Large-scale forest-based biofuel deployment in the Nordic forest sector: Effects to the economics of forestry and forest industries

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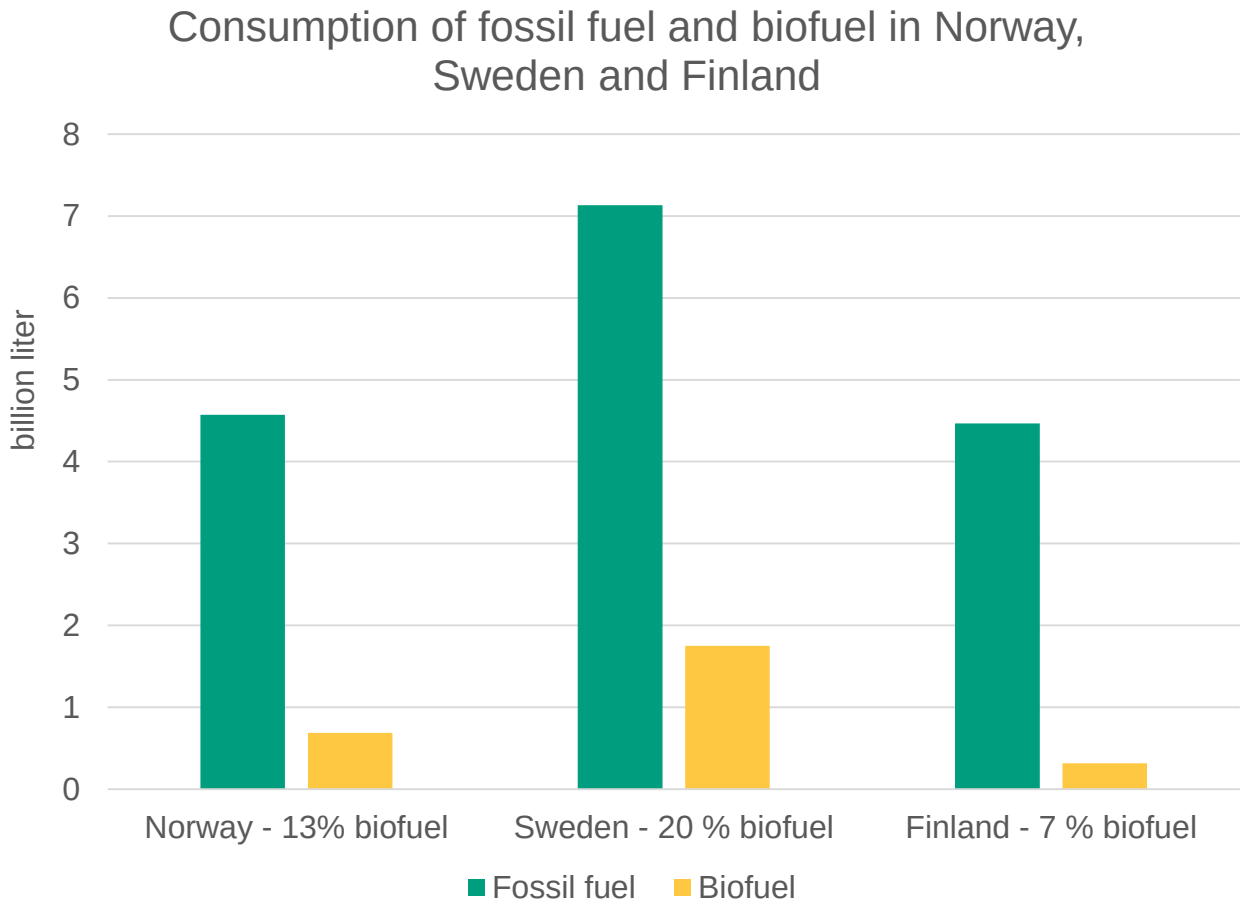
My work in Bio4Fuels (WP1.3)

- Modelling and assessments of wood biomass markets and bioenergy policies
- Examples:
  - What are the forest sector value chain implications of large-scale biofuel production?
  - How may learning affect competitiveness?
  - What are the implications to raw material prices?
  - What are the best locations biofuel plants?
  - Impacts of policies

Biofuels in the Nordic countries

- So far, mainly first-generation biofuel
- Small amount of second-generation raw materials



Nordic targets and policies

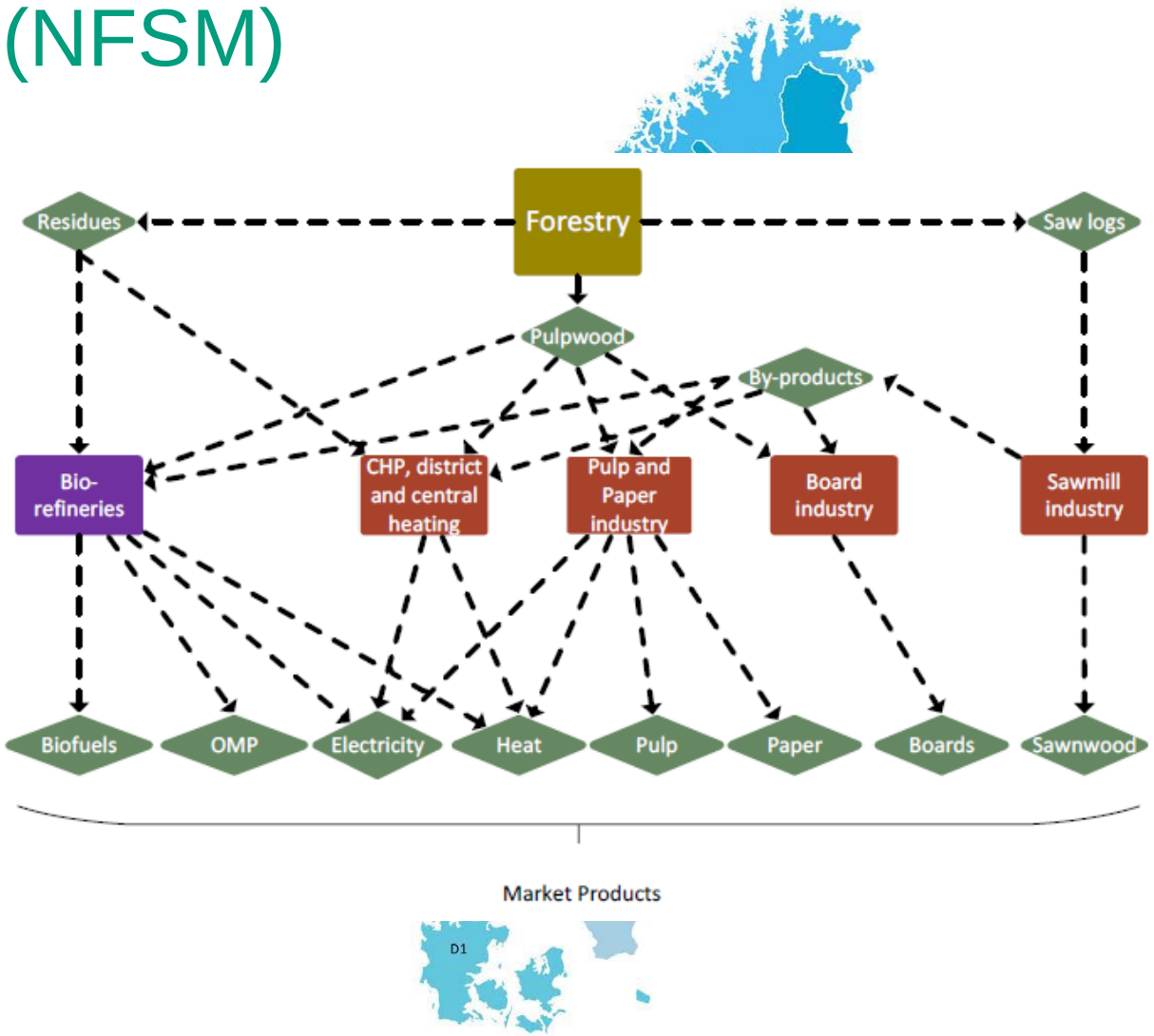
- Norway
  - Quota obligation
    - At least 3.5% (2018), 8% (2020), 16% (2030) advanced biofuel with doublet counting
- Sweden
  - Quota obligation
    - CO2 reduction
    - Tax reduction
- Finland
  - Quota obligation
- Denmark
  - Quota obligation
- EU
  - Double counting
  - GHG emission reduction
  - Max 7 % food-based biofuel

Targets for biofuel in the liquid fuel mix

	2018	2020	2030
Norway	10%	20%	
Sweden – diesel	19.3%		70%
Sweden - gasoline	2.6%		70%
Finland	15%	20%	30%
Denmark	5.75%	10%	
European Union		10%	14%

Nordic Forest Sector Model (NFSM)

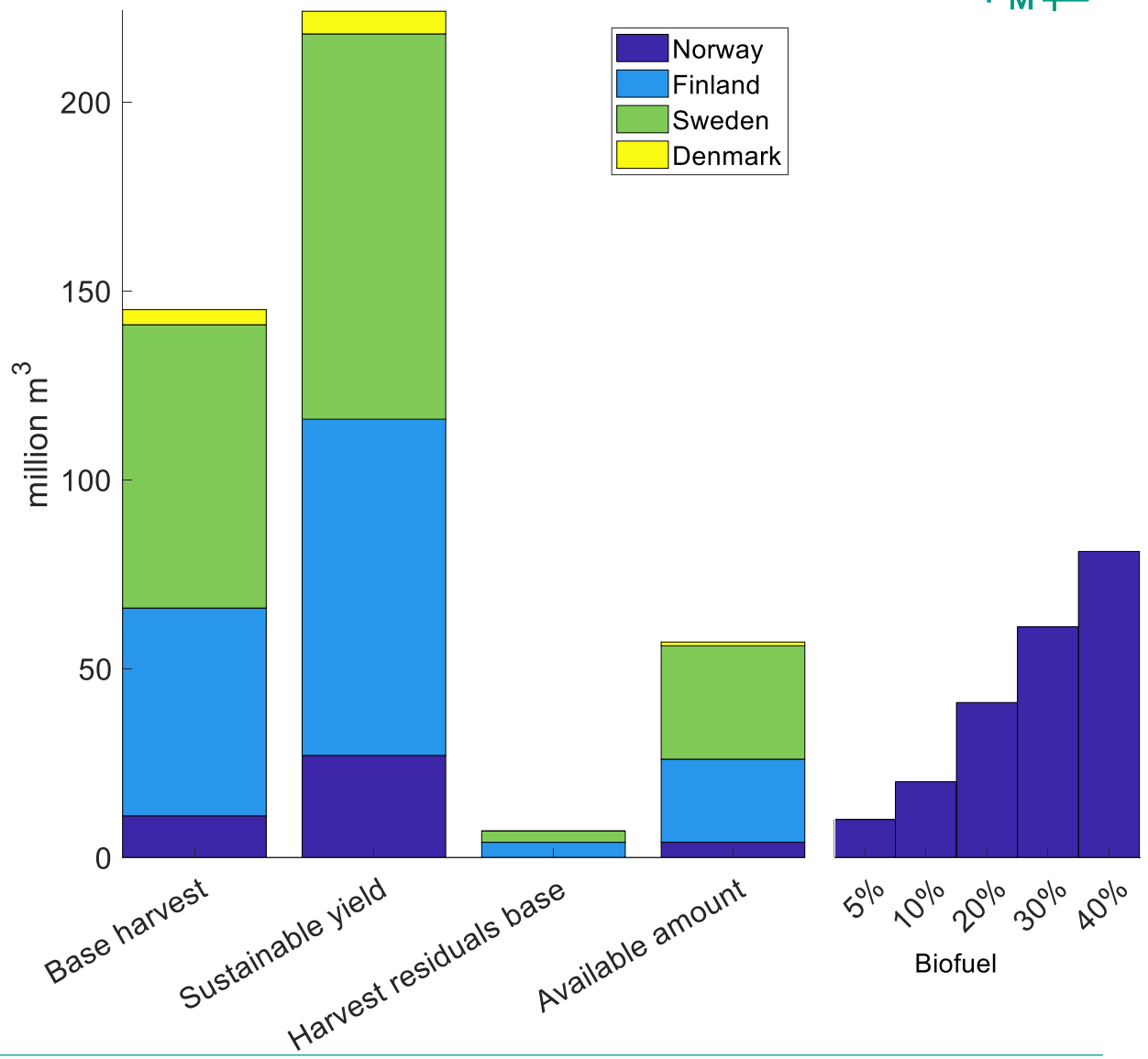
- Spatial, partial equilibrium model
- MILP
- Maximising consumer plus producer surplus
- 29 products:
  - Spruce, pine, and non-coniferous sawlogs and pulpwood
  - Harvest residuals
  - 13 final products



(Mustapha 2016)

Forest sector

- The Nordic forest sector harvest less roundwood than the growth
- Harvest less harvest residuals than possible
- 40% biofuel production from wood would require about 2/3 of the current harvest



Model study:

Scenarios and main assumptions

- 58% efficiency

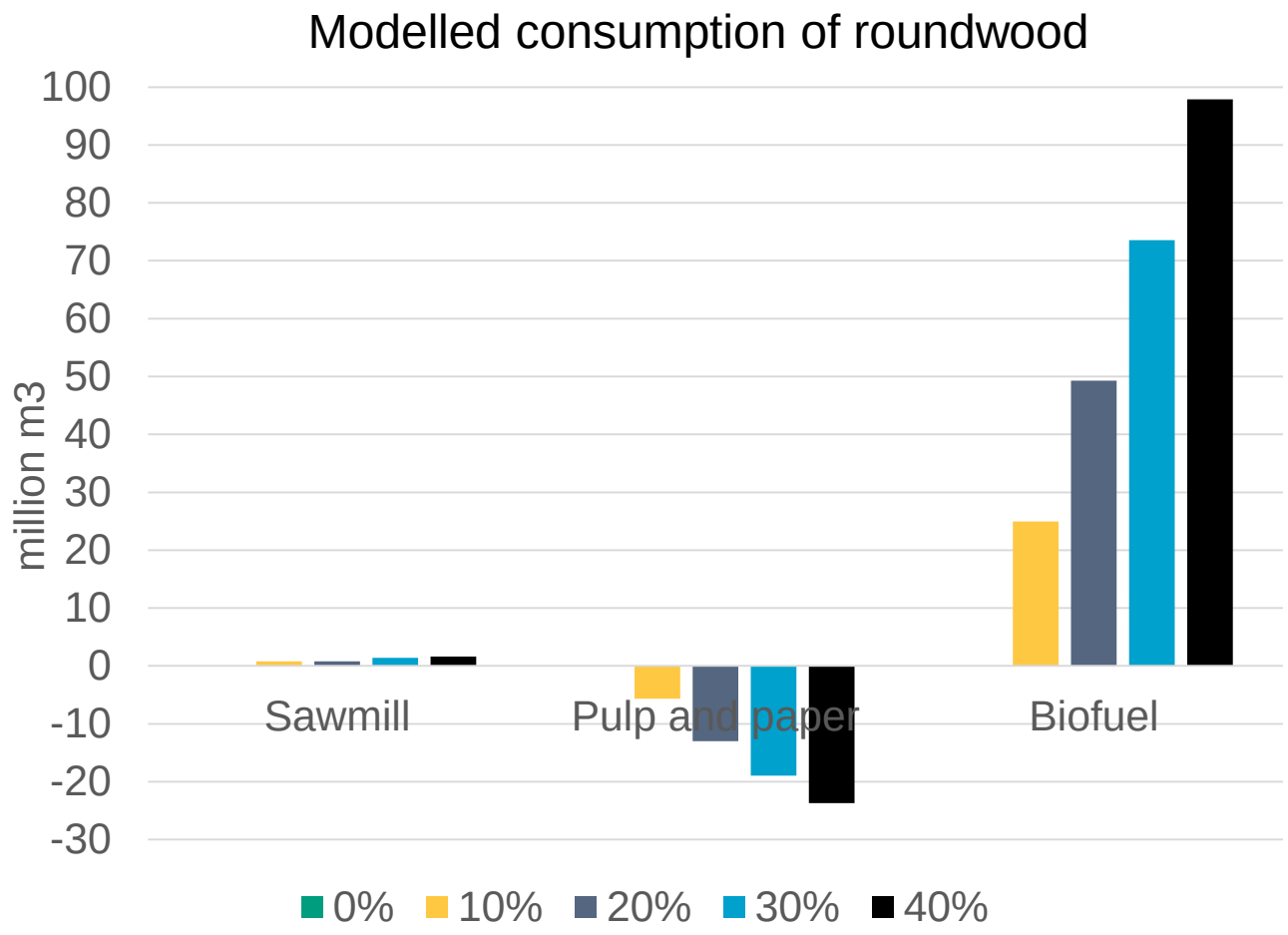
  => 1 m3 pulpwood = 120 L biofuel

- Biofuel can be made from:
  - Spruce, pine, and non-conifers pulpwood, residuals from sawmills, harvest residuals, and a mix of them

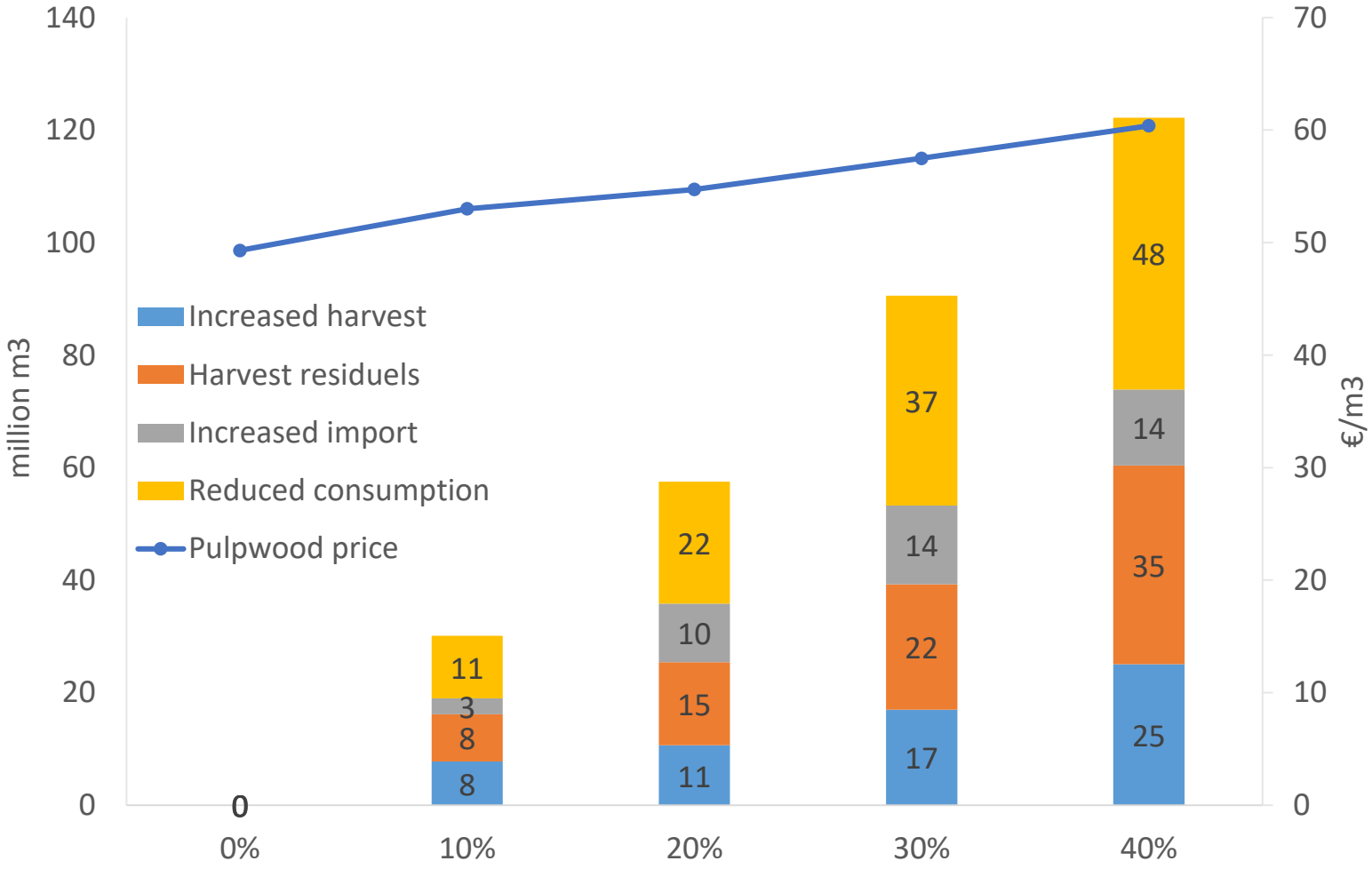
Scenarios	0%	10%	20%	30%	40%
Production [billion L]	0	2.9	5.8	8.7	11.6

Model results:
Roundwood consumption

- Slightly increase at the sawmill
- Reduction at pulp and paper mills
  - Up to 33%
- Biofuel production need up to 98 million m3
  - 2/3 of the initial harvest

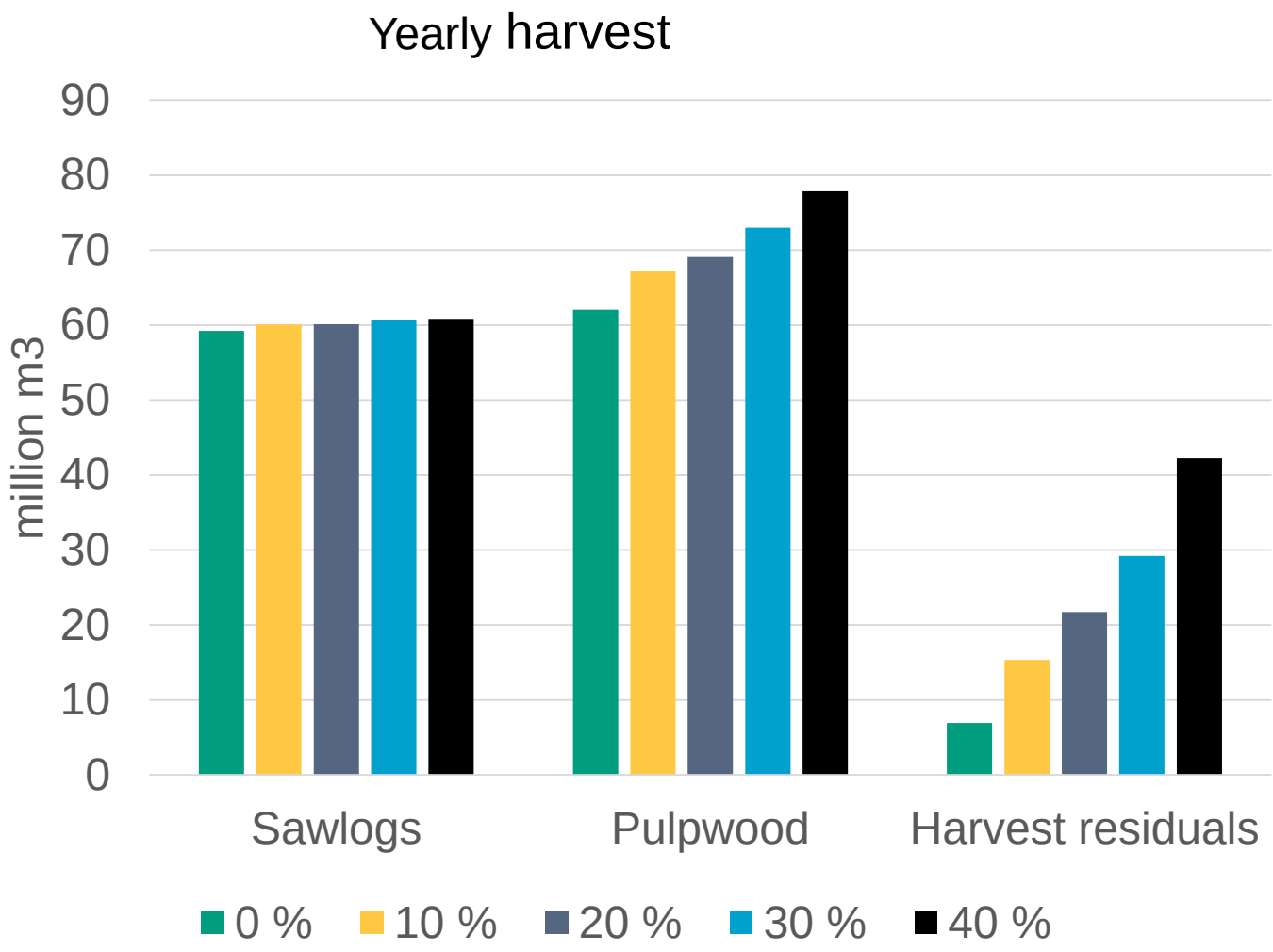


Model results:
Change in Nordic wood balance and pulpwood prices

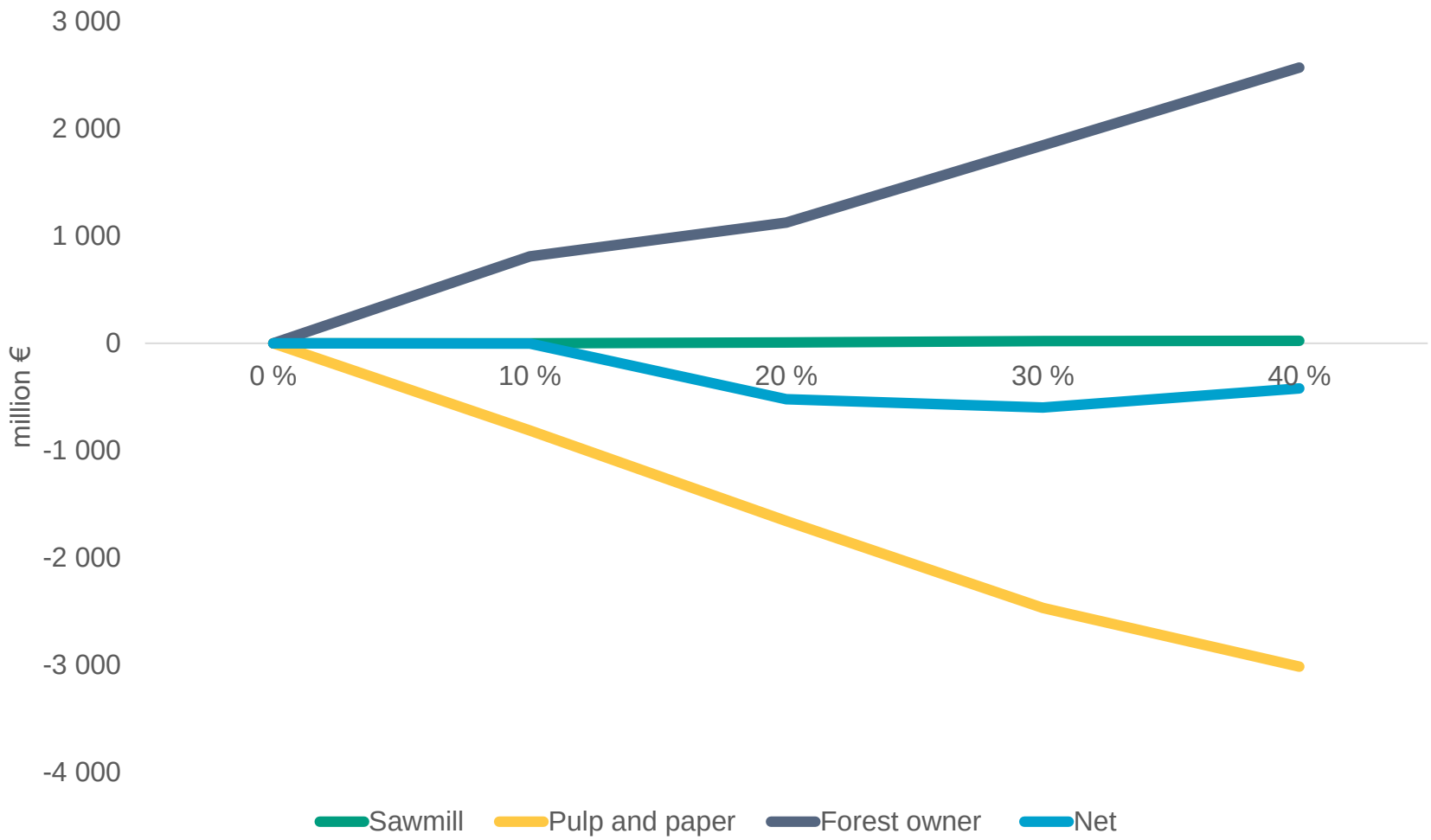


Effects to forestry

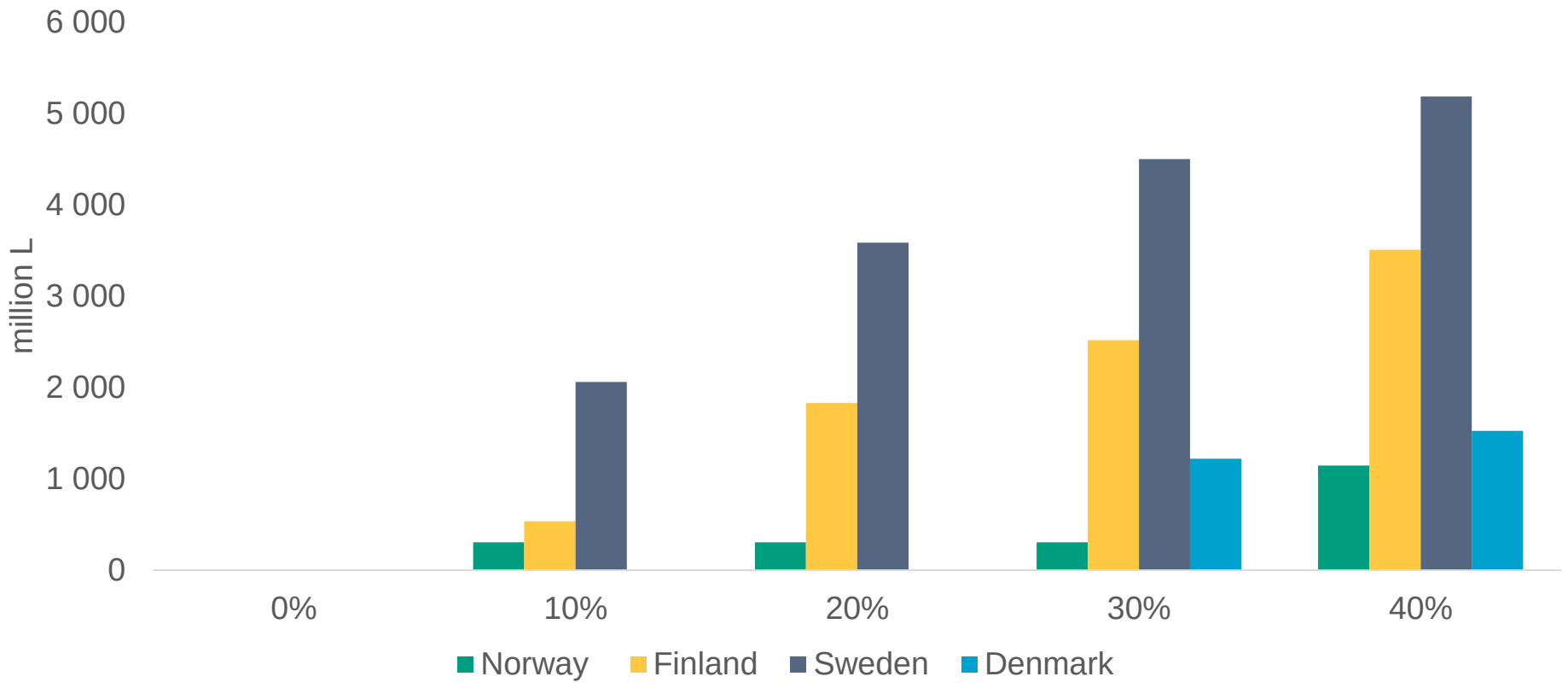
- Increase in use of
  - Sawlogs 3%
  - Pulpwood 25%
  - Roundwood total 15%
  - Harvest residuals 500%



Model results:
Impacts to the net revenues in the forest sector



Model results:
Location of biofuel production (million liter/year)



Conclusion

- Implementation of large-scale forest biofuel will influence the forest sector substantially
- Impacts in general
  - Harvest levels (+)
  - Utilization of harvest residues (+)
  - Biomass imports (+)
  - Wood use/production in heating and pulp and paper (-)
- Increasing biomass prices should be accounted for at large deployment levels