LCA of bioplastics packaging

Comparison of CO_2 impact for various applications

In collaboration with the Instituto Superior Técnico, Universidade de Lisbao

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Content

- About Total Corbion PLA
- Setting the scene
- Process models & results
- Overall conclusions

Two parent companies with complementary strengths

	TOTAL	Corbion
Position	World's 4th largest oil & gas company	World's largest lactic acid producer
Headquarters	Courbevoie, France	Amsterdam, the Netherlands
Revenue	$ 150 B	$ 970 M
Employees	98,000	1,700
Profit	$ 8.2 B	$ 189 M
Main businesses	Oil & Gas, Solar & Bioenergy, Commodity & Specialty Chemicals	Food Ingredients, Biochemicals, Bioplastics, Biomedical

Source: 2016 annual reports.

Building a world scale PLA plant

Capacity 75 kTpa
Situation Under construction, next to the world's largest lactic acid and lactide plants
Location Rayong, Thailand
Timeline Start of operations 2nd half 2018
Status Groundbreaking ceremony took place 9 November 2016, construction is ongoing

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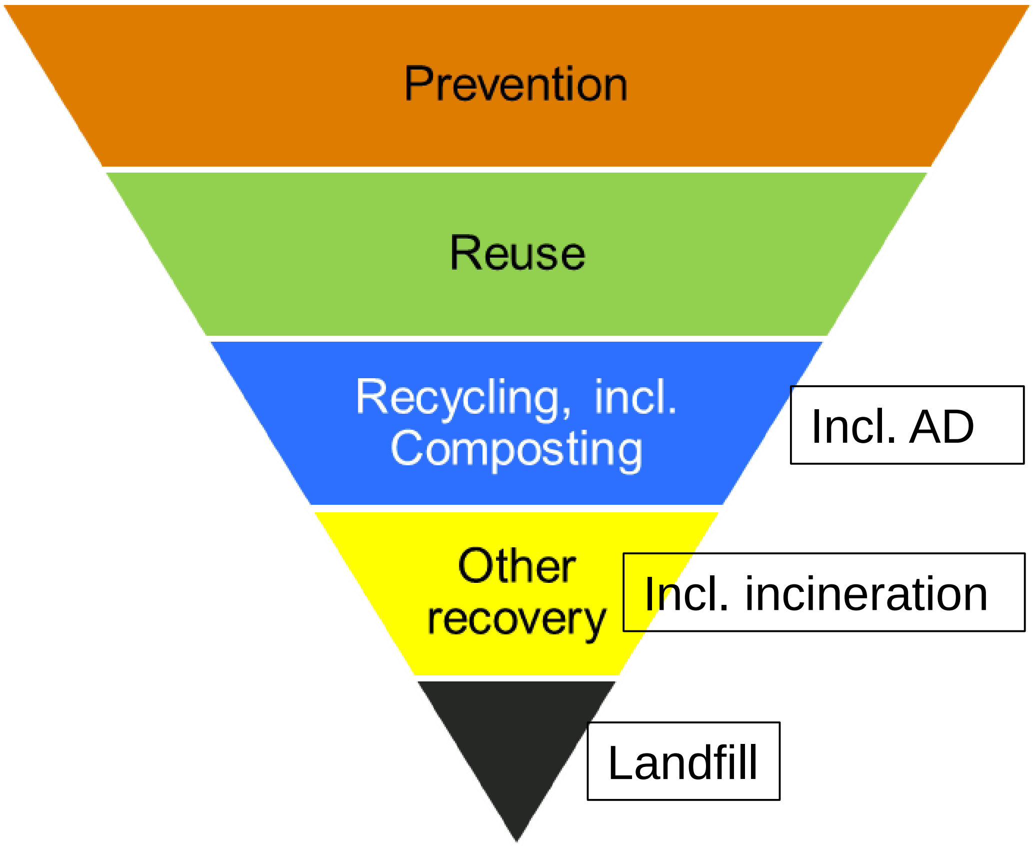
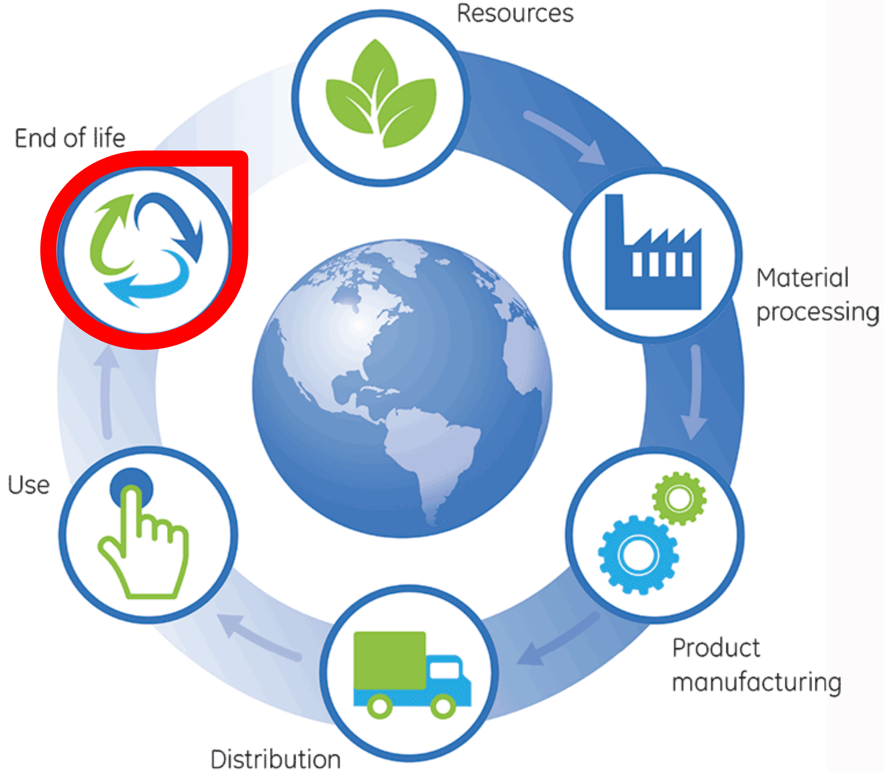
EU Waste Management: the waste hierarchy

“All the originals concerns that culminated in the waste hierarchy can be summarized as a desire to **divert waste from landfill**”



- Can **PLA** help divert organic waste from landfill?
- In which cases is that **beneficial** for the environment?

LCA: Scope and boundary conditions



Functional unit:

"1 kg of PLA food packaging including the weight of the food waste left behind when thrown away by the user"

Geographic boundaries: Europe

Impact categories:

Global warming potential	Acidification potential
Eutrophication potential	Water scarcity
Non-renewable energy	Renewable energy
Land Occupation	

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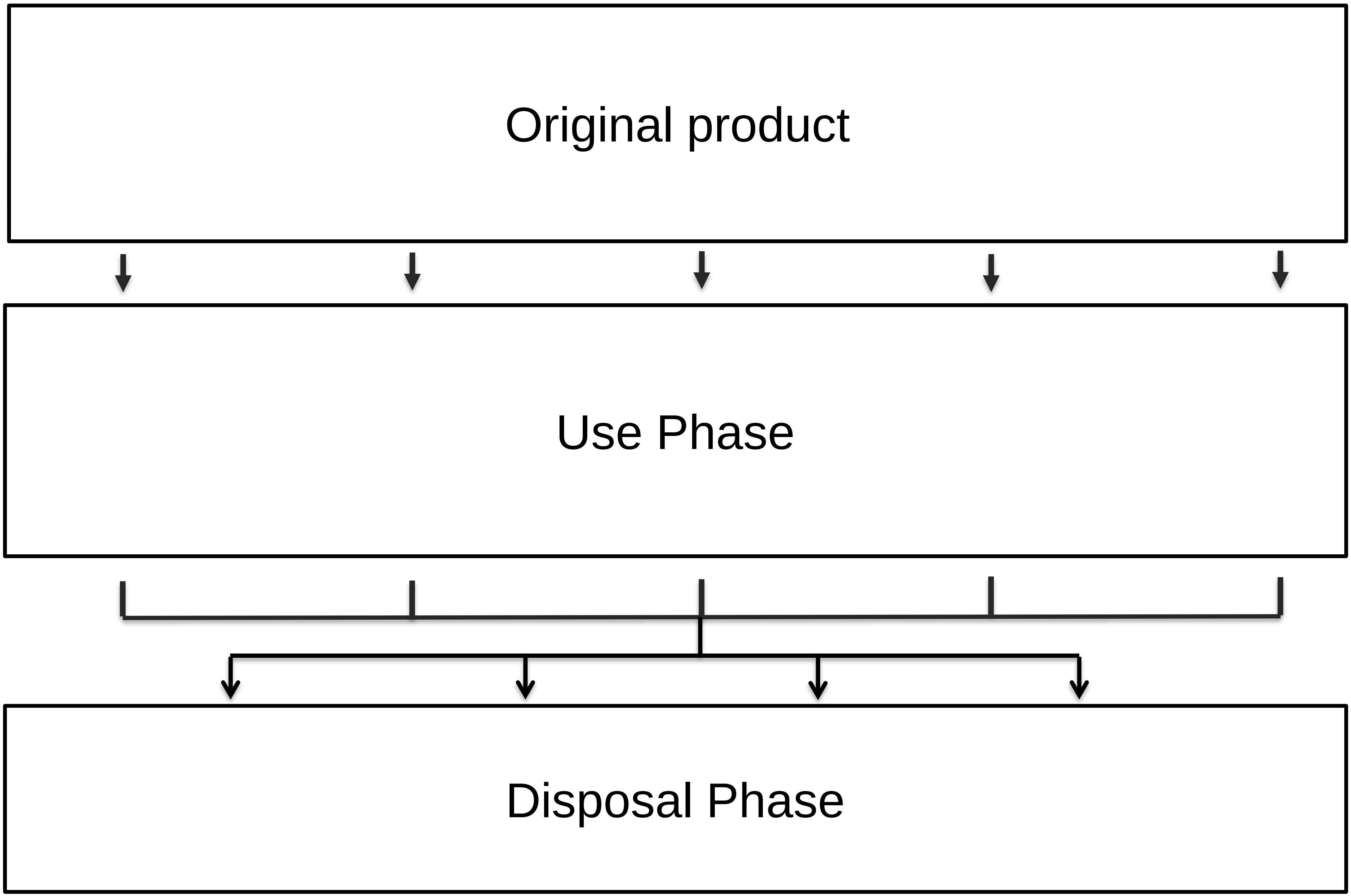
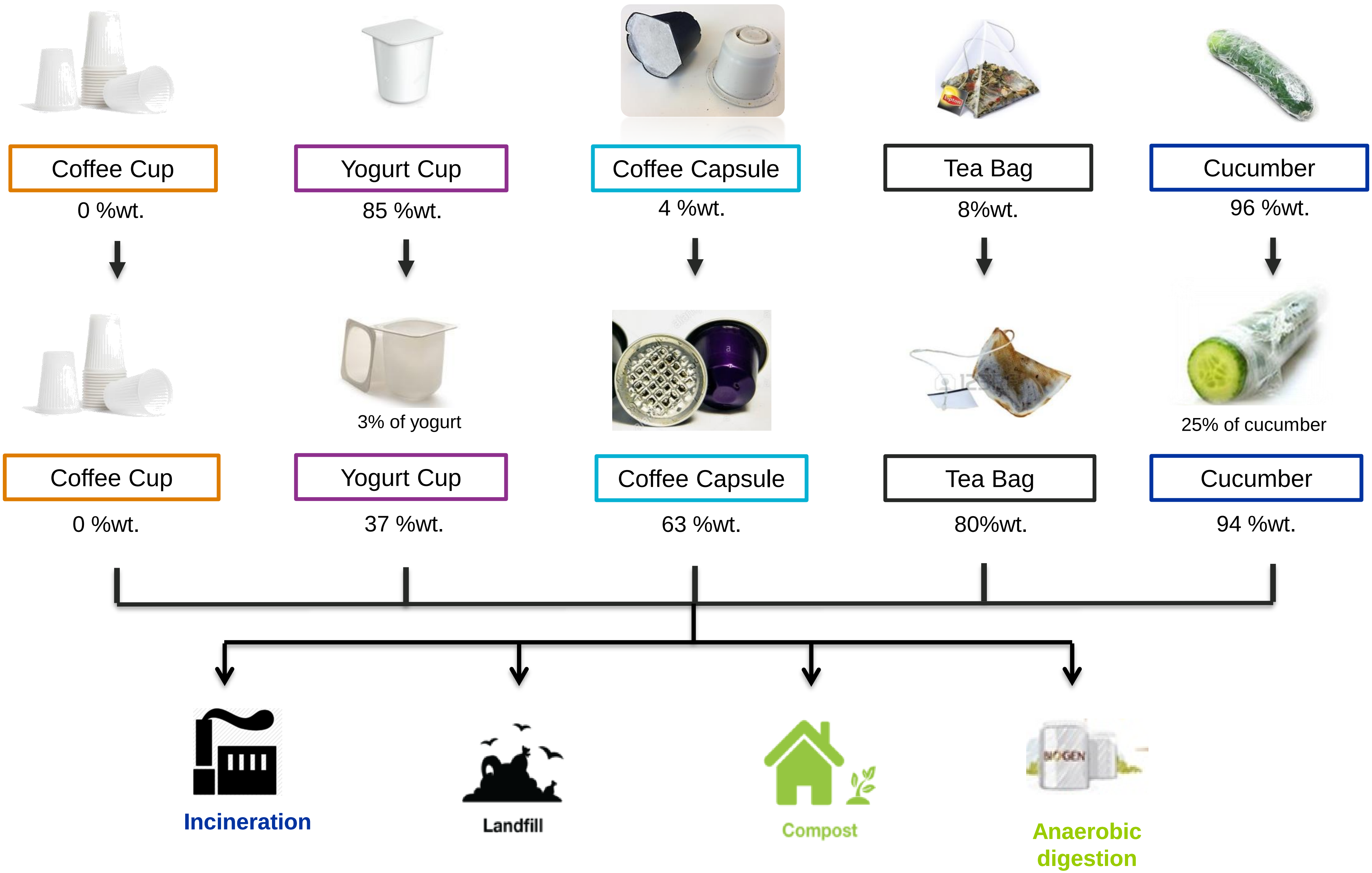
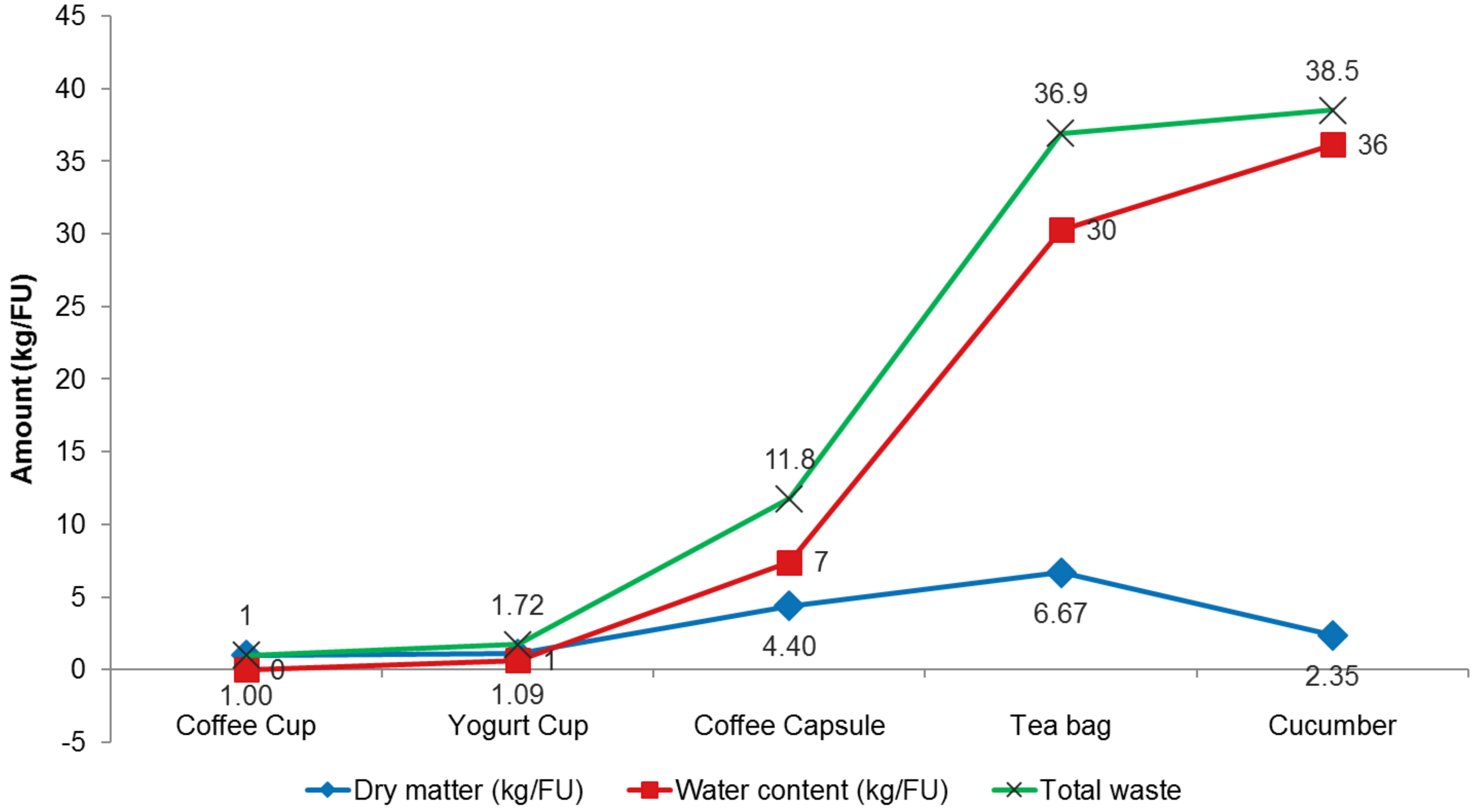
Definition: products before / after consumption



Definition: products before / after consumption



Reference flows after consumer's use
(Functional unit based on 1 kg PLA)



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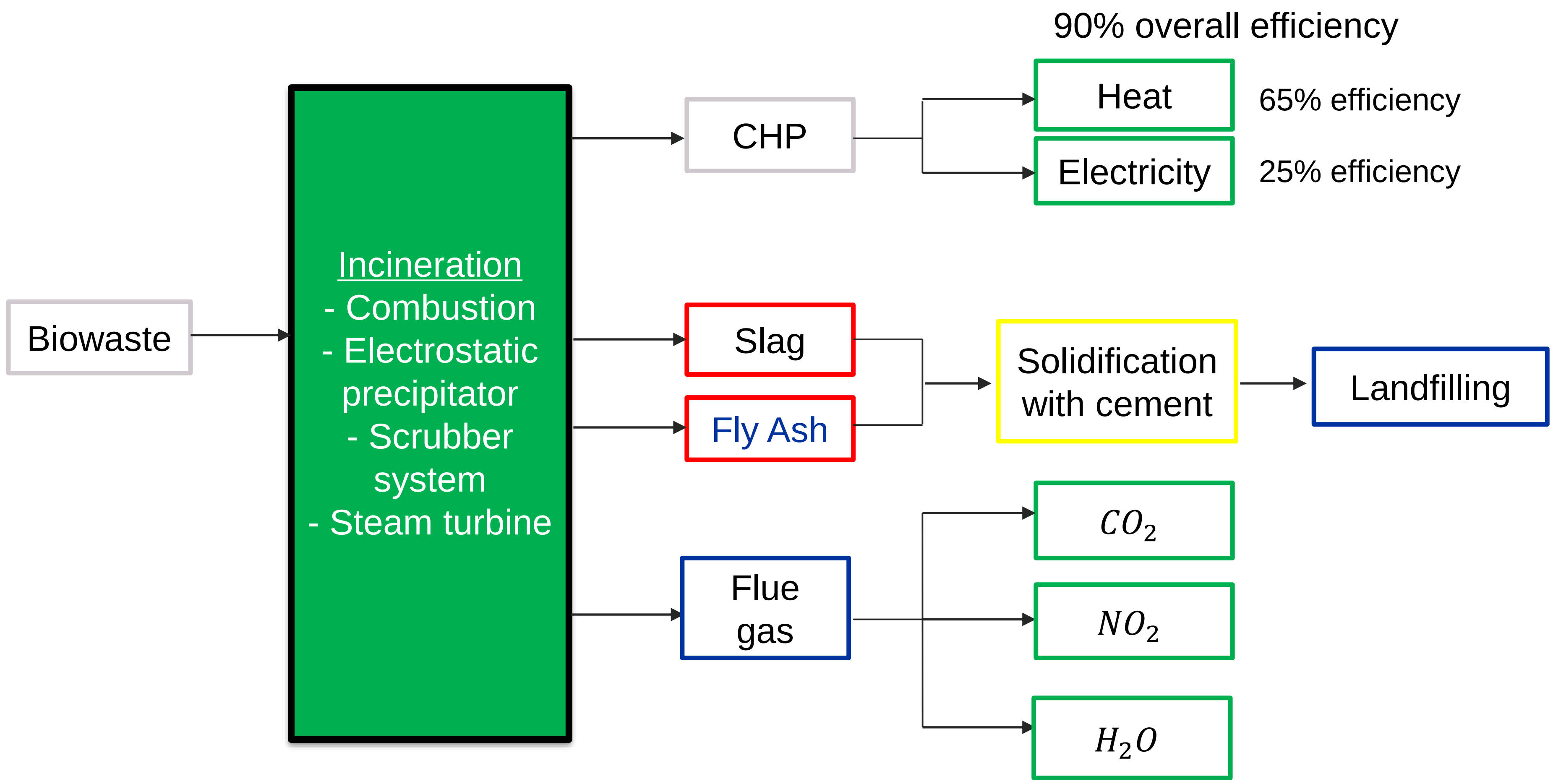
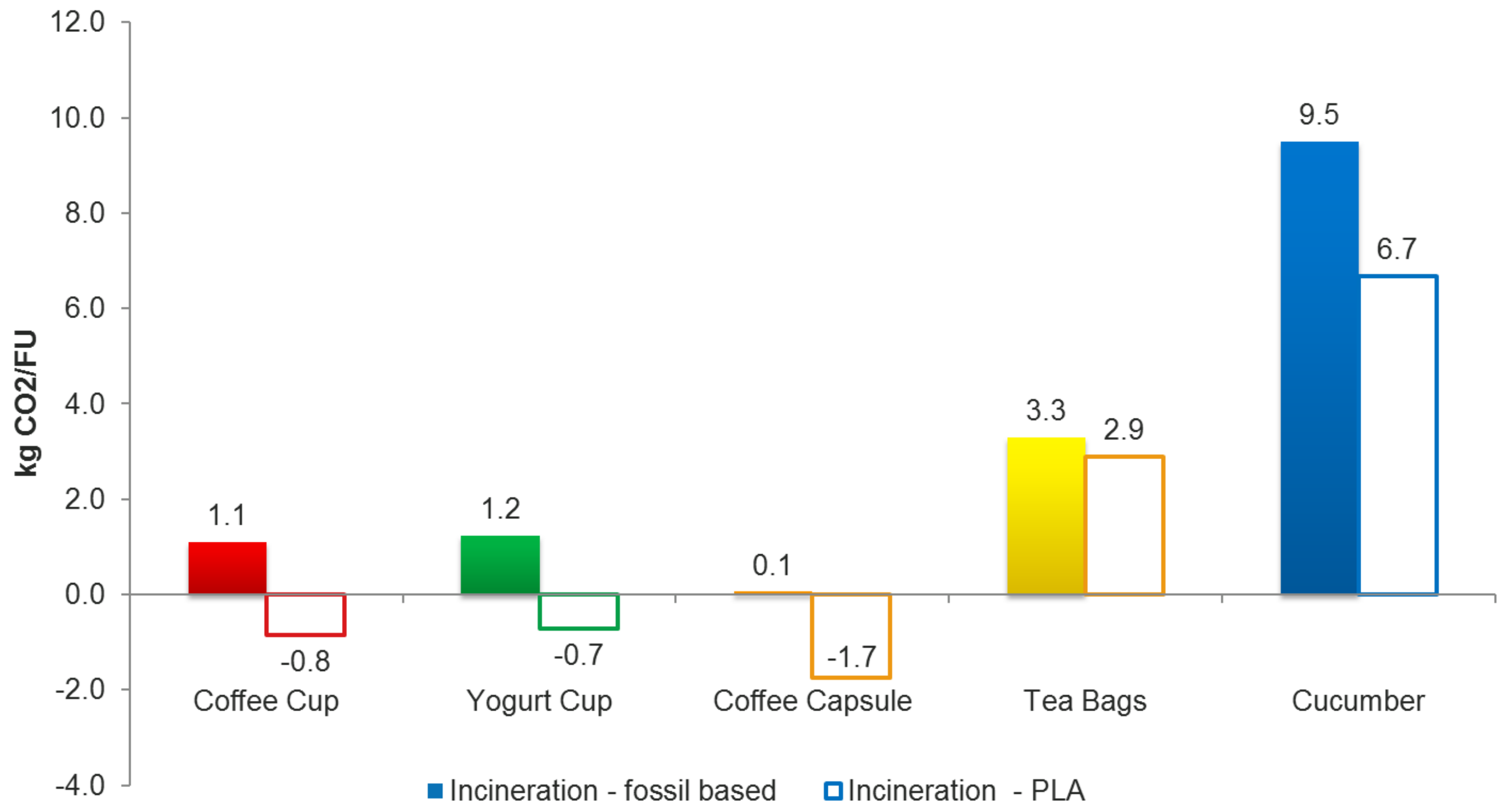
Process model for incineration

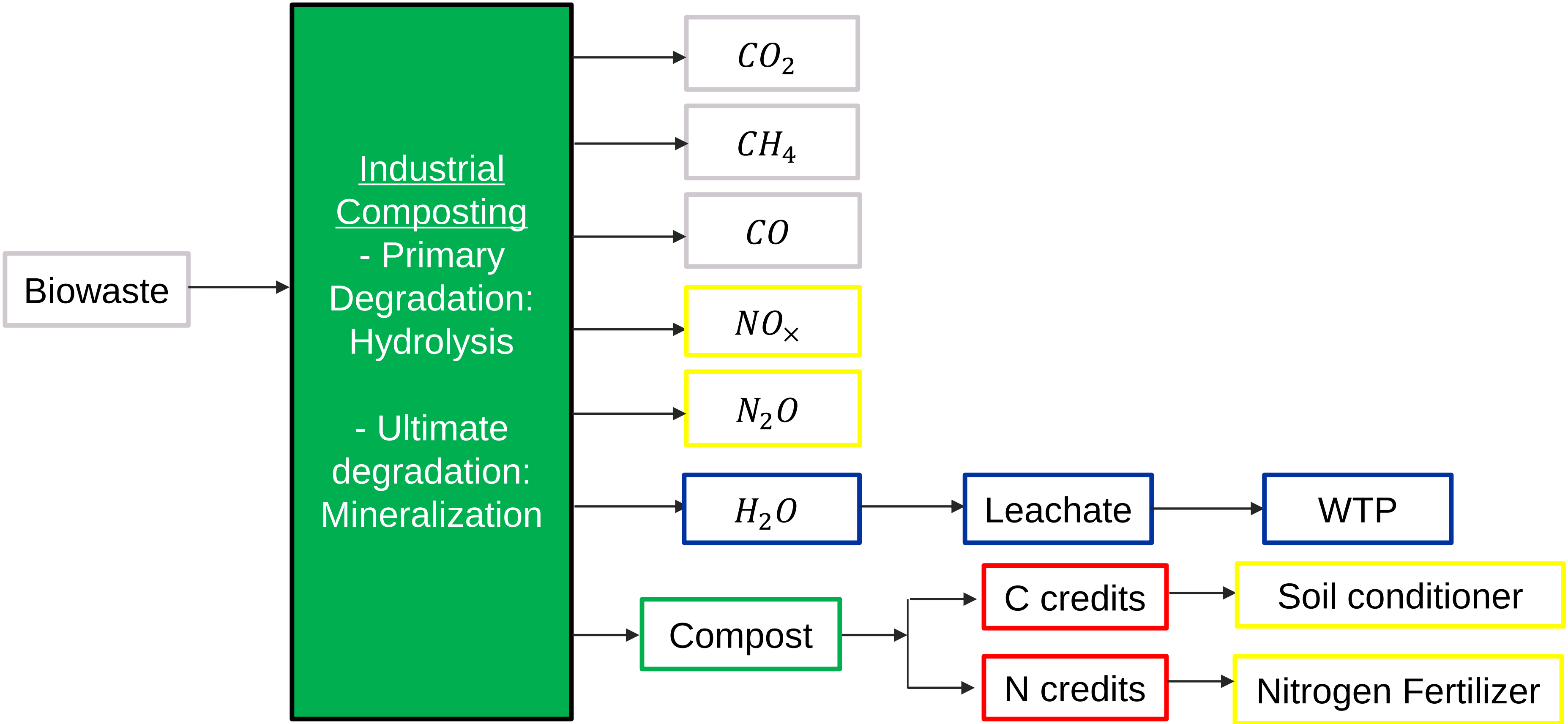


GWP of fossil-based plastics vs PLA in incineration



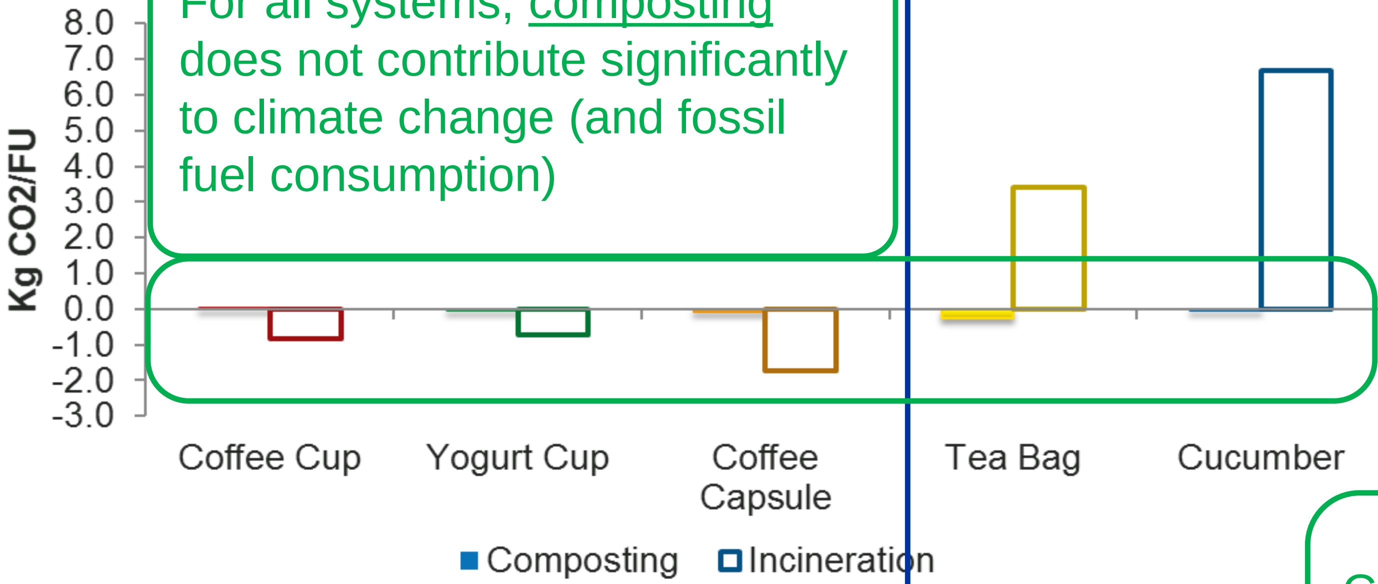
Due to its renewable carbon content, PLA is always the lower carbon footprint solution in incineration, Europe's most commonly used end-of-life option

Process model for industrial composting

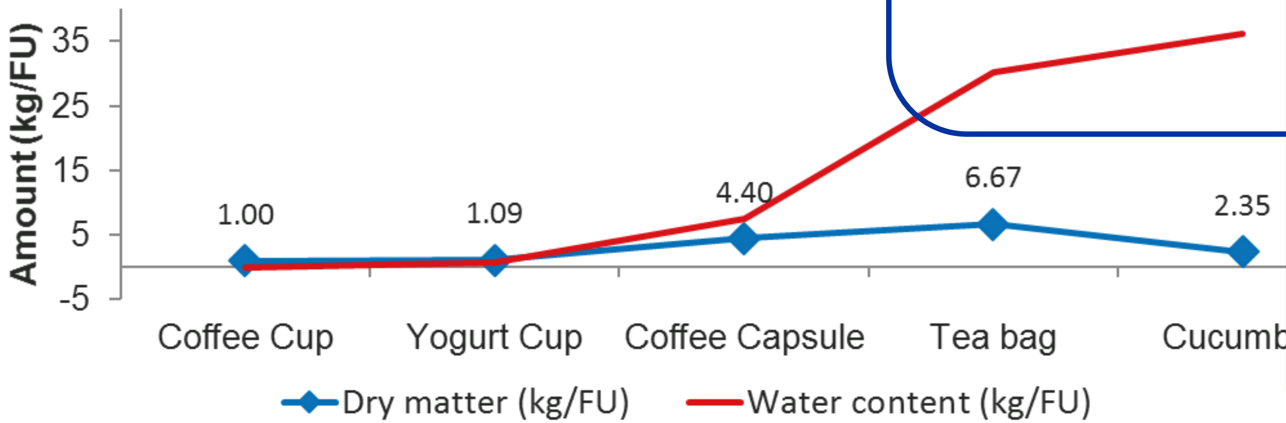


GWP: Composting vs Incineration

For all systems, composting does not contribute significantly to climate change (and fossil fuel consumption)



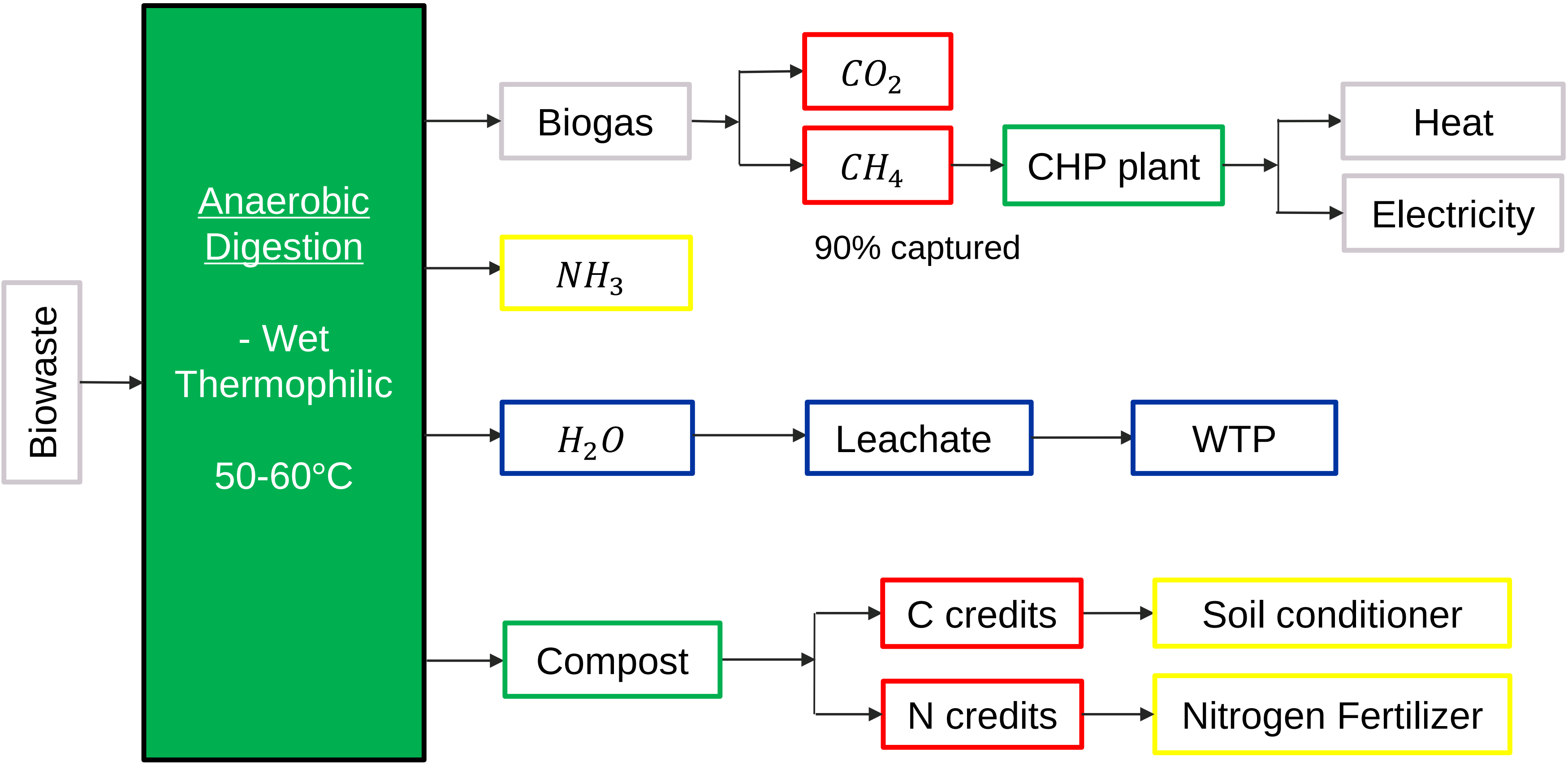
A high moisture content requires additional energy for incineration, which results in high fossil CO_2 emissions



Composting diverts organic waste away from incineration (and landfill);

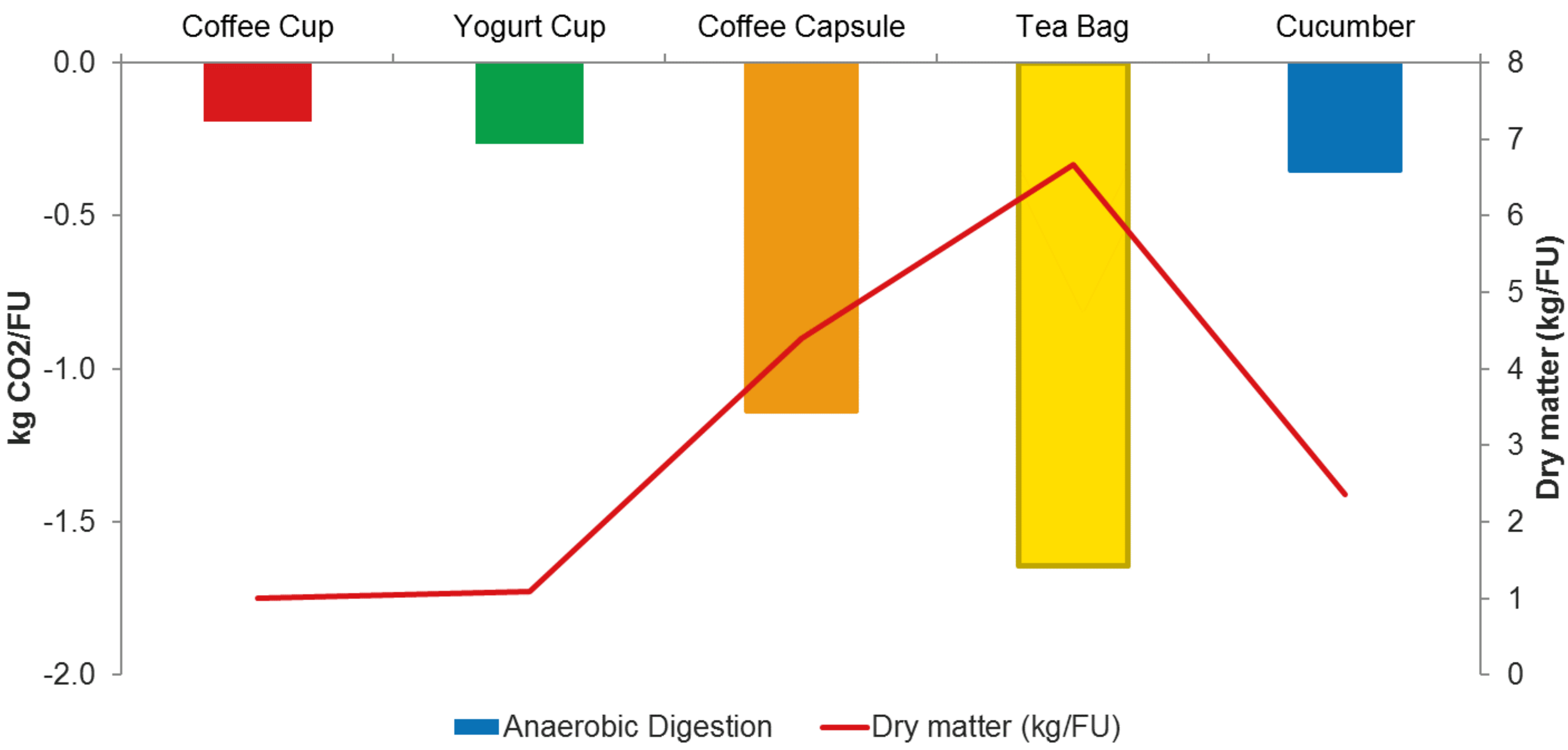
coffee capsule: 4.4
tea bag: **6.7**
(kg/kg of PLA)

Process model of anaerobic digestion



PLA – 60% biodegradation (lab scale data by Osaka Gas)
Food – 70% biodegradation

GWP for anaerobic digestion



Anaerobic digestion has substantial benefits, due to the recovery of a large amount of thermal energy ’embedded’ in the PLA, while also returning biomass and nutrients back to the environment

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Overall conclusions

- For incineration, in terms of GWP, **PLA** bioplastic is **always a better option vs. fossil-based** alternatives

- In terms of GWP, **composting** is more favorable at high moisture content, such as tea bag and cucumber.

- In case of **composting of coffee capsules and teabags,** a significant amount of organic waste **can be diverted from incineration**.

- **Anaerobic Digestion** has the **lowest** GWP impact. This is related to the **recovery of a large amount of thermal energy and electricity.** Additionally, **recovery of biomass** makes this by far the most environmentally sound and circular solution.

- For **Anaerobic Digestion** the infrastructure still needs to be set up, which will be (technically) challenging, but in the long run this the most favorable solution.

www.total-corbion.com