biosweet
Biomass for Swiss Energy Future
Swiss Competence Center for Energy Research

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

In cooperation with the CTI
Energy funding programme
Swiss Competence Centers for Energy Research
Schweizerische Eidgenossenschaft
Confédération suisse
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Swiss Confederation
Commission for Technology and Innovation CTI

IPESE
Industrial Process and Energy Systems Engineering

An early-stage decision support tool for the optimal design of integrated wood biorefineries

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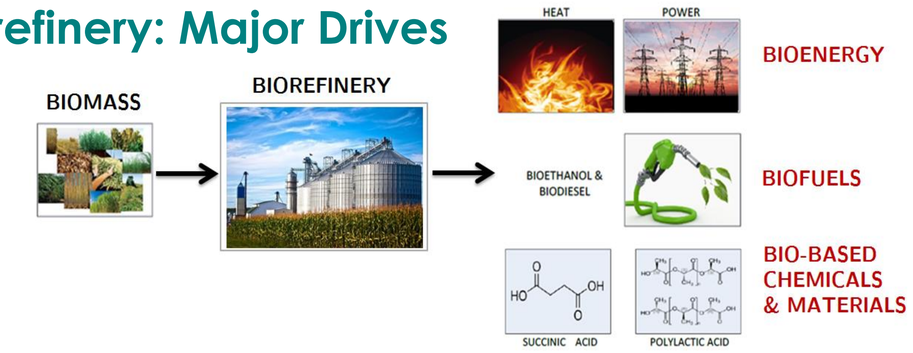
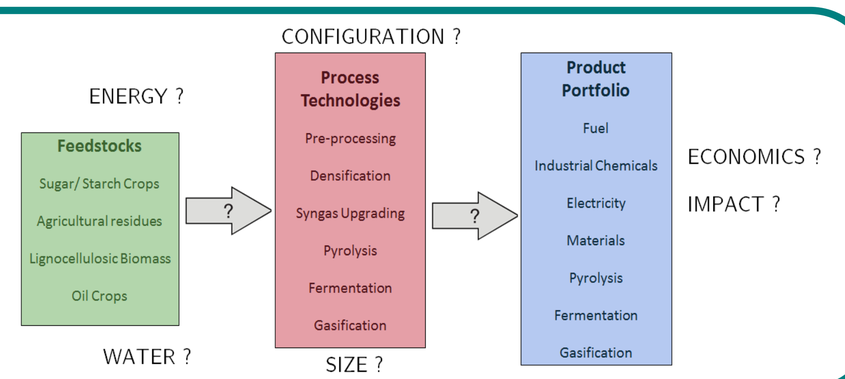
1. Biorefinery: Major Drives

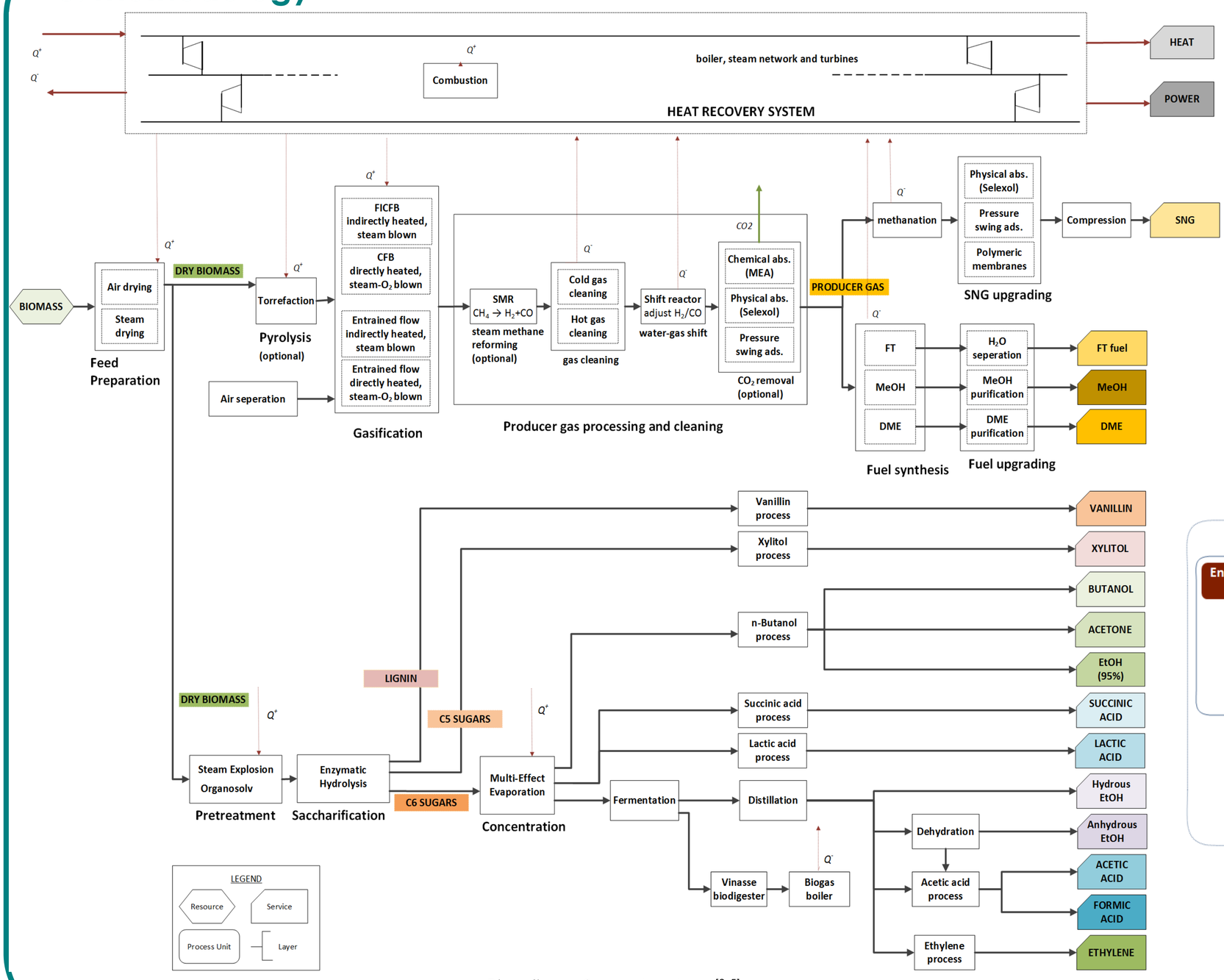


2. Objectives

Aim is to develop optimal energy integration algorithms for process synthesis and unit designs in large scale biorefining systems.

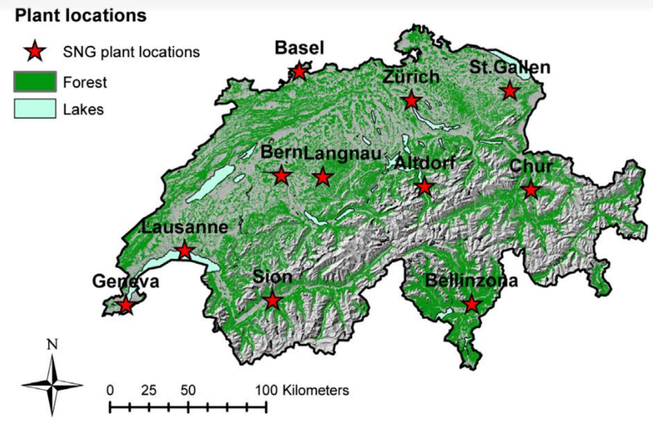


3. Methodology [3]

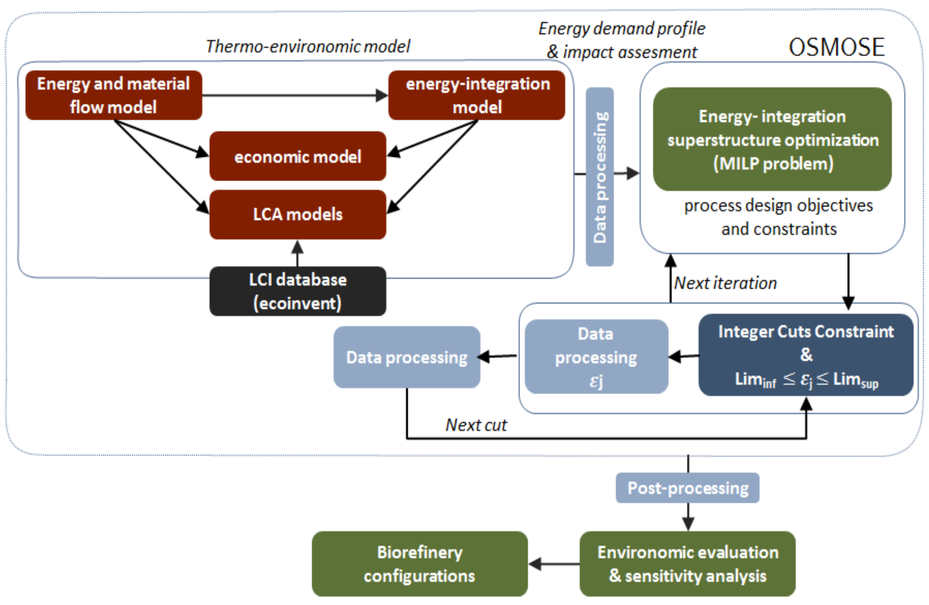


Biorefinery Superstructure [2-5]

Biofuels and Biochemicals production from woody biomass available in Switzerland (Plant ref. size : 200 MW)



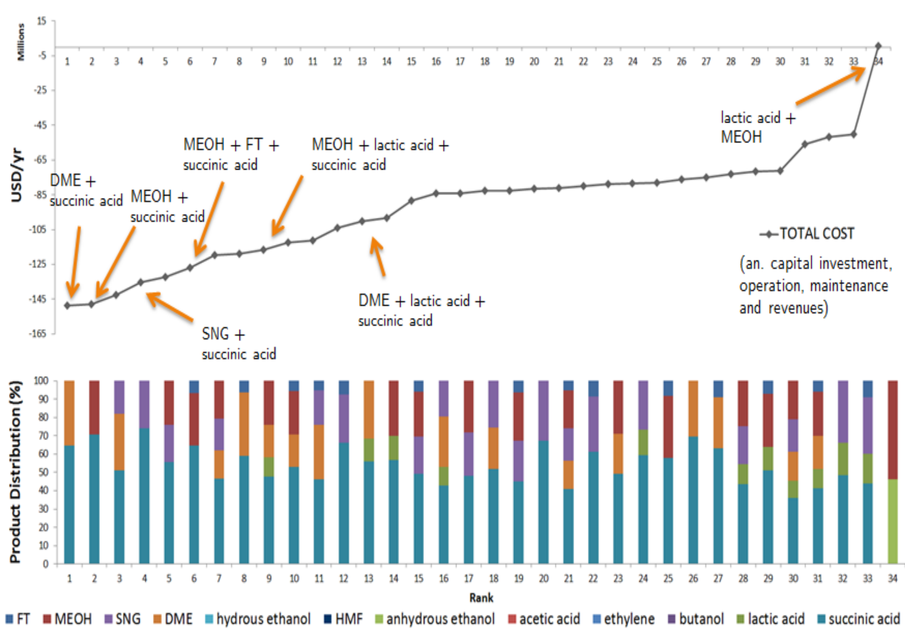
Case Study [1]



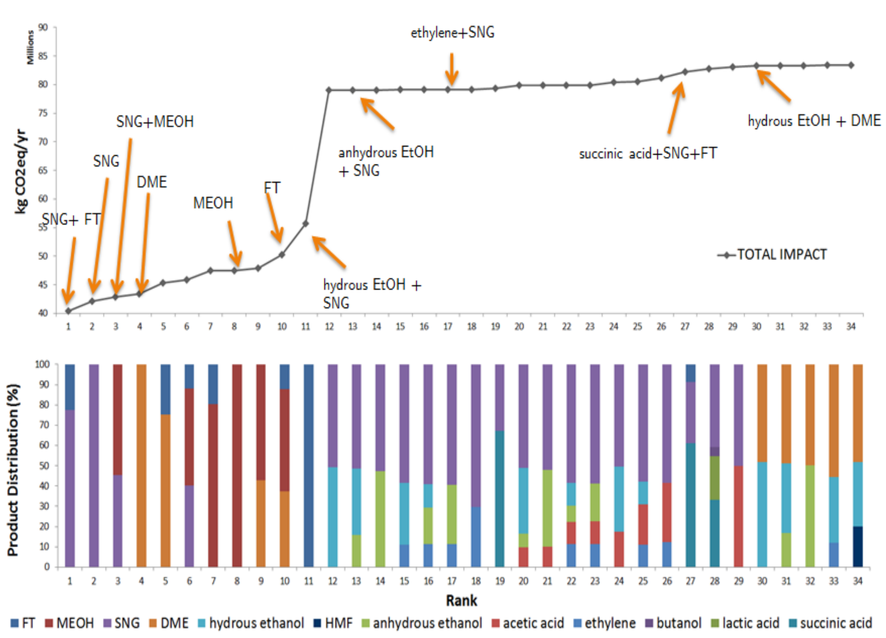
Methodology Overview [6]

4. Process Performance [3]

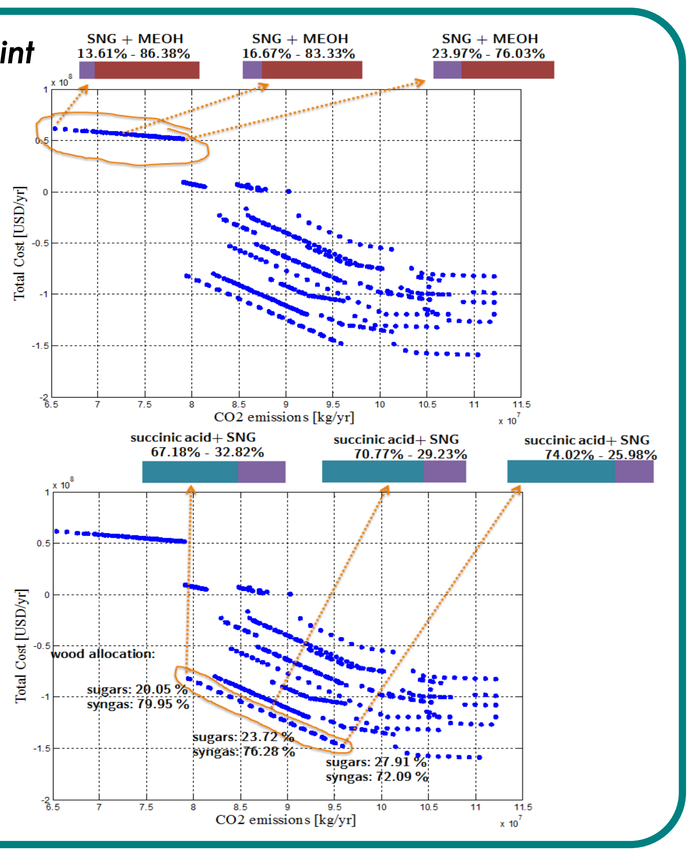
Ranking Results-Economic Objective - ICC method



Ranking Results-Environmental Objective - ICC method



Results of MOO with (ICC) & Epsilon constraint



5. Conclusion

A systematic process design methodology is applied. Different objective functions such as economic and environmental criteria are simultaneously considered. The integration between products of biochemical and thermochemical conversion pathways increase the utilization of biogenic carbon. The results of the proposed approach provide a set of non-dominated solutions (i.e. Pareto front), and each solution shows different biorefinery configuration.

6. Acknowledgements

Financial support by Marie Curie network RENESENG, The Renewable Systems Engineering grant and Swiss Competence Center for Energy Research BIOSWEET - Biomass for Swiss Energy Future is gratefully acknowledged.

References: [1] B. Steubing et al., Identifying environmentally and economically optimal bioenergy plant sizes and locations: A spatial model of wood-based SNG value chains, Renewable Energy, 2014, 61, 57-68, [2] L. Tock et al. Thermochemical production of liquid fuels from biomass: Thermo-economic modeling, process design and process integration analysis. Biomass & Bioenergy 2010, 34, 1838−1854 , [3] A. D. Celebi et al., Early-stage decision making approach for the selection of optimally integrated biorefinery processes. Energy, 2017, ISSN 0360-5442 [4] M. Morales et al., Sustainability Assessment of Succinic Acid Production Technologies from Biomass using Metabolic Engineering. Energy & Environmental Science 9, 2016, 9, 2794-2805, [5] Wood2Chem Project. – Available at: < https://www.rdb.ethz.ch/projects/project.php?proj_id=32132&int=0> [accessed 1 May 2015], [6] S. Fazlollahi et al., Methods for multi-objective investment and operating optimization of complex energy systems, Energy, 2012, 45, 12-22