



# Economic aspects of PHA production

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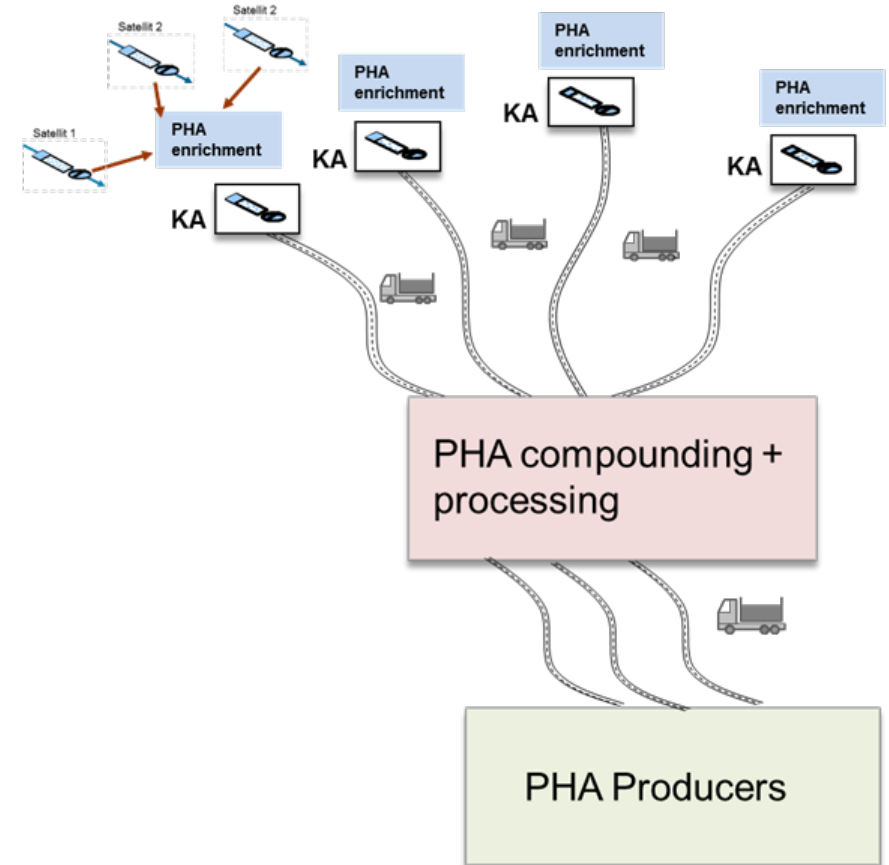
**WOW! CLOSING EVENT – PART 2  
FRIDAY SEPTEMBER 8TH – DUBLIN**

# Agenda

- PHA-Production from municipal waste water
  - Concept for PHA-production from municipal waste water in Scotland
  - Economics
- PHA-Production from industrial streams
  - Potential of PHA-production in NWE from the brewery und juice industry
  - Implementation of a PHA-enrichment plant at a production site of brewery industry
  - Economics & acceptance

# PHA-Production: Primary sludge

- PHA-production is economical feasible with primary sludge from two mio. PE (result from technical and economical assessment)
- Combination of different STPs necessary
- Finding of suitable location with GIS-tool
- Development of different concepts with local/regional aspects is required



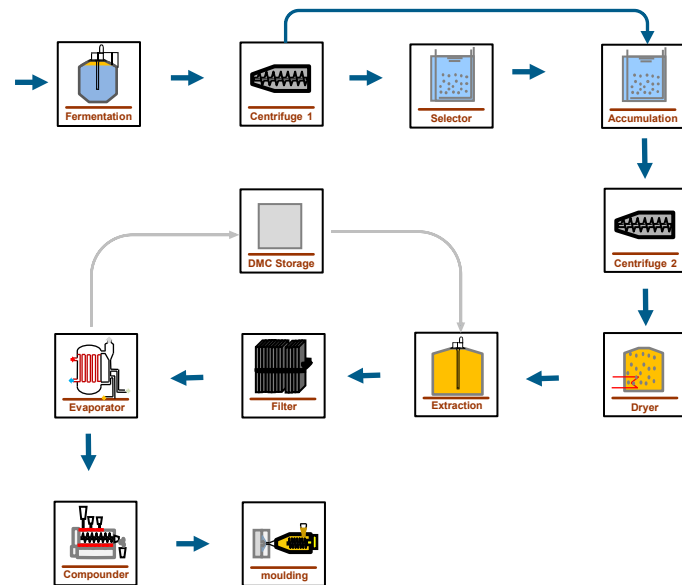
# PHA-concepts: pros & cons

	primary sludge transport		PHA rich biomass transport		Remarks
	One central plant	One central plant One decentral PHA-enrichment system	dewatered PHA rich biomass transport	dried PHA rich biomass transport	
Specific investment cost	++	+	-	--	
Transport cost	--	-	+	++	
Free capacity of original digesters	central plant: -- PS supplier: +	central plant: - PS supplier: + PHA-rich biomass supplier:-	central plant: + PHA-rich biomass supplier:+	central plant: + PHA-rich biomass supplier:+	assuming that digesters exist in all plants
Biogas production	central plant: ++ PS supplier:--	central plant: + PS supplier: -- PHA-rich biomass supplier:+	central plant: - PHA-rich biomass supplier:-	central plant: - PHA-rich biomass supplier:-	
Nitrogen load in reject water from digesters	central plant: -- PS supplier:+	central plant: - PS supplier: + PHA-rich biomass supplier:-	central plant: + PHA-rich biomass supplier:+	central plant: + PHA-rich biomass supplier:+	

# PHA-production central/decentral

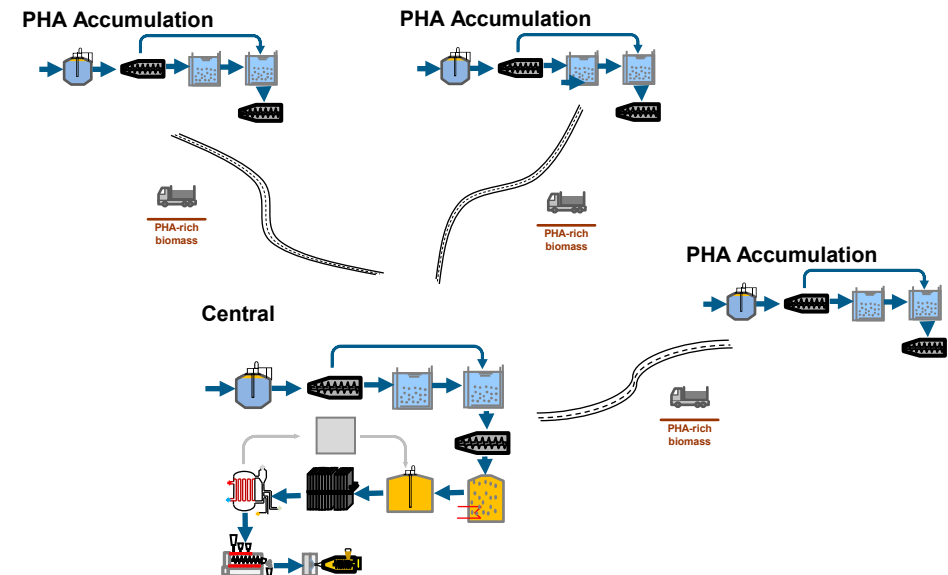
Concept 1:  
 Central: PHA-enrichment, extraction & compounding

Transport of primary sludge  
 Dry matter: 5%



Concept 2:  
 Central: PHA extract. & compounding  
 decentral: PHA-enrichment

Transport of PHA-rich biomass  
 Dry matter: 30%



# PHA-Production: e.g. transports

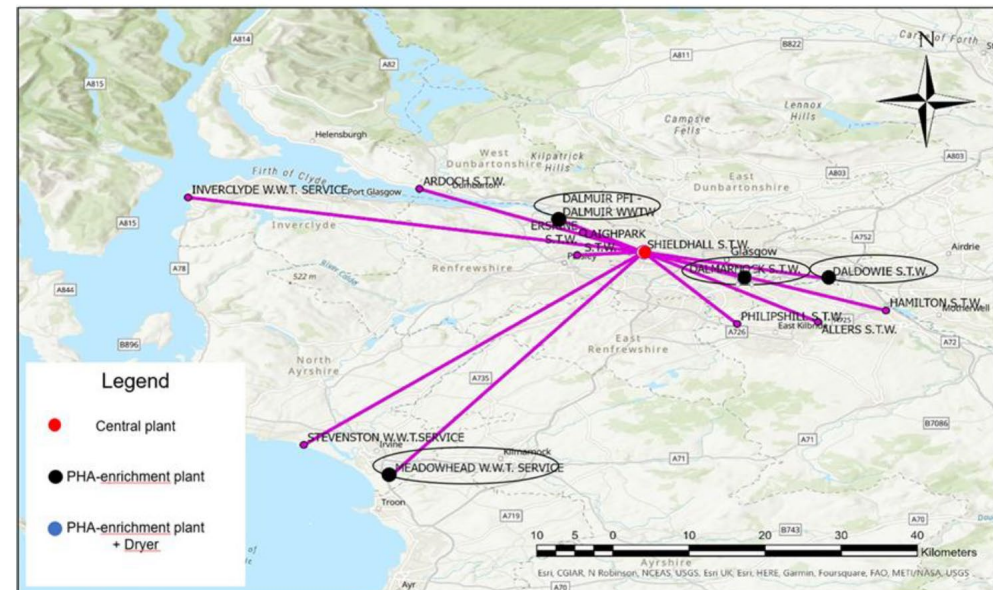
**Concept 1:**  
 Central: PHA-enrichment, extraction & compounding

Transport distance: 320,000 km  
 Drymatter: 5%



**Concept 2:**  
 Central: PHA extract. & compounding  
 decentral: PHA-enrichment

Transport distance: 11,000 km  
 Drymatter: 30%



# Economics: annual costs

	Unit	Concept 1: PS-Transport	Concept 2: PHA-rich biomass transport
Capex	[€/y]	3,816,100	7,174,000
Opex excluding transport	[€/y]	20,374,600	24,465,800
Transport	[€/y]	3,131,800	171,200
<b>Annual cost</b>	<b>[€/y]</b>	<b>27,322,500</b>	<b>31,811,000</b>
PHA production	[tons/y]	5,610	5,120
specific cost	[€/kg PHA]	4.87	6.21

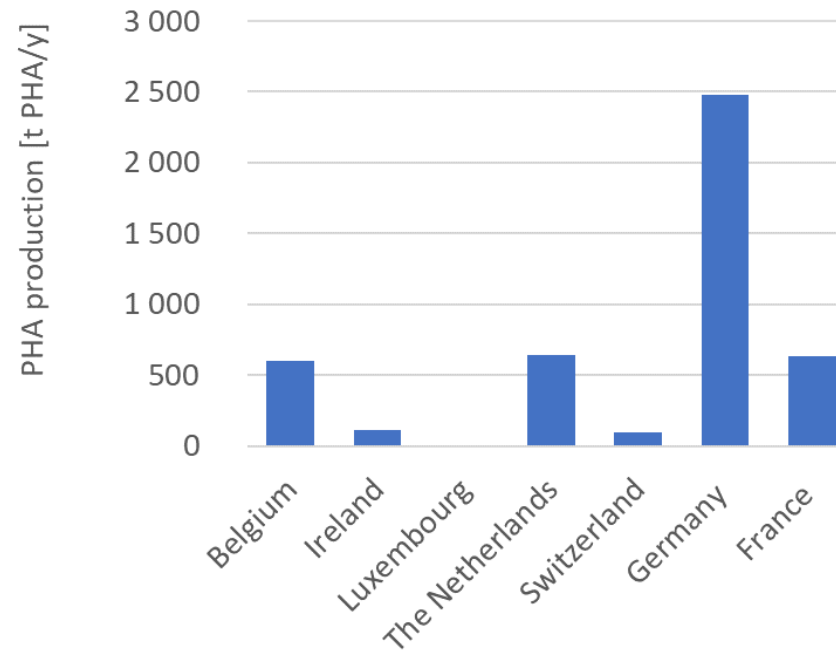
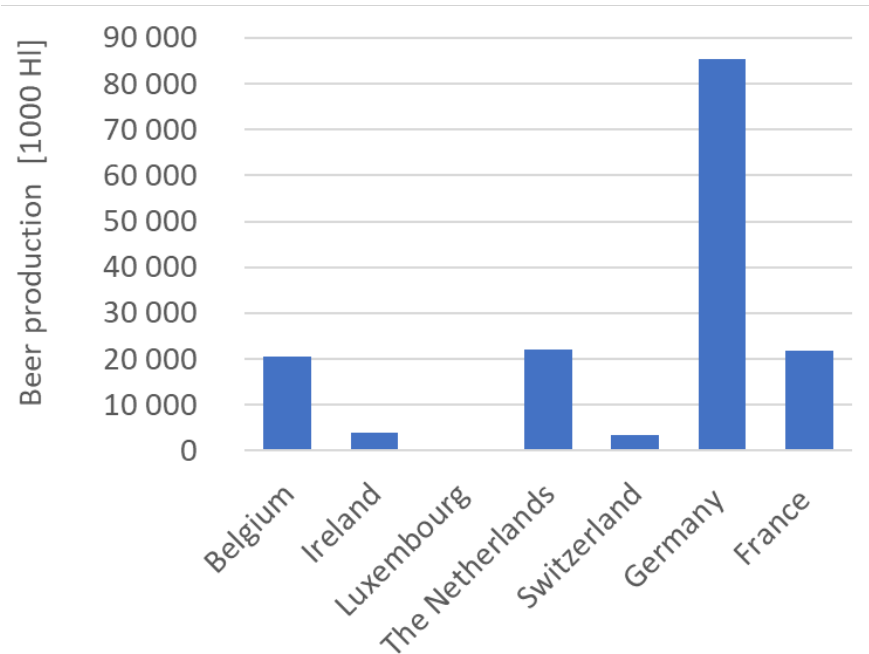
hint: market price renewable raw material PHA from about 4 €/kg

# PHA-Production: beer & juice





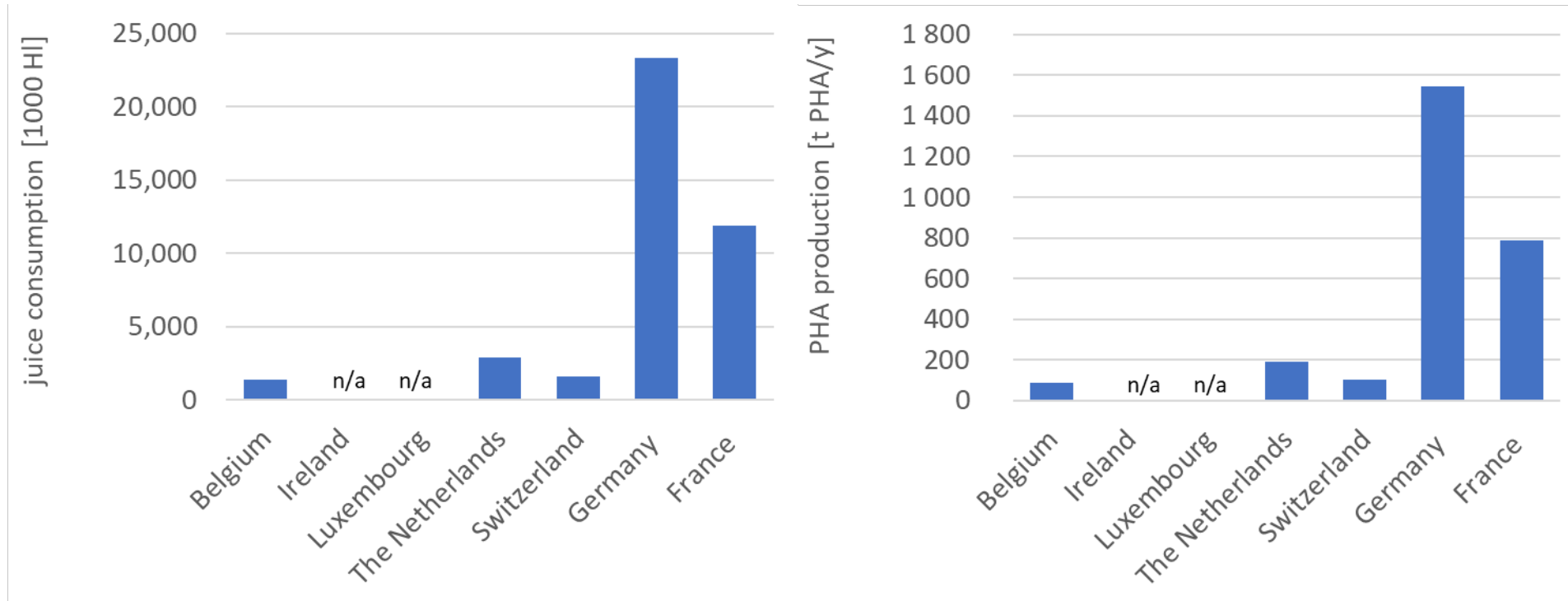
# Potential PHA-Production: brewery industry NWE



Reference:  
[https://brewersofeurope.org/site/media-centre/index.php?doc\\_id=1007&class\\_id=31&detail=true](https://brewersofeurope.org/site/media-centre/index.php?doc_id=1007&class_id=31&detail=true)

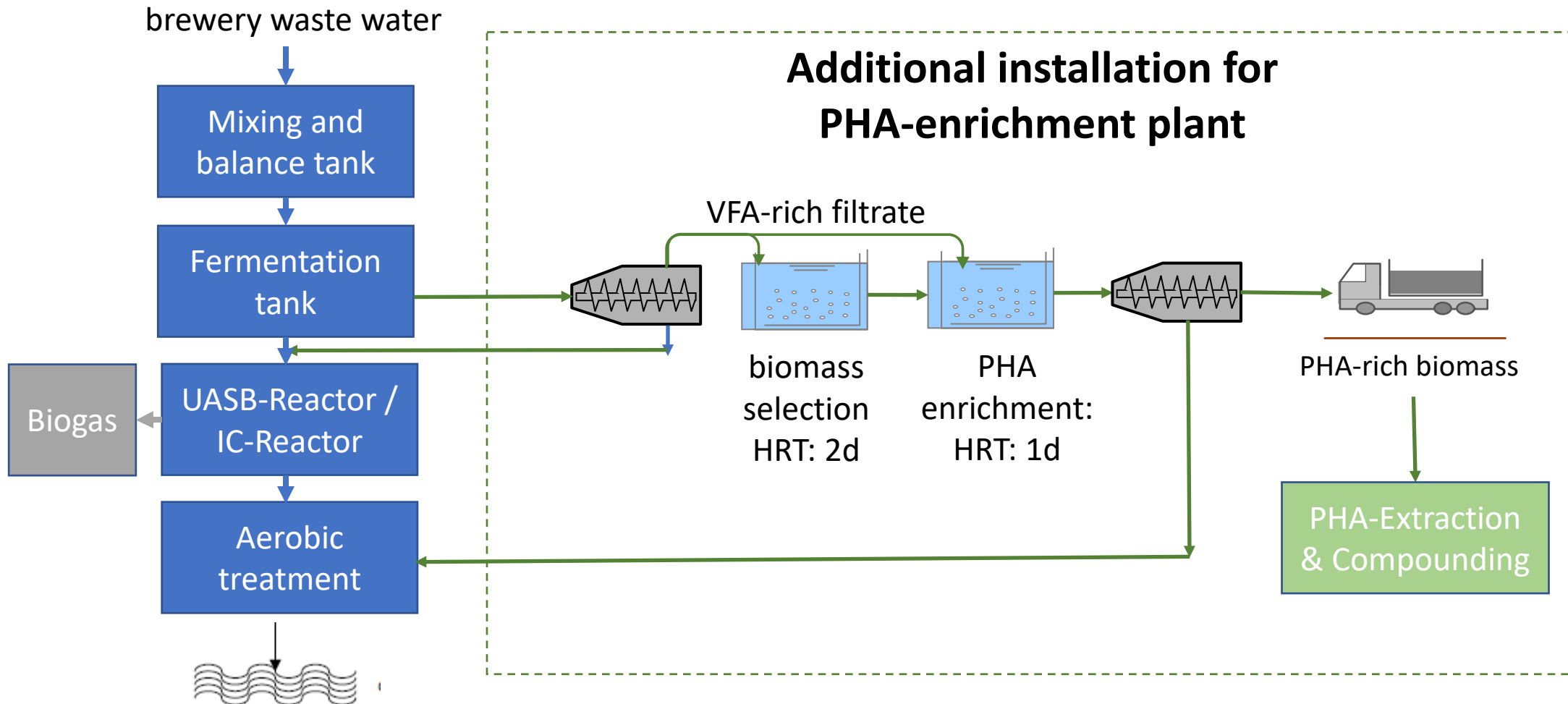
- Yield: PHA production from brewery industry: 29 g PHA/hl beer
- PHA production in NWE from brewery industry: 4,000 t PHA/y

# Potential PHA-Production: juice industry NWE



- Yield PHA production from juice industry: 66 g PHA/hl juice
- PHA production in NWE from juice industry: 2,700 t PHA/y

# PHA-enrichment plant at a brewery



# Economics: Next steps

- Design for the PHA-enrichment plant at a brewery and juice production site
- Estimation of the costs for installation and operation at the production sites

# Acceptance of products

- Survey among consumers, juice and brewery industry on the acceptance of implementation & products from waste streams

Consumer



Beer Industry



Juice Industry



Consumer: <https://www.umfrageonline.com/c/annrrukt>

Brewery industry: <https://www.umfrageonline.com/c/ika37mes>

Juice industry: <https://www.umfrageonline.com/c/vyugr7iz>



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