Life Cycle Assessment Based Environmental Impact of NARA Biojet

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The Life Cycle Assessment (LCA) method is used to estimate the overall environmental impact associated with producing bio-jet fuel from recovered residual woody biomass, as well as any net reduction in emissions to the atmosphere achieved by displacing fossil fuel-based bio-jet fuel. LCA is an internationally recognized methodology to assess the environmental impacts of a product or activity over its entire life cycle. A comprehensive LCA of forest residue based aviation fuel was performed using a 'cradle-to-grave' approach where 'cradle' is defined as forest residues collected into slash piles in the forest and 'grave' is defined as the combustion of the jet fuel during flight in an aircraft. Utilizing a 'Woods-to-Wake' (WoTW) LCA approach, which is comparable to a Well-to-Wake (WTW) LCA for petroleum based aviation fuel, the environmental implications of feedstock recovery, production, and utilization of residual woody biomass based bio-jet fuel were assessed. A comparative assessment of the environmental implications of substituting petroleum based jet fuel with that of residual woody biomass based bio-jet fuel was also conducted.

System boundaries

Identifying a system boundary is key to understanding the overall scope of the assessment as is identifying the processes that are included as part of the entire life cycle system and the assumptions specific to the system being assessed. For the comparative analysis, it is critical to use similar system boundaries for both of the processes under consideration. A simplified diagram of the system boundaries associated with the production and utilization of woody biomass based bio-jet fuel (Panel A) and petroleum based jet fuel (Panel B) is shown in Figure 1.

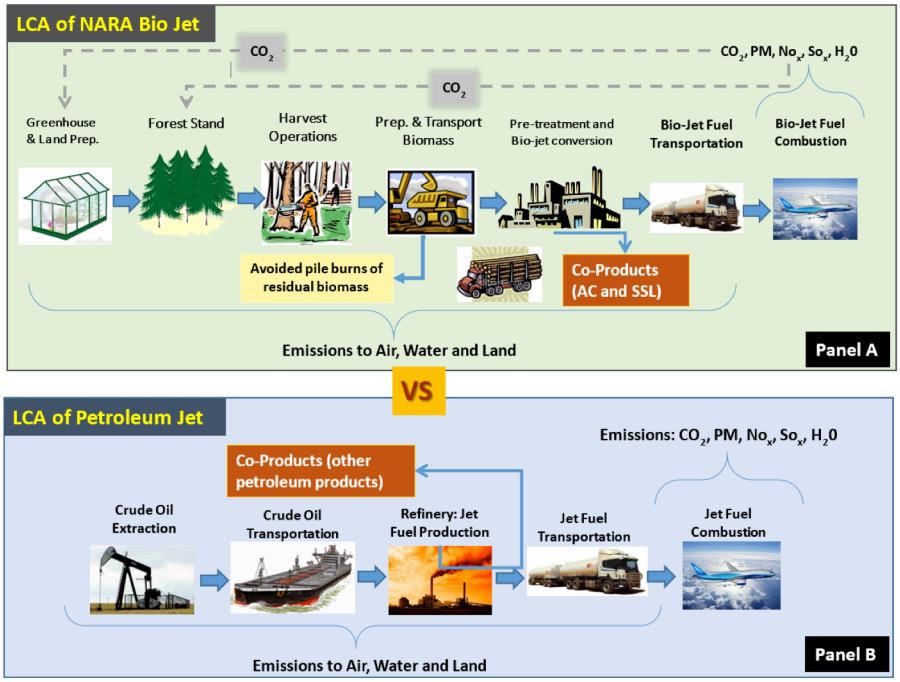

Figure 1. *Comparable system boundaries for the production of bio-jet fuel and petro-jet fuel.*

Results

The results presented here correspond to two of the most environmentally conservative and realistic scenarios developed by the NARA researchers. The 'cradle to grave' comparative analysis of petro-jet and bio-jet reveal that a more than 70% reduction in the global warming potential, as a result of the reduction in greenhouse gases (GHGs) into the atmosphere, can be achieved by substituting petroleum-based jet fuel with 100% residual woody biomass-based jet fuel, even for the most conservative scenario, Figure 2. The key environmental benefits associated with residual biomass based bio-jet fuel are the avoided emissions from not burning the residual slash pile which is indicated by the net negative 'respiratory effects' LCA impact category. The residual woody biomass based jet fuel also contributed to a substantial reduction in the 'carcinogenics', 'non carcinogenics', 'smog' and ecotoxicity LCA impact categories.

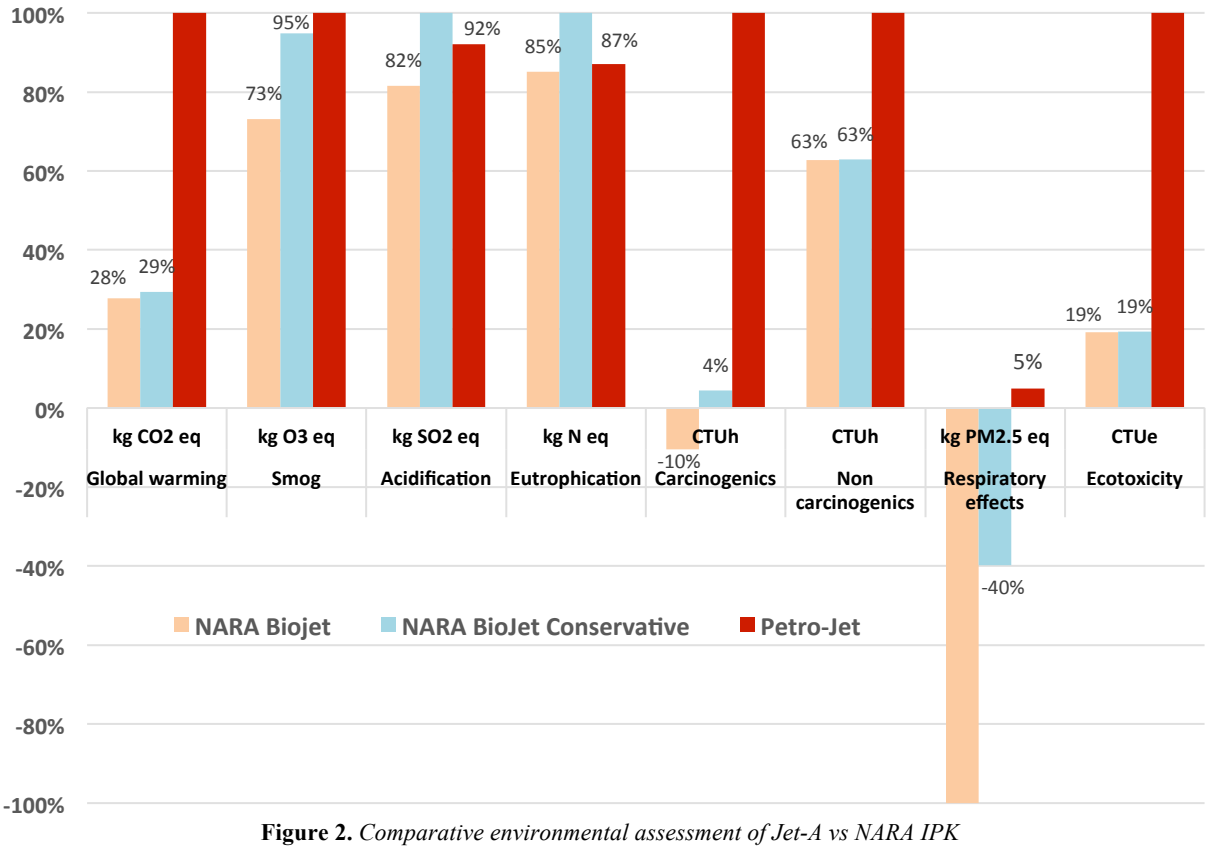

Figure 2. *Comparative environmental assessment of Jet-A vs NARA IPK*

Highlights

- The WoTW/WTW comparative analysis of petroleum and residual biomass-based jet fuel reveals that a more than 70% reduction in global warming potential (GWP) can be achieved by substituting 100% petroleum-based jet fuel with 100% residual woody biomass-based jet fuel. This result is significantly better than the US Environmental Protection Agency mandated 60% GWP reduction.
- Another important environmental benefit associated with producing residual biomass-based bio-fuel is the avoided slash pile burns which improves local air quality and reduces the local health impacts caused by the harmful pollutants generated from burning slash piles in the forest.
- The residual woody biomass based jet fuel also contributed to a substantial reduction in the 'carcinogenics', 'non carcinogenics', 'smog' and ecotoxicity LCA impact categories. These positive local environmental benefits make residual woody biomass a much more environmentally appealing feedstock for bio-energy production than fossil fuel-based alternatives.