

Article

Impacts of Road Infrastructure on the Environmental Efficiency of High Capacity Transportation in Harvesting of Renewable Wood Energy

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Figure S1. Three categories of road network in wood transportation: forest roads with speed ≤ 30 km h⁻¹, rural gravel roads with speed >30 and < 60 km h⁻¹ and 2nd class highway with speed ≥ 60 km h⁻¹.

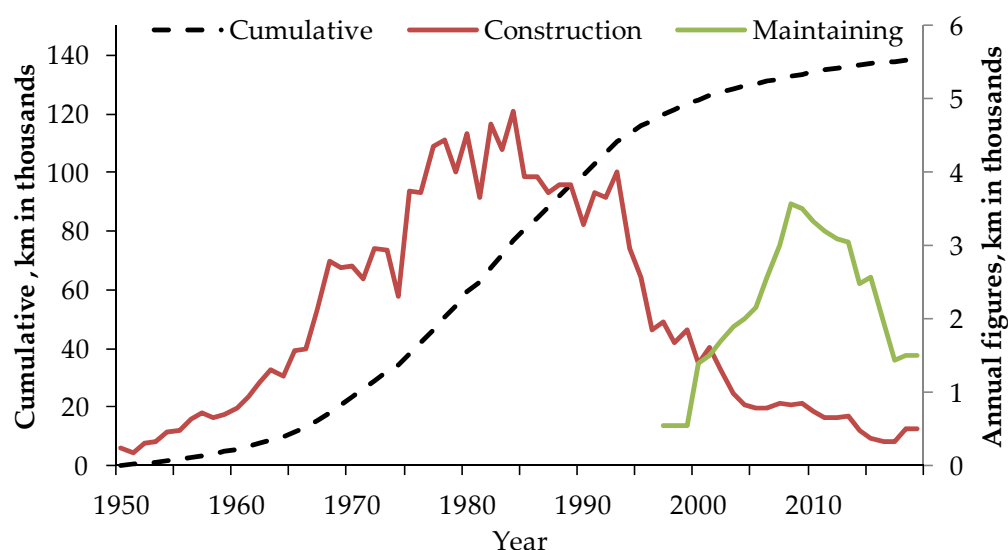


Figure S2. Forest road construction and maintenance in Finland. Figure was modified from forest statistics of [17].

In addition to the forestry, the forest road network is in public use for social and environmental activities. Even when both forestry and earth moving operations are using the road network, trucks make up only 26% of the traffic on forest roads. However, about 80% of wood transportation consists of trucks. Therefore, transportation conditions on the forest roads are a key issue for the effective wood supply of the forest industry to factories (Figure 3). This is quite expected, as better access to harvesting areas has been the primary reason for the construction of new forest roads.



Figure S3. High capacity transportation of renewable wood operates on environmentally friendly forest road network.

Figure 4 shows that line hauls consist of a route driven with a payload from wood inventory 1 to mill 1, and of a route driven with an empty load back to the wood inventory 1. Line hauls with backhauls consist of a route driven with a payload from the wood inventory 1 to mill 1, and of a route driven with an empty load from mill 1 to the wood inventory 2. In addition, two-way backhauls consist of a route driven with a payload from the wood inventory 2 to mill 2, and of a route driven with an empty load from mill 2 back to the area of wood inventory 1.

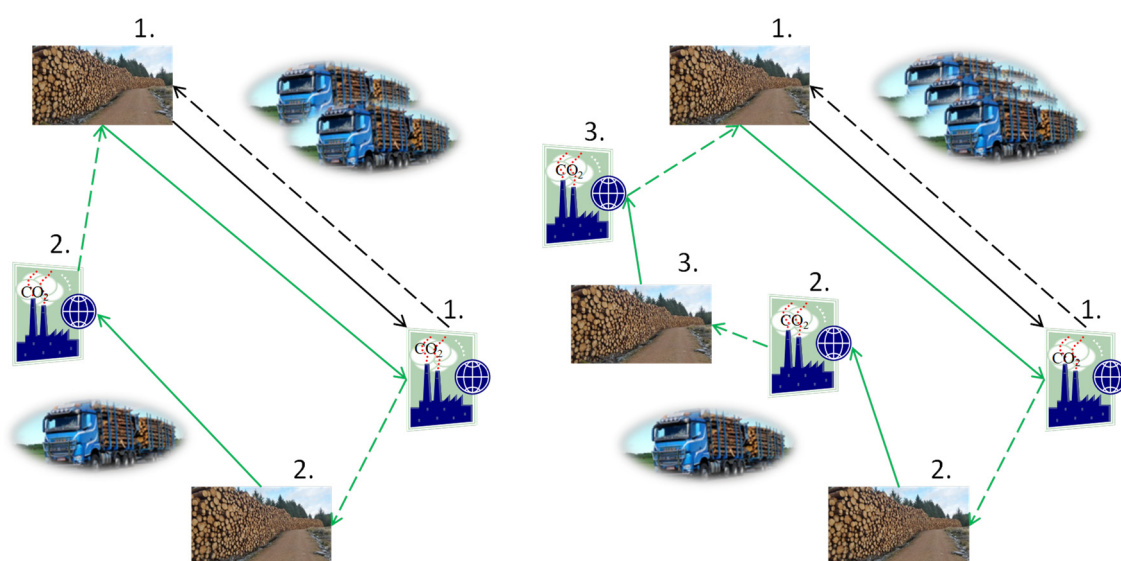


Figure S4. Transportation services of two-way backhauling (left) and tree-way backhauling (right) compared to line hauling: line hauls (black), line hauls with backhauls (green), and backhauls (green). The routes driven with an empty load are marked as dashed lines and the routes driven with a payload as solid lines.

The backhauling formulations are also a better description of real transportation conditions. Actually, two-way backhauling was used in this study. The components of backhauling happen on the road-network components with varying percentages of them including the forest roads as well. This is an important aspect that must be taken into account when studying the effects of the road network on the environmental emissions, because fuel consumption of the trucks increases by tens of percentages when forest roads are used instead of highways.