Techno-economic evaluation of a biorefinery for isobutanol and derivatives

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Introduction

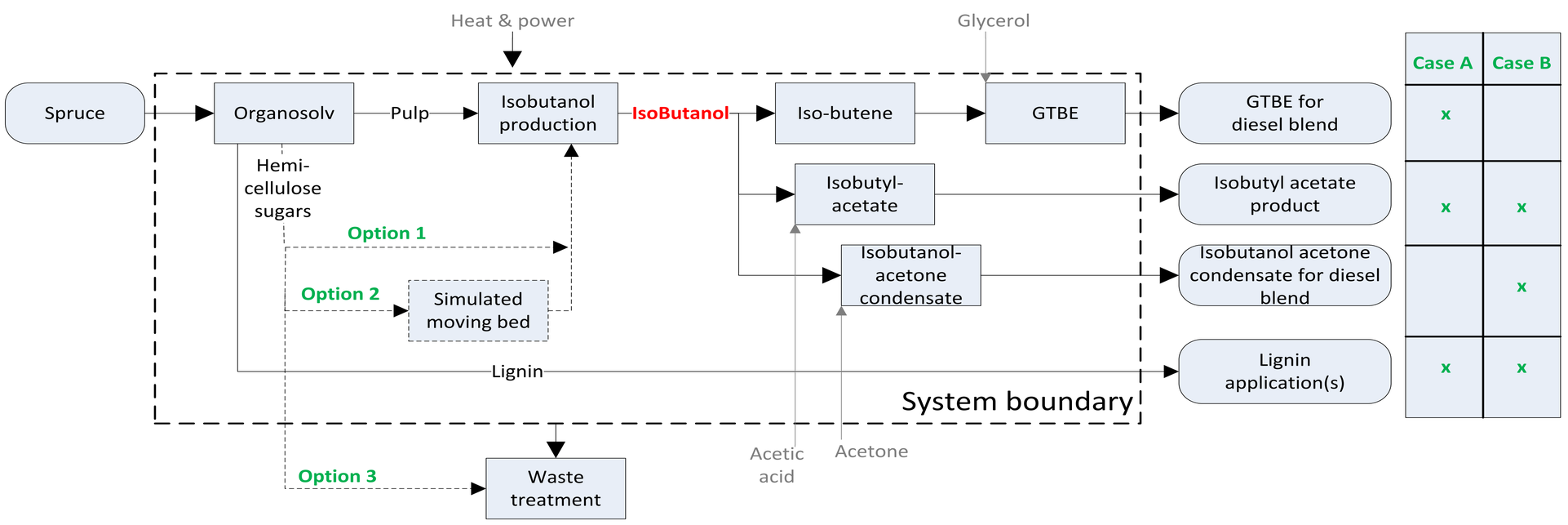
The IsoButanol Platform Rotterdam (IBPR) consortium aims to develop an environmentally benign, economically viable process to produce high-value chemicals and fuel (additives) from sustainable ligno-cellulosic biomass sources via the platform molecule Isobutanol.

The objective of the work presented here was to make a conceptual process design and evaluate the techno-economic viability of the process concept including design alternatives.

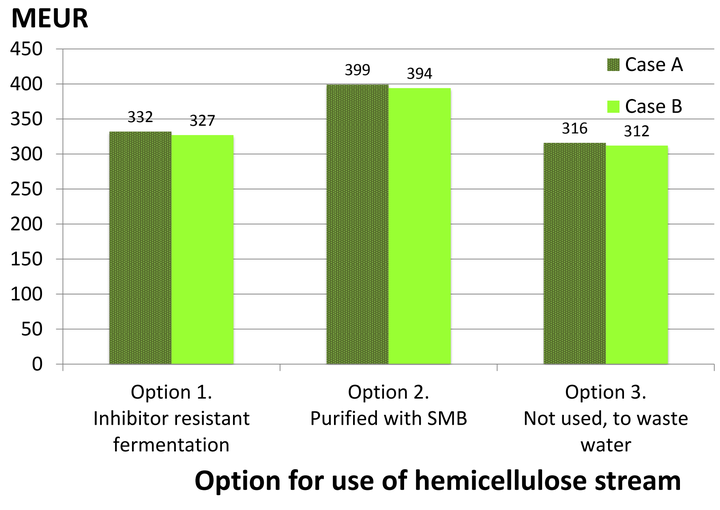
Methodology

- Detailed Aspen Plus simulation of all process sections
- Equipment sizing of all unit operations
- Process economic evaluation (CAPEX, OPEX)
- Design alternatives:
  - Cases: Product mix
  - Options: Use of hemicellulose sugars stream containing potential inhibitors for fermentation

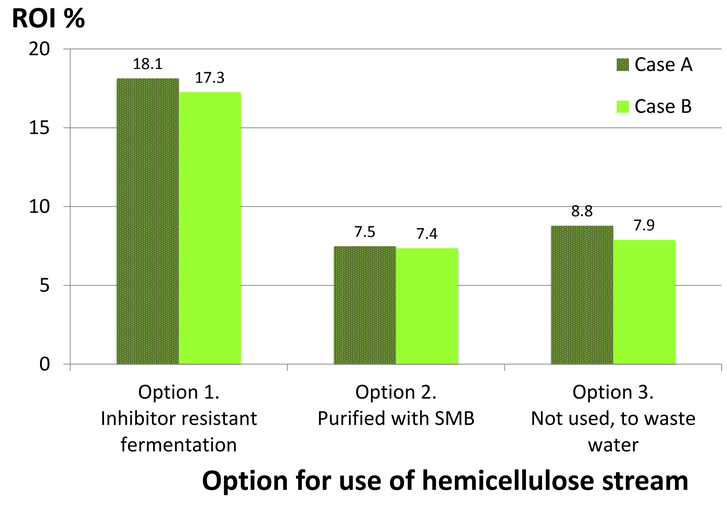
Process concept



Total capital investments



Return on investment (ROI)



Products, costs and revenues

Option 1	kton/yr Case A	kton/yr Case B	MEUR/yr Case A	MEUR/yr Case B
	Main feedstock		Costs	
Spruce	1000		100	
Glycerol	86		17	
Acetic acid	9		4	
Acetone	2	54	2	43
	Intermediate		Intermediate	
Isobutanol intermediate	196		-	
	Main products		Revenues	
GTBE	188		188	
Isobutyl acetate	15		20	
Isobutanol acetone condensate		105		158
High value lignin	262		197	

Conclusions

- A techno-economic evaluation was performed of the process chain from biomass to three targeted products, on the basis of a full conceptual process design. The best case has a Return on Investment of 18.1%/year, corresponding with a pay out time of 6 years.
- Case A is by a slight margin better than Case B. In the preferred case the products are GTBE, isobutyl acetate and lignin.
- If technically feasible, the best economics are obtained by direct fermentation of the hemicellulose sugars stream (option 1). Purification by a SMB (option 2) has too high investments. Not using these sugars (option 3) also significantly decreases the ROI.

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Investing in your future.
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The IBPR consortium consists of AVR, BE-Basic, Corbion, Deltalinqs, ECN, GEVO, Grontmij, Port of Rotterdam, Procede, Delft University of Technology, Utrecht University, Wageningen UR, Zirk©Technology .

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