A COMPARATIVE LIFE CYCLE ASSESSMENT (LCA) OF FOSSIL OIL AND A NEW INNOVATIVE SOLID BIOMASS CHAINS FOR SMALL-SCALE SPACE HEATING SYSTEM

Lappeenranta-Lahti University of Technology LUT
Laboratory of Bioenergy, Mikkeli, Finland

Raghu KC*, Raghu.kc@lut.fi
Jarno Föhr, jarno.fohr@lut.fi
Tapio Ranta, tapio.ranta@lut.fi

Aim of the study

South-Savo region of Finland has about 9000 oil-fired heaters and they consume about 620GWh of oil in a year. The region is looking for renewable fuels to replace oil. Biomass is one of the alternatives to replace it but environmental impacts needs to be studied.

Aim of the study is to conduct a comparative life cycle assessments (LCA), of small scale light fuel oil-fired space heating system (80000 l/y) and biomass (pellets and wood chips) as alternative fuels.

Biomass delivery from three locations on a new and innovative container truck with a blower (Figure 1) that blows chips/pellets directly into the storage silos is studied.

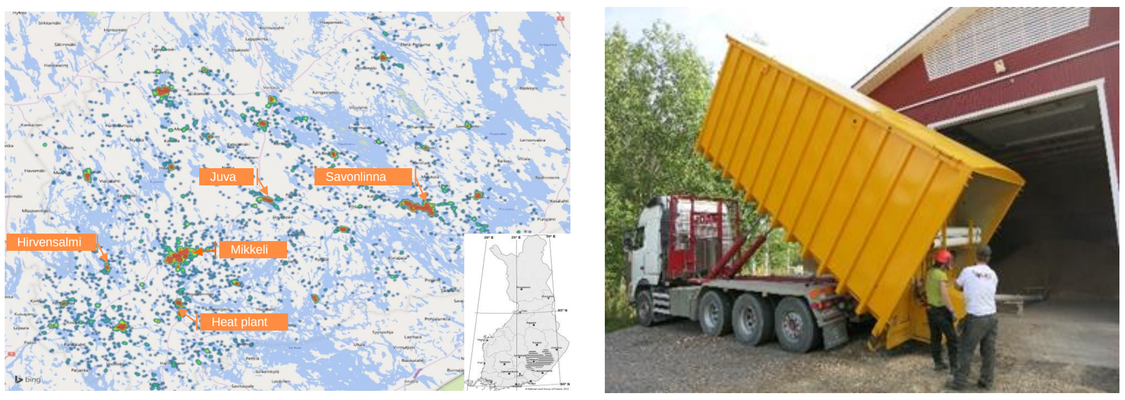

Figure 1: *Light fuel oil consumers for heating in the region of South Savo (left) and container truck blowing wood chips (right)*

Material and methods

The LCA is conducted in four phases: Goal and scope definition, Life cycle inventory, Life cycle impact assessment, and Interpretation.

The inventory is collected from literatures and databases. The impact assessment for Global warming potential (GWP) for 100 years is done based on CML 2001 (2016) methodology.

The system boundary includes from raw material acquisition to fuel combustion but excludes production of infrastructures and ash management.

Pellets are produced in Vierumäki (100km) and oil refinery is located in Provoo (170km). Wood chips are harvested and chipped in forest road side in three different locations but for comparative scenarios, energy wood is chipped in biomass terminal, which is located 10km away from the heat plant.

Results

- 89% GHG emission saving with wood pellets
- Up to 96% of the GHG emission saving with wood chips
- Chipping is largest contributor for nearest biomass supply point but as the delivery distance grow, transportations contributes the most.
- Wood pellet production and oil combustions are major contributors in respective energy systems
- There is no significant GHG benefit of delivering biomass via biomass terminal for nearest supply point but >7% of GHG emissions can be cut down if the delivery distance is over 140 km.

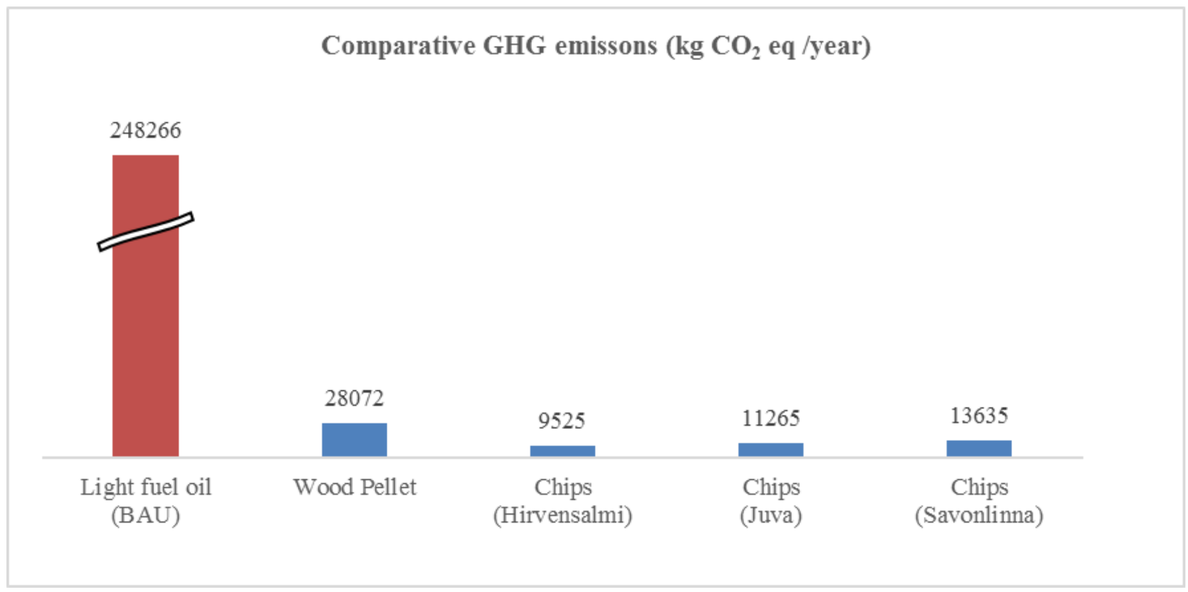

Figure 2: *Comparative GHG emissions from different fuels*

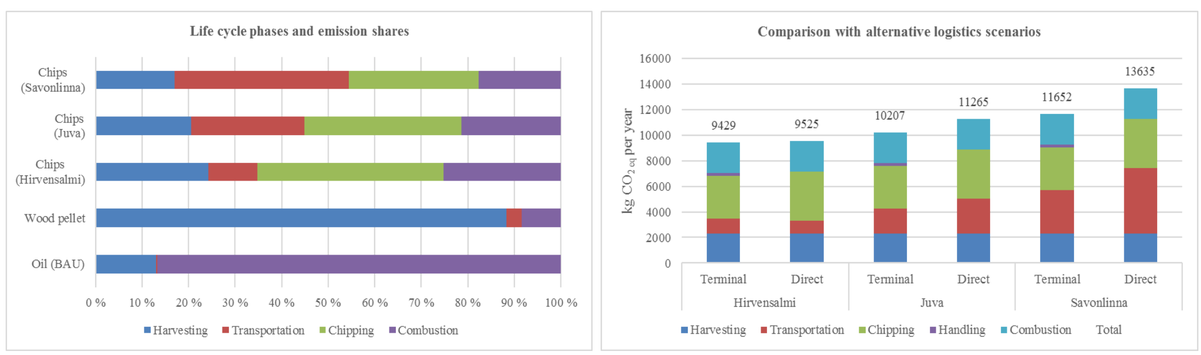

Figure 3: *Share of emissions frim different life cycle phases (left), emissions from comparative scenarios where biomass is chipped in a terminal*

Conclusion

Significant amount of GHG emissions can be saved from decentralized space heating in rural Finland by swapping fossil oil to biomass. For longer delivery distances, terminal chipping is more environmental friendly. Local biomass as a fuel also helps municipalities become energy independent, at least for heating sector

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