ENI Systems

ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Integration of LCA in a thermo-economic model for synthetic natural gas production from woody biomass

Léda Gerber, Martin Gassner, François Maréchal
Industrial Energy Systems Laboratory, EPFL, leda.gerber@epfl.ch

1. Context

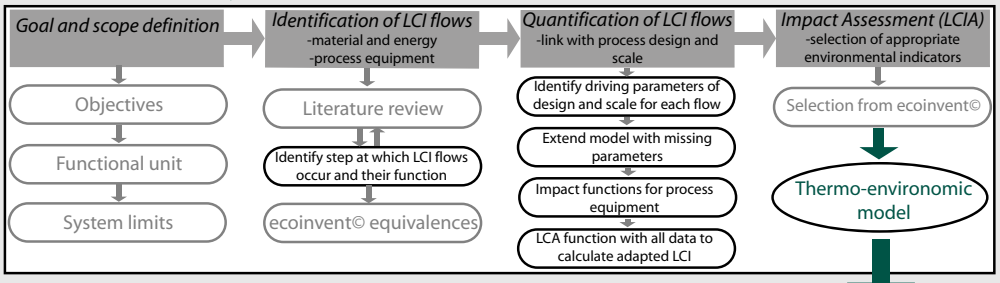
Conventional **LCAs** (Life Cycle Assessment) for emerging technologies, such as biofuels, are based on average technology at development stage and at pilot-scale. Therefore, the effects on the LCA of changes in **process design**, **technology evolution and scaling** are not considered. Moreover, conventional LCA can not be used by engineers as a **design tool**.

2. Objectives

For the production of **SNG** (synthetic natural gas) from residual wood:

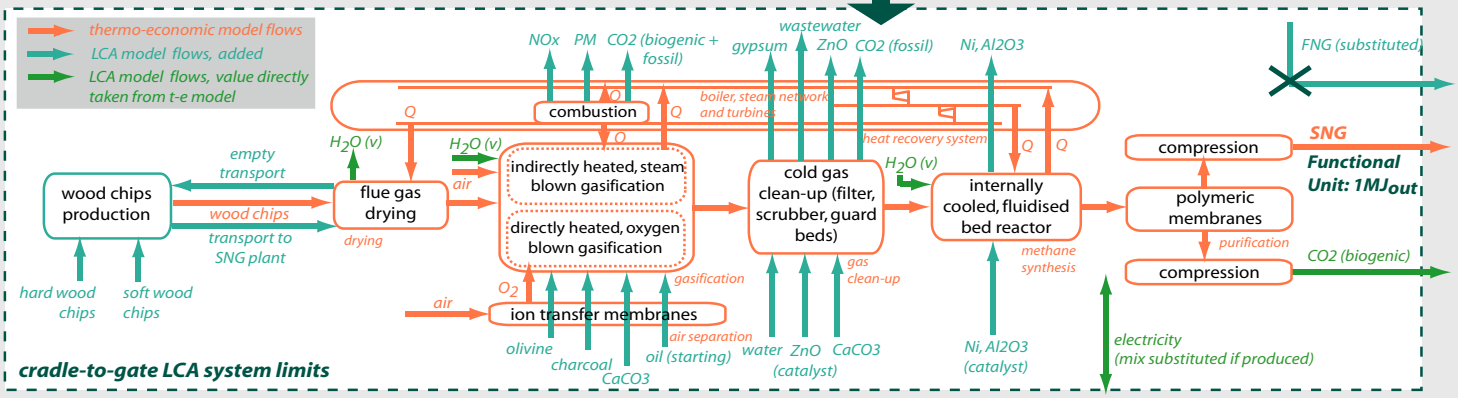
- **Adapt life cycle inventory** (LCI) to process design and scale, by writing a LCA model linked to the parameters of an existing thermo-economic model.
- Use the model for **multi-objective optimization**, to study the effects of economic optimization and scaling on environmental impacts.

3. Methodology



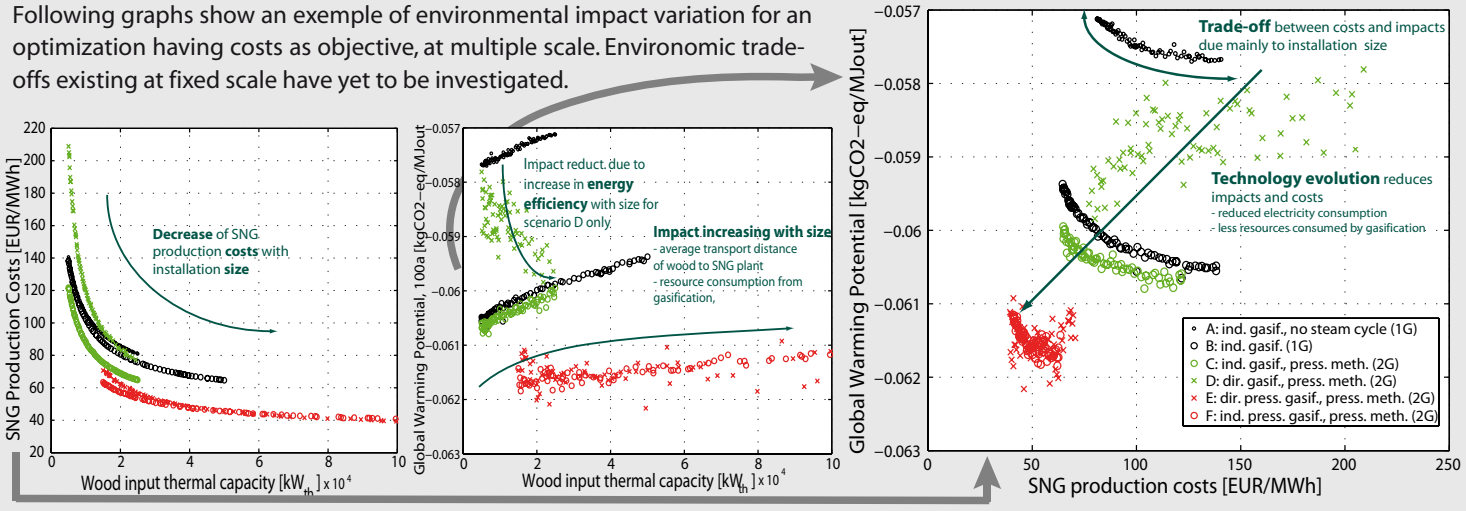
6 scenarios for optimization based on:

- SNG plant scale as wood thermal capacity (5-25, 15-50, 40-100 MW_{th})
- Technological choices (use of a Rankine cycle, indirect or direct gasification, pressurized methanation or gasification)
- Technology evolution (1st and 2nd generation SNG plants)



4. Results

Following graphs show an exemple of environmental impact variation for an optimization having costs as objective, at multiple scale. Environomic trade-offs existing at fixed scale have yet to be investigated.



5. Conclusions and perspectives

The present work demonstrated that changes in process design and scale affect the environmental impacts, and can influe on the decisions taken with the use of the LCA. Moreover, it opens the possibility for engineers to use **thermo-environomic models** at the conception stage to take into account environmental aspects in addition to economic and thermo-dynamic aspects when searching for **optimal process configurations**. The developped method to link LCA with design may be applied to other technologies in the field of energy production.