2-platform (C5&C6 sugars, biogas) biorefinery to produce the biopolymer Polyhydroxybutyrate (PHB), electricity & heat from sugar beet or sugar cane

Part A: Biorefinery plant

PHB is produces based on sugar cane. The first step is the sugar extraction from the sugar cane. Downstream processing of sugar consists of a batch fermentation process using four fermentation tanks in order to guarantee a continuous process. The fermentation broth is fed into a continuous separation process where the PHB rich biomass is harvested. For this purpose a decanter centrifuge is utilizes and the resulting biomass cake is brought to lysis tank where the biomass cake is treated with a solvent to crack the cell walls. The PHB is then extracted from the biomass cake. After a filtration and evaporation step the PHB is ready for storage. The PHB biorefinery process described in the following fact sheet is designed for a capacity of processing 100 m^3 fermentation broth per day with a PHB yield of 44 %.

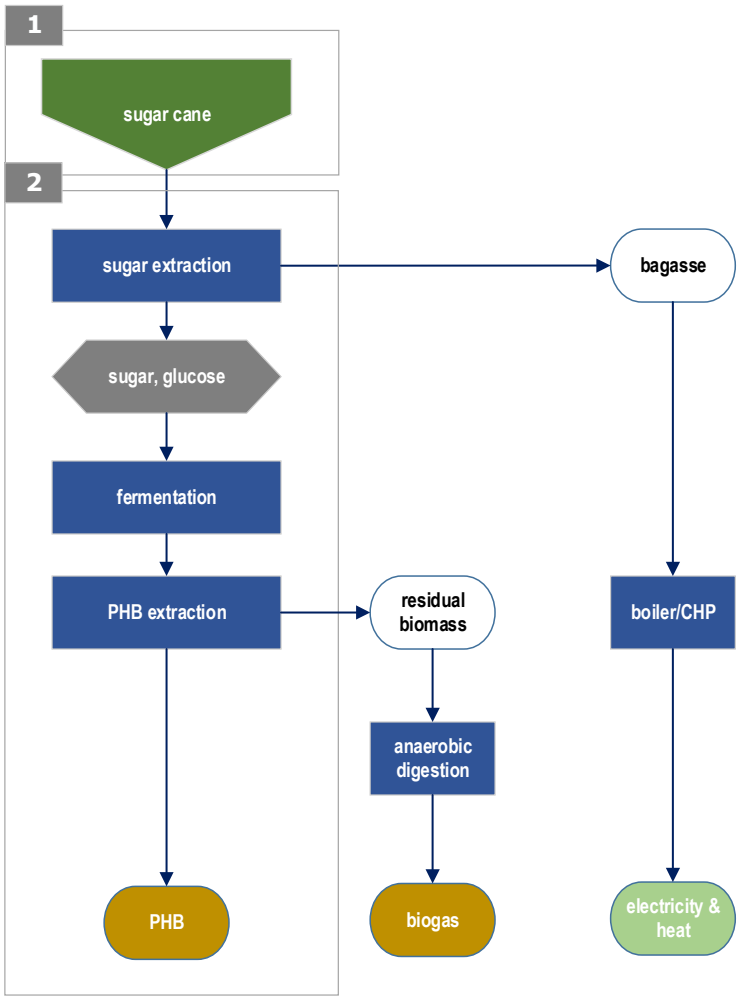

Figure 1: 2-platform using sugar cane to produce PHB, electricity and heat

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Key characteristics

2-platform (C5&C6 sugars, biogas) biorefinery to produce the biopolymer PHB, electricity & heat from sugar cane							
State of technology	Pilot/Demonstration (TRL 5-7)						
Country	EU 27						
Main data source	Literature						
Products				**Auxiliaries**			
	PHB	46,200	kg/a		Energy	309,007	MJ
					Chemical inputs	407,668	kg/a
Feedstock				**Costs**			
	Sugar cane	1,015,938	kg/a		Investment costs	606,673	€
					Feedstock costs	345,419	€/a
PHB extraction rate		5%		**Efficiencies**			
					Sugar cane to PHB	22	kg/kg

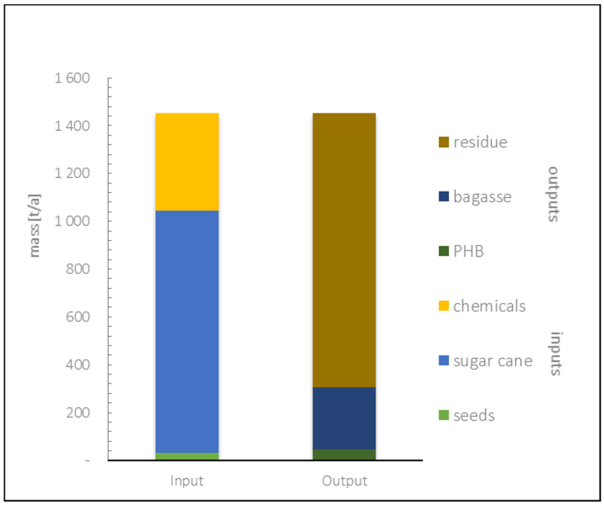

Figure 2: Mass balance of biorefinery plant

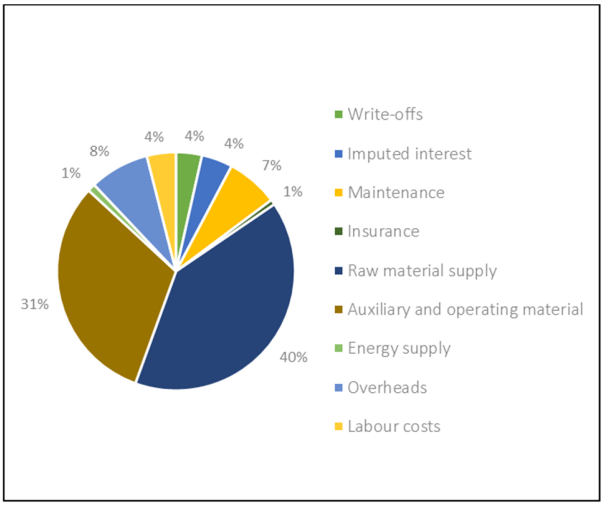

Figure 3: Share of costs

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Part B: Value Chain Sustainability Assessment

2-platform (C5&C6 sugars, biogas) biorefinery to produce the biopolymer Polyhydroxybutyrate (PHB), electricity & heat from sugar beet or sugar cane

Conventional reference system

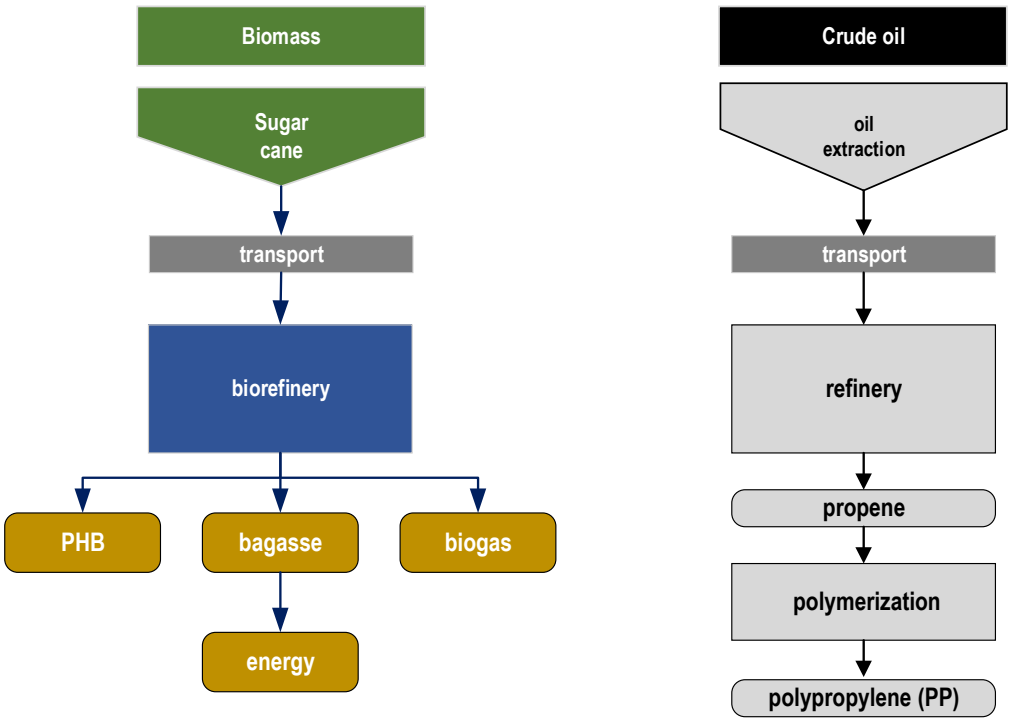

Figure 4: Biorefinery and reference system - value chain (cradle to gate)

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Key characteristics of biorefinery value chain

Greenhouse gas emissions		
Sugar cane cultivation	27,605	$kg_{CO2,eq}$
Biorefinery	32,199	$kg_{CO2,eq}$
Reference system	124,740	$kg_{CO2,eq}$
Savings	64,936	$kg_{CO2,eq}$
Cumulated energy demand		
Sugar cane cultivation	29,035	MJ
Biorefinery	1,016,400	MJ
Reference system	3,670,590	MJ
Savings	2,625,155	MJ
Costs		
Annual costs	862,080	€
Specific costs	19	$€/kg_{PHB}$
Investment costs	606,673	€
Revenues		
Revenues PHB	172,788	€
Specific revenues	3.74	$€/kg_{PHB}$

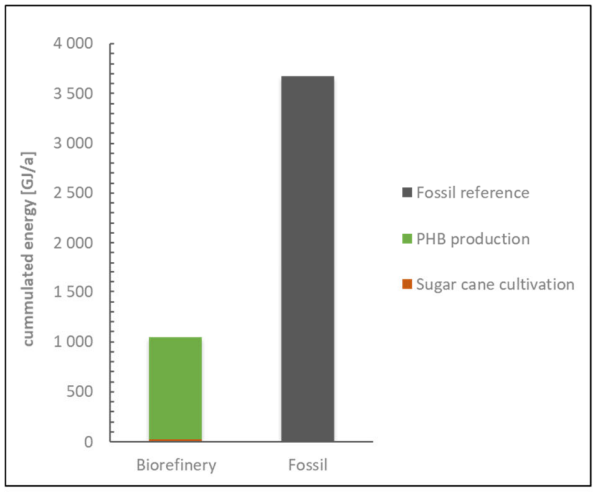

Figure 5: Cumulated energy demand of biorefinery and reference

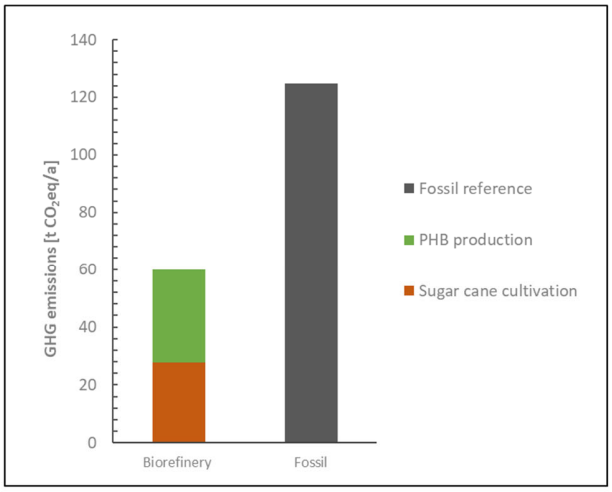

Figure 6: Greenhouse gas emissions of biorefinery and reference

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