

# Evaluation of advanced solutions for wood transportation by road

## *a simulation approach*

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Leverage from  
the EU  
2014–2020



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# Road transportation reforms in Finland

## New truck dimensions (since 2013)

Gross weight: **76 t** (earlier 60 t)

Maximum length / height: **25.25 m / 4.4 m**

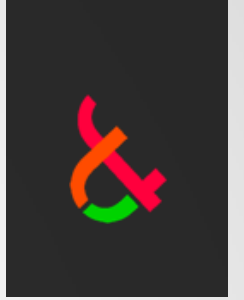
## High-capacity transportation (**HCT**) by truck

i.e. trucks heavier than 76 t and/or longer than 25.25 m

permissions to operate on specific routes between terminals



# Impact assessment of new road transportation methods



Economic impacts, environmental impacts, traffic safety impacts...

New truck dimensions

- Empirical data collection, static analyses

High-capacity transportation (HCT)

- Empirical data collection, static analyses
- **Simulation studies**





Source: Finnish Transport Safety Agency ([www.trafi.fi/hct](http://www.trafi.fi/hct))

# Why simulation studies?

**HCT** requires a network of permitted routes, i.e. “**corridors**”

- At present, HCT is limited to **certain routes**, but the network could be extended in the future if experiences are positive
  - In wood transportation, **weight** is the critical factor
  - Operation on the future corridor network cannot be demonstrated in real world, but it can be simulated

Roundwood-HCT usually includes a **transshipment** in a terminal between the roadside storage and the mill

- HCT is dependent on the efficiency of the remaining wood supply system (and vice-versa)
- Assessment of the profitability should not be based only on the operation of a HCT truck but the whole system

**HCT routes**  
as of August 2016



# HCT transshipment terminal

- Regular trucks feed the terminal from forest roads
  - Fast collection at roadside, no sorting of timber needed
- Transshipment directly onto HCT truck or to a pile
  - Different handling and storing solutions
  - No need for large storage facilities; in the fastest rotation the pile is needed only to complete the HCT load when the forest truck has been unloaded
  - In practice, a sufficient buffer storage is needed because of the risk of system overheating
- Final delivery to the mill by HCT truck
  - HCT truck has been built for highways
  - Lighter structures, longer service life, less cost/ton/km
  - 160 km one-way distance can be economically critical because of driving legislation (mandatory breaks)

Photos: Esa Hirvonen



HCT: 100 - 200 km

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# Case study: Pulpwood transportation in Southeastern Finland

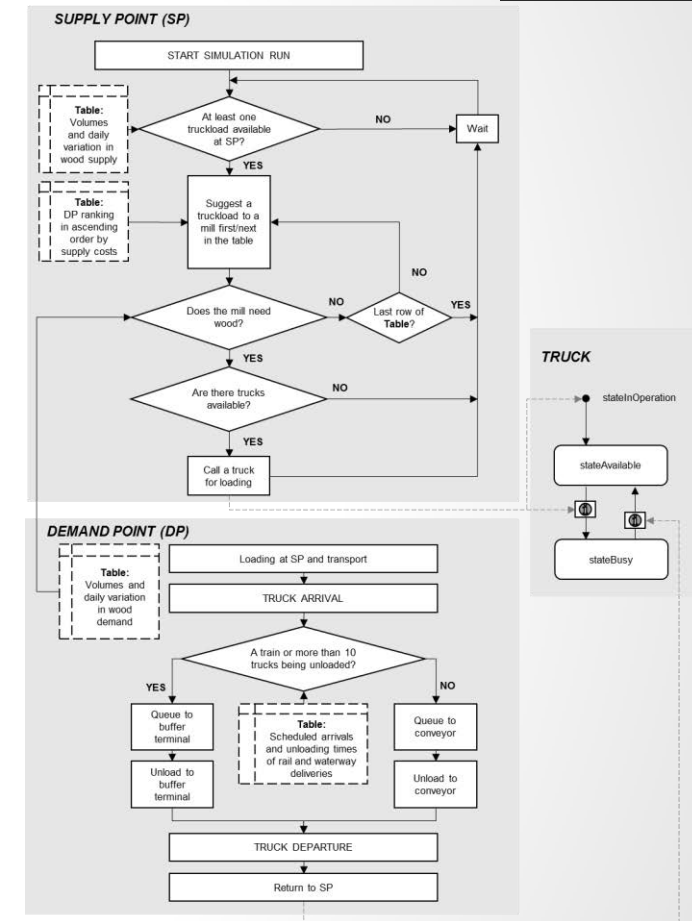
- 7 mills consuming 15 mill. m<sup>3</sup><sub>OB</sub>/a of pulpwood
- Net importer of roundwood from other regions and abroad (hardwood mainly from Russia)
- Some assortments need to be delivered by truck also from remote areas
- **Purpose of the study:** to compare the outputs from simulation runs carried out in
  1. A system representing existing pulpwood transportation
  2. A system including also HCT corridors






# Principles of operation

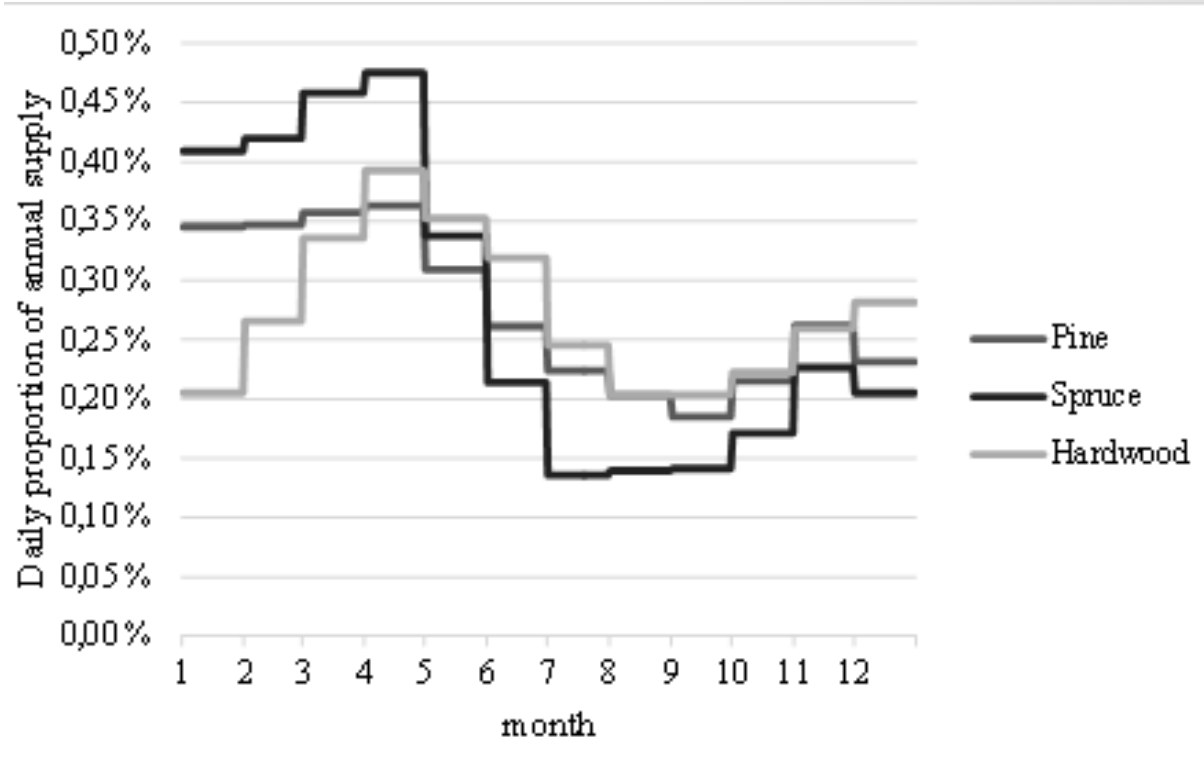
- Entity in the model = 1 ton of wood (pine, spruce or hardwood)
- Supply points (roadside storages) offer entities to demand points (mills)
- Demand points accept or reject offers
  - Decision is based on storage situation
- Supply points send trucks to demand points according to predefined rules
- HCT terminals are like demand points when supply points offer entities and like supply points when they offer entities to demand points





# Source data...

- **Demand**
  - **Annual volumes** converted to transported tonnes
  - **Temporal variation** stable at pulp mills
- **Supply**
  - **Annual volumes:** estimated pulpwood availability per municipality disaggregated to a geographical grid (5 km × 5 km supply point network)
  - **Temporal variation** 
- **Transport network**
  - A GIS dataset of road network traversable for roundwood trucks







## ...more source data

- Annual volumes of wood delivered by **rail and waterways**
- **Timetables/probability distributions** for train and vessel arrivals
  - Deliveries fulfil the mills' demand for their part, and increase storage levels
  - Trains reserve unloading capacity at mills, affecting the truck transport system
- Several data sources defining e.g. time consumption and restricting factors in transportation



Pulpwood system  
SE Finland

Top level agent

Number of trucks idle

green supply points = wood a

Wood storage at mills

A train being unloaded

Truck fleet definitions

A train and a vessel being unloaded

Boring...

Wood available at roadside

Unfulfilled demand at mills (accumulated)

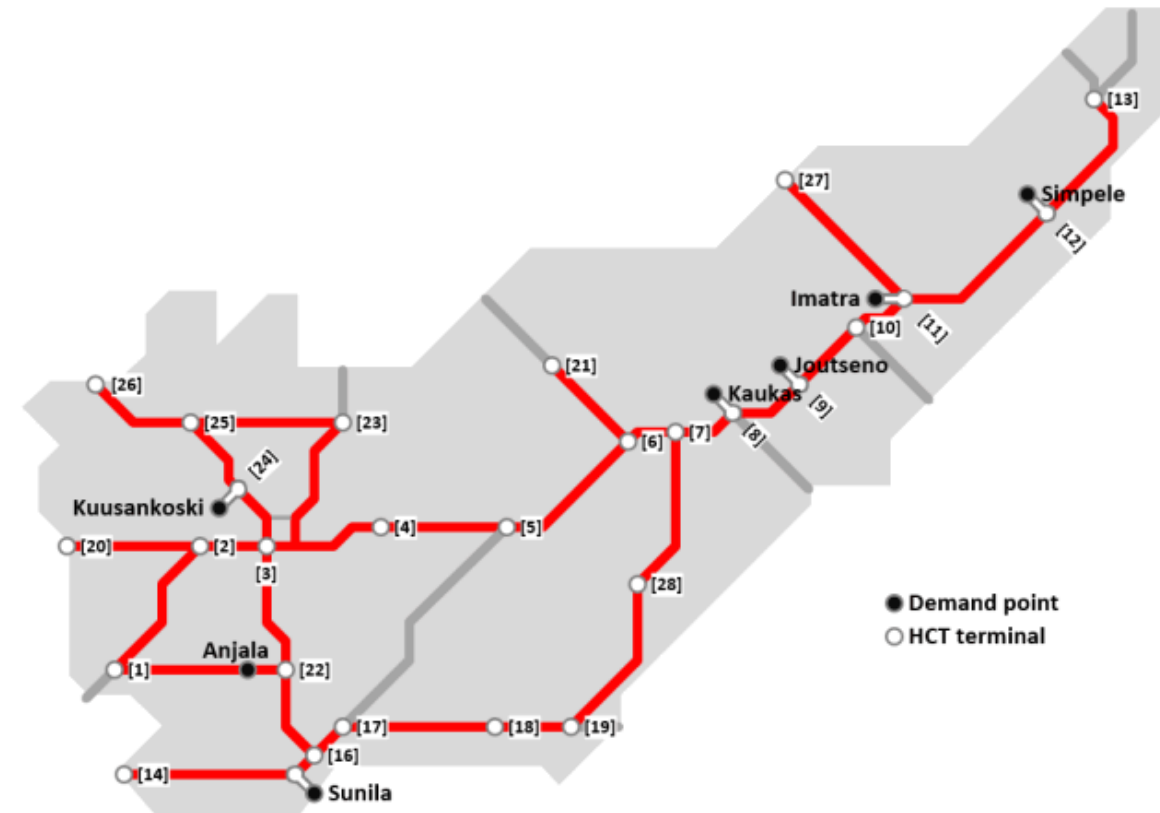
Simulation run with no HCT

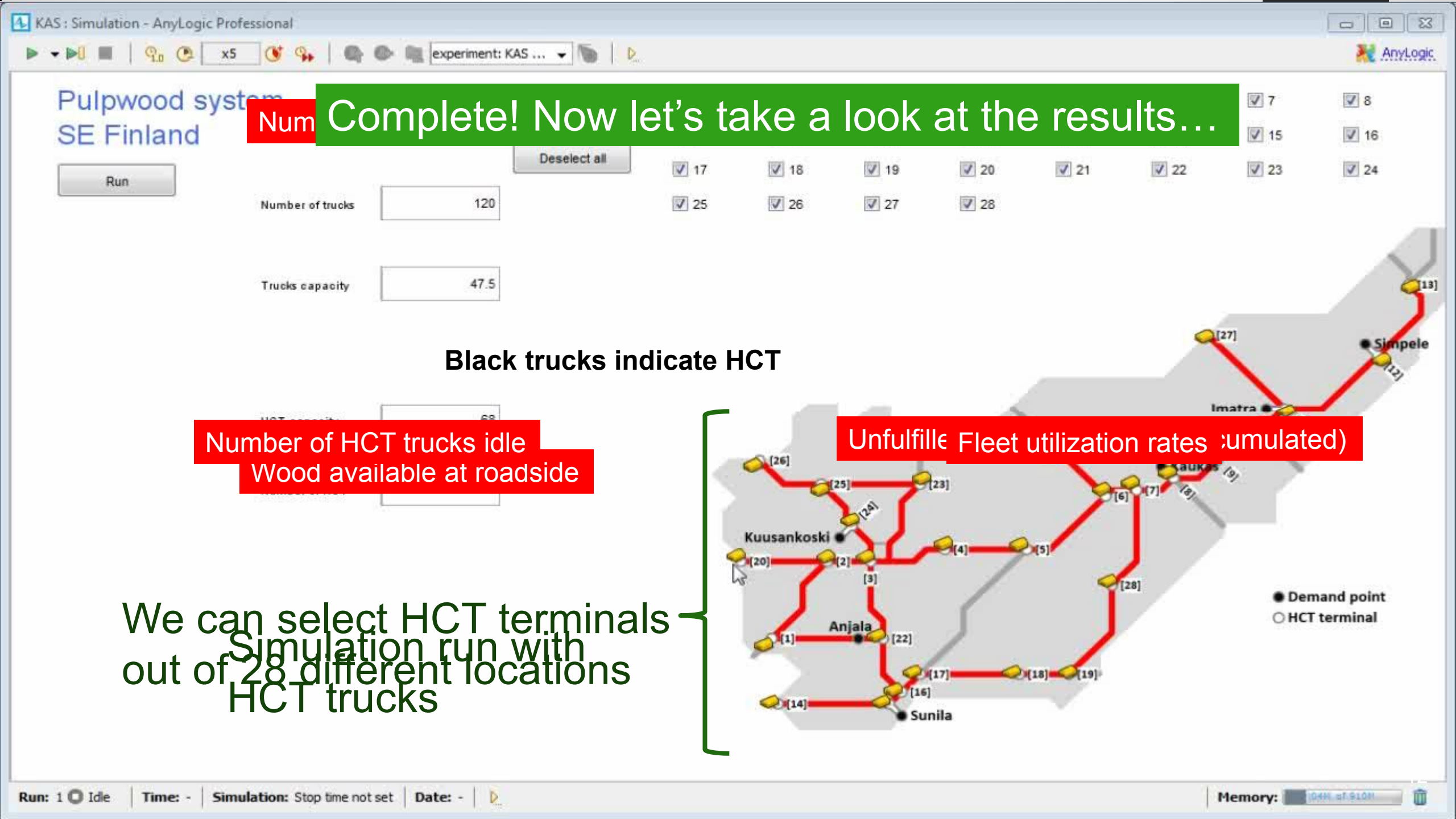
Supply points  
Border points  
Pulp mills

# Next: similar run with HCT corridors and terminals



- 120 trucks → 100 trucks + 10 HCT-trucks
  - Total transport capacity 5700 t → 5430 t
- Max storage for HCT-terminal 2000 t per assortment
- Transport distance for loaded HCT-truck > 50 km
- Unloaded HCT-truck is directed to the nearest HCT-terminal that offers wood to demand points





Complete! Now let's take a look at the results...

Black trucks indicate HCT

Number of HCT trucks idle  
Wood available at roadside

Unfulfilled Fleet utilization rates (simulated)

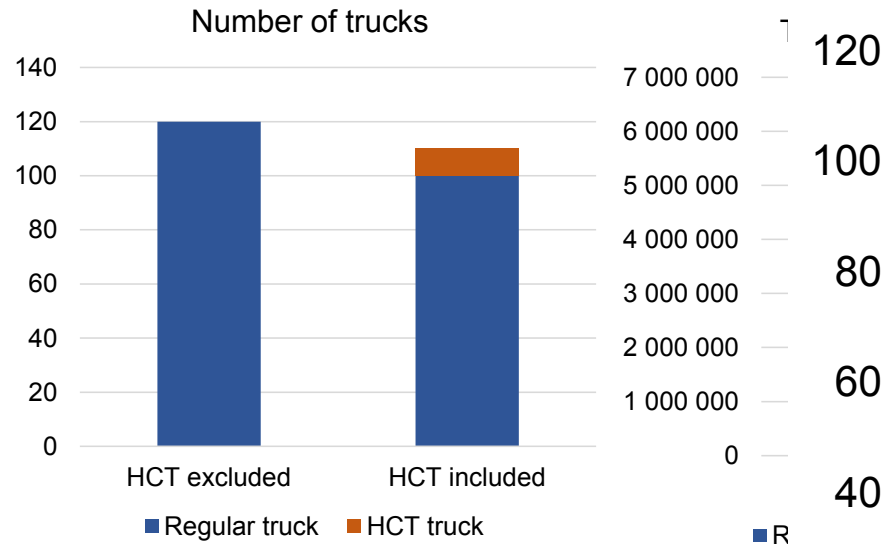
We can select HCT terminals  
Simulation run with  
out of 28 different locations  
HCT trucks

● Demand point  
○ HCT terminal

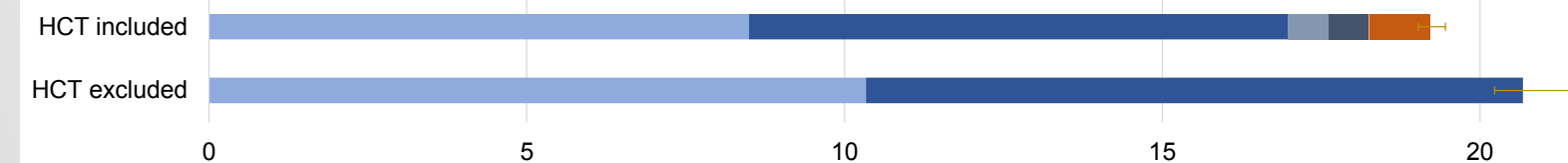


# Results from the presented scenarios (8 parallel simulations)

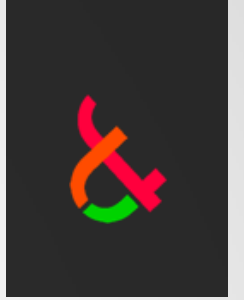
Average driving distance, km



Distance traveled, mill. km



- Full regular truck to mill
- Empty regular truck from mill
- Full regular truck to HCT terminal
- Empty regular truck from HCT terminal
- Full HCT truck to mill
- Empty HCT truck from mill
- All trucks



# Discussion

- Based on the results, an extensive (28 terminals) **HCT system could save time and total distances** in truck transportation
  - Impacts of fixed and variable costs of HCT terminals were not included, is smaller number of terminal locations more realistic?
- The model proves to simulate **advanced transport methods**, HCT and backhauling
  - Good for the model, but would HCT-backhaul be possible in practice?
- Still to do:
  - Replacing distance-based decisions with **cost function based decisions**
    - Different functions for regular and HCT trucks
  - Limiting the model to include only the **best HCT terminal locations** (e.g. 5, 10 or 15 terminals) ranked according to storage rotation speed
  - Small adjustment in source data to **balance supply and demand**
    - Unfulfilled demand at mills should be ~ 0 t

Thank you!



More information about:

HCT and terminal projects

<http://www.metsateho.fi/hct/>  
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