Life cycle assessment of wood-based ethanol production at high gravity conditions

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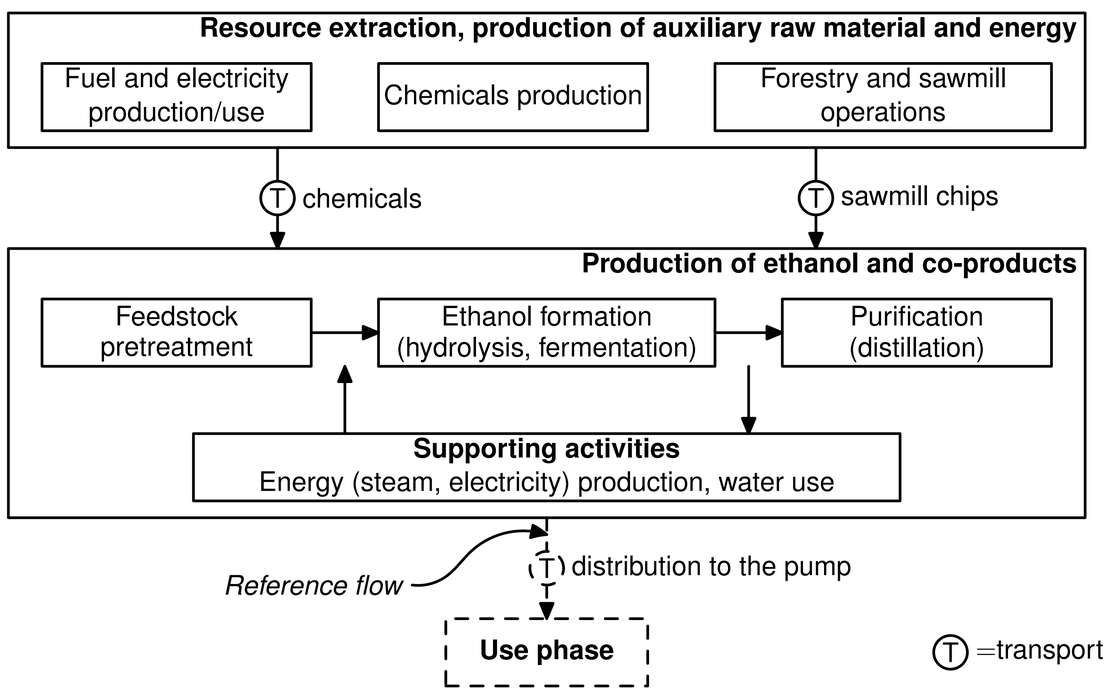
1. Introduction

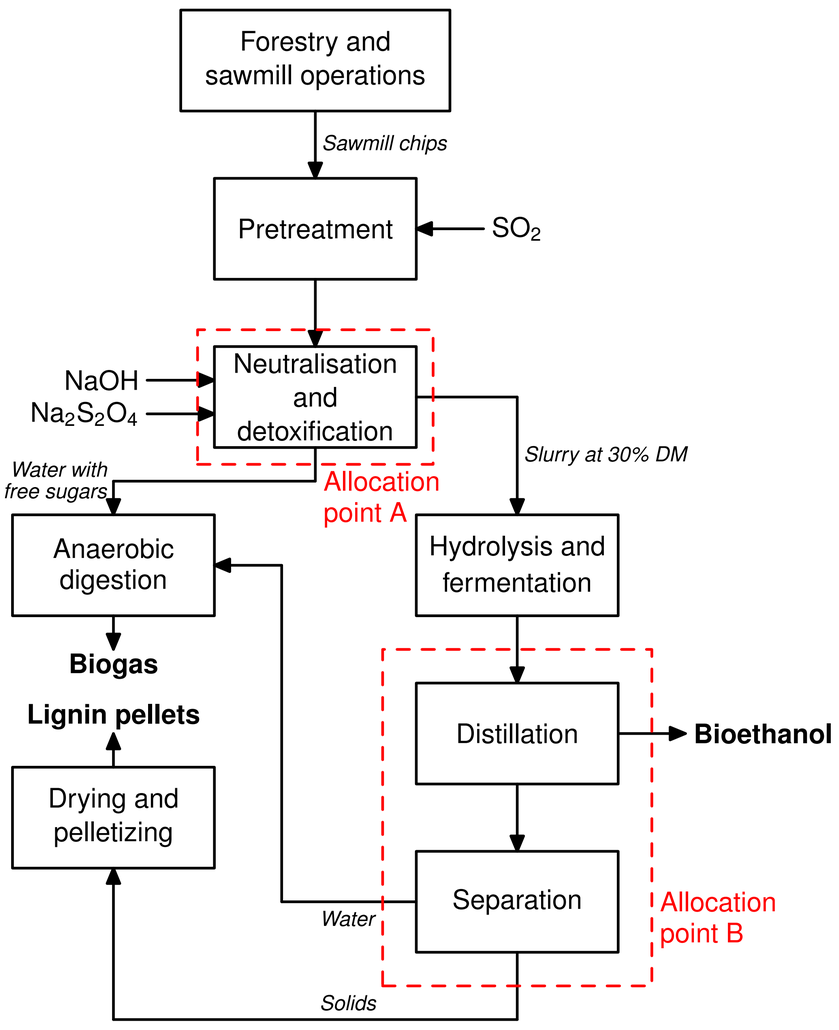
- Sustainable biofuel production processes are in development
- Processes at high gravity conditions are an option
- Challenges include high concentrations of inhibitory substances, high concentrations of sugars and ethanol and high viscosity of the pretreated material[1]
- Life cycle assessment (LCA) has been used to determine the environmental performance of high-gravity technology under development for the production of ethanol from wood and straw[2,3] using experimental data

2. System description



- The functional unit is 1 L of ethanol produced
- The LCA is done from cradle to the plant gate
- An attributional approach is taken, using economic allocation

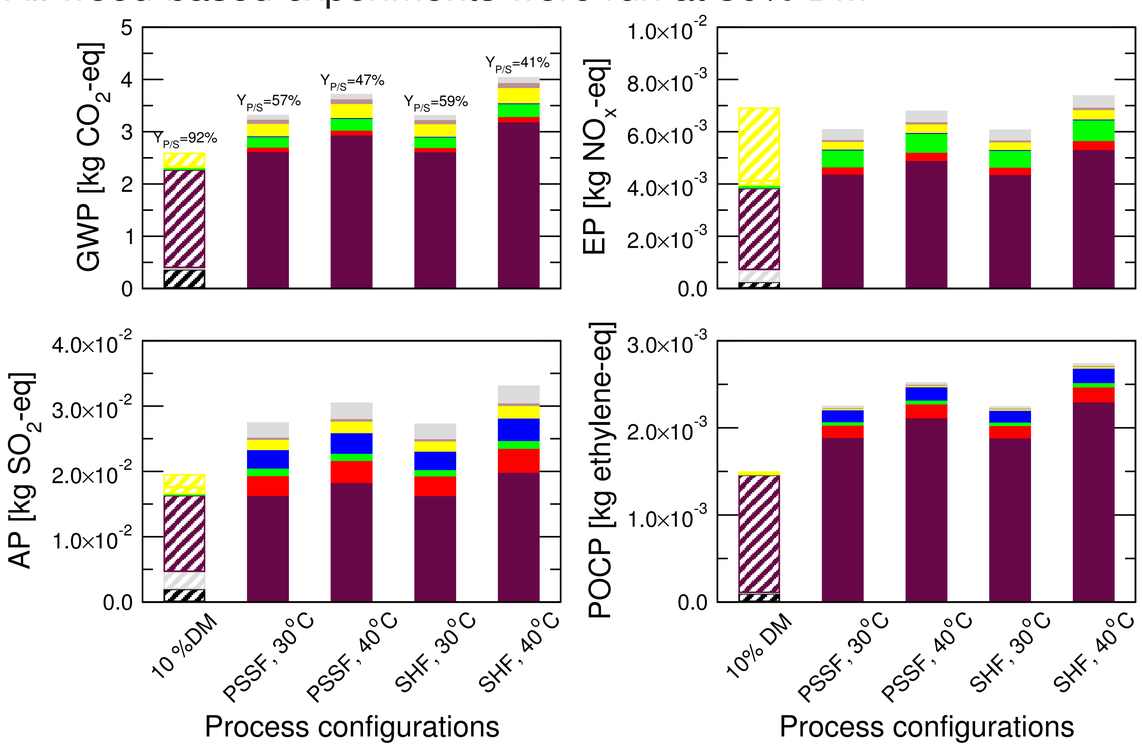
3. Process flow diagram



4. Results and discussion

Environmental impact

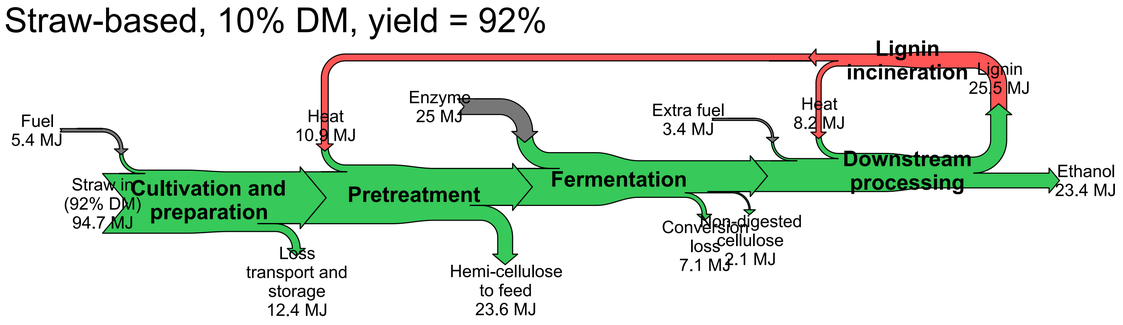
All wood-based experiments were run at 30% DM



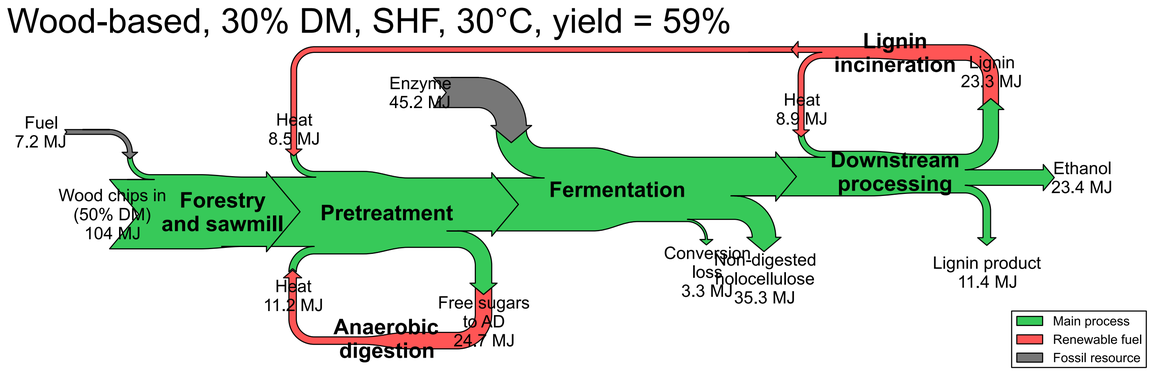
- Enzyme production is the main contributor for all impact categories due to its high fossil resource use
- High gravity conditions lead to lower yields, and in general to higher environmental impacts

Energy flows

Straw-based, 10% DM, yield = 92%



Wood-based, 30% DM, SHF, 30°C, yield = 59%



- Wood-based ethanol production is energy self-sufficient
- Low gravity conditions can lead to additional fossil fuel use

References

[1] R. Koppram et al. *Trends Biotechnol.* 32.1 (2014), pp. 46–53.
[2] D. Cannella et al. *Biotechnol. Biofuels* 5 (2012), p. 26.
[3] D. Cannella and H. Jørgensen. *Biotechnol. Bioeng.* 111.1 (2014), pp. 59–68.
[4] I. Muñoz et al. *Int. J. Life Cycle Assess.* 19.1 (2014), pp. 109–119.

5. Conclusion

Compared to fossil-based ethanol production[4], high gravity processes have a higher global warming potential in their current state of development. Including the end of life (the use phase), and reducing enzyme use or increasing yields may tip this impact to the advantage of the high gravity processes.