

Life cycle assessment of a new biomass-to-liquid process comparing different process configurations

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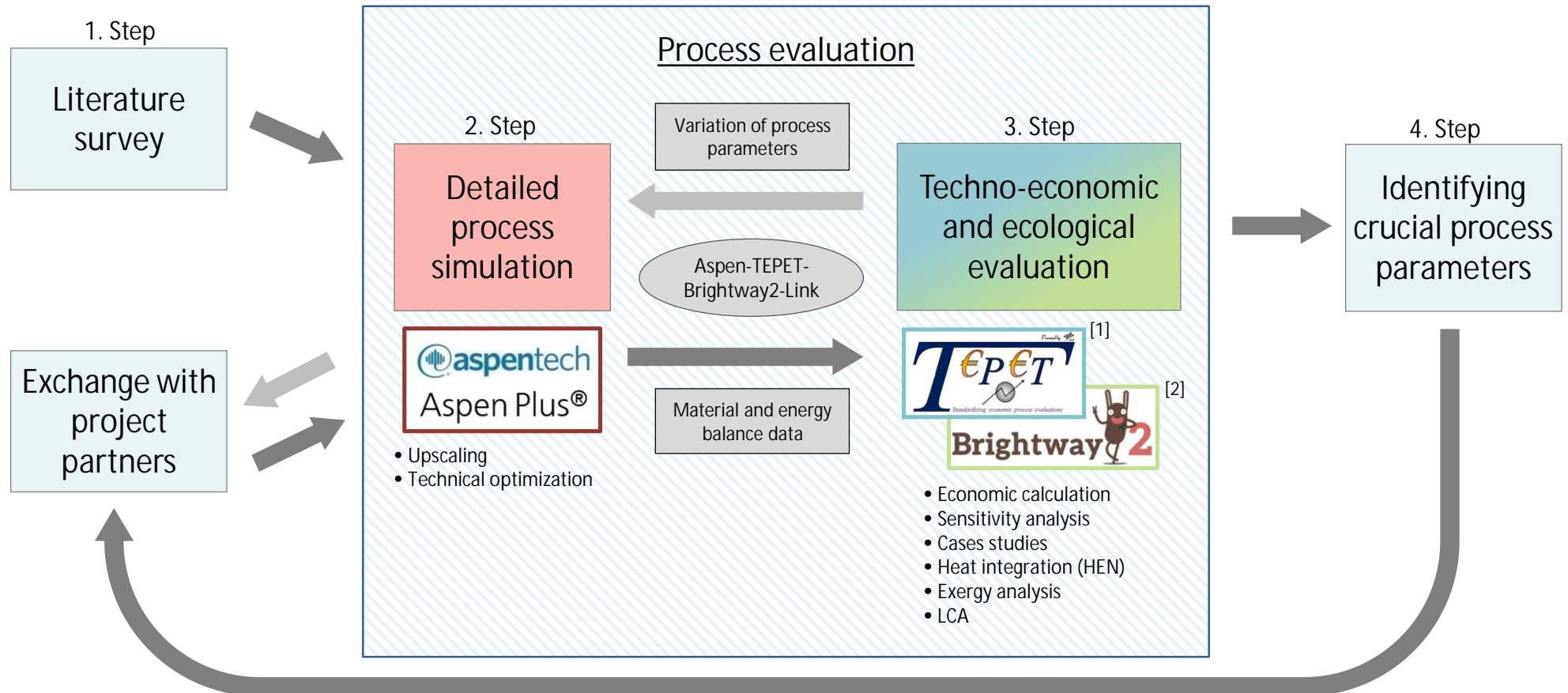
²VTT Technical Research Centre of Finland



Knowledge for Tomorrow



Techno-economic and ecological assessment tool



[1] Albrecht et al. (2016) - A standardized methodology for the techno-economic evaluation of alternative fuels – A case study, Fuel, 194: 511-526

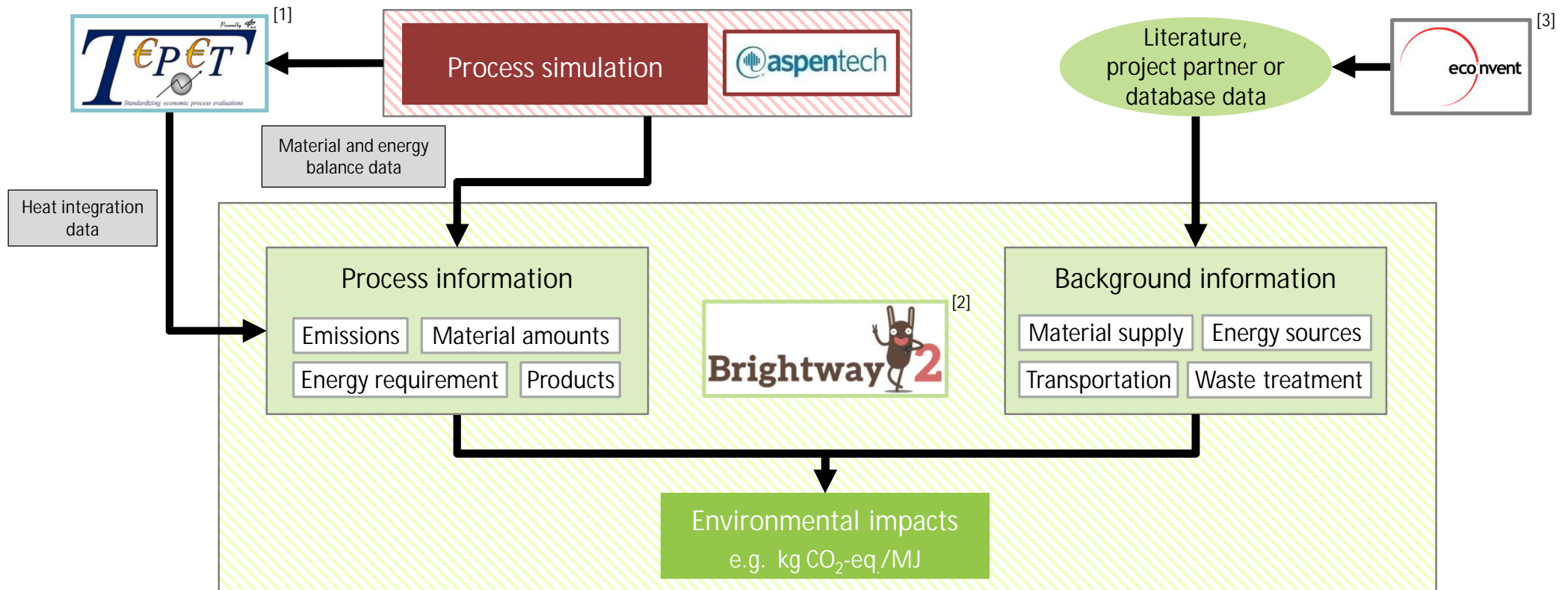
[2] Mutel (2017) - Brightway: An open source framework for Life Cycle Assessment, Journal of Open Source Software, 2(12): 236

[3] Wernet, G et al. (2016) – The ecoinvent database version 3 (part I): overview and methodology. The International Journal of Life Cycle Assessment, 21(9): 1218–1230.





Process simulation based life cycle assessment



[1] Albrecht et al. (2016) - A standardized methodology for the techno-economic evaluation of alternative fuels – A case study, *Fuel*, 194: 511-526

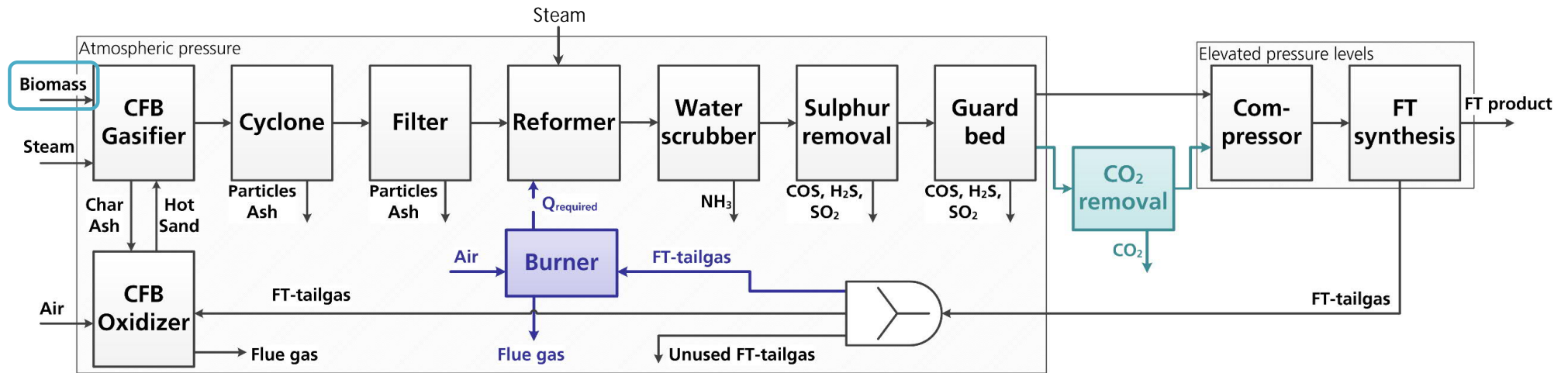
[2] Mutel (2017) - Brightway: An open source framework for Life Cycle Assessment, *Journal of Open Source Software*, 2(12): 236

[3] Wernet, G et al. (2016) – The ecoinvent database version 3 (part I): overview and methodology. *The International Journal of Life Cycle Assessment*, 21(9): 1218–1230.





COMSYN process configurations



Case 1

- Base case
- Autothermal reforming with air

Case 2

- Autothermal reforming with air
- CO₂ removal after guard bed
 - Operating at 5 bar
 - 80 % CO₂ is removed

Case 3

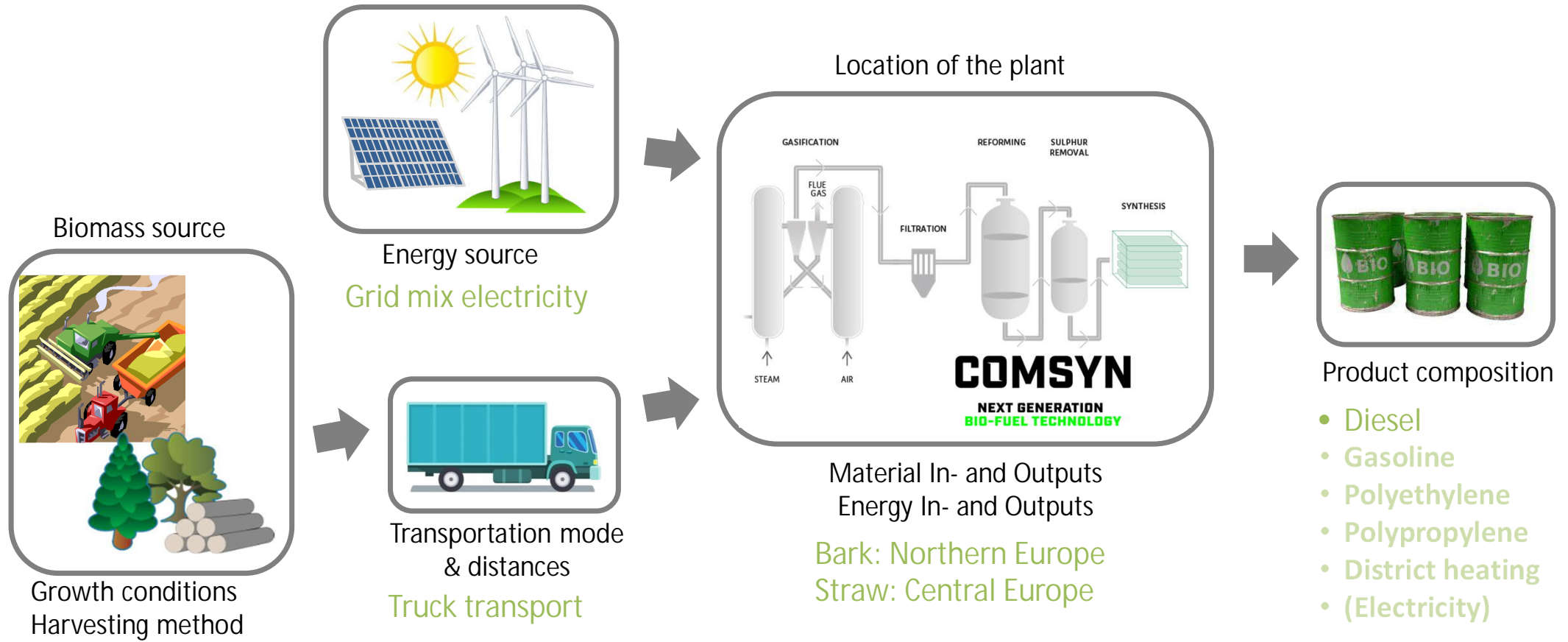
- Allothermal steam reforming
 - Required heat is provided by an additional burner
 - Steam is led into the reformer

Techno-economic assessment in 3BO.6 by Simon Maier





LCA boundary conditions

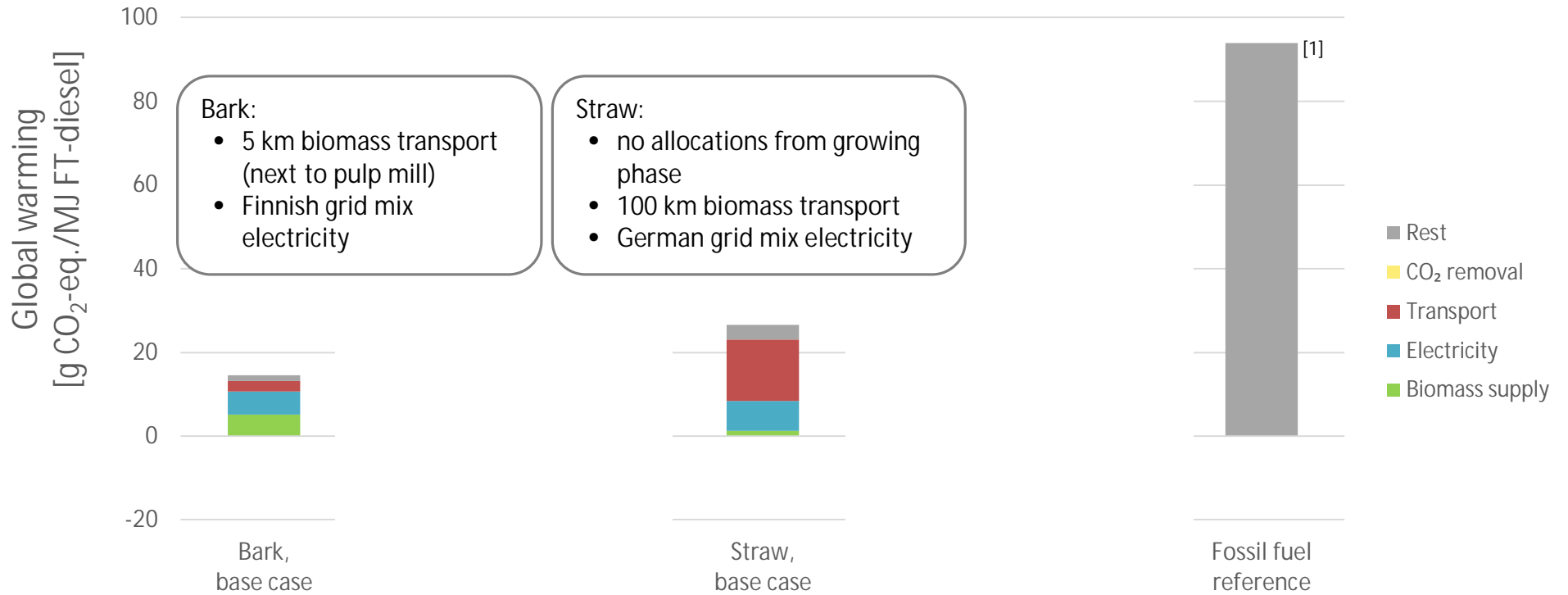


Truck, Sun: <https://classroomclipart.com/clipart/Clipart.htm>
Wind turbine: http://clipartbarn.com/wind-turbine-clipart_15864/





Global warming potential (IPCC 2013)

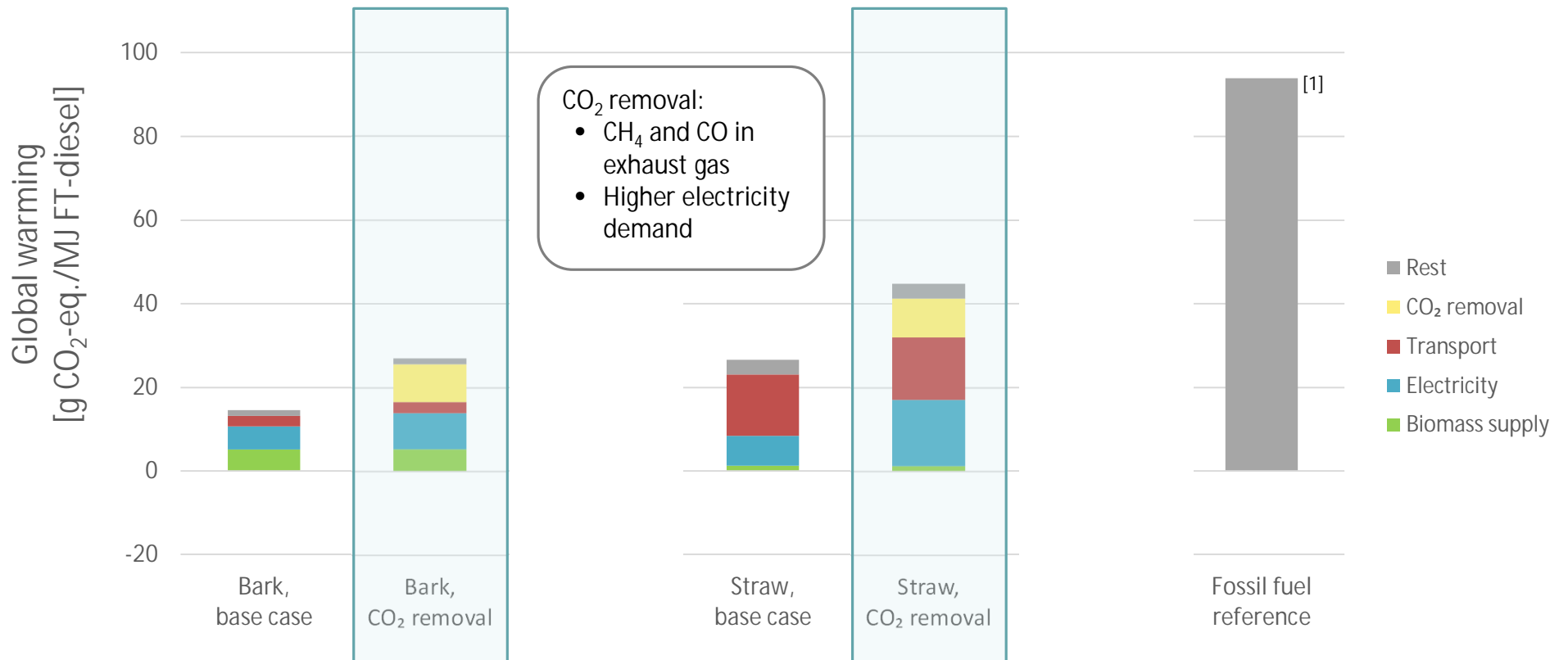


[1] European Union (2018) "Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union





Global warming potential (IPCC 2013)

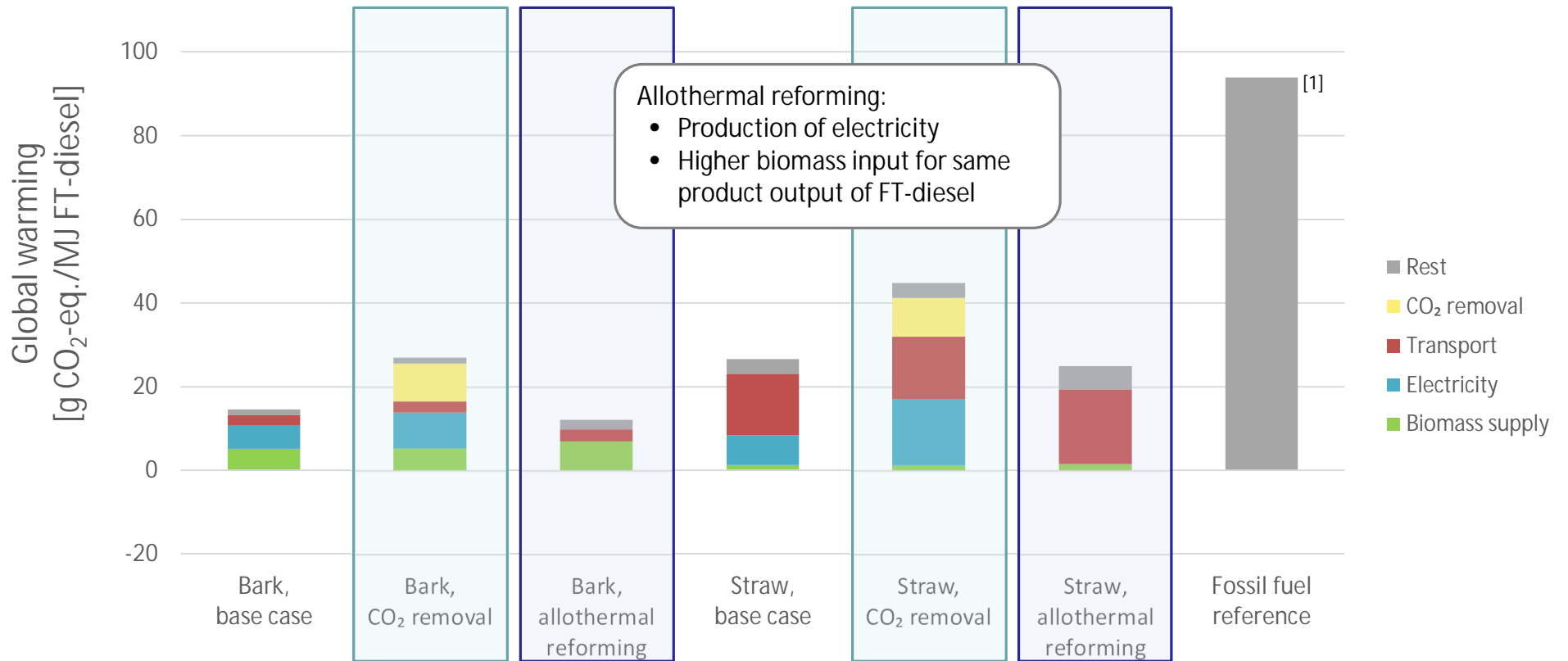


[1] European Union (2018) "Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union





Global warming potential (IPCC 2013)

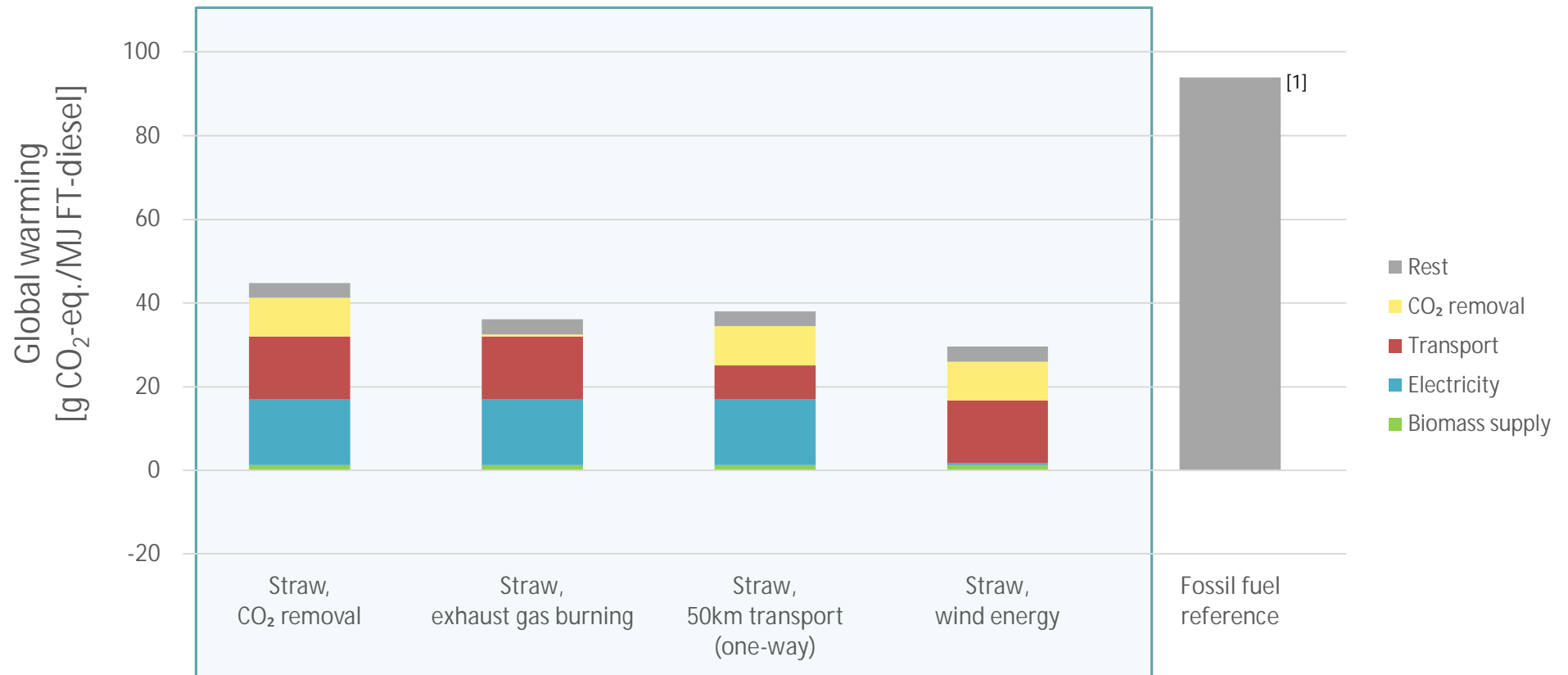


[1] European Union (2018) "Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union





Global warming potential – parameter variations



[1] European Union (2018) "Directive 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources (recast)", Official Journal of the European Union





Conclusion & Outlook

- Linking LCA with process simulation and ecoinvent enables flexible evaluation
 - multiple cases can be easily assessed
- Coupling of Aspen Plus with TEPET and Brightway2 allows a uniform techno-economic and ecological assessment
- Methodology was successfully applied to 3 configurations and two feedstocks in the COMSYN project
 - Case 3 with allothermal reforming has lowest GWP (no electricity consumption but instead production)
- Perform LCA for other impact categories
- Merit order for impact categories of alternative fuel production pathways
- Ecological process optimization





Thank you for your attention!

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COMSYN project partners:



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