

7.3 Economic Assessment Workshop d. 13.12.2011, Brussels

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Agenda

- Data Origin and Philosophy
- Economic Feasibility Chemical Pathways and biogas scenarios
- Comparison of scenario
- Reference Chemicals and biogas

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Data Origin and philosophy:

All mass balance related and process specific data has been obtained from relevant partner.

Ethanol Fermentation: Technical University of Denmark

Butanol + PDO: Biogasol

PDO: A&A Biotechnology

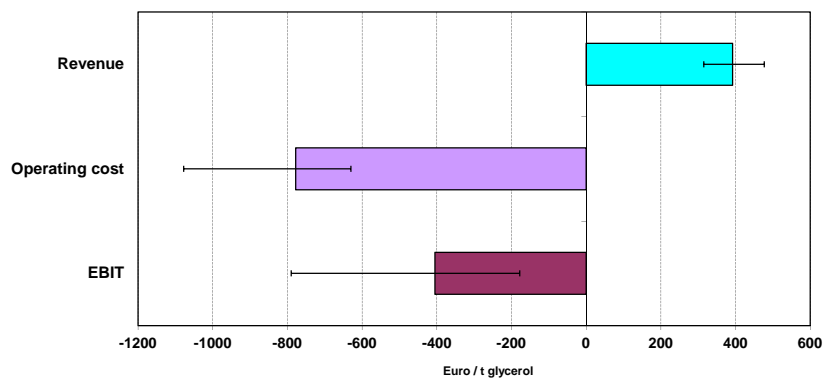
Biogas: Technical University of Denmark

Recovery processes of products: Prochimia

Data is based on the expert judgment of the relevant partner based on mature technology in 2020.

The best, typical and worst case scenario is defined after mass balance not necessarily economy.

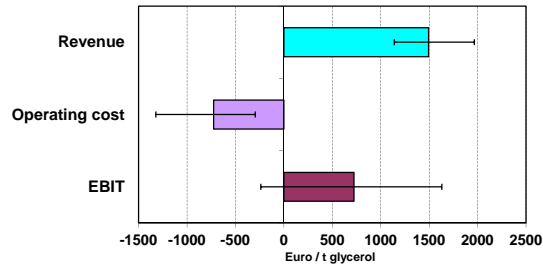
Economic Feasibility Chemical Pathways - Ethanol



Comments

- The revenue only half the operating cost
- Very far from being feasible

Economic Feasibility Chemical Pathways - PDO



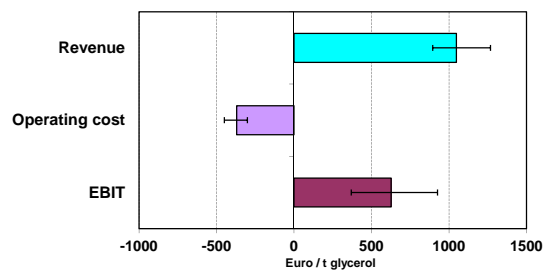
Parameter	Unit	Best	Typical	Worst
Capacity	Ton gly/yr	68961	83814	99119
CAPEX	Mn Euro	53	75	113

Comments

- The uncertainty in relation to operating cost mainly the nutrient consumption has a huge impact
- This has a huge impact on feasibility from a considerable deficit in the worst case to very convincing IRR in the best case

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Economic Feasibility Chemical Pathways - Butanol



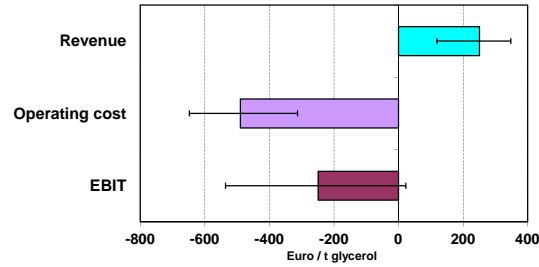
Parameter	Unit	Best	Typical	Worst	
Capacity	Ton Gly/yr		35875	40503	41740
CAPEX	Mn Euro		30	42,5	63,8

Comments

- Process less sensitive to best and worst case scenario
- More secure because of the established butanol market
- Less capital investment, important if equity financing is not possible.

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Economic Feasibility Biogas Pathways – Mono fermentation



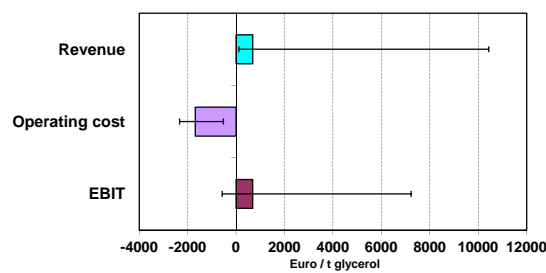
Parameter	Unit	Best	Typical	Worst
Capacity	MW	10	7	4
CAPEX	Mn Euro	10	8	6

Comments

- The mono fermentation process is highly sensitive to the scenario and is only remotely feasible in the best case scenario.

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Economic Feasibility Biogas Pathways – Co fermentation with corn silage



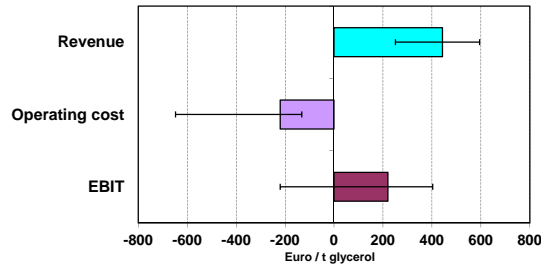
Parameter	Unit	Best	Typical	Worst
Capacity	MW	285	46	15
CAPEX	Mn Euro	711	116	38

Comments

- The co fermentation seems like a feasible pathway:
 - If no nutrients are needed
 - If the glycerol price is below 170 Euro/ton
 - The biogas plants is already there
 - There is a potential nearly unlimited demand

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Economic Feasibility Biogas Pathways – Co fermentation with Manure

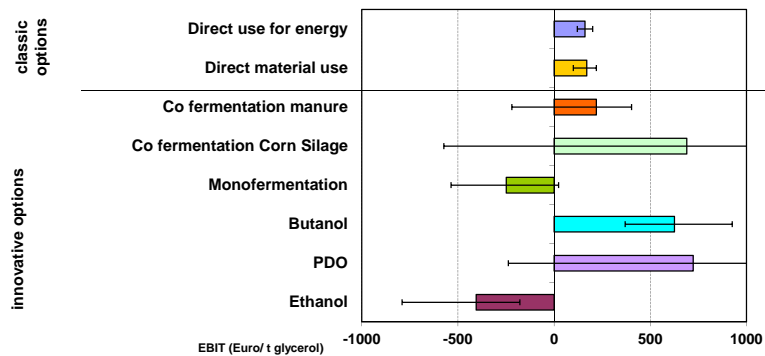


Parameter	Unit	Best	Typical	Worst
Capacity	MW	19	9	15
CAPEX	Mn Euro	48	9	13

Comments
- Same as corn silage

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Comparison Chemical Pathway



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Comparison Chemical Pathway

Pathway	Pro	Con
Ethanol		- Very far from economic viability
PDO	- The most convincing EBIT in best and typical cases	- Sensitive to nutrients cost - Limited market size and potential
Butanol	- Reasonable an stable EBIT in all scenarios - Established product - Very large market - Stable market and selling price - Lower capex requirement than PDO.	- Not as convincing IRR as PDO

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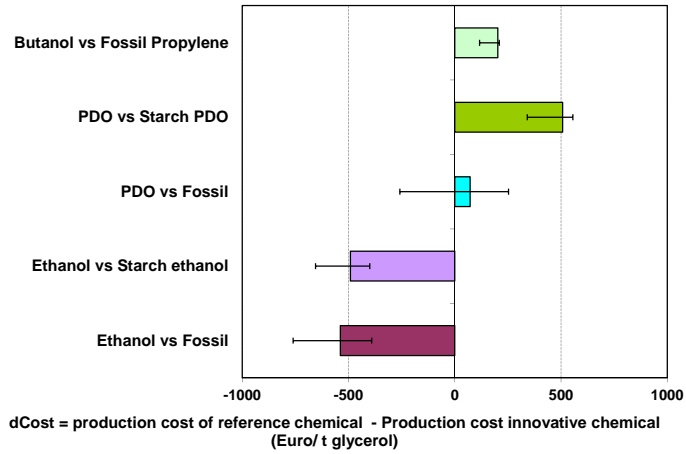
Comparison Biogas Pathway

Pathway	Pro	Con
Mono fermentation		Not considered economic viable
Co fermentation Corn silage	-Reasonable EBIT -The Biogas facilities is already there. - Glycerol booster is already standard practice in biogas facilities	- the glycerol price should be below 170 Euro/ton - Corn silage a commercial product - Can't not afford nutrients
Co fermentation Manure	- Same as Corn silage - Not dependant on corn silage prices.	- Same as corn silage

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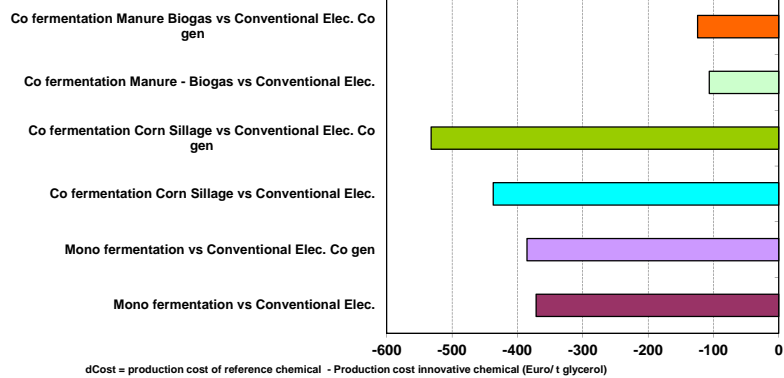
Comparison Reference Chemical Pathways

dCost = Production cost of reference chemical - Production cost innovative chemical (Euro/ t glycerol)

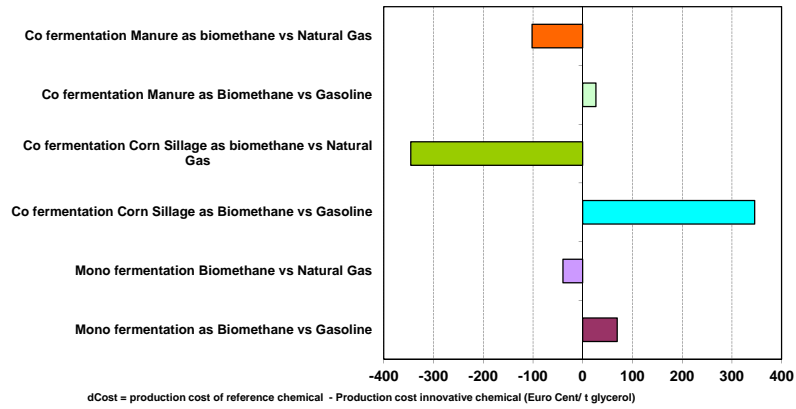


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Comparison Reference Biogas Pathways as Electricity



Comparison Reference Biogas Pathways as Methane



Thank you for your attention!