Comparative Life Cycle Assessment of the Biomass Logistics Model: Mid-Cascade to Pacific Region

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Introduction

Typical forest harvest operations in the Mid-Cascade to Pacific region of the Pacific Northwest leave a considerable volume of unused woody biomass in the forest in the form of treetops and branches. Despite the environmental benefits, the economic feasibility of extracting these residuals from the forest is limited due to low market demand and high collection and transportation costs. To evaluate the various logistical/procedural pathways, this poster explores two biomass collection and transportation scenarios within the forest by utilizing LCA calculations. The environmental burdens for each of these scenarios are assessed in terms of global warming, acidification, smog, ozone depletion, respiratory effects, and ecotoxicity.

The current project looks at using forest residuals (woody biomass) derived from timber harvest and forest thinning operations as the raw material input for bio-jet fuel within the NARA region. The LCA results will be critical in demonstrating that bio-jet fuel produced from forest residuals meets the greenhouse gas (GHG) reduction target specified in the US Energy Independence Act of 2007. The EIA requires that the overall GHG emissions of cellulosic biofuel produce 60% lower carbon emissions (**H.R.6:** http://www.gpo.gov/fdsys/pkg/BILLS-110hr6enr/pdf/BILLS-110hr6enr.pdf, Argyropoulos 2010: http://www.eia.gov/conference/2010/session2/paul.pdf), relative to jet fuel produced from fossil fuel, in order to be considered for public procurement.

Background: Biomass Collection

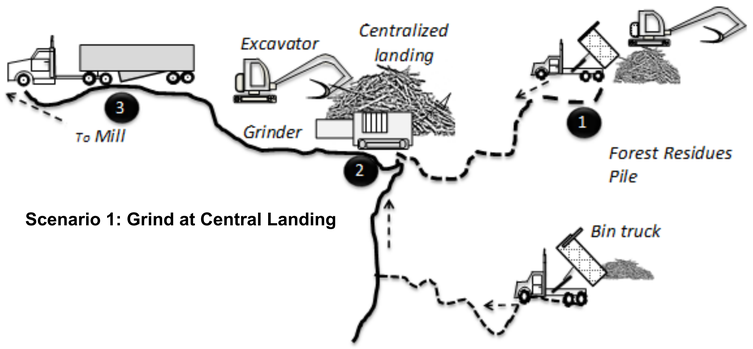
Many mills and plants utilize left over forest residuals for a cheap, combustible fuel source, but there are currently very few other markets available to make the collection of these residuals worthwhile. The main market barrier for their usage is the high cost of transporting the low density, high volume tree tops and branches. To maximize the efficiency of transportation, residual biomass needs to be compacted and or densified to fill the space of a truck trailer or container. This can be achieved by either grinding or bundling the material for easier transportation (smaller size) and easier utilization (less processing at plant).

The utilization of bundles allows for more efficient transportation of forest residuals and the elimination of a diesel fuel grinder which is more expensive to operate and more detrimental to the environment because of increased emissions. Bundling generates a higher density and more transportable material than loose residuals, which allows for greater mobility by putting them on modified log trailers (Loeppky 2014). With meeting the threshold of lower emissions, the next hurdle is minimizing the cost for bundling since under current technologies it is still not as cost effective.

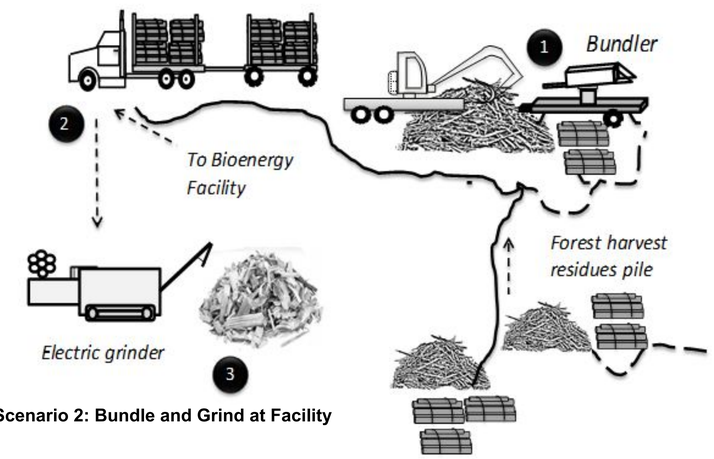
Objectives

- ✓ To compare the role and impact of two various biomass collection scenarios
- ✓ To show the greenhouse gas emissions from the utilization of electric powered equipment (grinder) compared with equipment utilizing fossil fuels
- ✓ Evaluate the environmental impact of utilizing a bundler in biomass collection operations

System Boundaries – Biomass Collection Scenarios

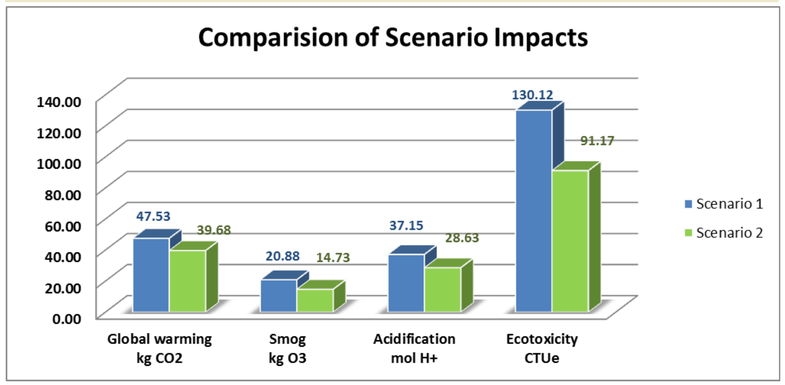


Scenario 1: Grind at Central Landing

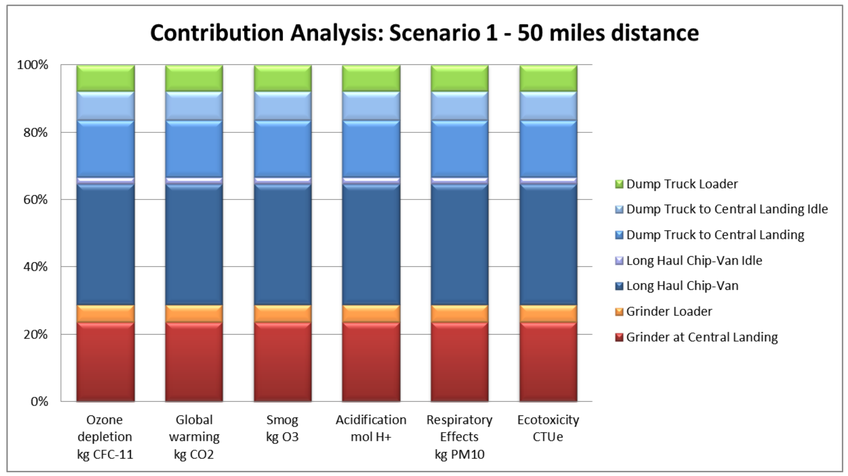


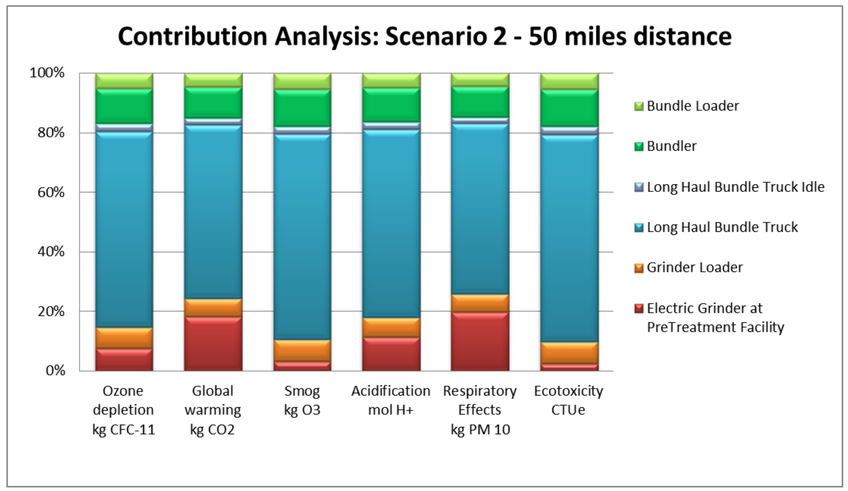
Scenario 2: Bundle and Grind at Facility

Emissions Comparison from Feedstock Collection Scenarios



Scenario Emission Profiles





Conclusions

As shown, the emissions determined in the Life Cycle Impact Assessment of different biomass collection scenarios can vary greatly. The use of an electric grinder that utilizes an energy mix as opposed to fossil fuels to operate can help in reducing a systems overall carbon footprint. Also utilizing a reload system with trucks having to idle can contribute significantly to a systems emissions profile. Bundling may not be as cost effective, but it is a process that can be done at a separate time and trucks can pick up the bundles at their convenience and not have to wait to be filled by a grinder. These results were from data gathered from primary sources and the results provided are giving more realistic outcomes as opposed to data from secondary sources that make various assumptions.

NARA
Northwest Advanced Renewables Alliance

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