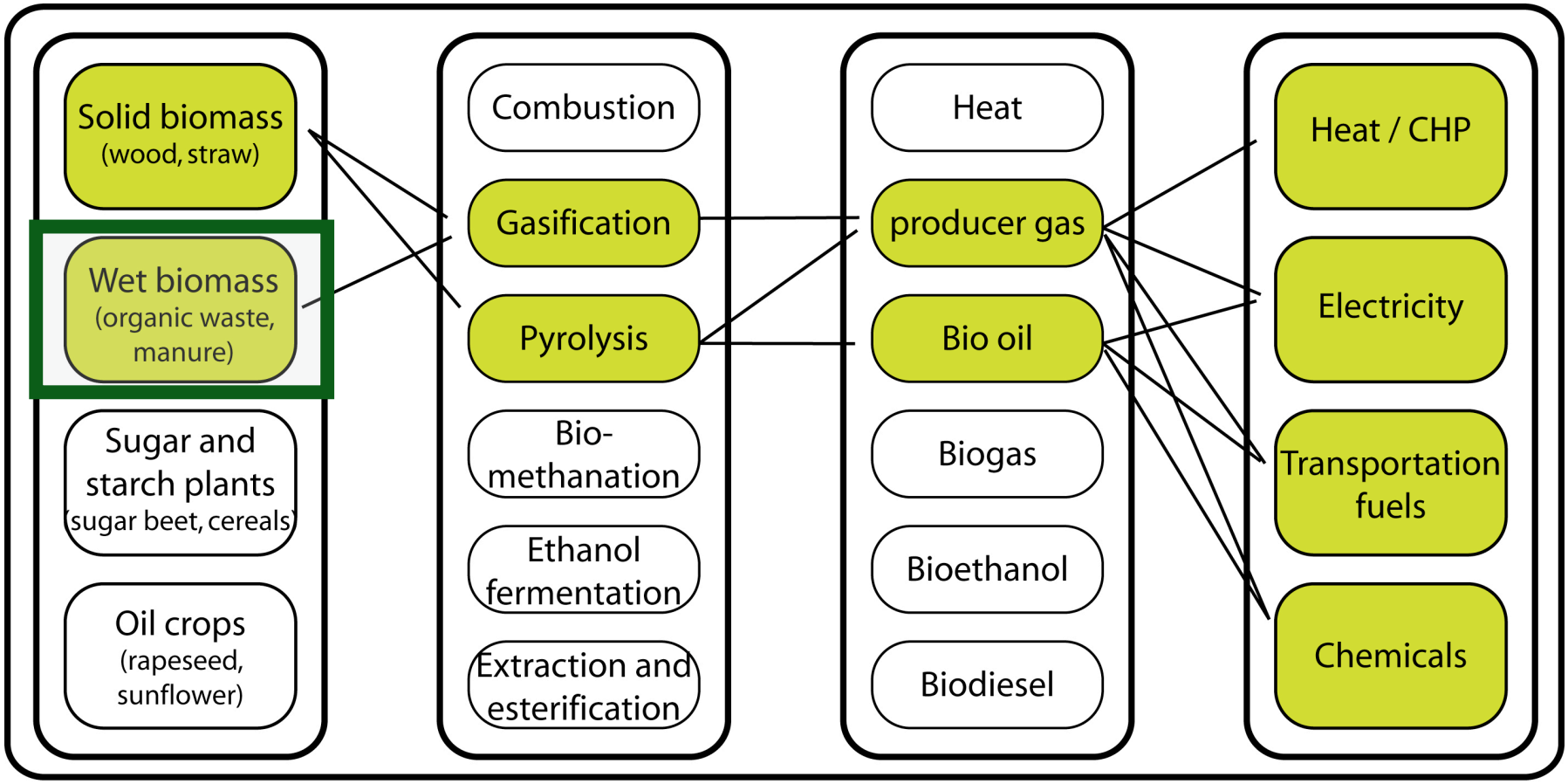
Thermochemical conversion of biomass

Synthetic Natural Gas by Hydrothermal Gasification

François Maréchal

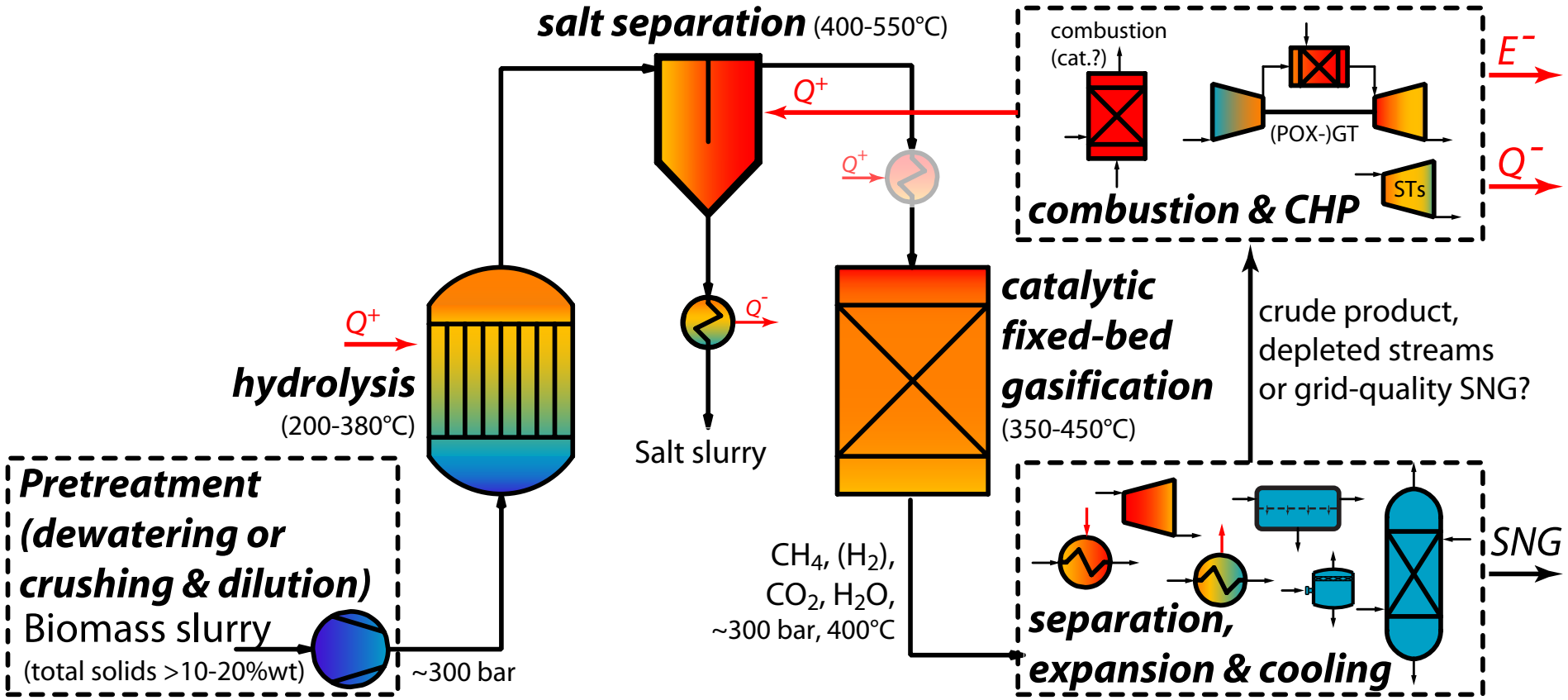
IPESE
Industrial Process and Energy Systems Engineering
EPFL Valais-Wallis
CH - 1950 Sion

Biomass conversion
Thermochemical routes



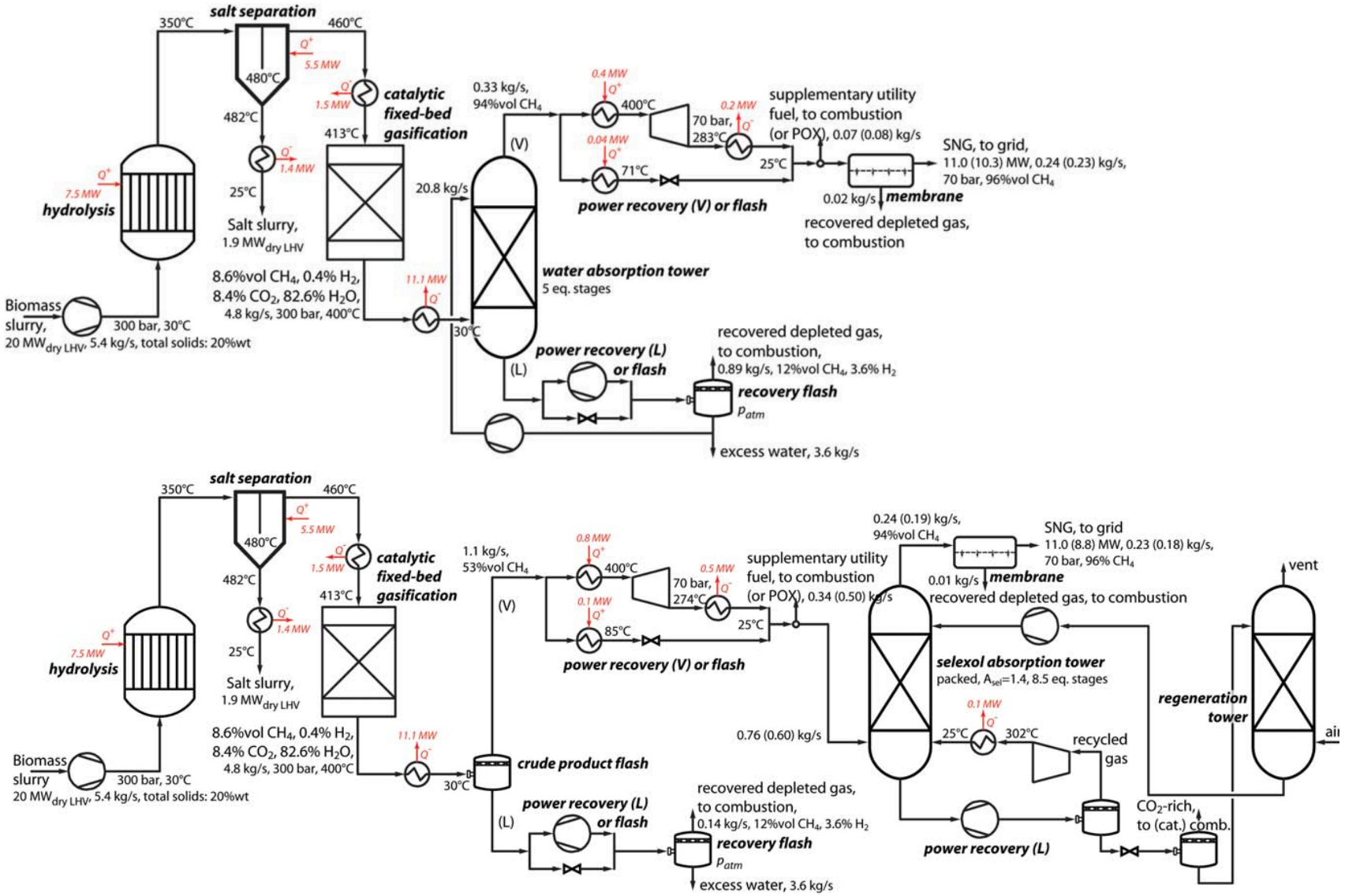
adapted from Chemical Engineering 10 (2006)

Hydrothermal supercritical gasification



Martin Gassner, Frederic Vogel, Georges Heyen and Francois Marechal , *Process design of SNG production by hydrothermal gasification of waste biomass: Thermo-economic process modelling and integration*, submitted to Energy & Environmental Science (2010)

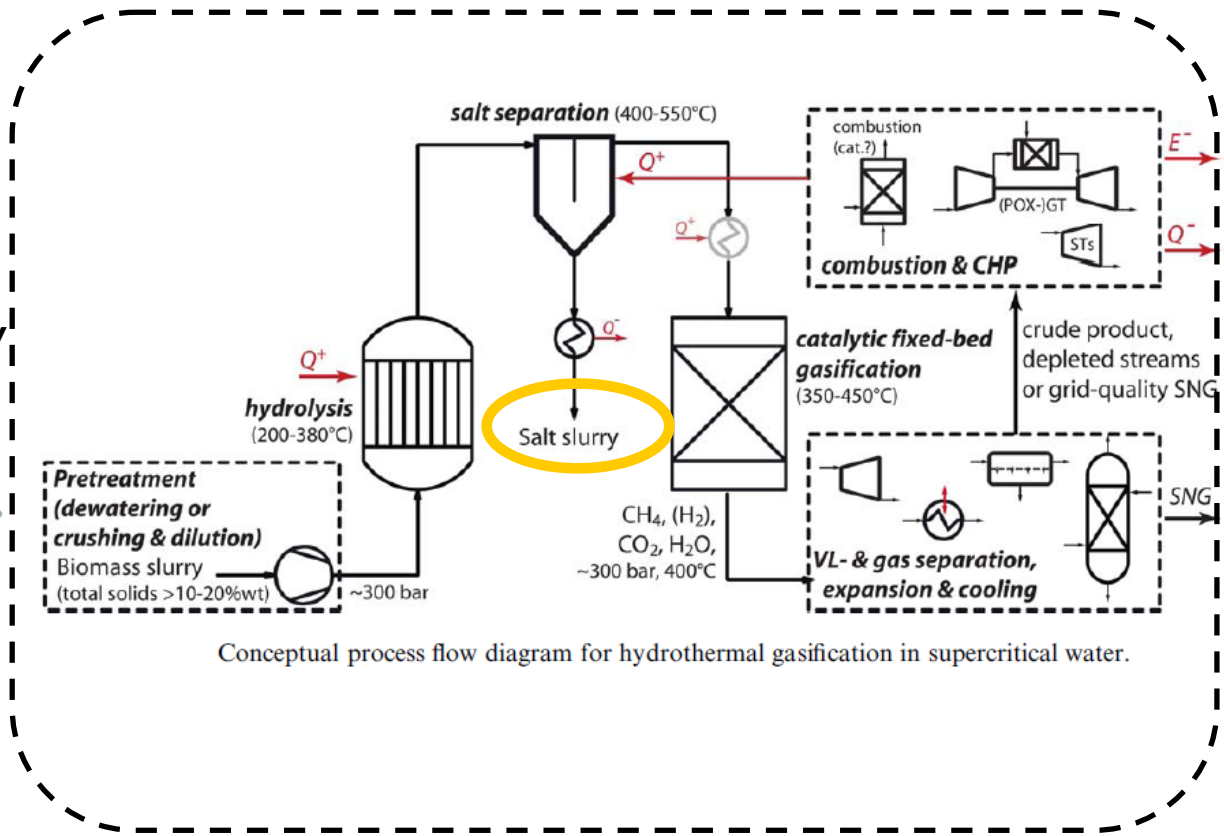
Different process configurations



New technology Hydrothermal gasification

15% solids content in feedstock – 94% CH4 in crude SNG
Sludge treatment

INPUT:
10 MW$_{dry}$
15 % solid content



Conceptual process flow diagram for hydrothermal gasification in supercritical water.

SNG 6.2 MW

ELEC 0.25 MWe

Salts

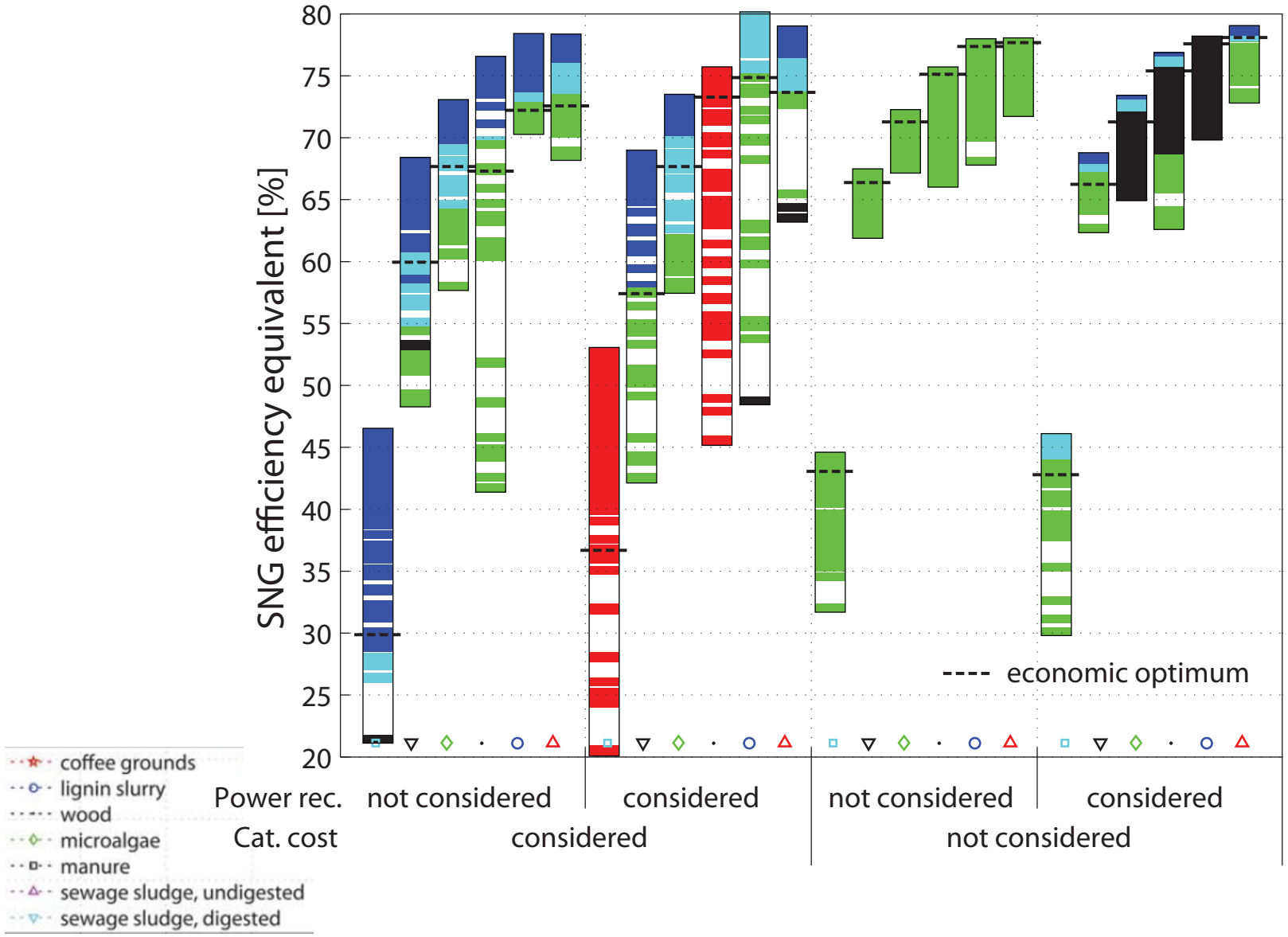
CO2

Water

- Depleted gas are not sufficient to close the energy balance;
- Considering a 94%vol methane rich crude product, about 8 % of the total massflow has to be burned in order to satisfy the energy demand of the process ;

Martin Gassner, Frederic Vogel, Georges Heyen and Francois Marechal, *Process design of SNG production by hydrothermal gasification of waste biomass: Process optimisation for selected substrates*, Energy & Environmental Science (2010)

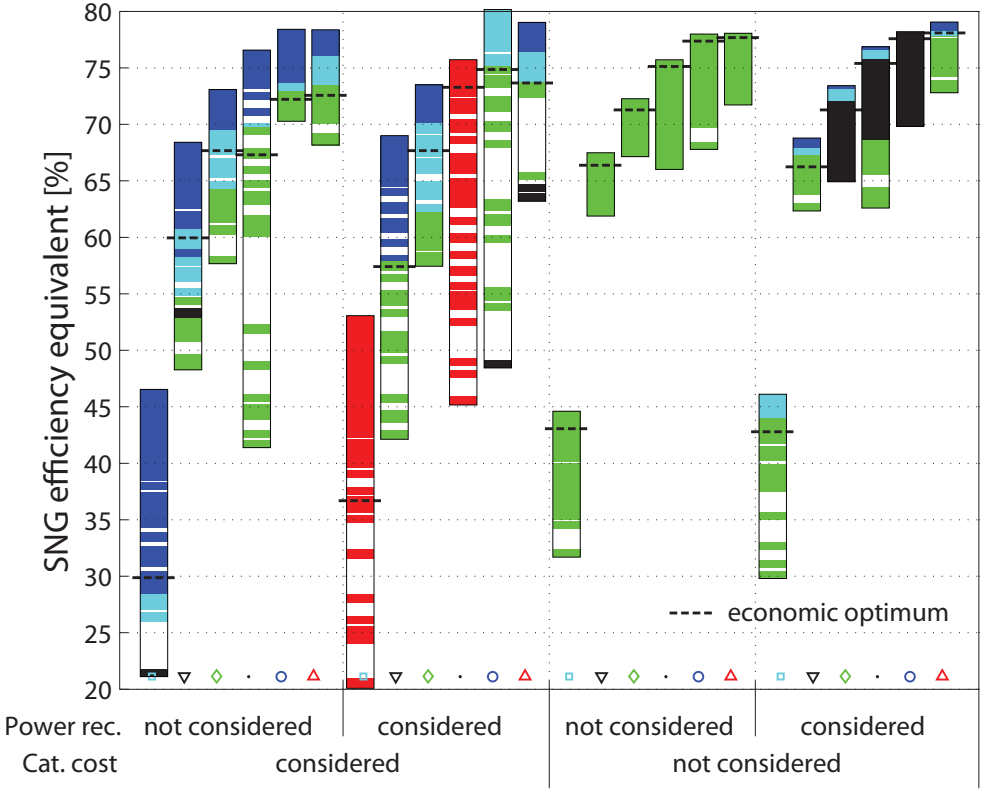
Results for different wet biomass substrates

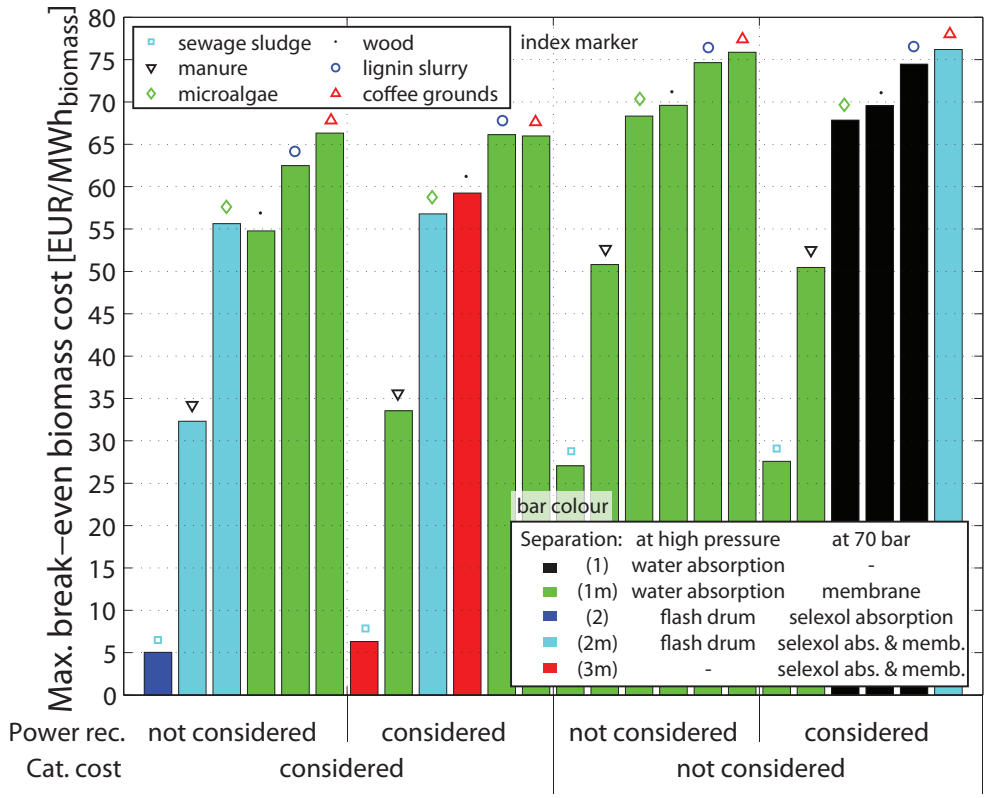


Gassner, Martin, and François Maréchal. "Thermo-economic Optimisation of the Polygeneration of Synthetic Natural Gas (SNG), Power and Heat from Lignocellulosic Biomass by Gasification and Methanation." *Energy and Environmental Science* 5, no. 2 (2012): 5768 – 5789.

Process optimisation
(2) Thermo-economic performance for different substrates

Optimal plant configurations





evolution on Pareto front

most economic conf. at 20 MW_{th}

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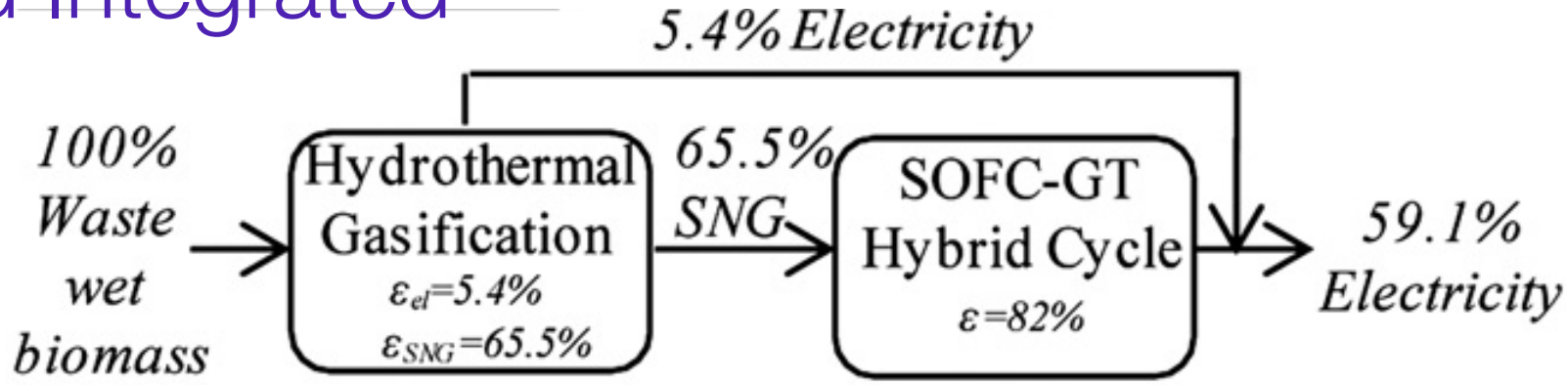
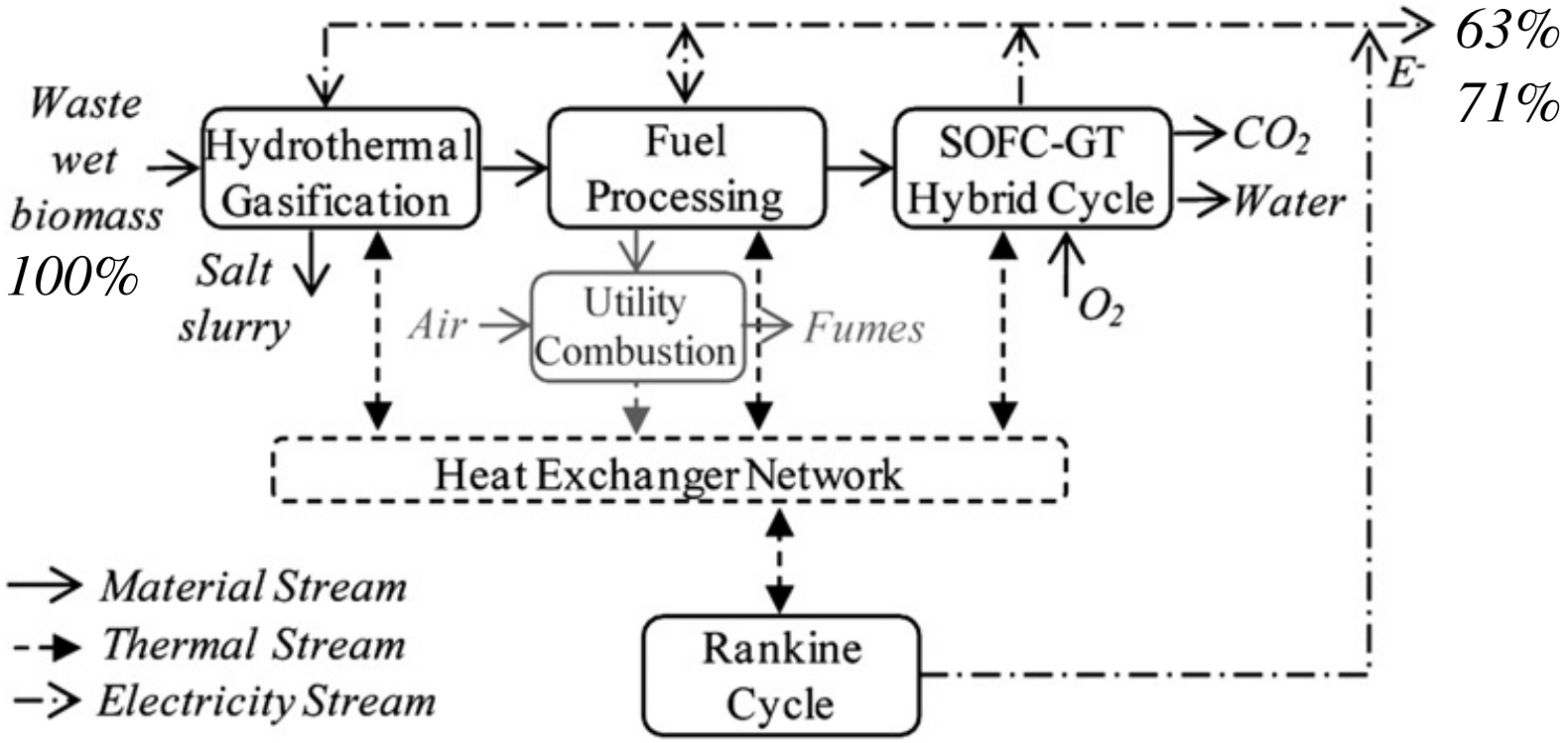
Integrate or not ?

Grid Integrated



Integrated



Facchinetti, E. et al. *Energy* 41, no. 1 (May 2012): 408–419.

Hydrothermal gasification

- **Wet biomass to Gas in the grid**
  - up to 70% efficiency
  - depends on the substrate
- **Water is purified**
- **Salts (fertilisers) are recovered**
- **CO2 can be separated**
- **Synergies for Electricity production with fuel cell**