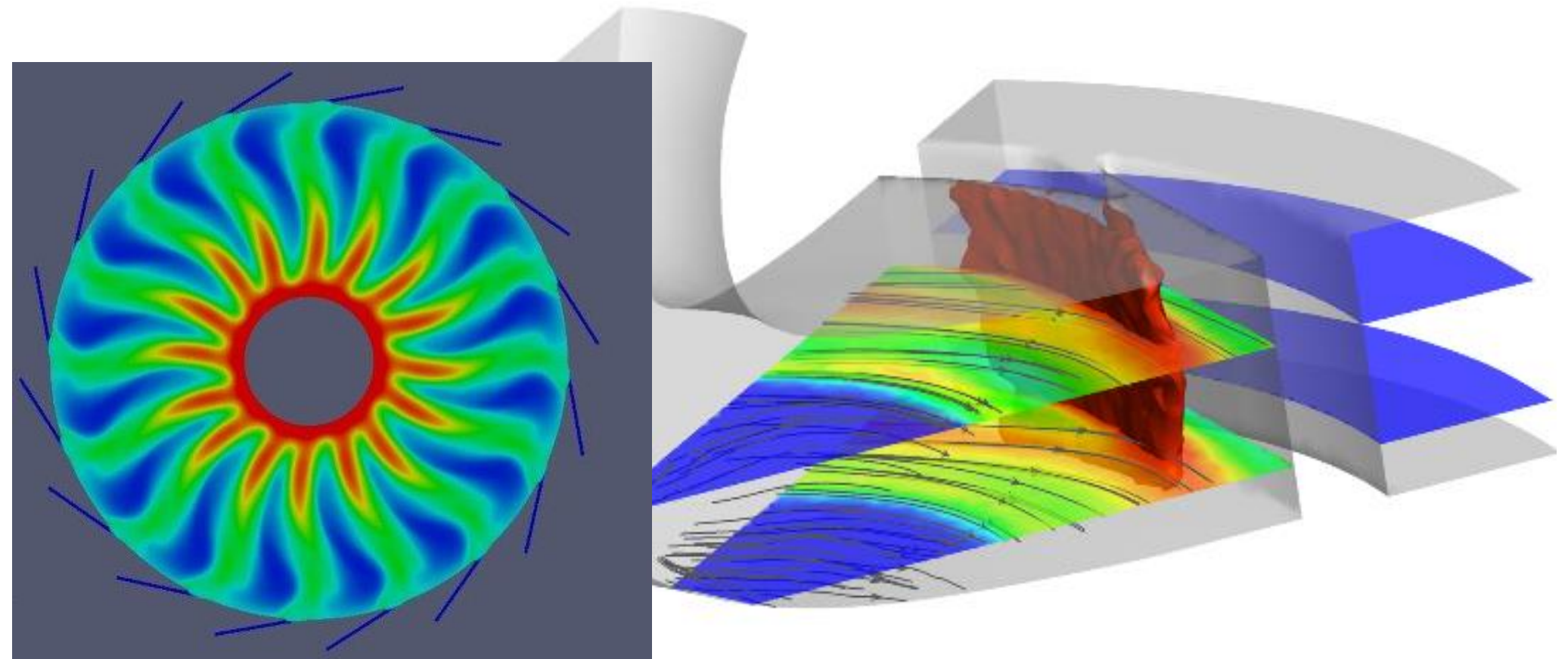
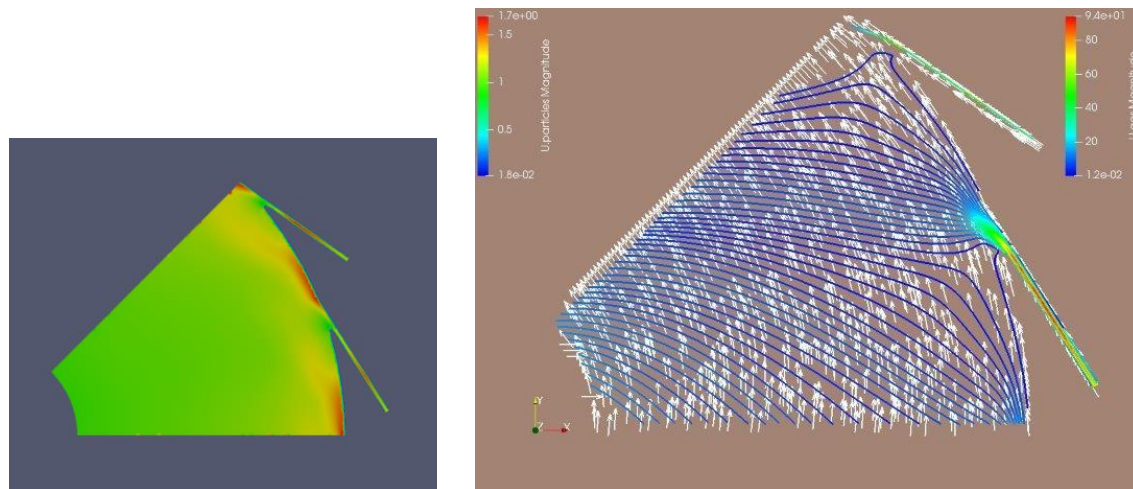
# Plastic Gasification Process in GSVR





# Objectives

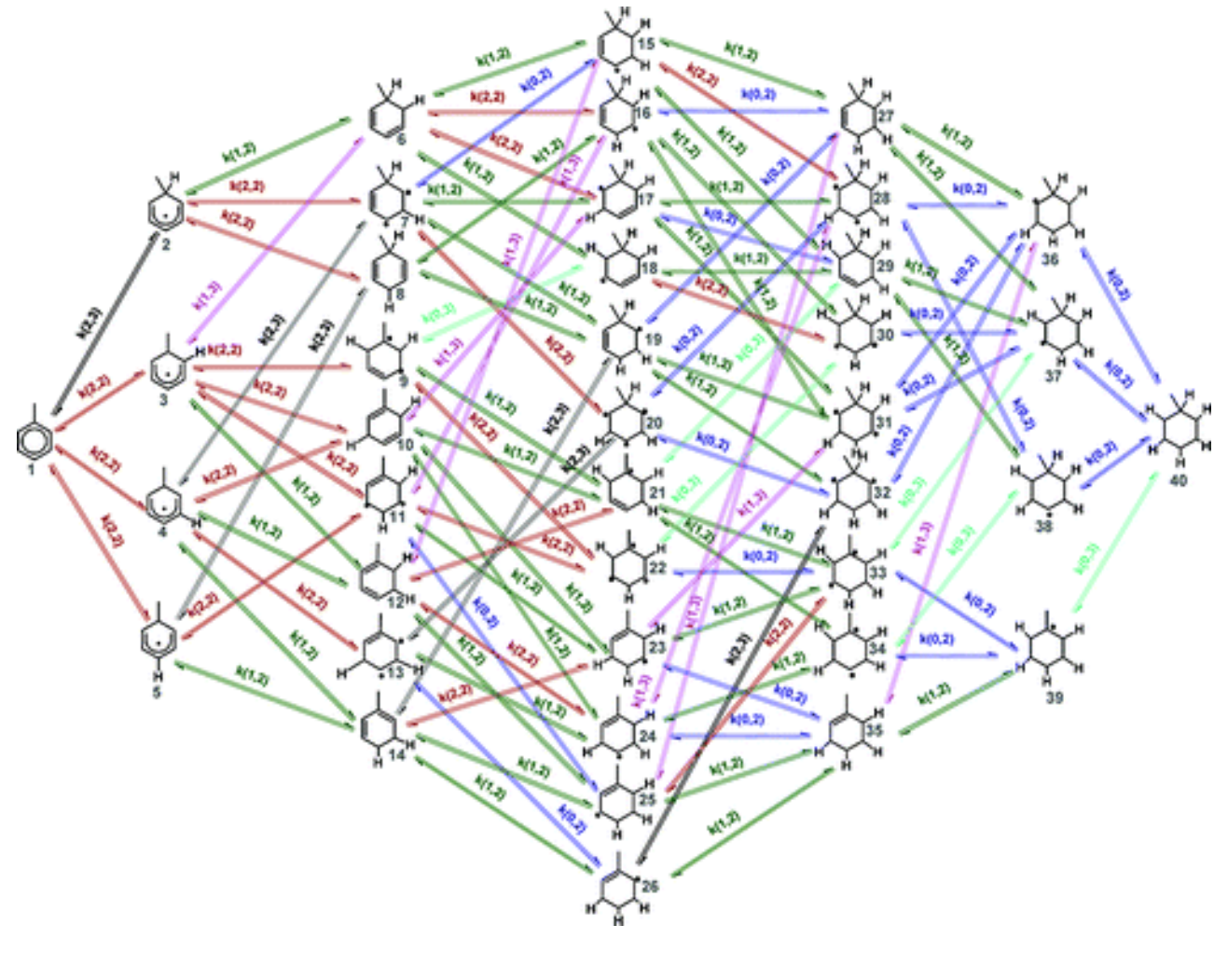
- Numerical Investigation of plastic waste gasification process in gas-solid vortex reactor
  - Computational Fluid Dynamics (CFD)
  - Coupling CFD and Kinetics from simplified to detailed level



# Olefin production from syngas

# Catalyst optimization and reactor design

Complex reaction phenomena

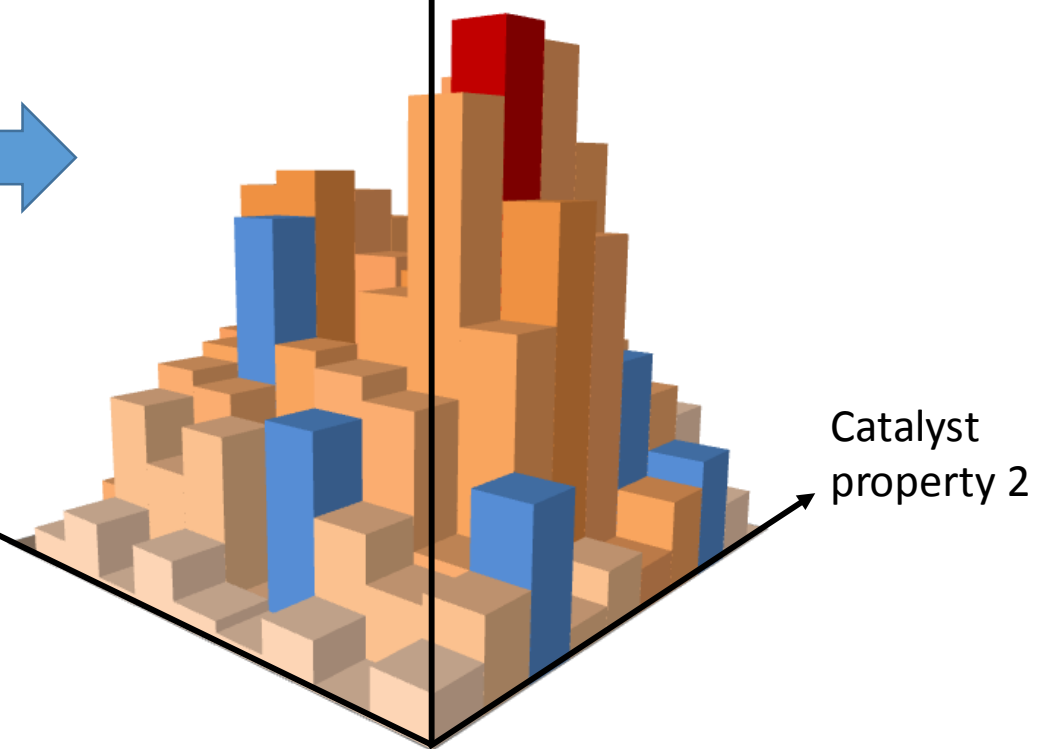


Catalyst optimization



Catalyst property 1

Performance



Catalyst property 2



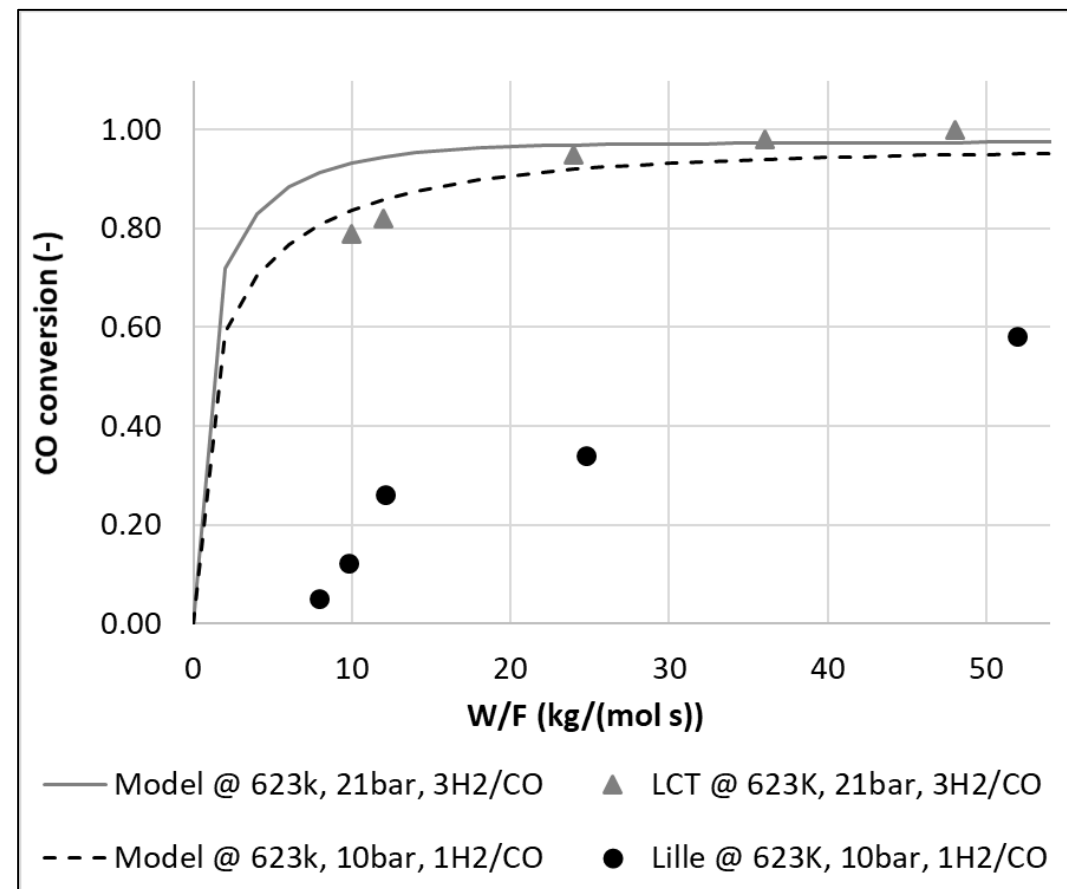
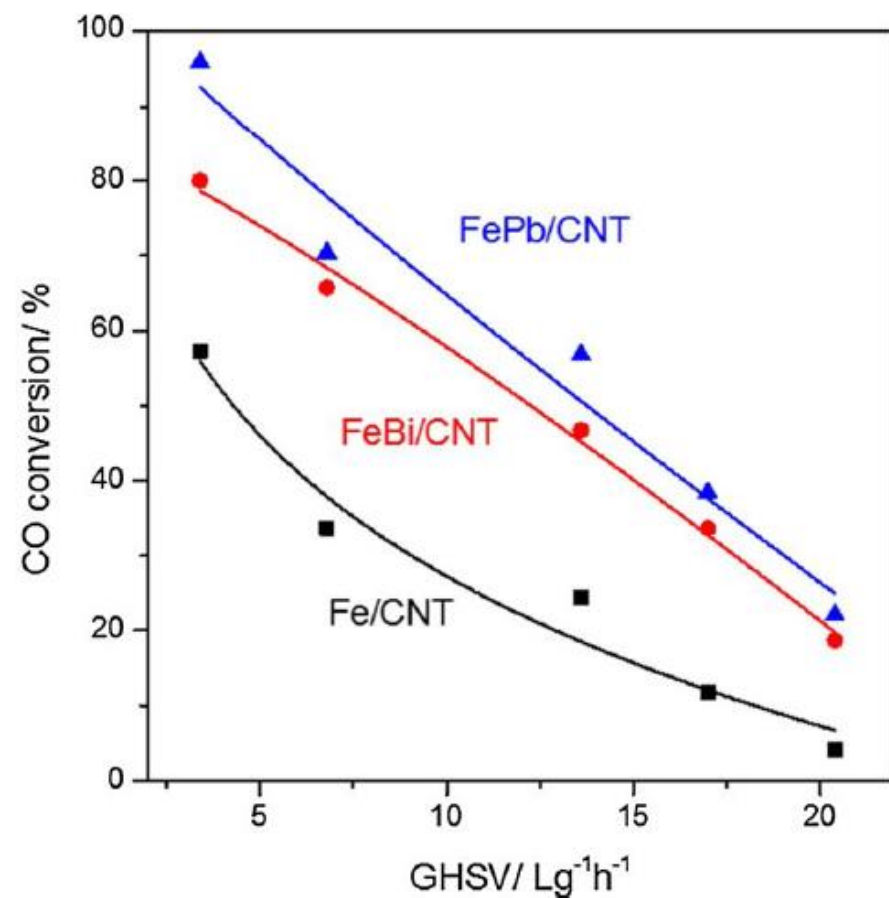
Scale-up studies





# Objectives

- ❑ To incorporate influence of catalyst descriptors, into the model.
- ❑ To allow extension of the model to other catalysts.
- ❑ To transform the model into a useful tool for catalyst design and development.



SEMK model for Fischer-Tropsch synthesis experimental data obtained on an iron-based catalyst with variation in promoters.

# Acknowledgements



**PSYCHE**



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Met steun van het Europees Fonds voor Regionale Ontwikkeling



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