

# CO<sub>2</sub> emissions from international biomass transport

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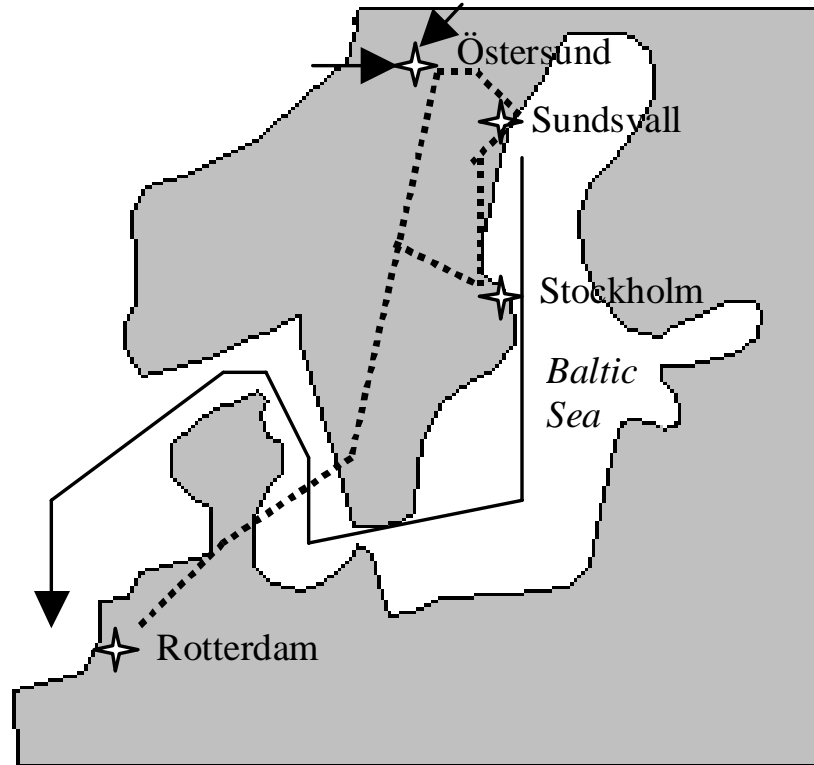
# Background

- When should we transport biomass over long distances from a CO<sub>2</sub> perspective:
  - 1) When there is a local excess of biomass and the CO<sub>2</sub> cost of transport is smaller than the CO<sub>2</sub> displacement at the final use.
  - 2) When the biomass is used more efficient elsewhere and the CO<sub>2</sub> cost of transport is lower than the end-use gain.

# Approach

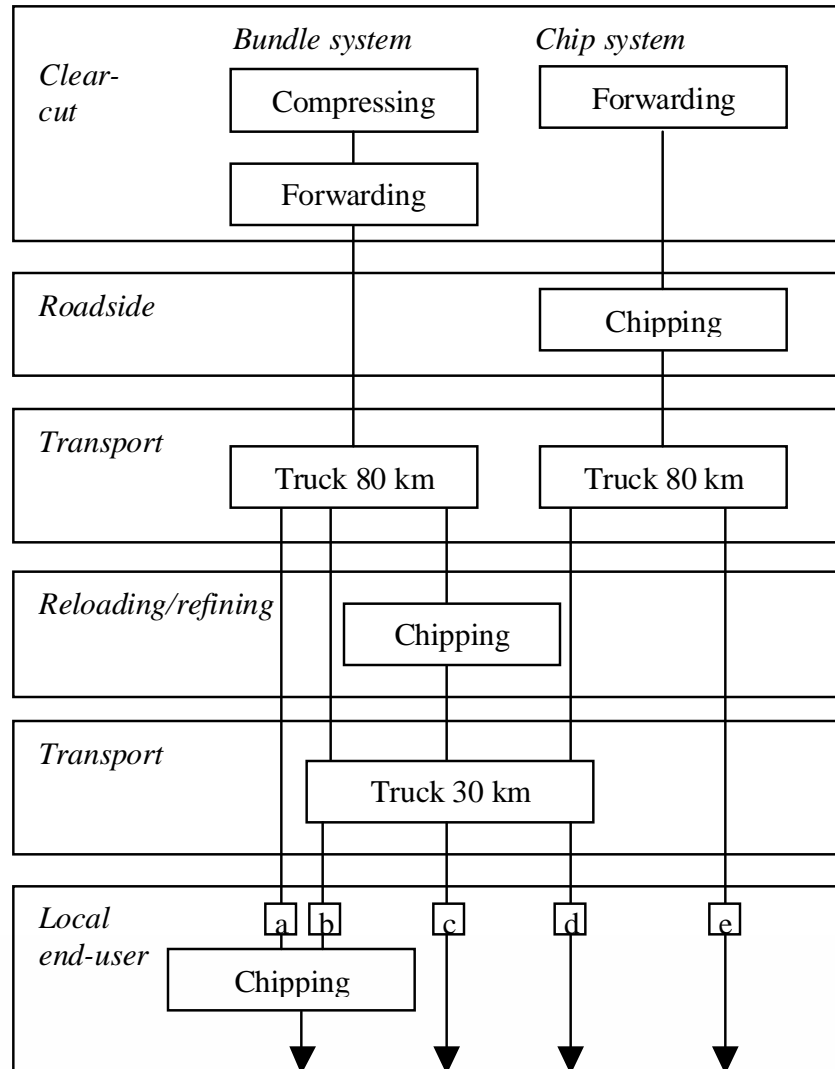
- The CO<sub>2</sub> cost of biomass transport on a full system analysis (from the clearcut to the end-user).
- Forest residues, with data from real experience in central Sweden.
- Functional unit: 1 MWh of delivered bio-fuel.

# Geographical outline of studied systems

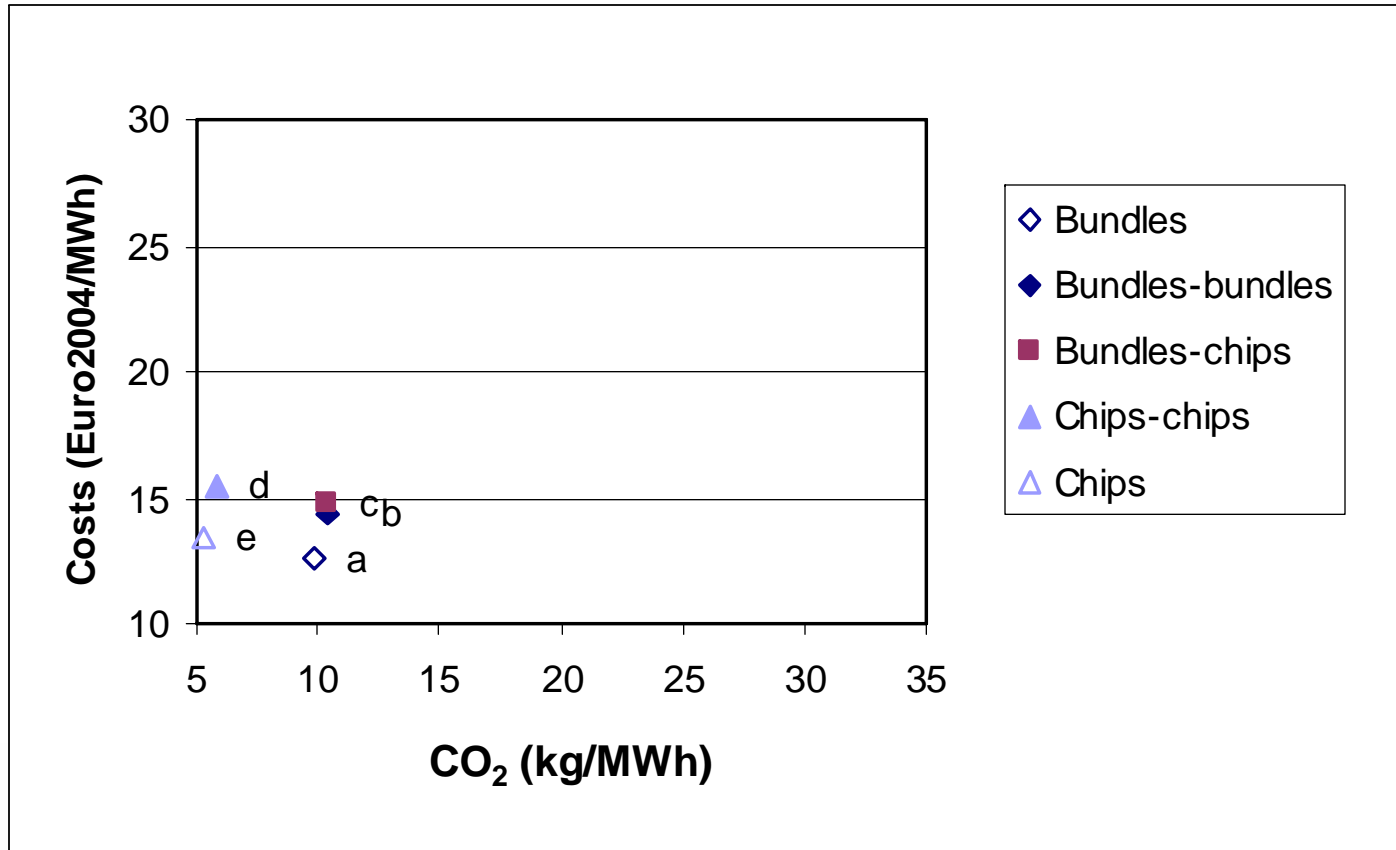


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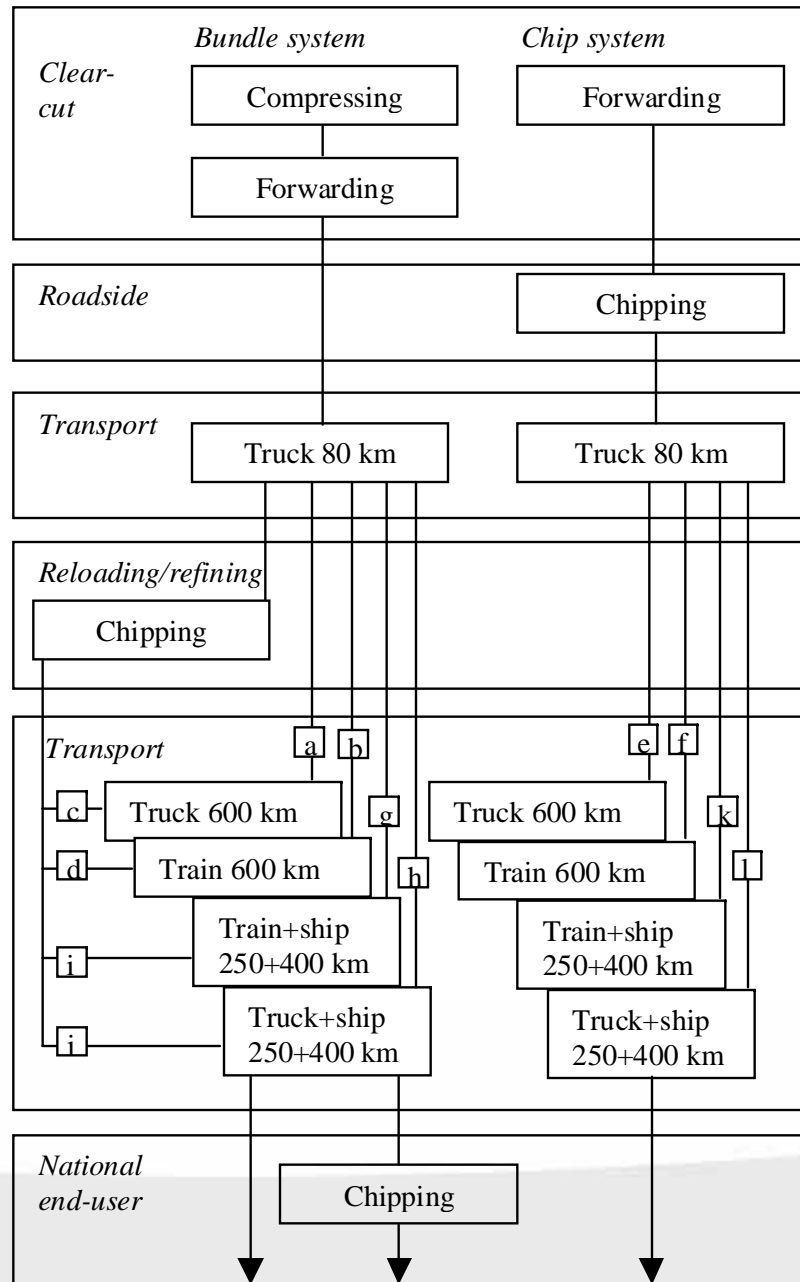
# Local transportation chains



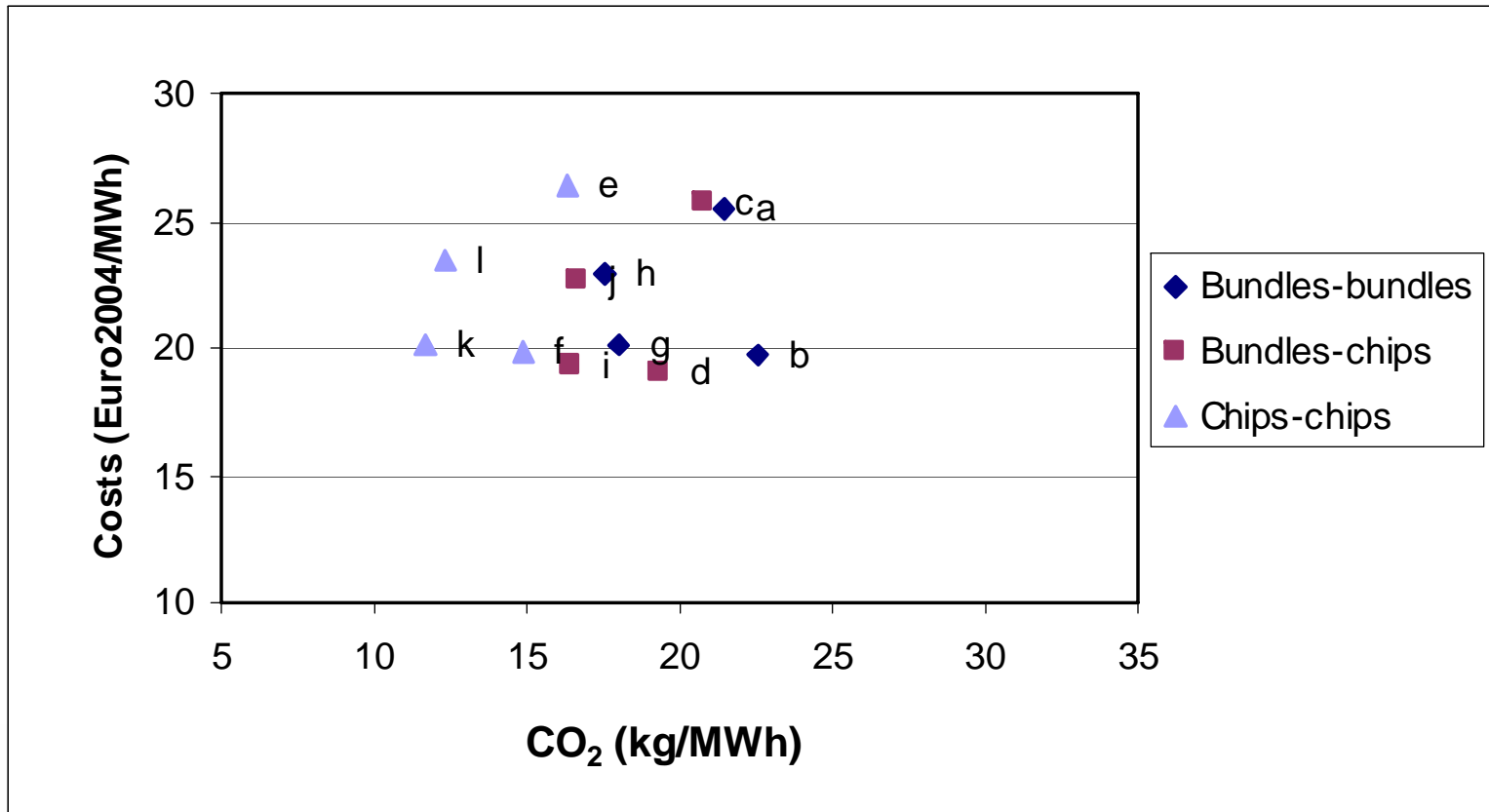
# Local alternatives



# National transportation chains

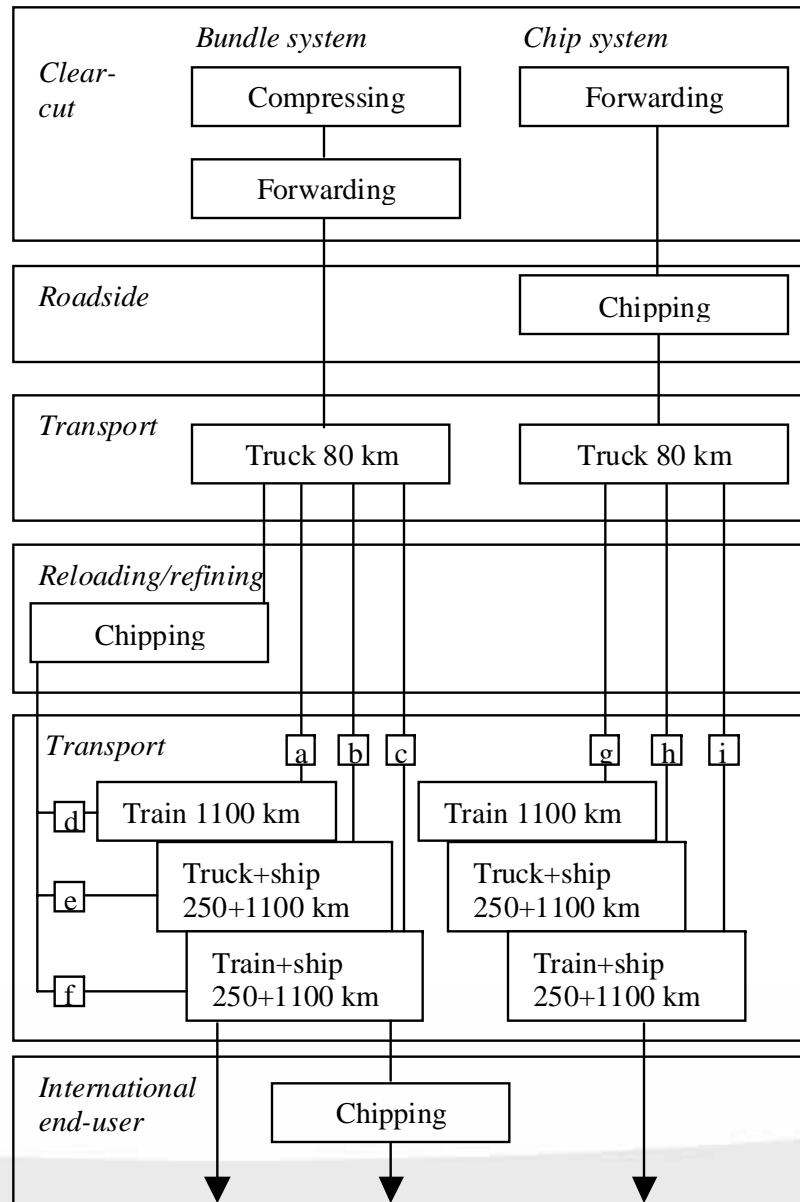


# National alternatives

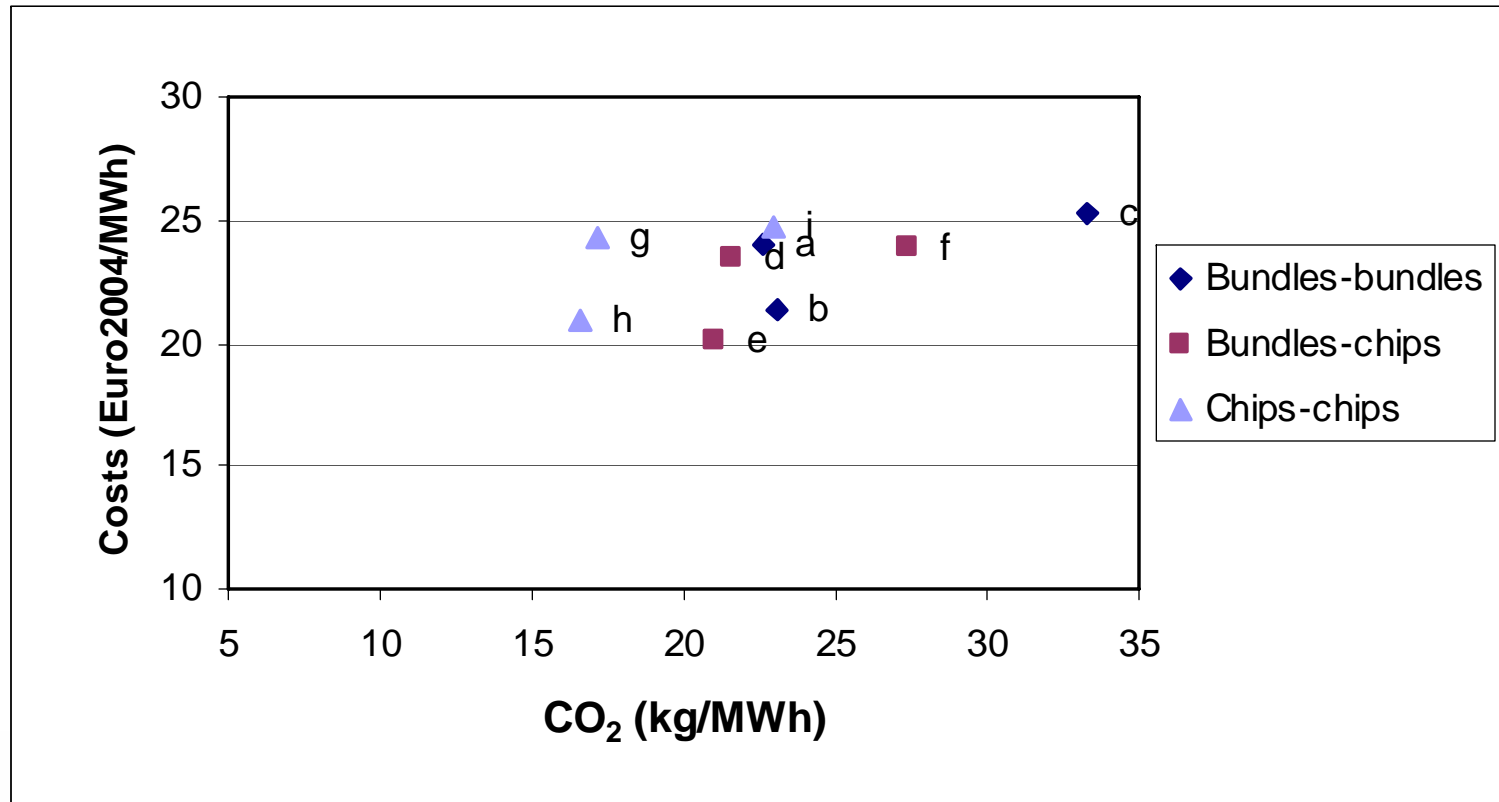




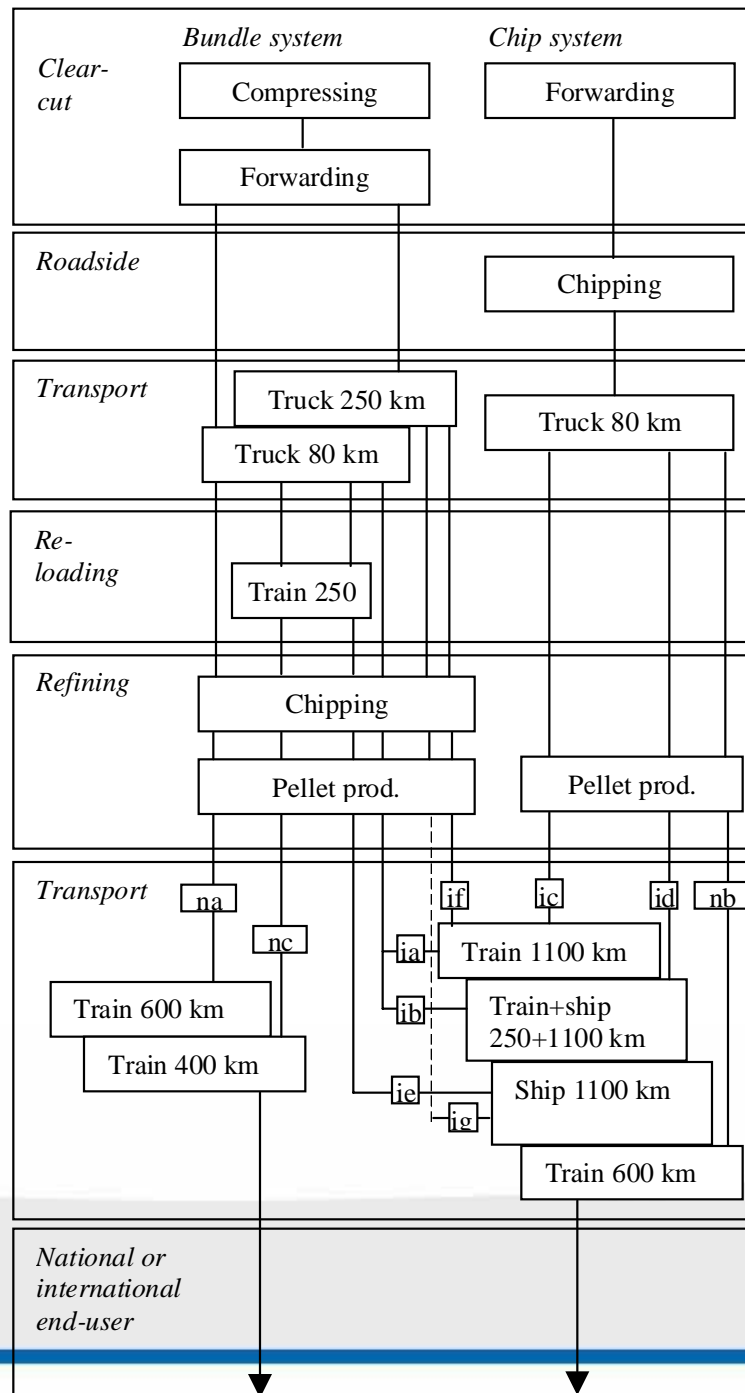
# International transportation chains



# International alternatives

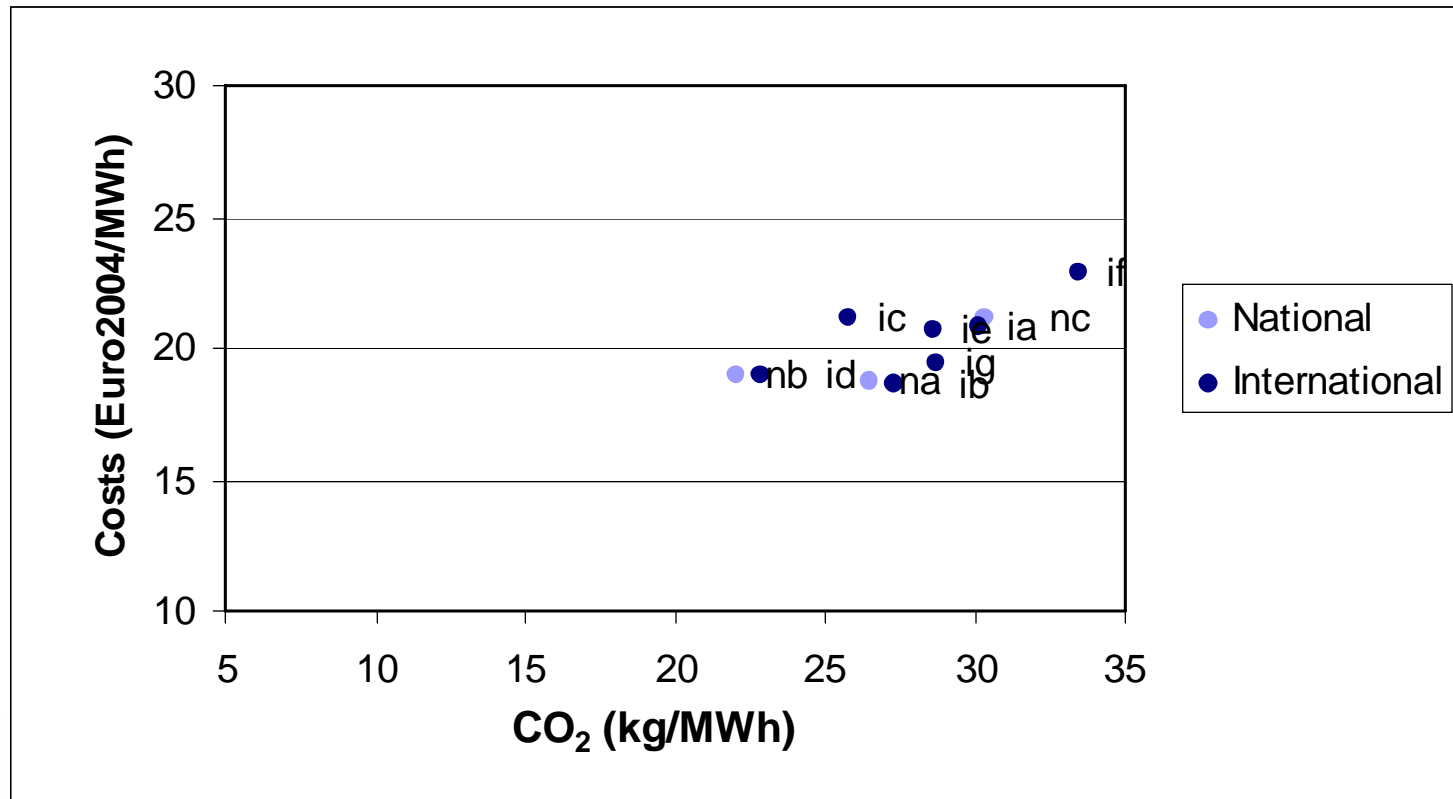


# Pellet alternatives (national or international)

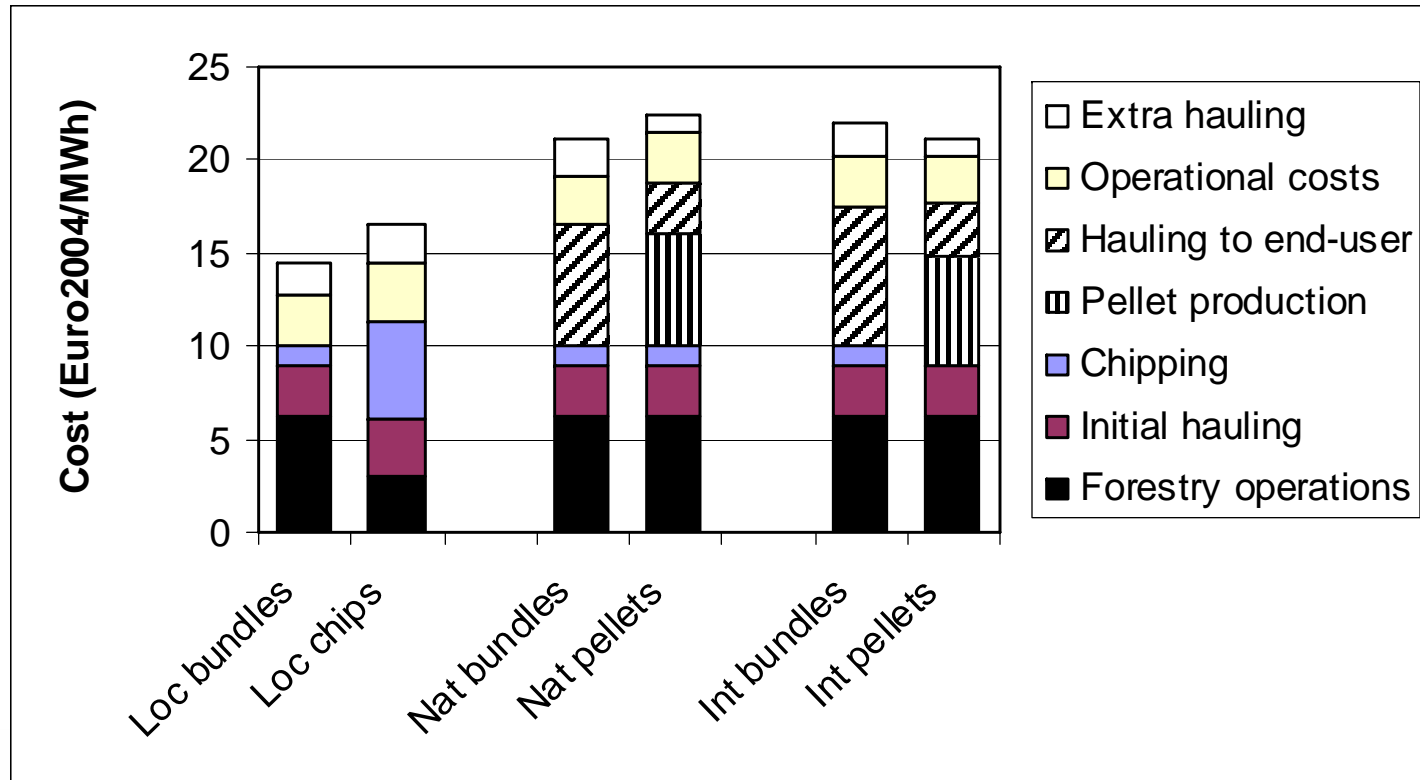


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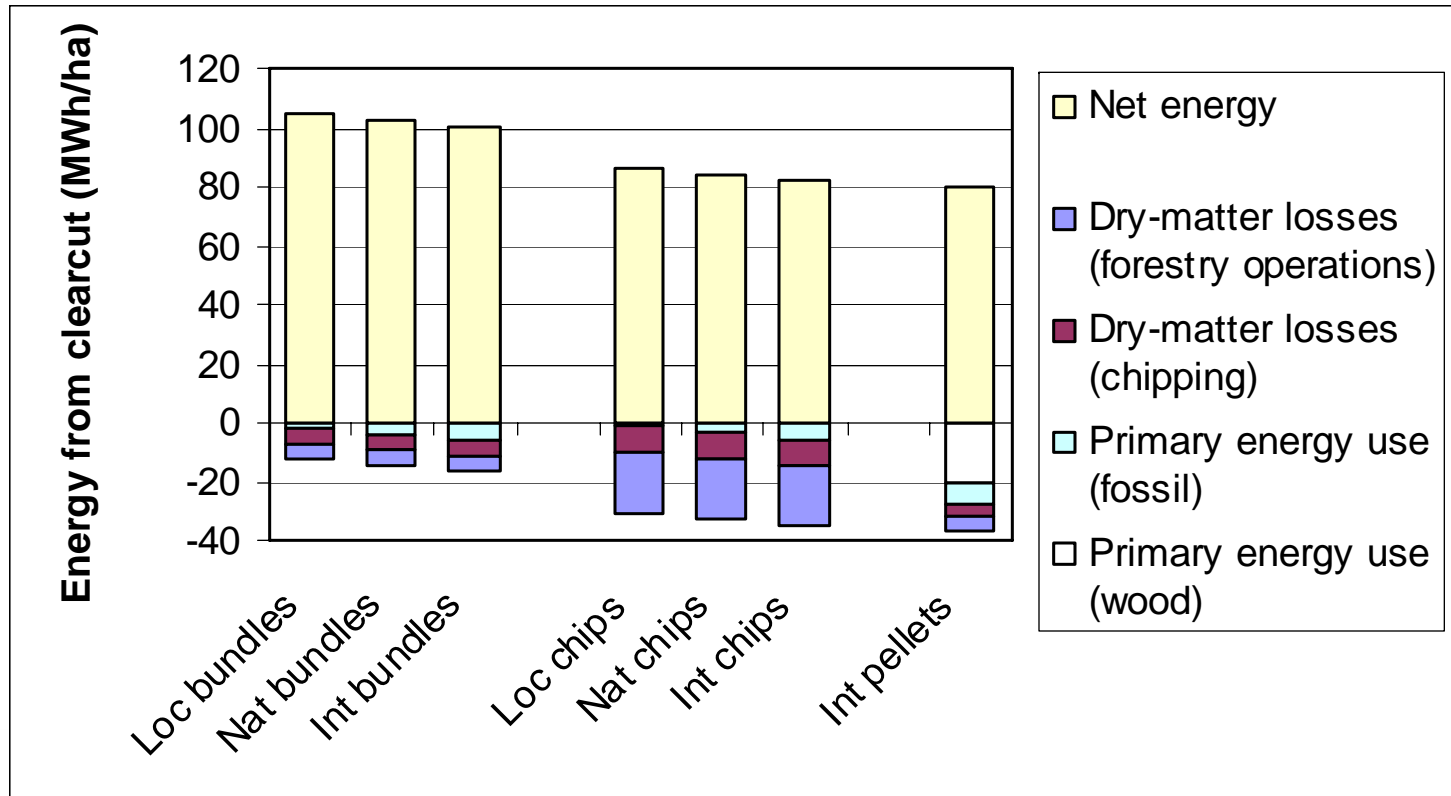
# Pellet alternatives



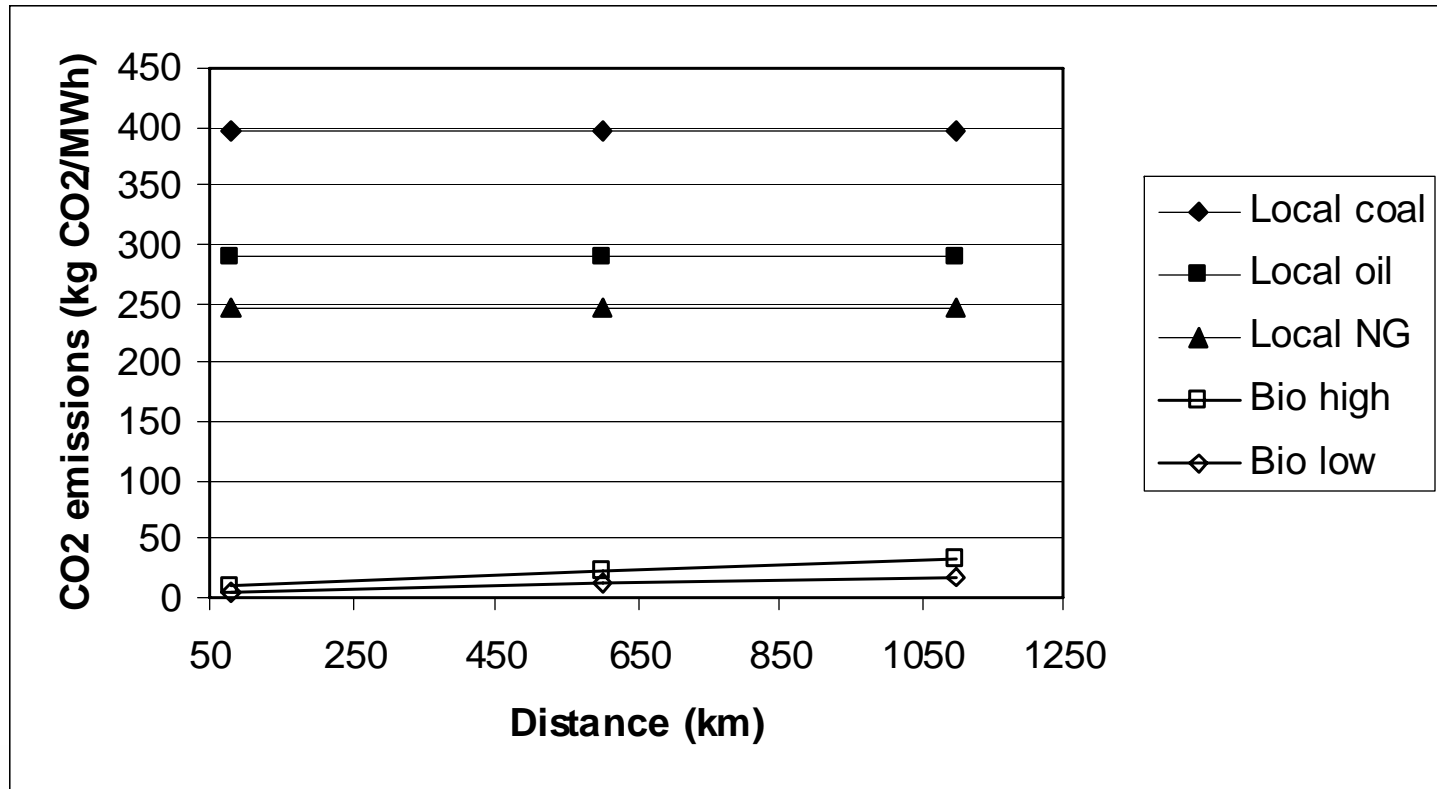
# Cost breakdown



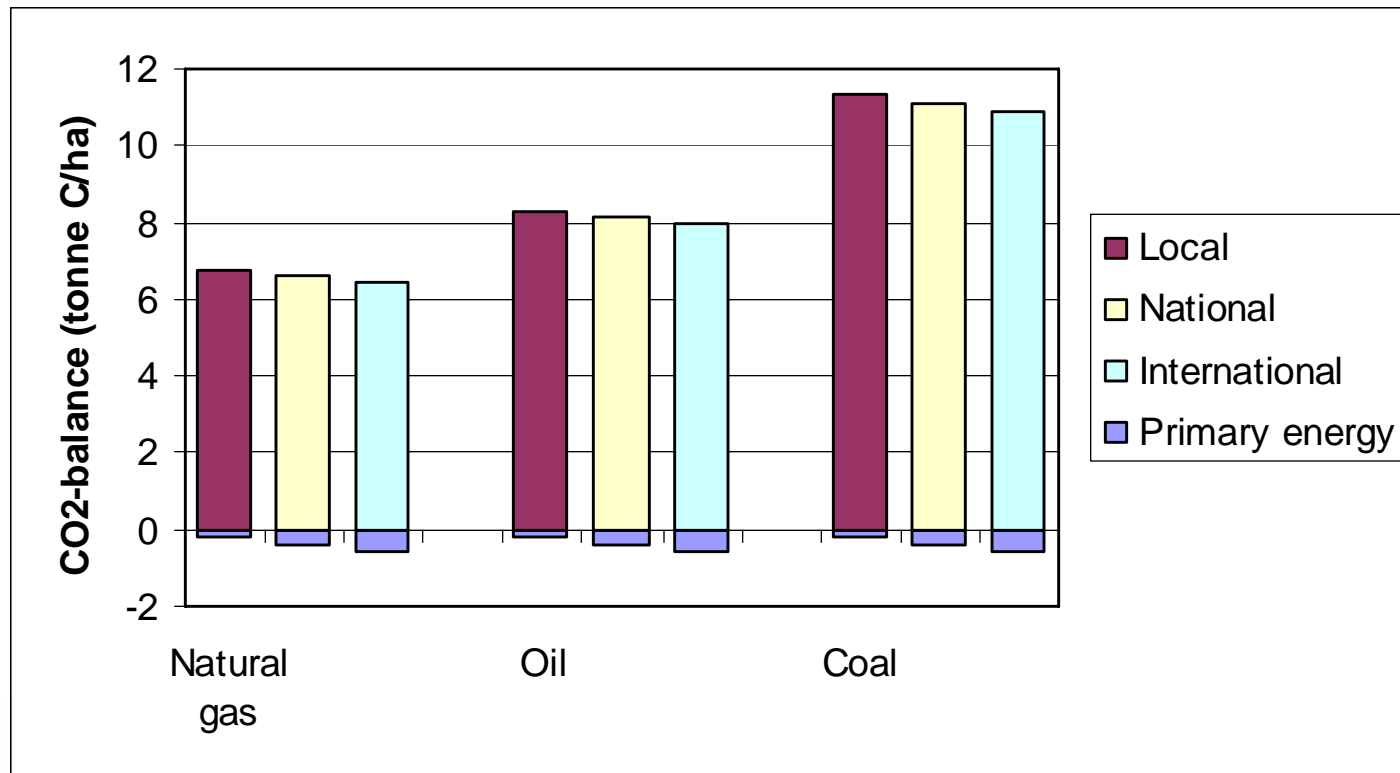
# Net recovery of biomass



# CO<sub>2</sub> emissions – Distance

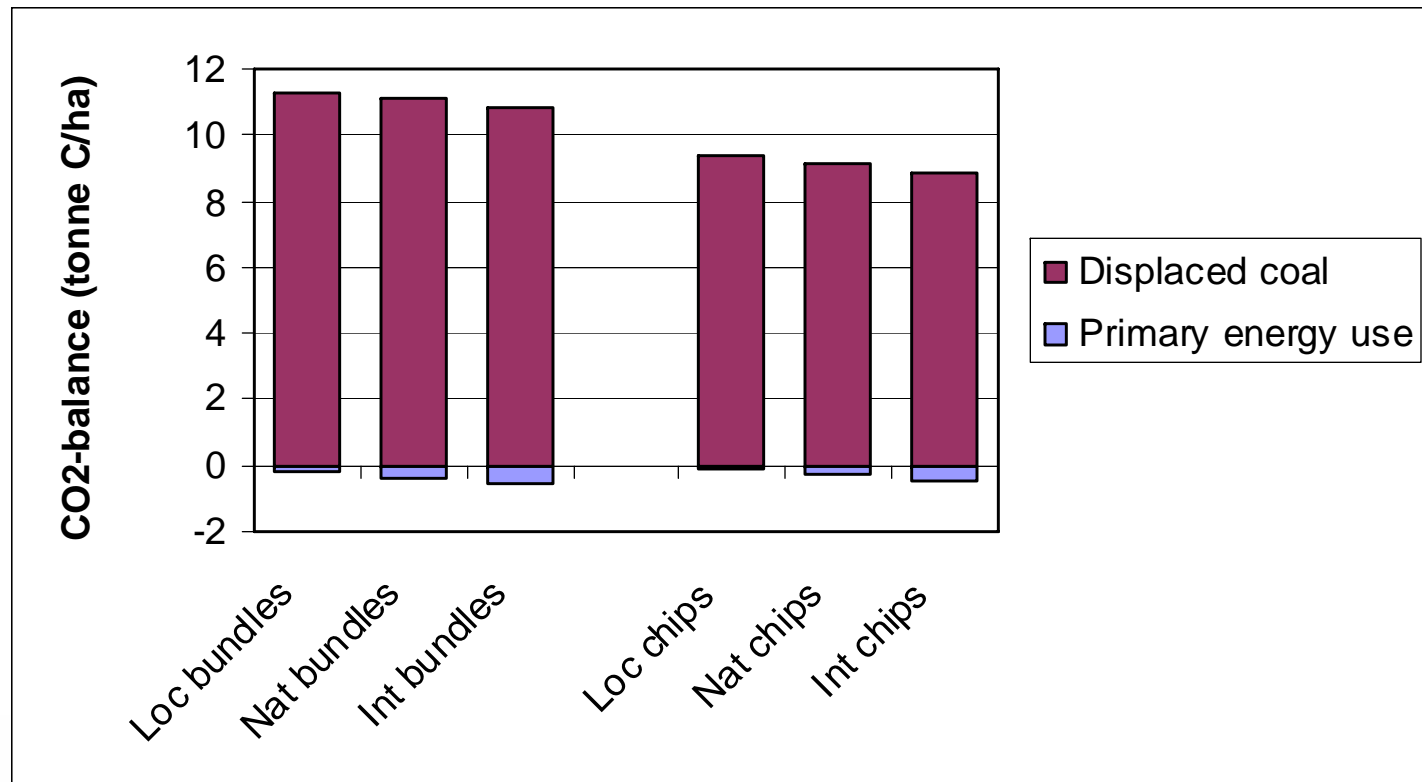


# CO<sub>2</sub>-balance – Different fossil fuels

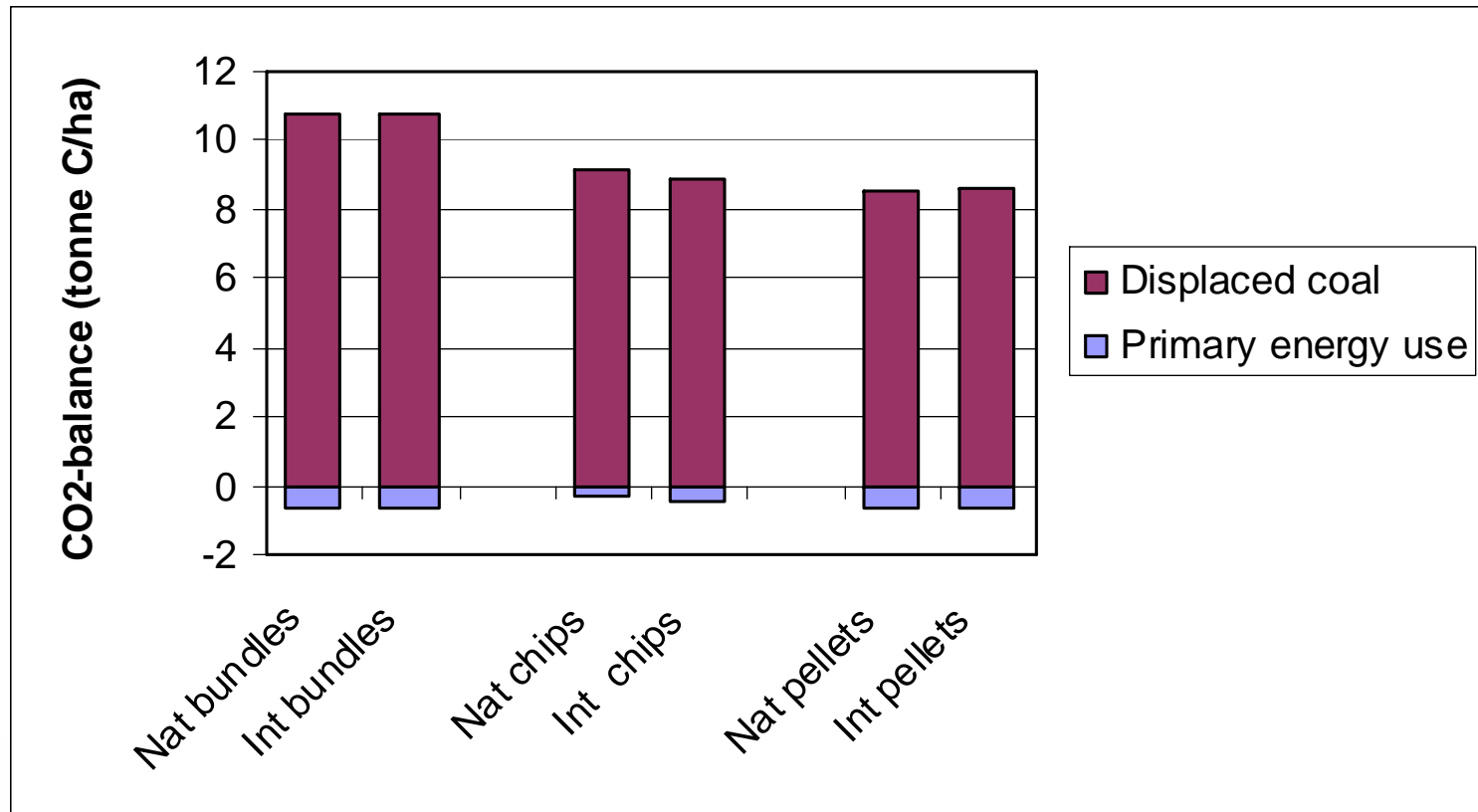




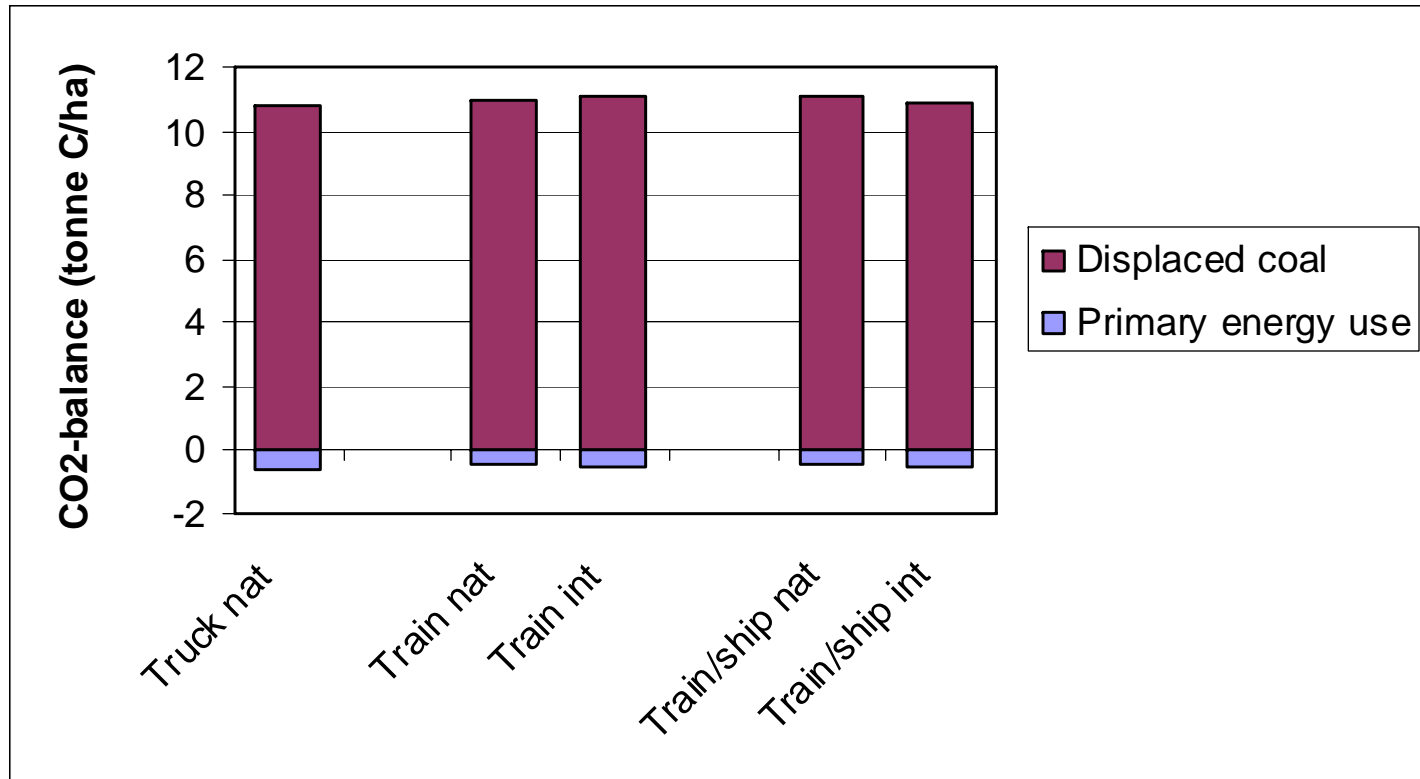
# CO<sub>2</sub>-balance – Different recovery systems



# CO<sub>2</sub>-balance – Different refined fuels



# CO<sub>2</sub>-balance – Different transportation systems



# Conclusions

- The percentage of primary energy for recovery, refining and transportation of forest residues is low.
- Transportation distance is of less importance for the CO<sub>2</sub> emissions per hectare than all other factors analysed here.
- Type of fossil fuel replaced is the most important factor analysed here.
- A bundle recovery system means that more biomass per hectare can be delivered to the end-user.
- A pellet system means that less biomass per hectare can be delivered to the end-user.
- The type of transportation system does not significantly influence the CO<sub>2</sub> emissions per hectare.
- The cost factor is important for long distance transportation of biomass.