Comparative Life Cycle Assessment Of Export Oriented Torrefied Pellets Industry In The U.S. Pacific Northwest

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Background

The Pacific Northwest (PNW) region has the highest concentration of residual woody biomass in the US [1]. There is a huge potential to utilize residual woody biomass for producing wood pellets, while achieving the environmental objective of displacing fossil fuels. While the domestic demand for wood pellets in the US remain low, the increasing demand for sustainable biomass-based energy in Japan, due to various national incentive schemes [2] and lack of steady domestic supply, present a great enviro-economic opportunity for the PNW. Among the pellets, torrefied pellets show superior properties. However, long-distance transportation, and energy use for torrefaction may pose a question about the environmental sustainability of export-oriented torrefied pellet industry in the PNW.

Methods and Assumptions

1. The study was performed in SimaPro Version 9.0.0.49 using TRACI US 2008 method for impact assessment.
2. Functional unit: 1 MJ of energy produced by fuel combustion.

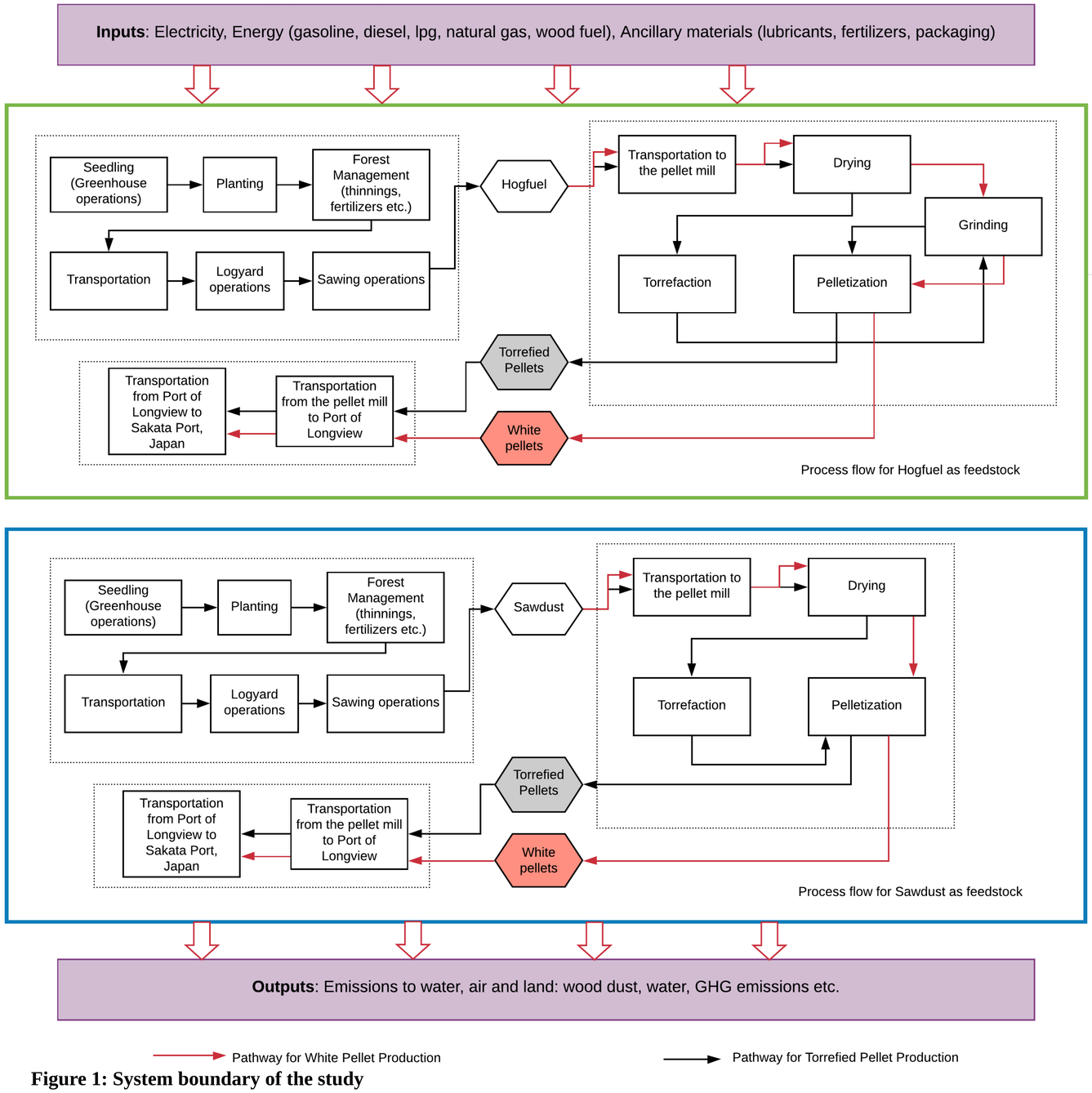

Figure 1: System boundary of the study

Objectives

To perform a comparative cradle-to-gate Life Cycle Assessment (LCA) for four scenarios of black and white pellets in terms of environmental impact, defined by combining two feedstocks – sawdust and hogfuel given they are different where hogfuel has high bark content. The scenarios are as follows.

1. White pellet made from hogfuel
2. White pellet made from sawdust
3. Torrefied pellet made from hogfuel
4. Torrefied pellet made from sawdust

Results

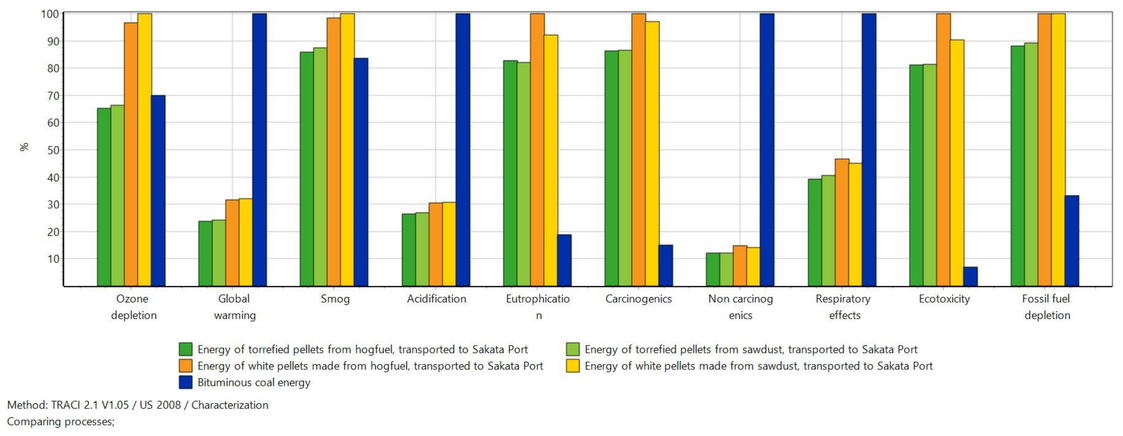

Figure 2: Energy to energy (MJ) comparison of LCA results between white pellets, torrefied pellets, and coal

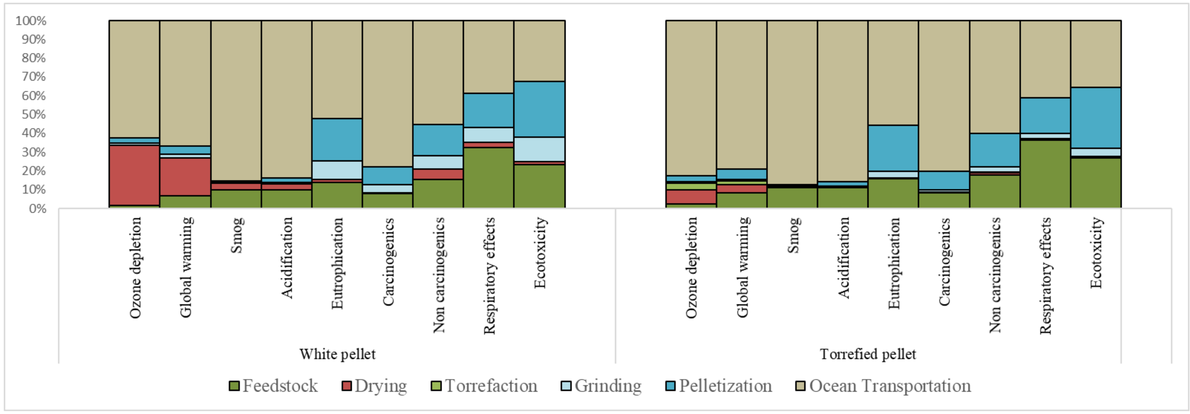

Figure 3: Process contribution analysis between white and torrefied pellet made from hogfuel

Conclusions and Discussion

1. Pellets have relatively less emission % in important emission categories as global warming potential and acidification compared to coal.
2. Among the pellets, white pellets perform poor in 5 out of 10 emission categories. This could be because of the efficient recycling of flue gases in the torrefaction system which is absent in white pellet process flow.
3. Sawdust is the better feedstock compared to hog fuel. The main reason is the additional grinding step required for hog fuel.
4. Ocean transportation is the major contributor to all impact categories followed by feedstock and pelletization.

References

1. US Department of Energy, 2011
2. Feed-in Tariffs in Japan: Five Years of Achievements and Future Challenges. Report by Renewable Energy Institute. September 2017.

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