

COMPACT-CLASS FOREST MACHINES AS A TOOL FOR REDUCTION OF GREENHOUSE GAS EMISSIONS



Forest Operations in Response to Environmental
Challenges
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I E G U L D Ī J U M S T A V Ā N Ā K O T N Ē

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The **proportion of mechanized early thinning** grows continuously becoming the dominant harvesting technology.

Still the most common approach in selection of harvesting equipment in thinning is **adaptation of machinery originally used in commercial thinning** instead of utilization of the compact-class machines.

The **climate change mitigation targets in energy and transport sector** may become one of the key drivers for considerable changes in selection of harvesting technologies, particularly in early thinning.

The **fuel consumed in harvester and forwarder engine** and for relocation of the machine, as well as **productivity** are the **main factors affecting GHG emissions** in harvesting.

The aim of the study is to estimate **GHG and cost reduction potential in early thinning** by utilization of compact-class machines in comparison to conventional harvesting technologies.



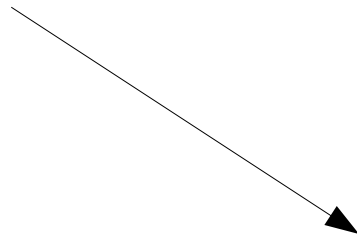
Choice of harvesting systems in thinning



Middle-class harvester



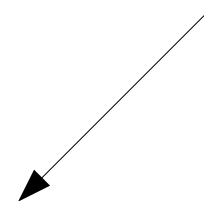
Middle-class forwarder



Compact-class harvester



Compact-class forwarder



Chipper



Road transport

Why compact-class forest machines?



Vimek 404 T5 harvester



Vimek 610 forwarder

Parameters	Values
Price: harvester + forwarder	Basic setup 180000 + 120000 = 300000 €
Forwarder load capacity	4-6 m ³
Fuel consumption	4-5 L per hour
Harvesting technologies	Cut to length or full tree harvesting, multi-stem handling
Harvester capacity	Trees with stump height diameter < 25 cm

Summary of the study results



Time studies



The average productivity:

- harvesting 6.5 m³ per productive hour;
- forwarding 10.8 m³ per productive hour.

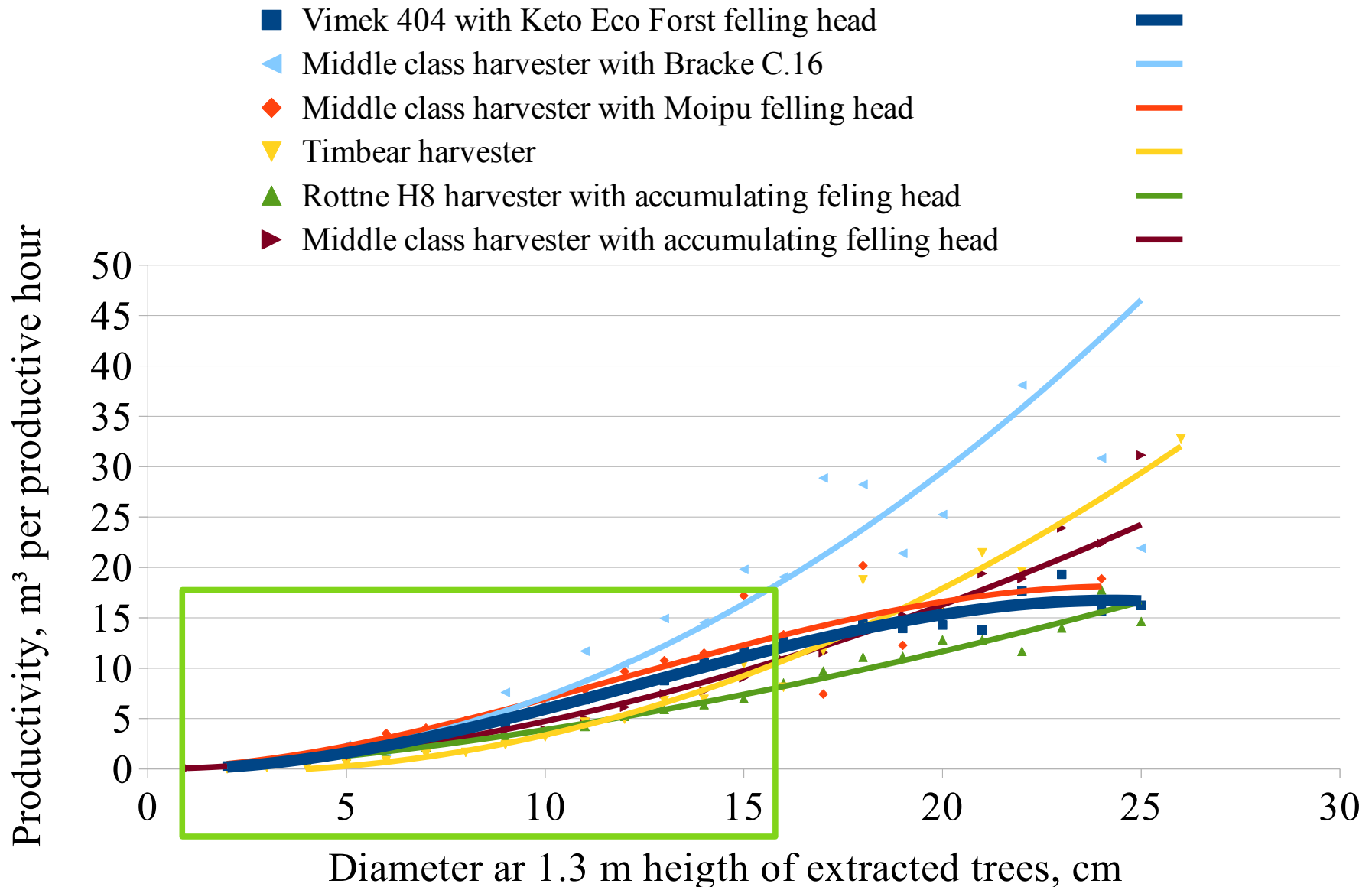
Fuel consumption



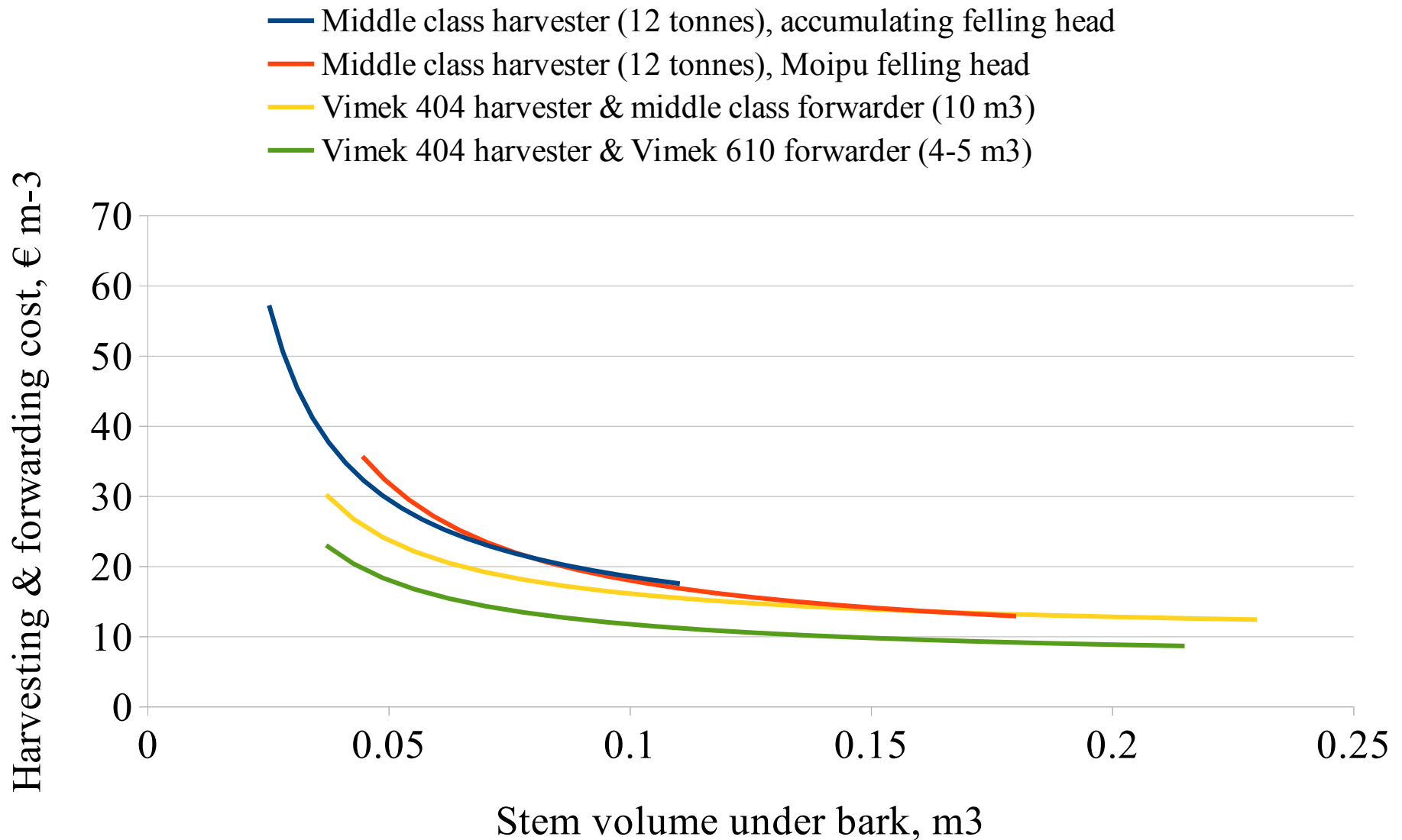
The average fuel consumption:

- harvesting 0.8 L per m³;
- forwarding 0.5 L per m³.

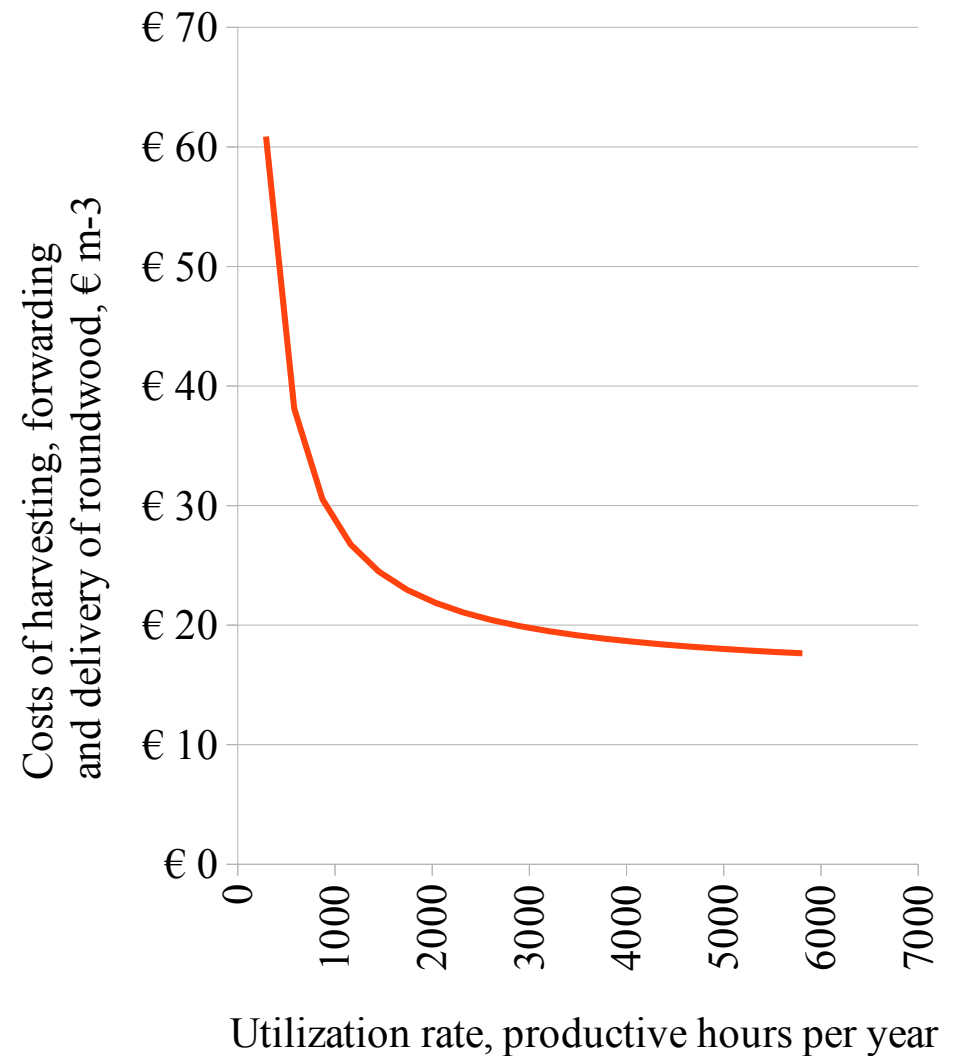
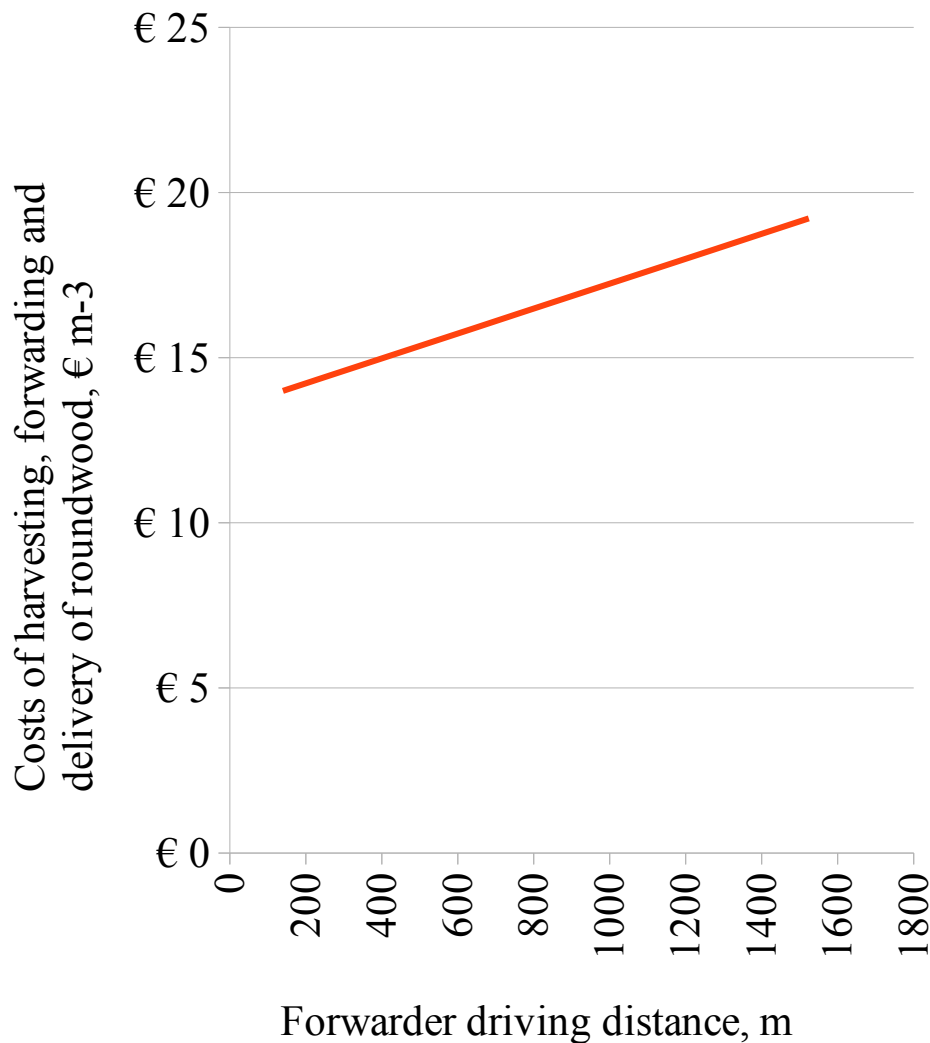
Comparison of harvester productivity in early thinning of coniferous stands



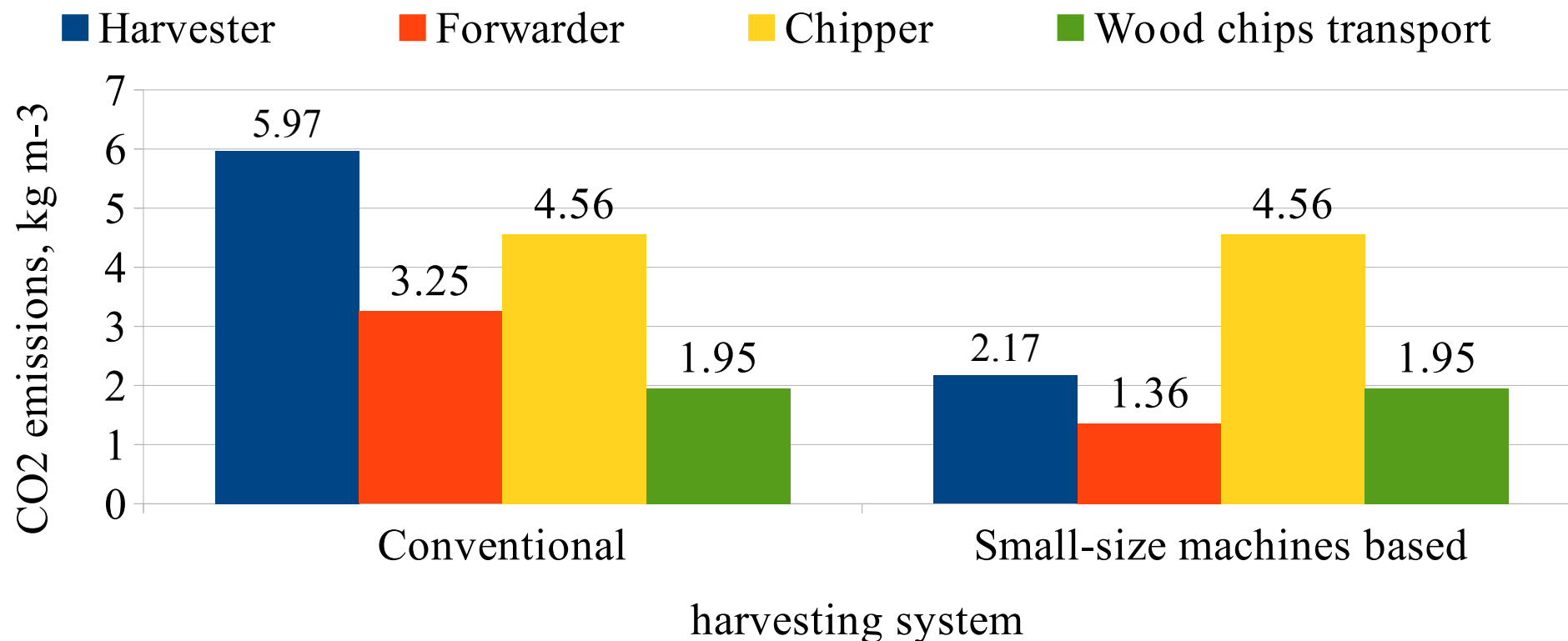
Comparison of cost of roundwood production in early thinning



Impact of driving distance and utilization rate on prime cost of roundwood



Comparison of amount of emissions in different harvesting systems



Total fuel consumption of conventional harvesting system
6.5 L per m³ (GHG emissions **15.7 kg CO₂ eq. per m³**).

Total fuel consumption of small-sized machines bases
harvesting system 4.7 L per m³ (GHG emissions
10.3 kg CO₂ eq. per m³).

Forwarding distance in forest – 145 m.
Forwarding distance from forest to
terminal – 50 km.

Potential savings of GHG emissions at a national scale



- Pre-commercial thinning (about 130 thousands m³ annually) – **700 tonnes CO₂ eq.** annually.
- Ditch cleaning (about 100 thousands m³ annually) – **540 tonnes CO₂ eq.** annually.
- Commercial thinning (about 1900 thousand m³ of biofuel annually) – up to **10.6 thousand tonnes CO₂ eq.** annually, depending from share of 1st thinning.
- Land cleaning, removal of undergrowth trees, final felling in grey alder stands – about **10 thousand tonnes CO₂ eq.**
- In total – **up to 10% of the GHG emissions** created by forest machines today.

Conclusions (1)

- Vimek 404 T5 based system is more efficient than conventional harvester based system in **pre-commercial and the 1st thinning**, as well as in **final felling** of grey alder stands (if $D_{1.3} < 20$ cm) and **land cleaning operations** (ditches, abandoned farmlands).
- Prime cost of Vimek 404 T5 harvester working hour in Latvia is by **34 € smaller** than of a middle-class harvester.
- Harvesting costs are heavily affected by **utilization rate** of the machines, which is the main challenge in implementation of this technology in an industrial scale.

Conclusions (2)

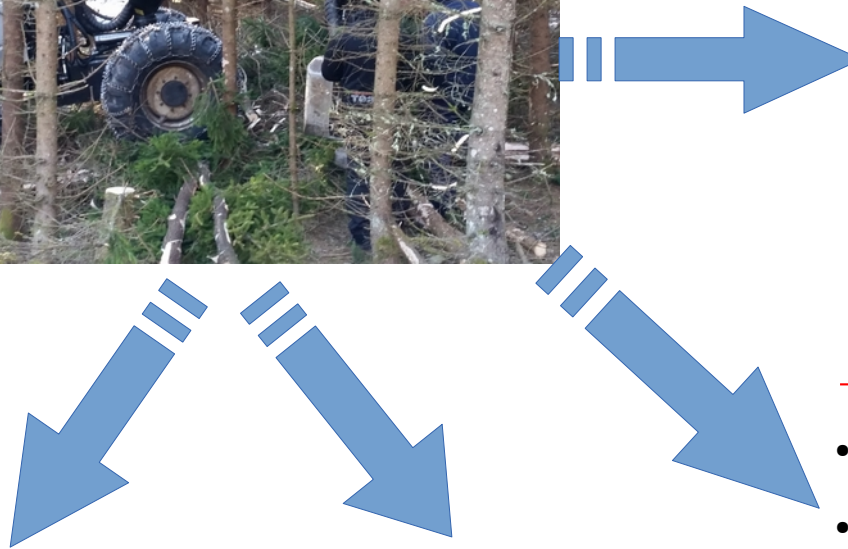


- The technology is very competitive; however, the approach in **planning of utilization of forest machines** needs to be improved.
- Operators of forest machines needs **broader knowledge on forest management** to use these machines efficiently.
- If using mall-sized harvester and forwarder in thinning, **fuel consumption and GHG emissions decreases by 27% and 36%** accordingly.

Integrated approach for compact-class forest machines



Thinning



Digging and cleaning of ditches



Early tending

- +
 - *Soil scarification.*
 - *Sowing (in pine & birch stands).*
 - *Sanitary thinning.*
 - *Cleaning of abandoned lands.*
 - *Spreading of wood ash and fertilizers (forwarder).*

