Productivity and cost of harvesting short-rotation downy birch

Paula Jylhä

Dan Bergström

Content

I Background

II Material and methods

III Results

IV Conclusions

I Background

International climate policy

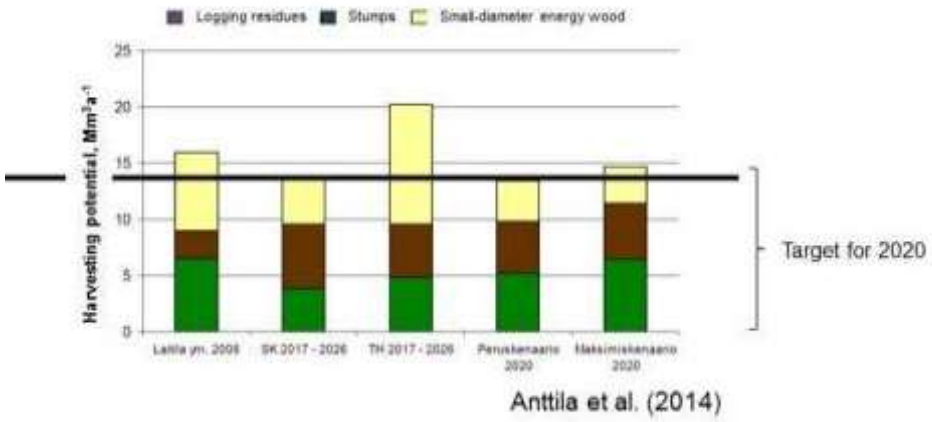
- 2030 Energy Strategy of the EU
  - A 40% cut in greenhouse gas emissions compared to 1990 levels
  - At least 27% share of renewable energy

→ demand of biofuels will increase

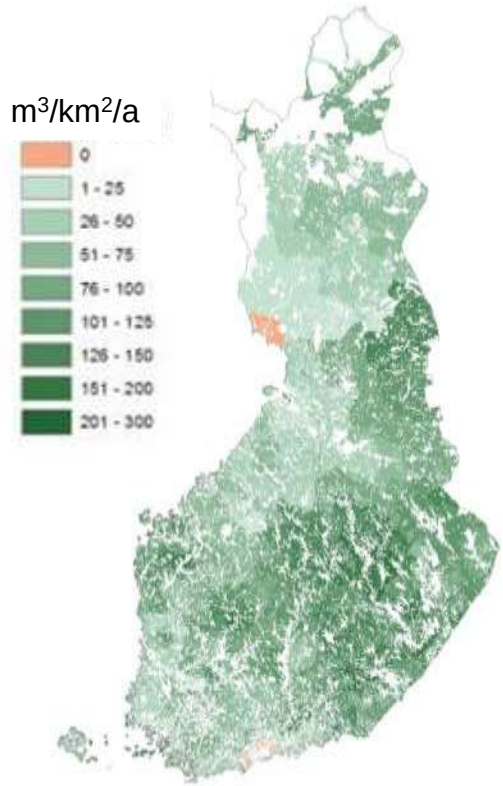
  - Availability?

Forest chip potential in Finland

National



Regional



Utilisation of marginal land?

- Case Hirvineva (Jylhä et al. 2015)
  - Downy birch (*Betula pubescens*) shows potential for profitable production of energy biomass on cutaway peatland without subsidies
  - Uncertainties in the calculations
    - Continuity of coppicing vigour
    - Biomass production of diverging management regimes
    - **Harvesting cost**
- Roadsides, field margins, power line corridors
- Coppice production

Harvesting technology in coppice production

- The trend of extending rotations in SRC
  - Quality of biomass
  - Harvesting cost
- Limitations of the SRC harvesters in natural thickets
  - Cutting capacity (max. 15 cm)
  - Lacking harvesting corridors
  - One-process operation → wet chips
  - Narrow field of application → risk to the owner

II Material and methods

Harvesting experiment

- Time study of cutting and forwarding at clear-cuts of naturally afforested downy birch thickes in a former peat production area (Hirvineva)
  - Conventional forest machines
- Regression models for productivity
- Cost calculations of forest chip production

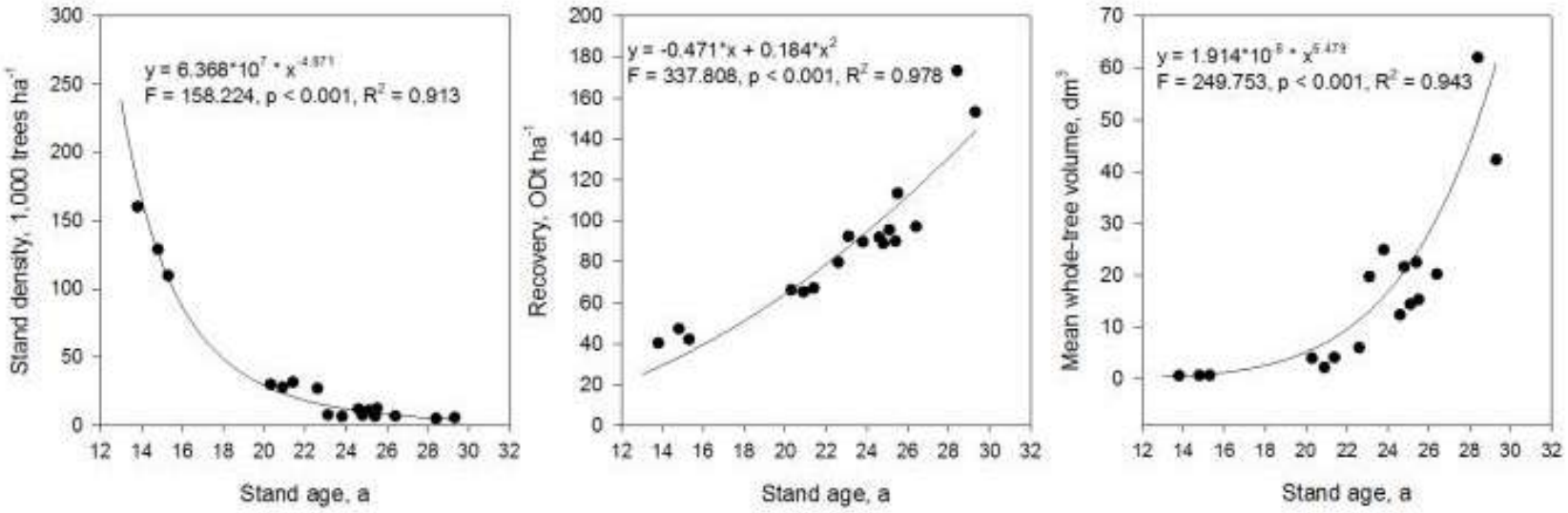
Cutting

- ***Valmet 911.3 (2006)***
- ***Bracke C16.b***
- ***17 harvesting units***

Forwarding

- ***Ponsse Buffalo (1998)***
- ***10 wheels***
- ***Heightened load space***
- ***Carrying capacity 14 t***
- ***26 loads from 14 harvesting units***
- ***Driving unloaded and loaded was excluded***

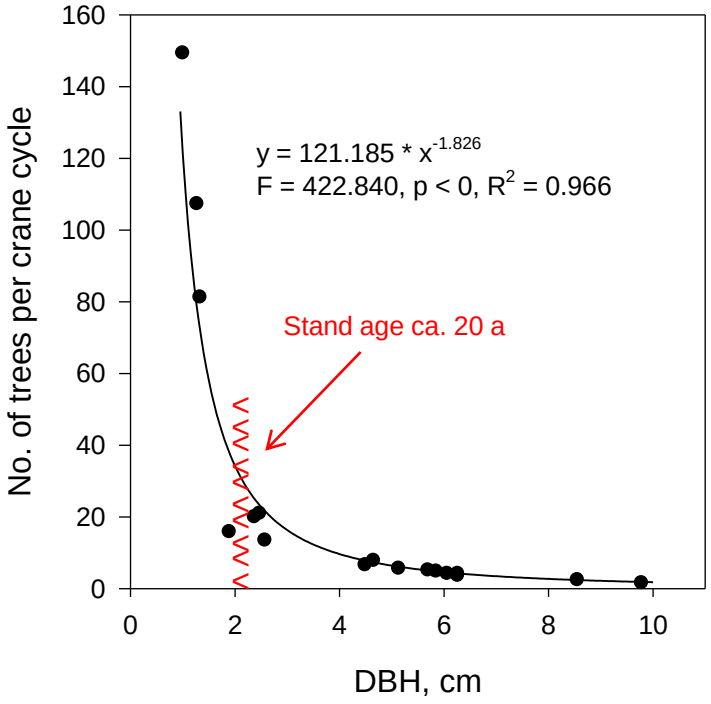
Stand properties

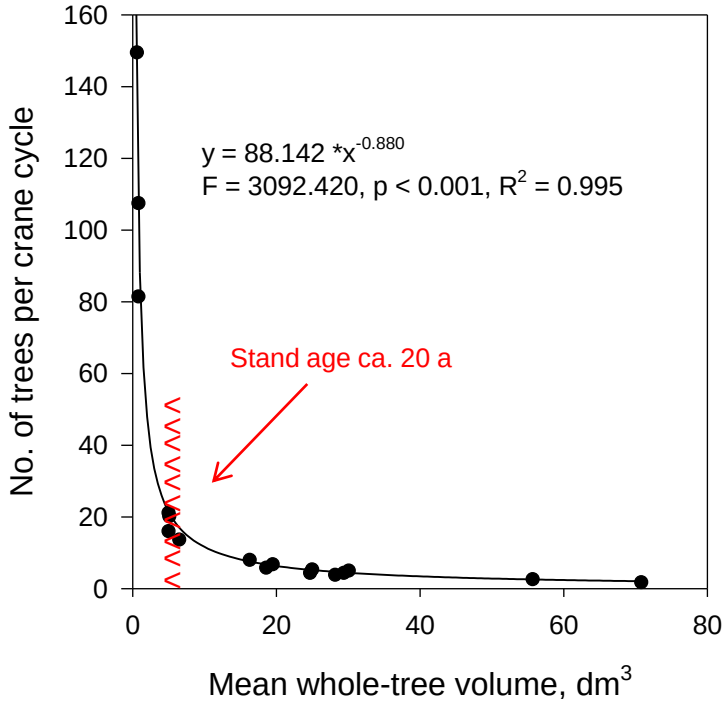


Even models with stand age as an independent value had high coefficients of determination (91% for cutting, 68% for loading time in forwarding)

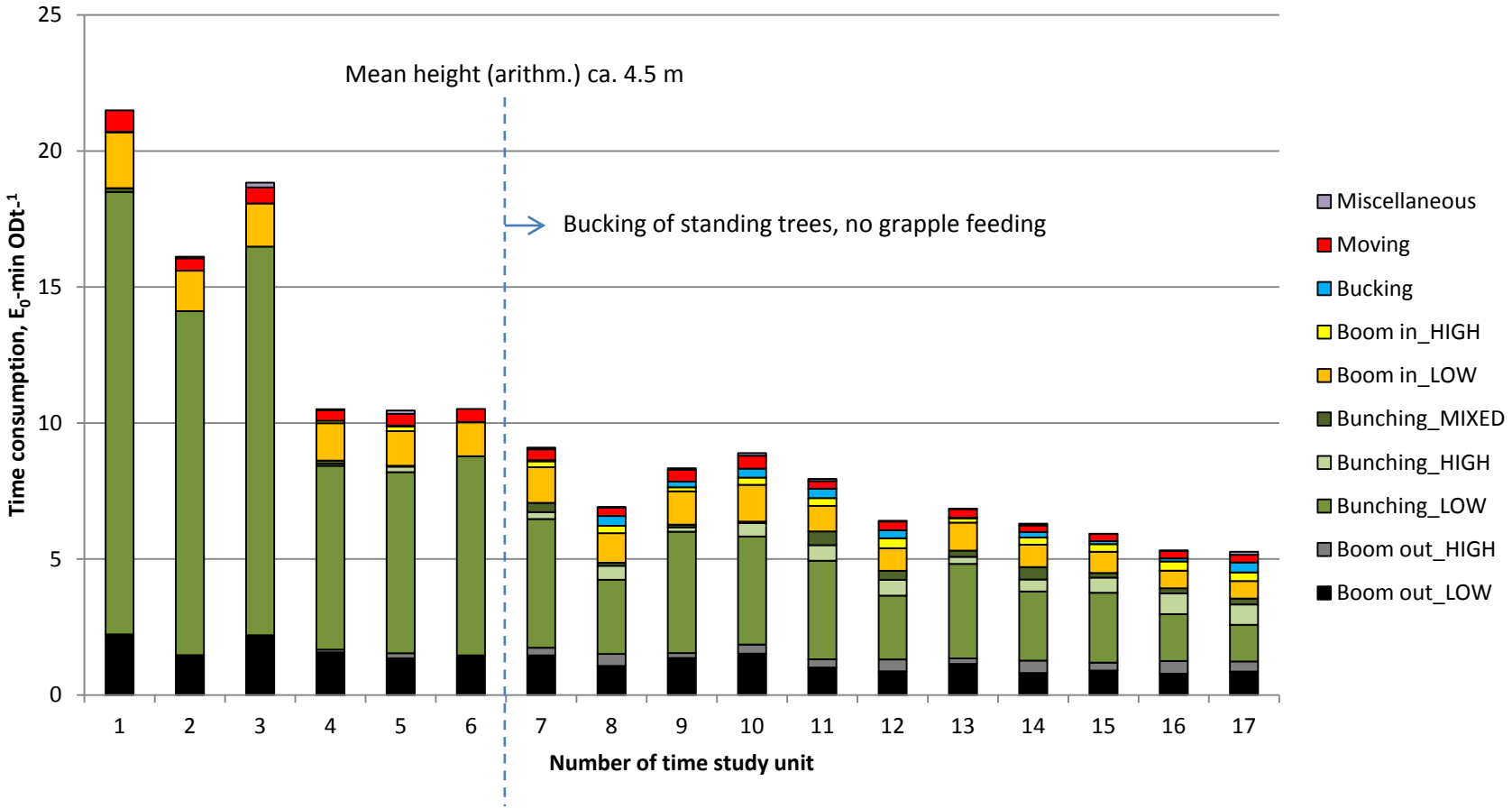
III Results

Multi-tree handling

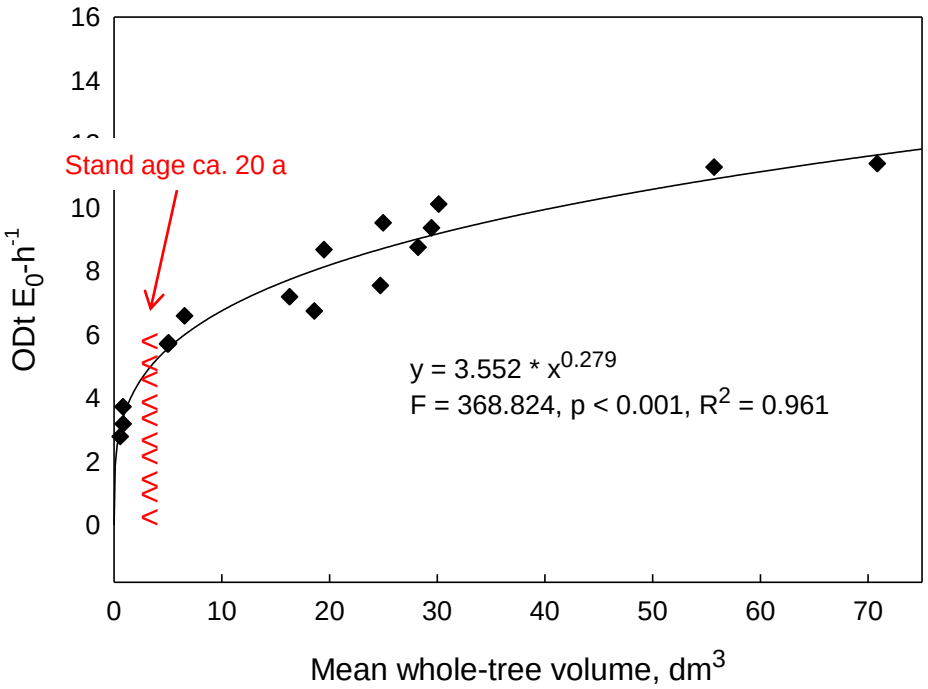




Division of effective time into elements / harvester



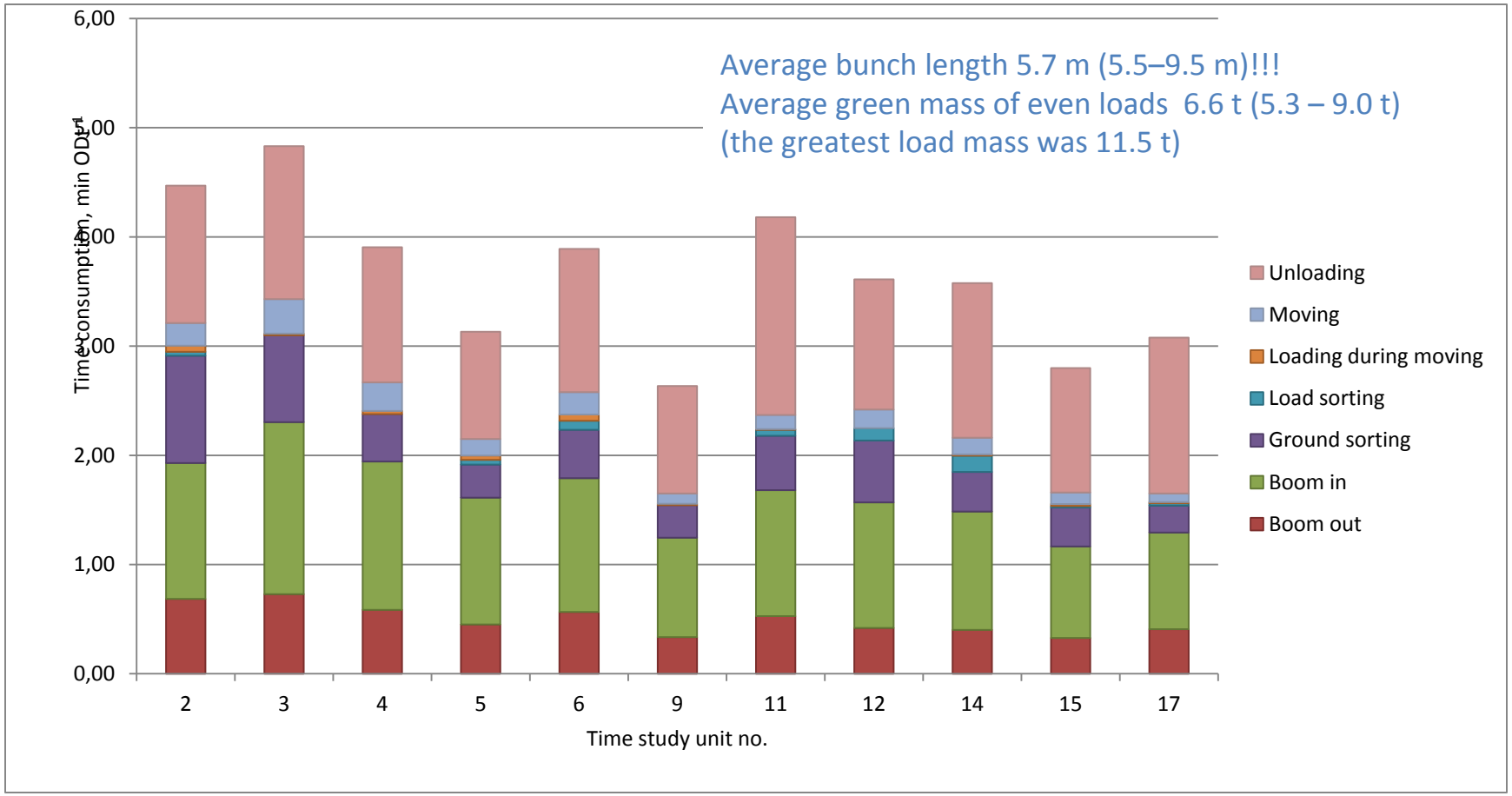
Cutting productivity



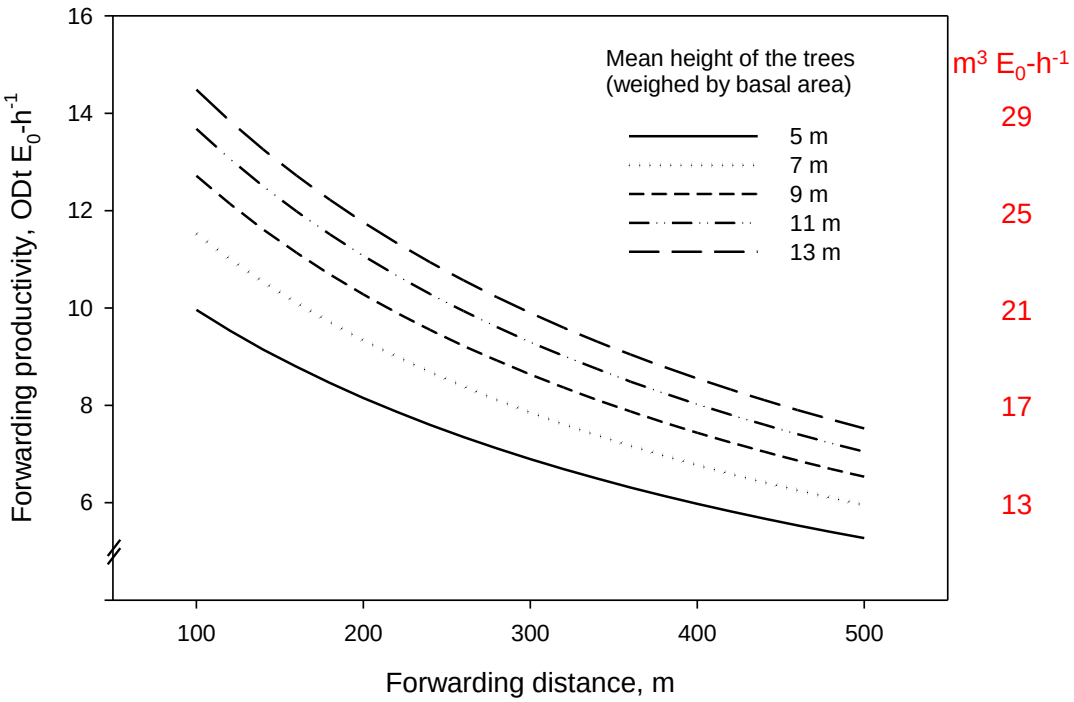
6–24 m^3/E_0-h

Residual biomass left on site after forwarding (3–8 t ha^{-1}, on average 7% removal) is not included in recovery.

Division of effective time into elements / forwareder



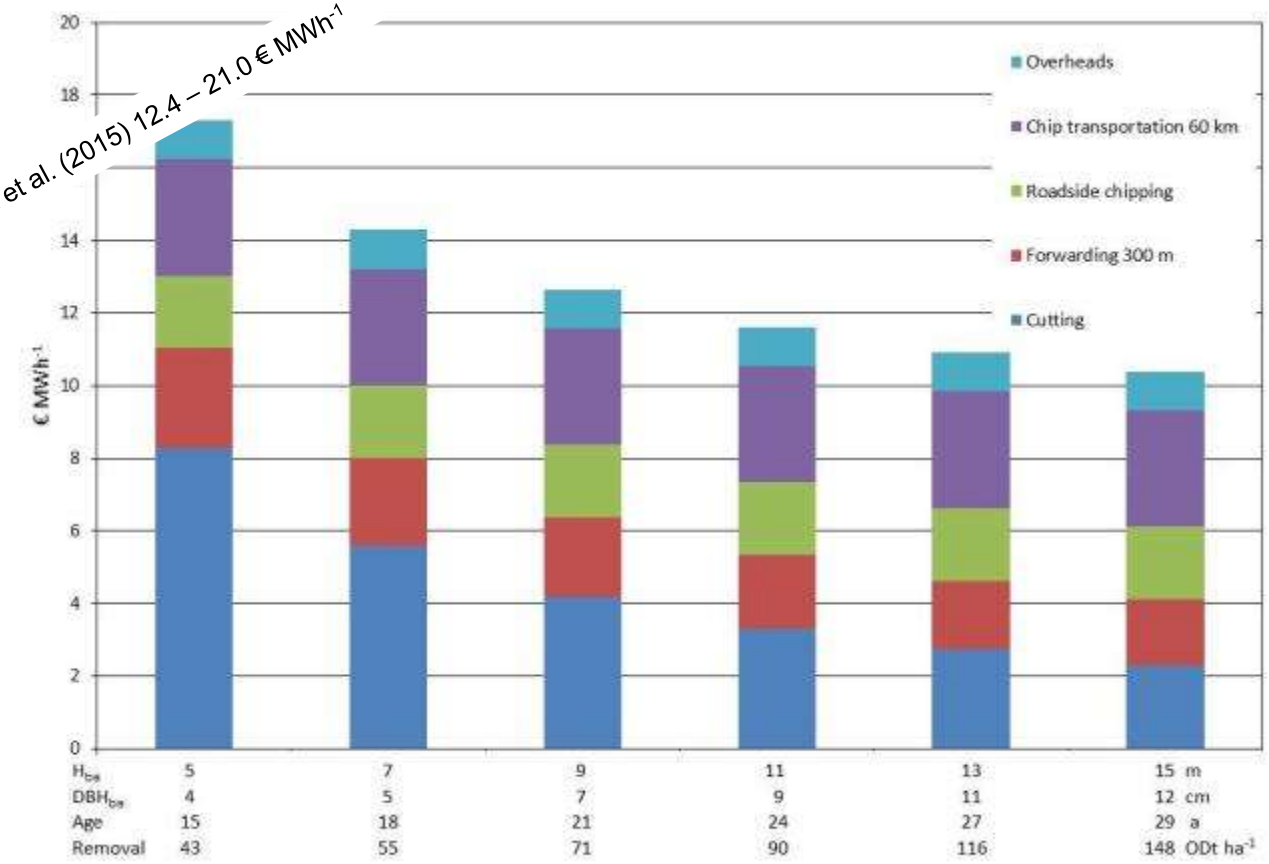
Productivity of forwarding



Ca. 25% higher productivity than assumed by Jylhä et al. (2015)

Production cost of forest chips

Assumption in Jylhä et al. (2015) 12.4 – 21.0 € MWh^{-1}

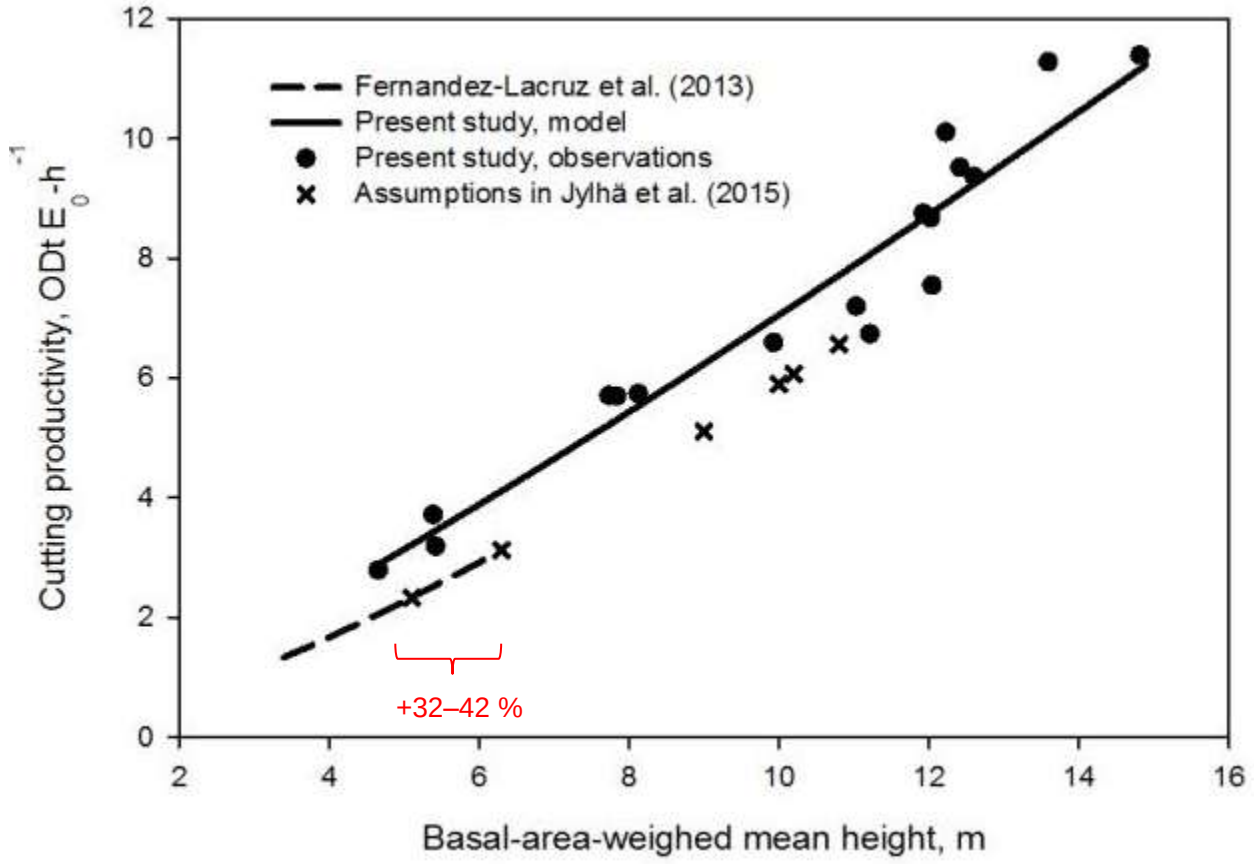


Moisture content on delivery 40 %

IV Conclusions

- Biomass can be harvested from dense downy birch thickets in cost-efficient way by clear-cuts
- In downy birch stands located in cutaway peat bogs in northern Finland, 20 years is a threshold age from the point of **a)** biomass production (Hytönen & Aro 2012), **b)** profitability (Jylhä et al. 2015) and **c)** cutting cost (present study)
- The operational cost in Jylhä et al. (2015) was underestimated by 10–20%
- The models are suitable for estimating the efficiency of harvesting small-diameter whole trees from **unthinned**, dense stands with comparable wood properties and biomass allocation of the trees

Comparison with Jylhä et al. (2015)



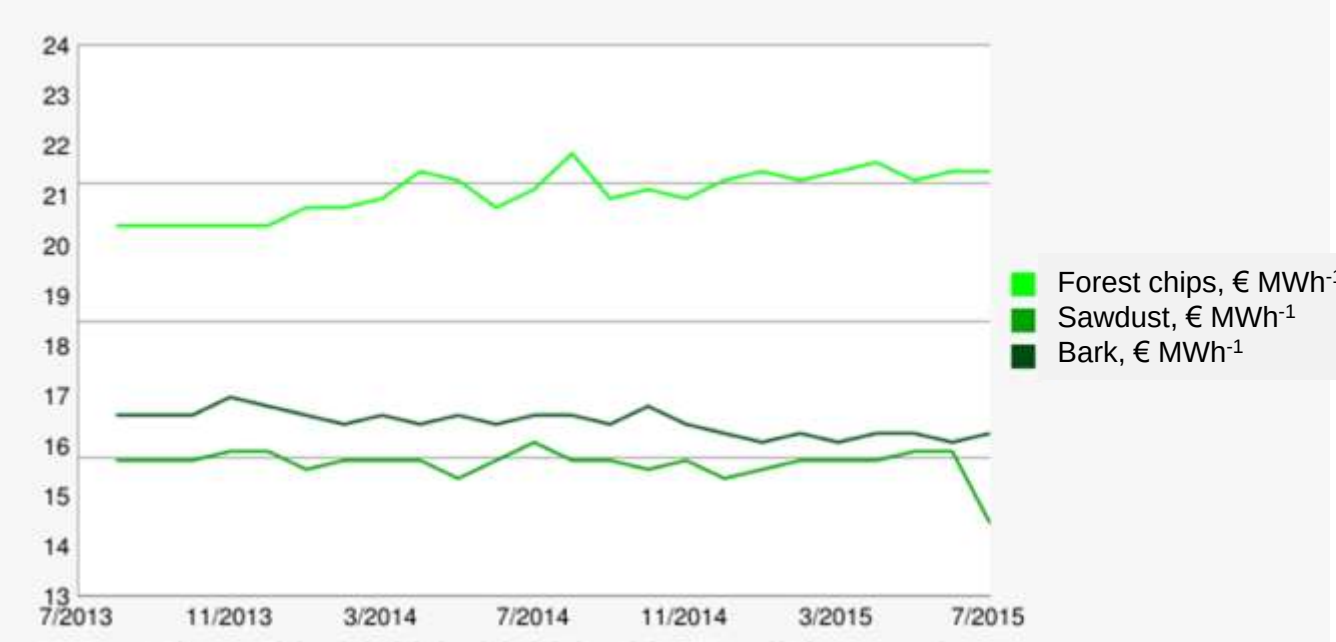
New cutting technology can lower the supply cost
- higher cutting speed, accumulation and bucking

Limitations of the clear-cut system

- Seasoning on leafless birch with intact bark?
- Potential soil damage on sites with poor bearing capacity (e.g. mires)

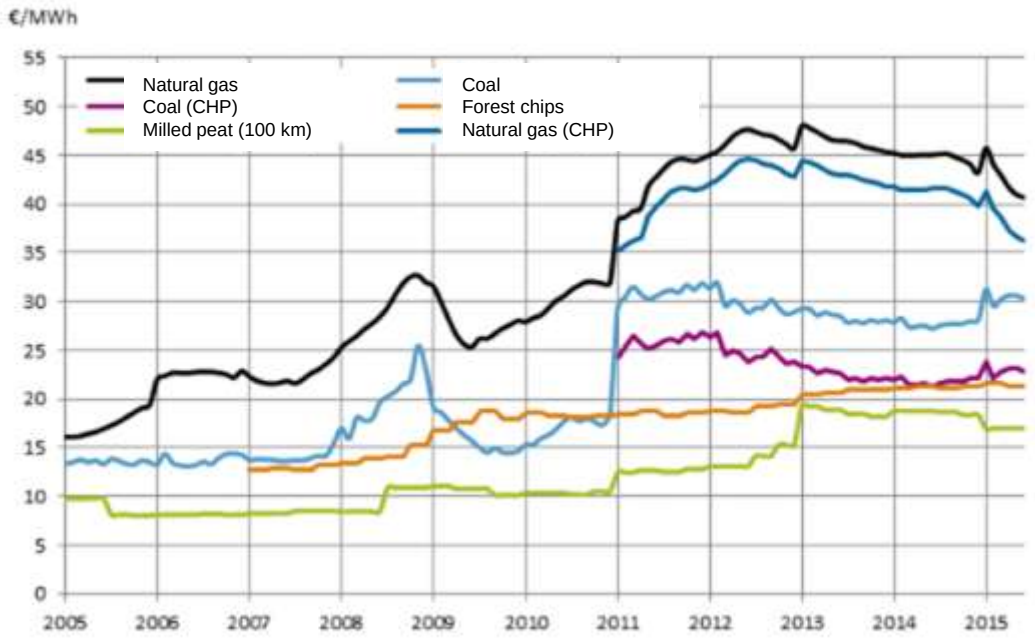
Price development of wood fuels in Finland

PIX Forest Biomass Index Finland / Foex Indexes Oy



→ Fuel chips made from clear-cut natural thickets or coppice stands are competitive without subsidies

Competitiveness of forest chips in heat generation in Finland



(Statistics Finland 2015)

Thank you!

Swedish Cluster of Forest Technology, Bracke Forest, Vapo Oyj and INFRES are acknowledged for supporting this project.