Potential to increase renewable energy in power generation and district heating

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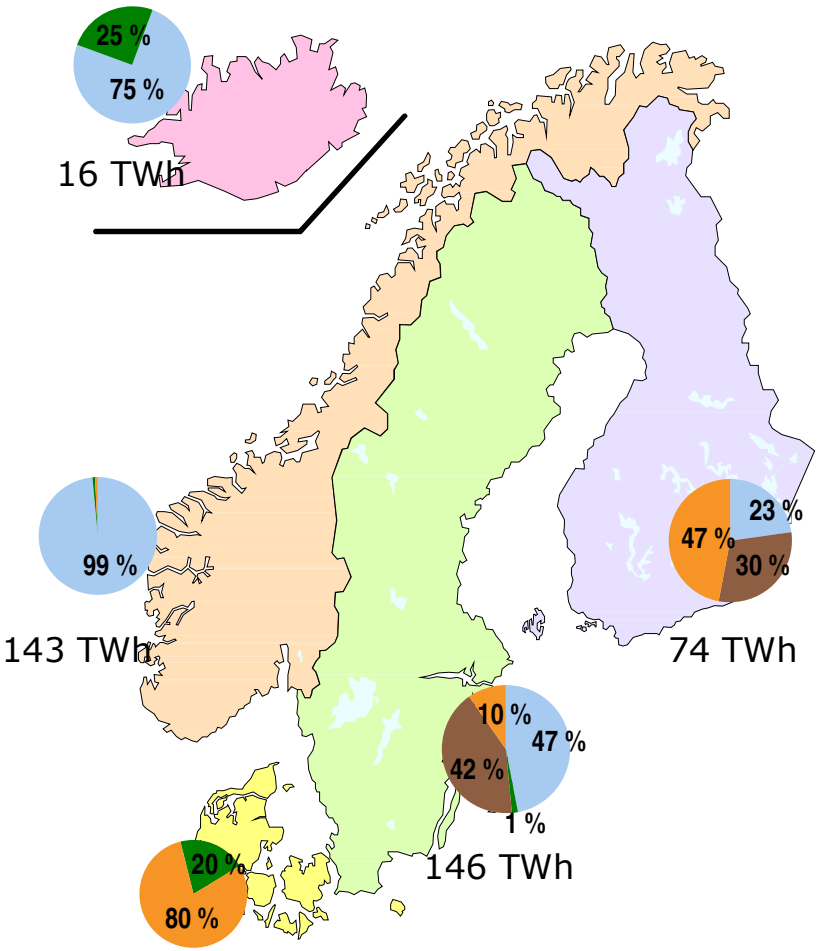
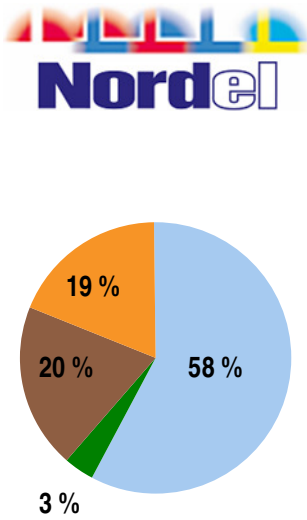
Finland – a small superpower in energy

- Largest use of electricity / capita in EU
- Second largest use of primary energy / capita in EU
  - behind Luxembourg
- Coldest country in EU = largest heating demand / cubic meter
- Largest use of biomass for energy production in EU
- Second largest producer of CHP electricity in EU
  - Best thermal efficiency of CHP plants in EU (average 83 %)
- Large export of energy technology: 5 billion euros in 2009
- No fossil energy sources

Energy is highly important for our economy and wellbeing and we have a lot of know-how in the energy field

Electricity generation in Nordic Countries 2008





- Water power
- Wind and geothermal power
- Nuclear power
- Thermal power

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Finland´s energy challenges

- Mitigation of climate change
  - Reduction of greenhouse gases and energy efficiency
- Structural dependency on electricity import, phase-out of older power plants
  - Investments needed in power generation capacity
    - An opportunity for introducing more renewables and nuclear
- Energy sources and self-sufficiency
  - Increase of domestic and renewable energy resources
  - Energy efficiency
  - Reduction of import dependency (especially electricity)

Cost-efficient renewables in energy production

- Price of energy matters – renewable energy needs to be increased cost efficiently
  - Customers are not ready to pay anything
  - If we manage to reduce the CO_2 emissions from power generation and production of district heat cost-efficiently we'll have…
    - competitively priced, low CO_2 electricity and district heat
    - chance to use these competitive products to decrease other sectors emissions (electric cars etc)

Cheapest ways to increase renewables in energy production

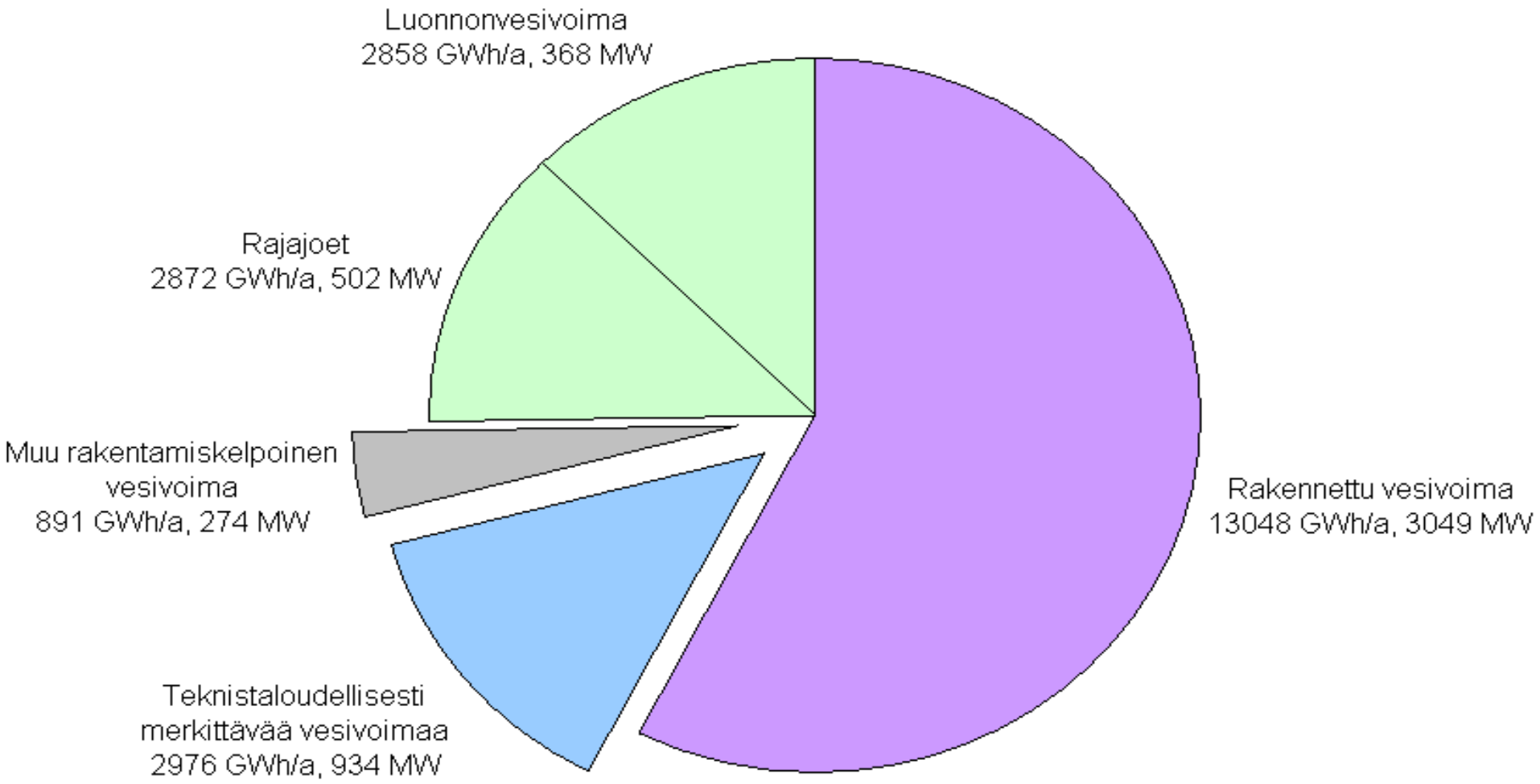
- Hydro power
- Biomass in combined heat and power
- Windpower

Hydro power

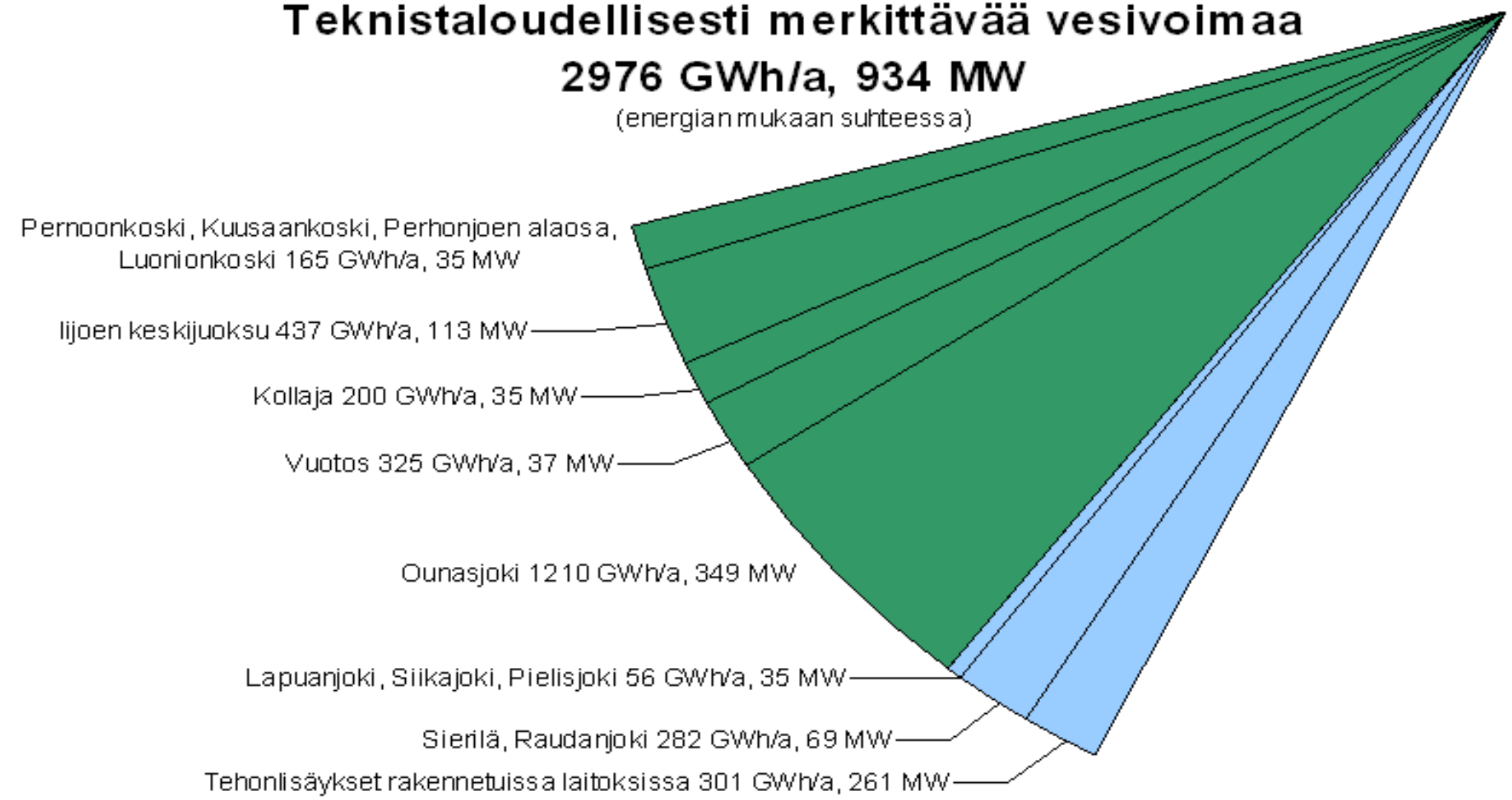
- Doesn’t require subsidies
- Provides more regulating power, which is very much needed in Finland due to
  - increase in wind electricity
  - closures of older peak load capacity
- Legislation limits

Suomen koko vesivoima 22645 GWh/a, 5127 MW

(energian mukaan suhteessa)



Teknistaloudellisesti merkittävää vesivoimaa
2976 GWh/a, 934 MW
(energian mukaan suhteessa)



Merkittävää vesivoimaa voitaisiin lisätä vuoteen 2020 mennessä 470 MW, 1 330 GWh/a

- Konetehojen nostot 261 MW, 301 GWh/a
- Kemijoella Sierilä 44 MW (lupahakemus jätetty), 120 GWh/a ja Raudanjoki 25 MW, 162 GWh/a
- Hankkeet Lapuanjoella, Siikajoella ja Pielisjoella yhteensä 35 MW, 56 GWh/a

<u>Suojelulainsäädäntöä tai –päätöksiä tulisi tarkistaa</u>

- Vuotos 37 MW, 325 GWh/a (natura ja vesilaki)
- Kollaja 35 MW, 200 GWh/a (koskiensuojelulaki)
- Pernoonkoski ja Kuusaankoski Kymijoella, Perhonjoen alaosa sekä Luonionkoski Tengeliönjoella, yhteensä 35 MW, 165 GWh/a (koskiensuojelulaki)
  - yli 200 MW lisää lyhytaikaissäätöä

Pienvesivoiman potentiaali varsin rajallinen

Pienvesivoimaa on 63 MW, 223 GWh/a

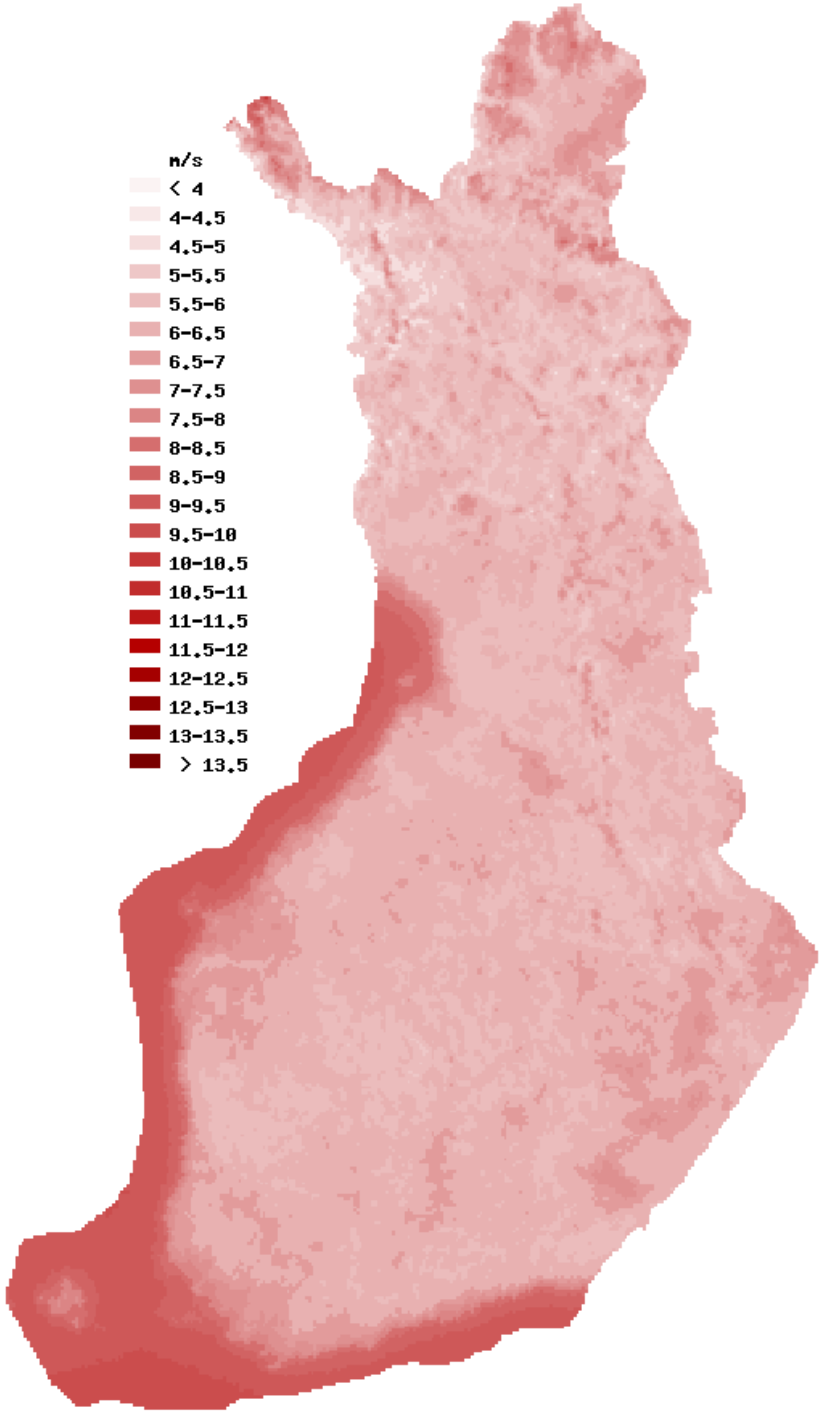
- Tästä on mahdollista rakentaa suojelua purkamatta ennen 2020 arviolta puolet eli 30 MW, 110 GWh/a
- Edellyttää vähintään nykyistä tukipolitiikkaa

Wind power

- The potential for wind power is in theory unlimited
- In practise there are limitations that are connected to
  - land use
  - costs, wind power is not the cheapest option in Finland and it needs subsidies
  - time, 2020 is almost here
- Companies are interested in investments in windpower. Planned projects:
  - Onshore 1400 – 2200 MW
  - Offshore 4100 – 5800 MW
- Few projects have all licences etc
- Spatial planning & environmental impact assesment processes a bottle neck for progress

Potential up to 2020

- National target for 2020 6 TWh windpower
- Challenging due to the time limitations and long authorisation processes
- Offshore wind most may be needed to reach 6 TWh (especially if licencing processes are not improved)
  - Demonstration project needed
  - Planned support levels do not make offshore profitable in Finnish conditions



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How bioenergy is utilised in Finland today

- Use of wood biomass 26-27 TWh/a
  - Bark, wood residue chips, sawdust, stubs, recovered wood, forest chips
  - District heat and CHP 7 TWh, industrial heat and CHP 18 TWh, condensing power 1 TWh

- In addition
  - energy use of peat 25-30 TWh/a
  - energy use of black liquor 40 TWh/a (pulp industry)
  - small combustion of wood 13 TWh/a

- Energy industry's wood supplies nowadays heavily dependent on forest industry

Opportunities for increasing the use of wood-based biomass in energy production

- The share of wood-based fuels can be increased in the existing plants

- In addition, many new biomass/peat plants under construction

- Policy measures should target mainly availability of biomass

- Energy production based on black liquor and forest industry's residues is dependent on forest industry's operations and should be treated separately when assessing bioenergy potential

Opportunities for increasing wood-based bioenergy in energy production

- Availability of biomass is dependent on prices - there are cheap and expensive fractions and costs depend also on transport distances

- There are many uses for wood and competition between and within industry sectors

- Potential for increasing use of biomass cannot be defined merely based on sustainable levels of cutting but it has to take into account different uses of wood

- Subsidies for energy production have to be moderate in order not to disturb competition too much

- Targets set by government ambitious but not impossible

Comments on Governments plans to increase renewables

- Focus on cost-efficient renewables

- Planned subsidies are pretty smart
  - Wind electricity to be sold normally to market
  - Same support level for all wind power projects
  - Support for supply chains of wood
  - Dynamic support for biomass electricity stabilising effect of changing CO_2 prices and avoiding too high support levels

- Funding for support mechanisms to be secured

- National support mechanisms are problematic in many ways and harmonisation will be needed in the future

Comments on Governments plans to increase renewables

- Efforts needed to develop spatial planning, permitting etc
- Other measures than subsidies needed to address challenges associated with biomass supply chains
- Policy measures to take into account that district heating is energy efficient and facilitates increasing use of biomass
- Future belongs to electric cars even though they may not be dominating by 2020
  - Promote plug-in-hybrids and electric cars in addition to biofuels

Conclusions

Potential for renewable energy cannot be estimated without considering the costs

2020 will be here soon and it will be very challenging for Finland to reach our renewables target in time