Finnish energy transition – from fossil to bioenergy and bioeconomy

AQPER 2019 Symposium, Quebec, 06.02.2019

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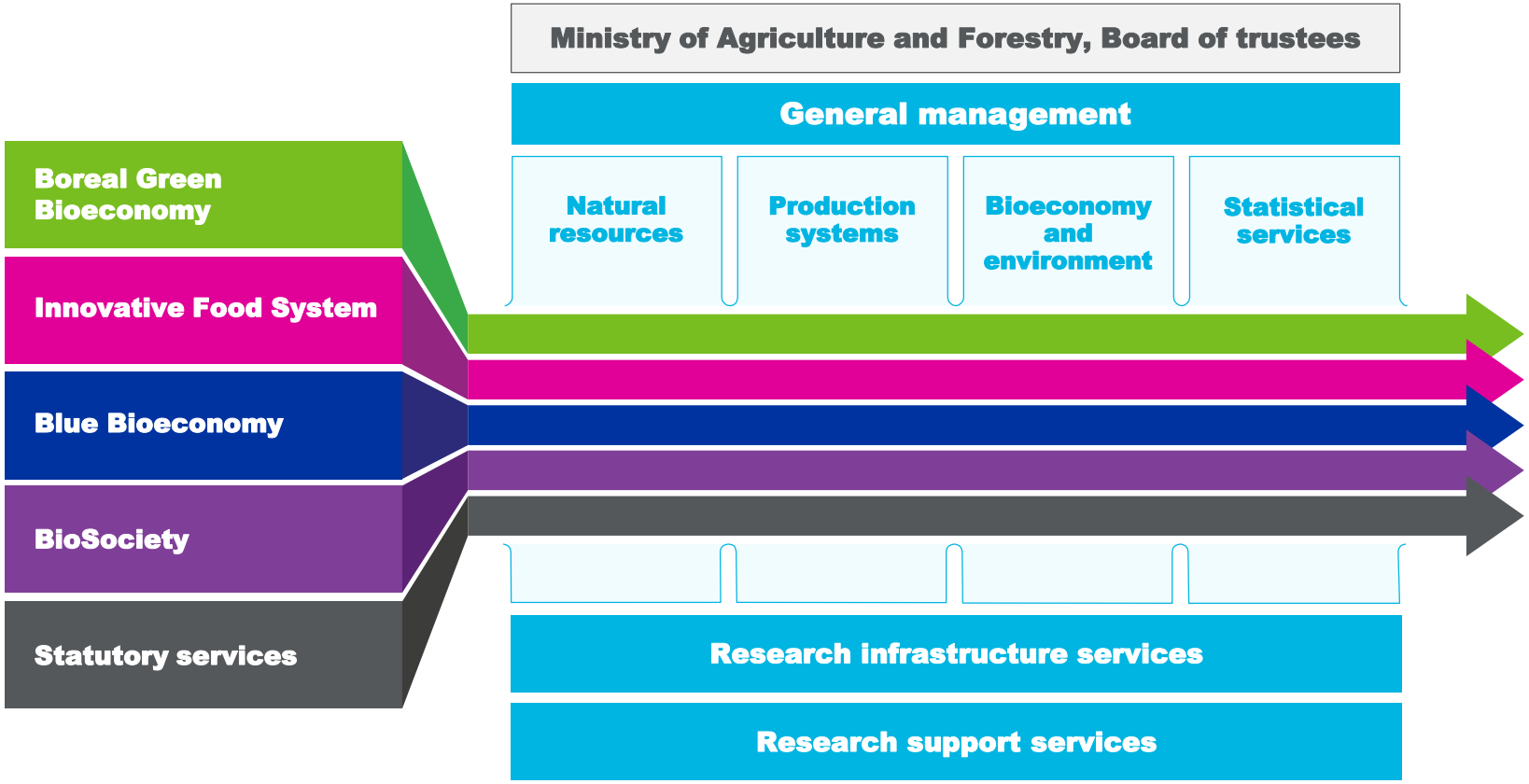
We are Luke

LUKE Natural Resources Institute Finland



120 M€
Turnover

90 M€
Research & customer portfolio

30 M€
Statutory services

25
Locations in Finland

HQ in Helsinki

Present in 12 campuses with universities, research institutes and polytechnics

1300
Employees

50 research professors
650 researchers

We are one of the four Statistical Authorities in Finland.

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Boreal Green Bioeconomy

Head of thematic research programme: **Antti Asikainen**
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Genomics and breeding

- Genomic understanding of key quality parameters of boreal species
- Precision breeding
- Development of breeding methodologies (genomic selection, genome editing)
- Technologies for modern breeding (somatic embryogenesis, automatisation)

Sustainable biomass production

- Intensification of biomass production
- Forest management concepts
- Abiotic and biotic risk management
- Environmental impacts of forestry

Forest resource supply management

- Reginal scenarios and models
- Active, sustainable and climate smart forest and land use planning
- Operational efficiency in wood sourcing and silviculture
- Reduction of adverse impacts of wood harvesting

Value-added bioeconomy products and processes

- Formation and location of structures and compounds of biomass (Biorefinery potential of biomass),,
- Valorisation of secondary streams and by-products, bioenergy
- Wood products, green building and living with wood

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Luke is located throughout Finland

Locations

Helsinki ja Espoo, Jokioinen, Joensuu, Oulu, Turku, Jyväskylä, Seinäjoki, Kokkola, Maaninka (Kuopio), Paltamo, Rovaniemi

Experimental stations

Piikkiö, Haapastensyrjä, Ypäjä, Parkano, Savonlinna, Suonenjoki, Paljakka, Siikajoki, Utsjoki

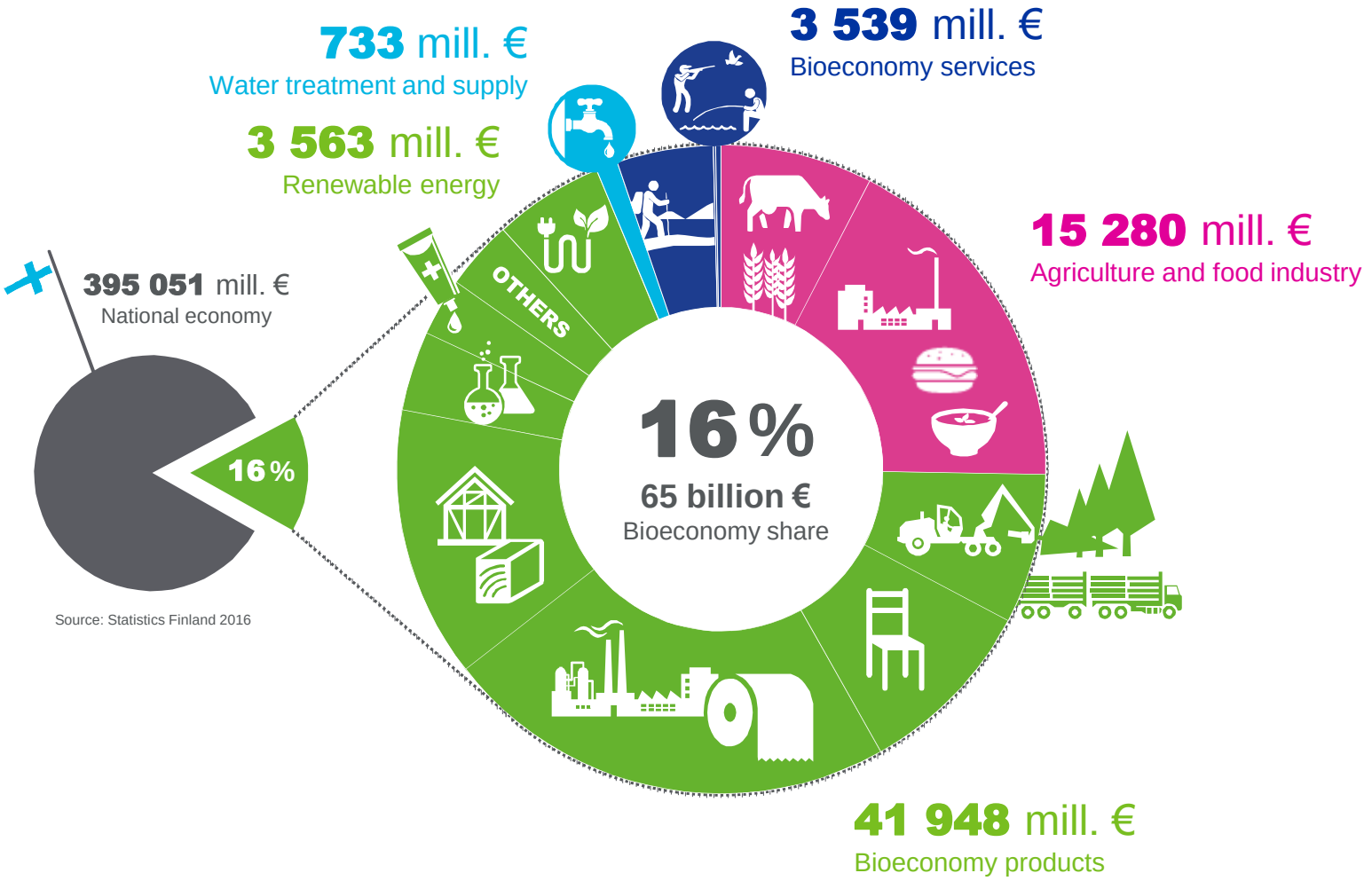
Aquaculture infrastructure

Enonkoski, Laukaa, Taivalkoski, Keminmaa, Inari

Research co-operation sites

Tampere, Mikkeli, Kajaani, Kuopio campus

Bioeconomy in Finland
1m³ of wood generates 200€ added value

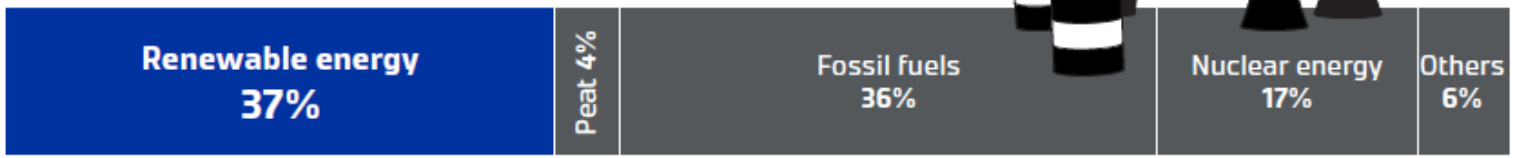


Source: Statistics Finland 2016

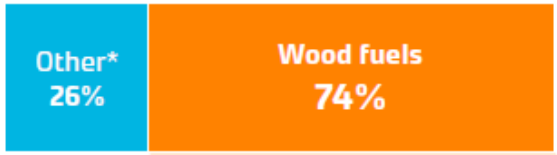
Graphics: Vihreä biotalous – 100-vuotiaan Suomen hyvinvoinnin ja kilpailukyvyn perusta.

CONSUMPTION OF WOOD FUELS 2017

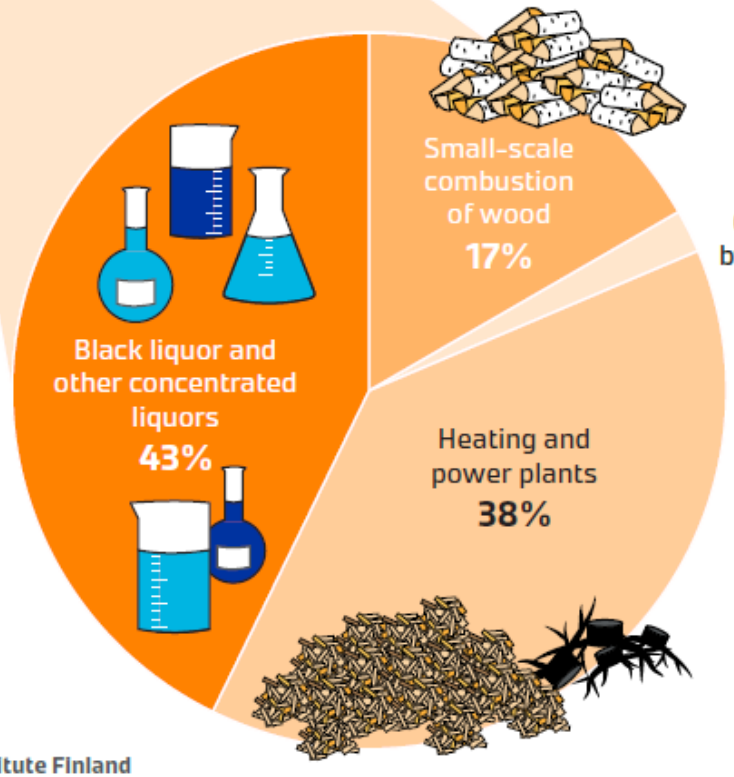
Total energy consumption
374 TWh



Renewable energy
137 TWh



Wood fuels
101 TWh



TWh= terawatt-hour

*Other renewable energy includes wind and hydro power, heat pumps, solar energy and other biofuels.

Source: Statistics Finland, Natural Resources Institute Finland

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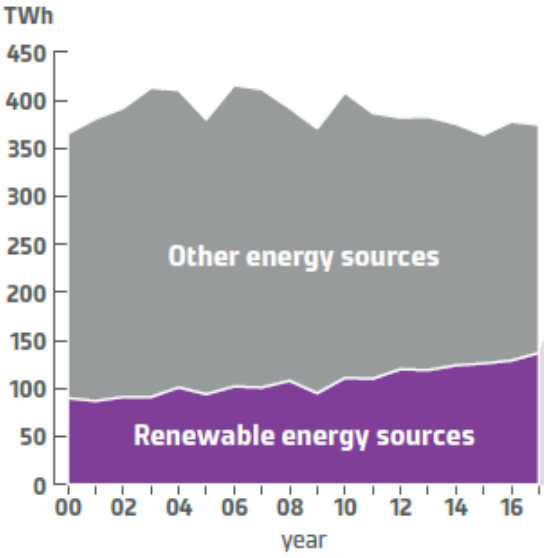
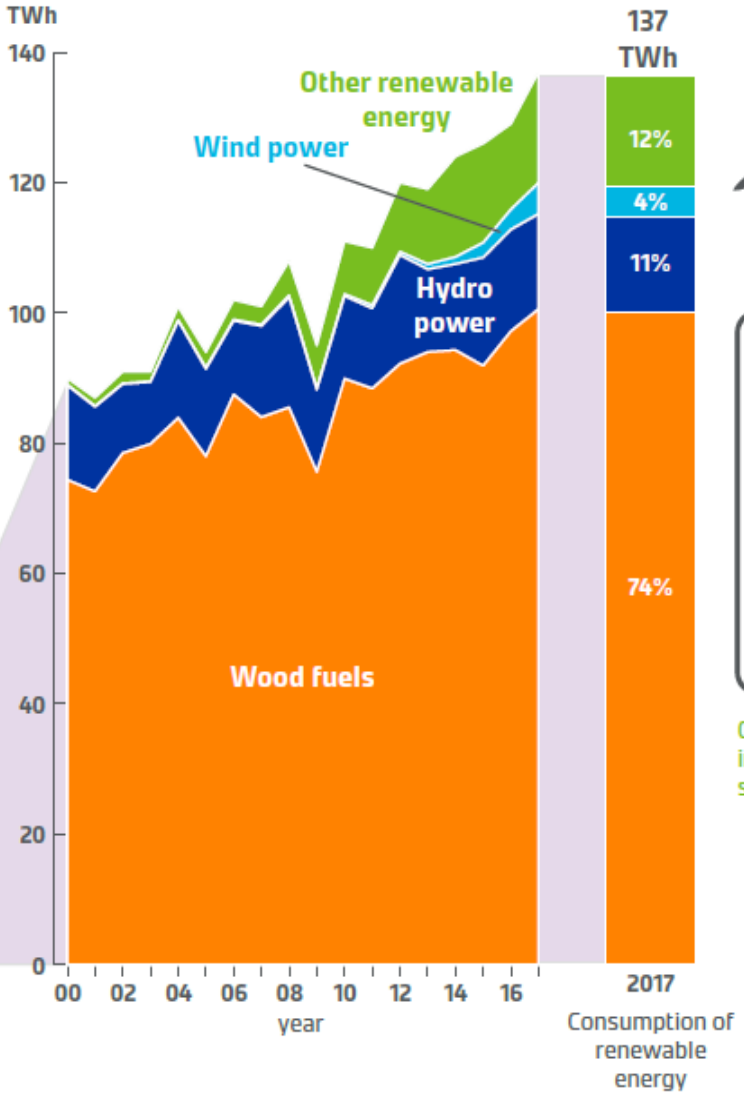
TOTAL RENEWABLE ENERGY CONSUMPTION BY ENERGY SOURCE

From year 2000 the consumption of renewable energy has increasedover 50%

In 2017 the share of renewable energy was 37% of total energy consumption





The consumption of other renewable energy and wind power has increased in the 2000s

Compared to 2016, the consumption of wind power has increased over 55%

Other renewable energy includes here heat pumps, solar energy and other biofuels

Source: Statistics Finland

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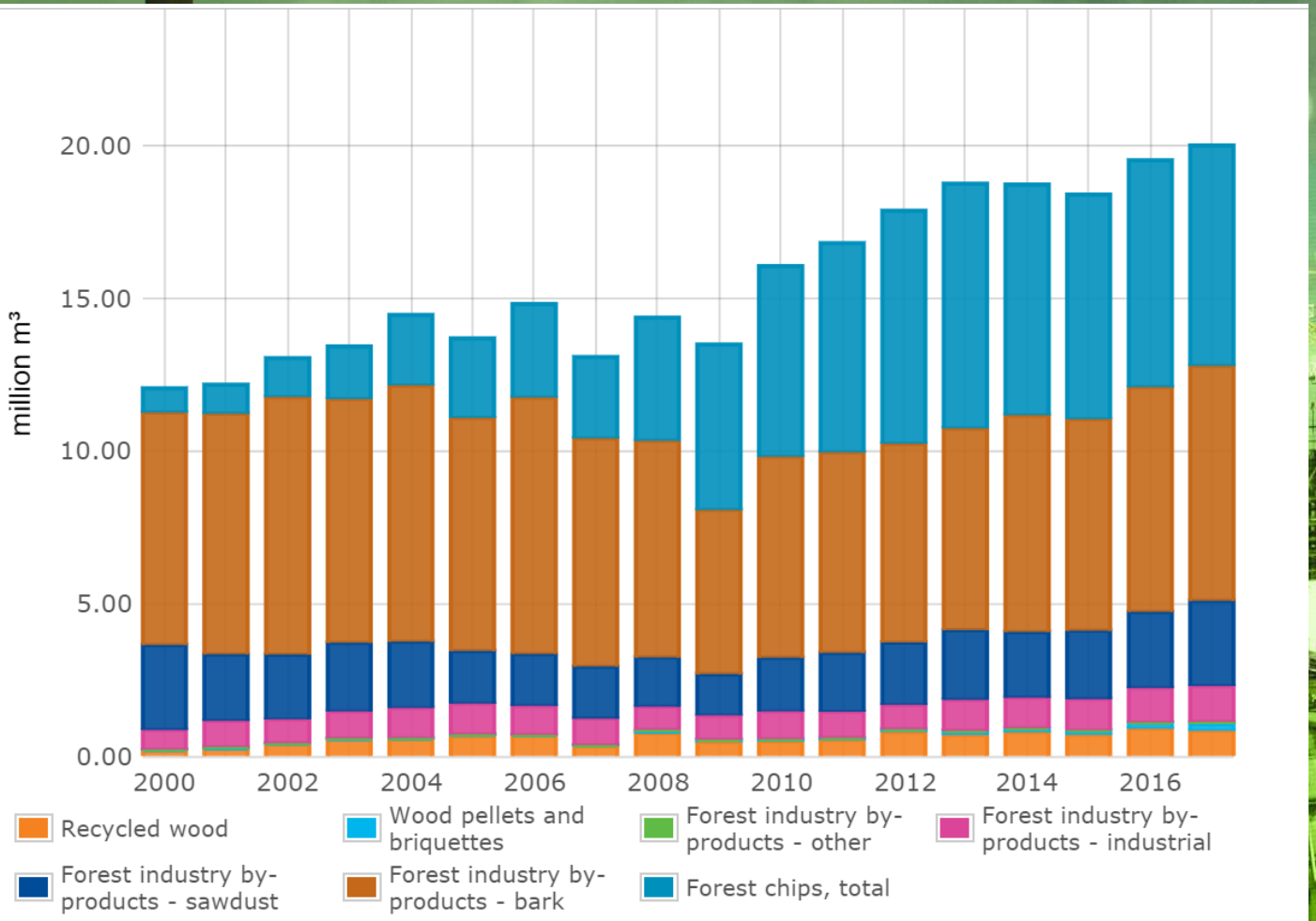
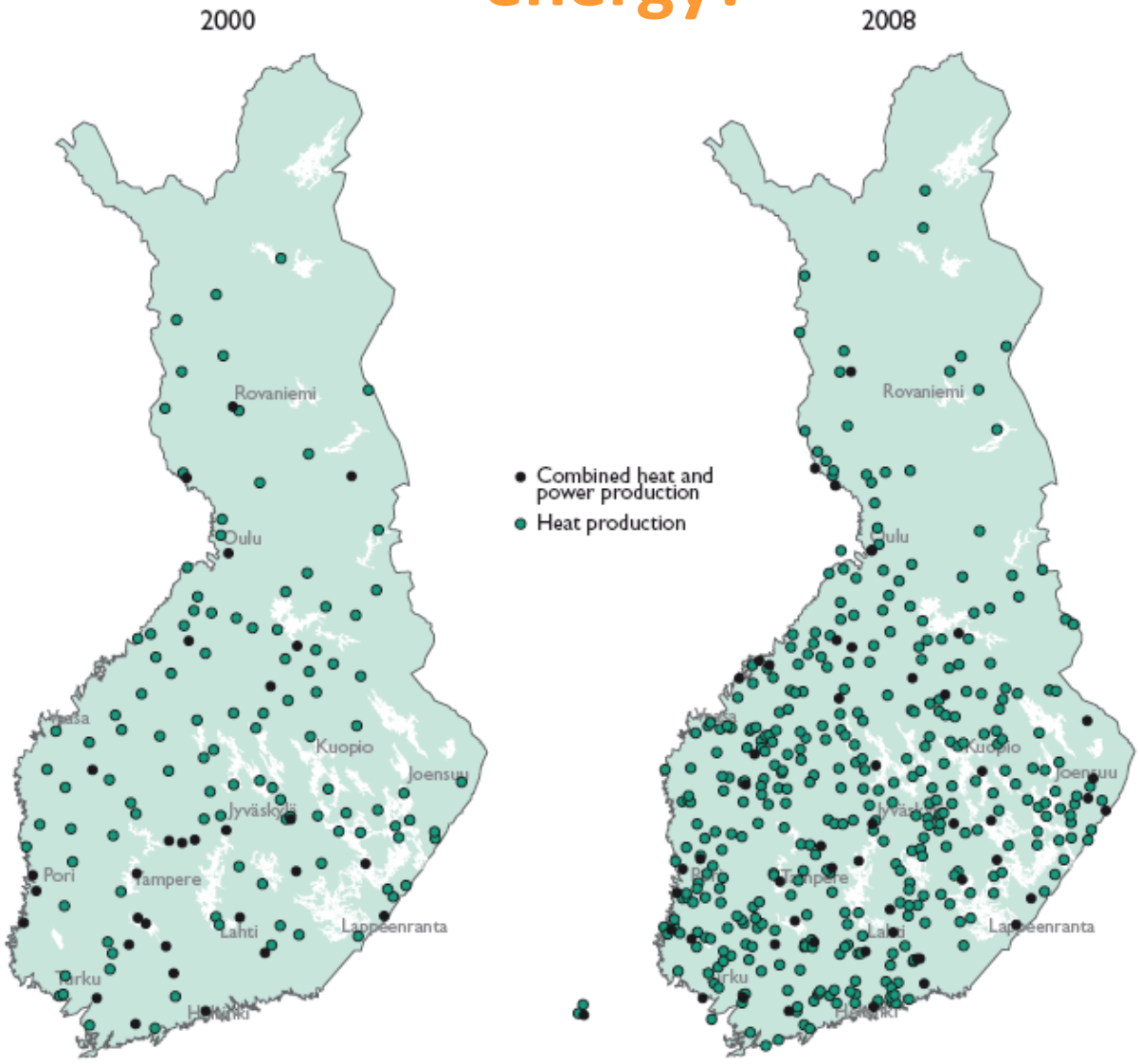
Rapid growth of use forest chips for energy



Source: OSF: Natural Resources Institute Finland, Wood in energy generation.

What induced the rapid growth of bio-based energy?

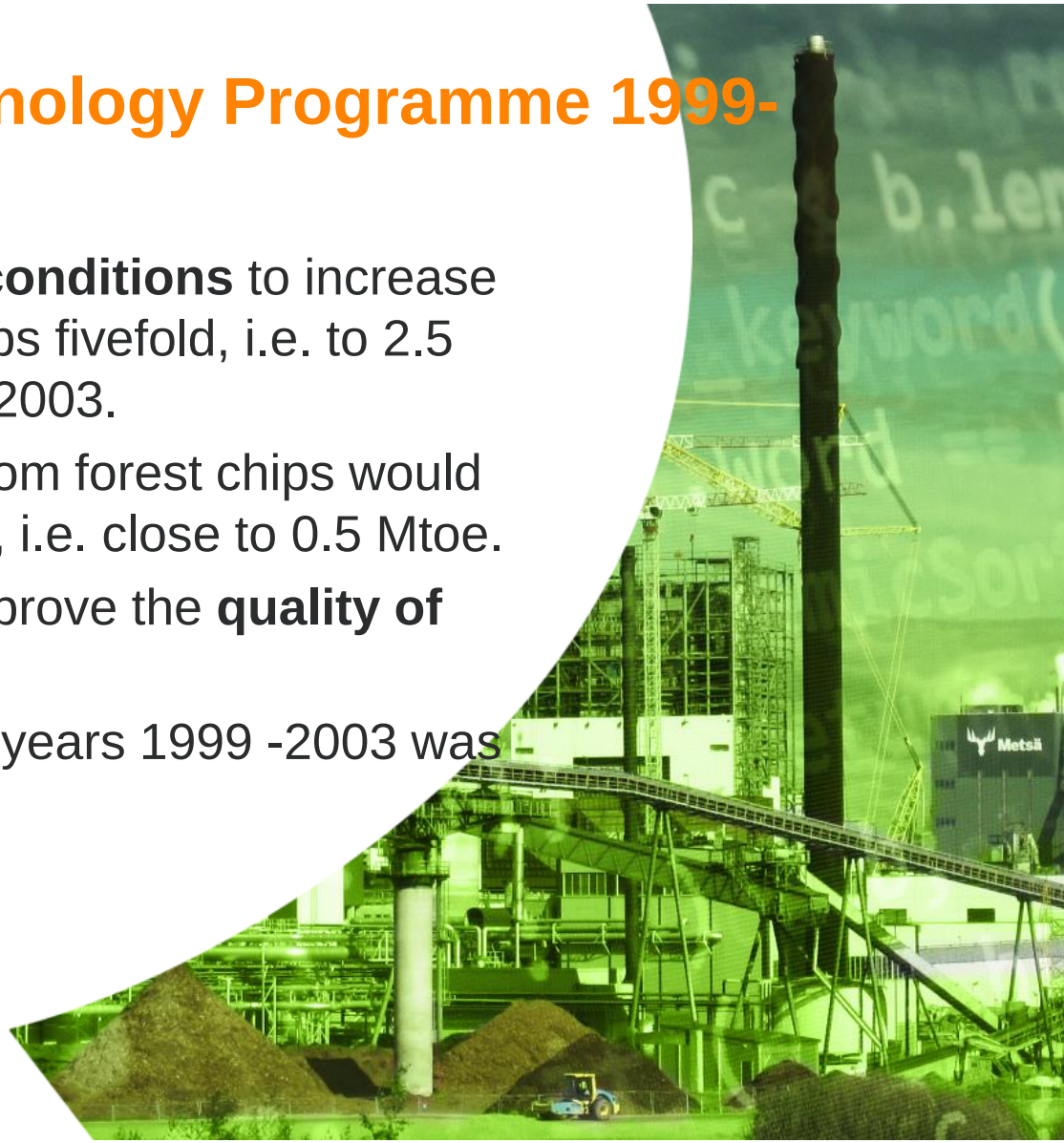


Outrageous investments in bioenergy R&D in 1990's ja 2000's

- Large technology programmes with concrete objectives
  - High industry involvement and technology development: **Bioenergy**
  - Technology for sourcing and combustion of biomass: **Wood energy technology**
  - Subsequently: Markets and bio-based business: **Climbus**
- **C.a. 20 R&D programmes in total for bioenergy**
- **IEA lists almost 100 policies and measures that Finland has been using to promote renewable energies and carbon free technologies**
  - **https://www.iea.org/policiesandmeasures/pams/finland/**

Wood Energy Technology Programme 1999-2003

- **Create the economic conditions** to increase annual use of forest chips fivefold, i.e. to 2.5 million cubic metres by 2003.
- The energy produced from forest chips would amount to about 5 TWh, i.e. close to 0.5 Mtoe.
- A parallel target is to improve the **quality of wood fuels**.
- The total budget for the years 1999 -2003 was € 42 million



ClimBus technology programme 2004-2008

- Aim: Finnish companies as internationally important suppliers of technology and services related to climate change mitigation.
- Target: Net sales of ClimBus participants at 7 billion euros, up from 4.5 billion euros in 2006.
- Clean energy production and business services
- Technologies for energy efficiency CO2 free technology
- Business and technology roadmap for renewable energy by 2010

Investment subsidy ignited the markets

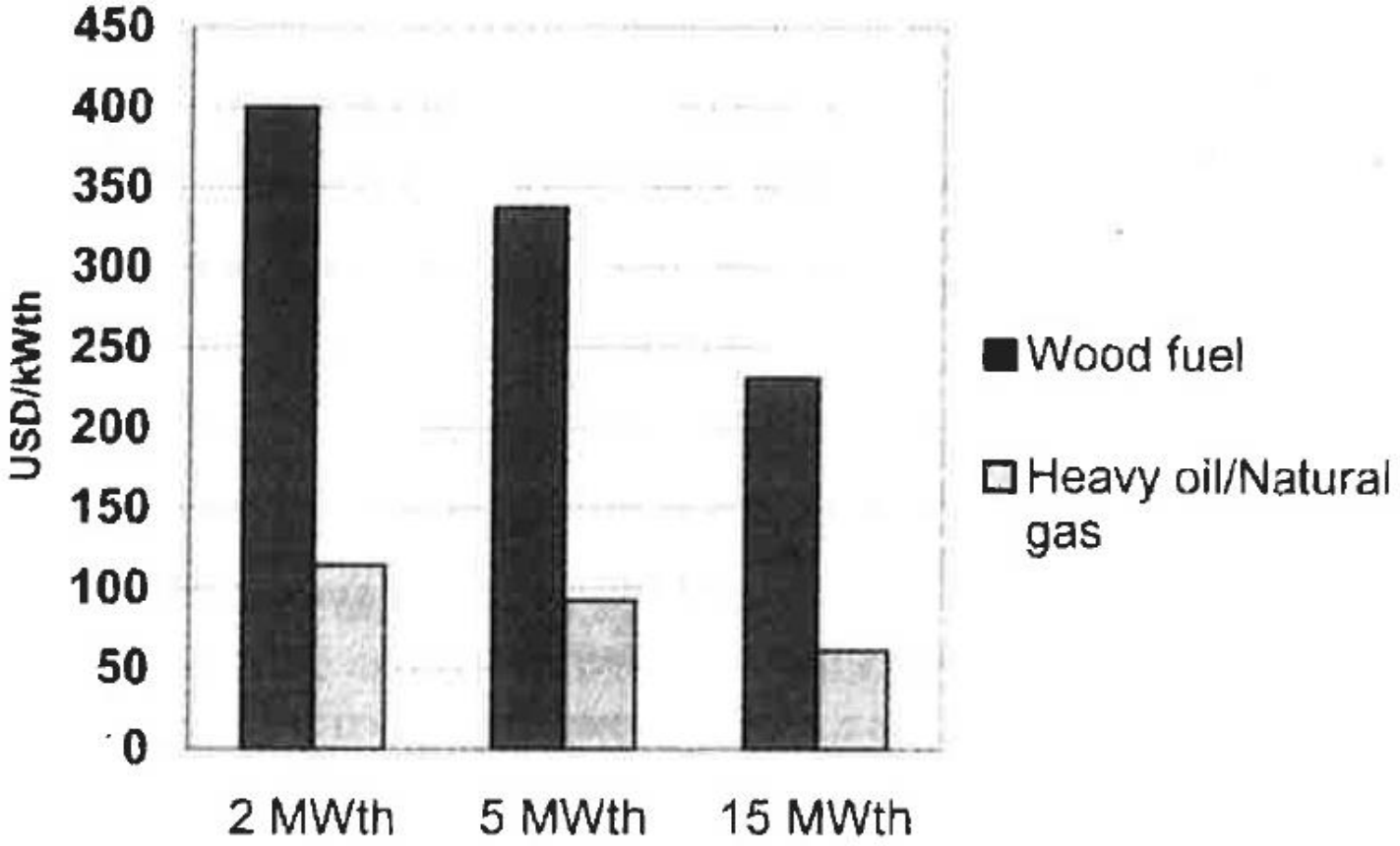


Figure 4.2-4. Typical investment costs for heating plants (Kosunen and Leino 1995, Kosunen and Rajamäki 1999).

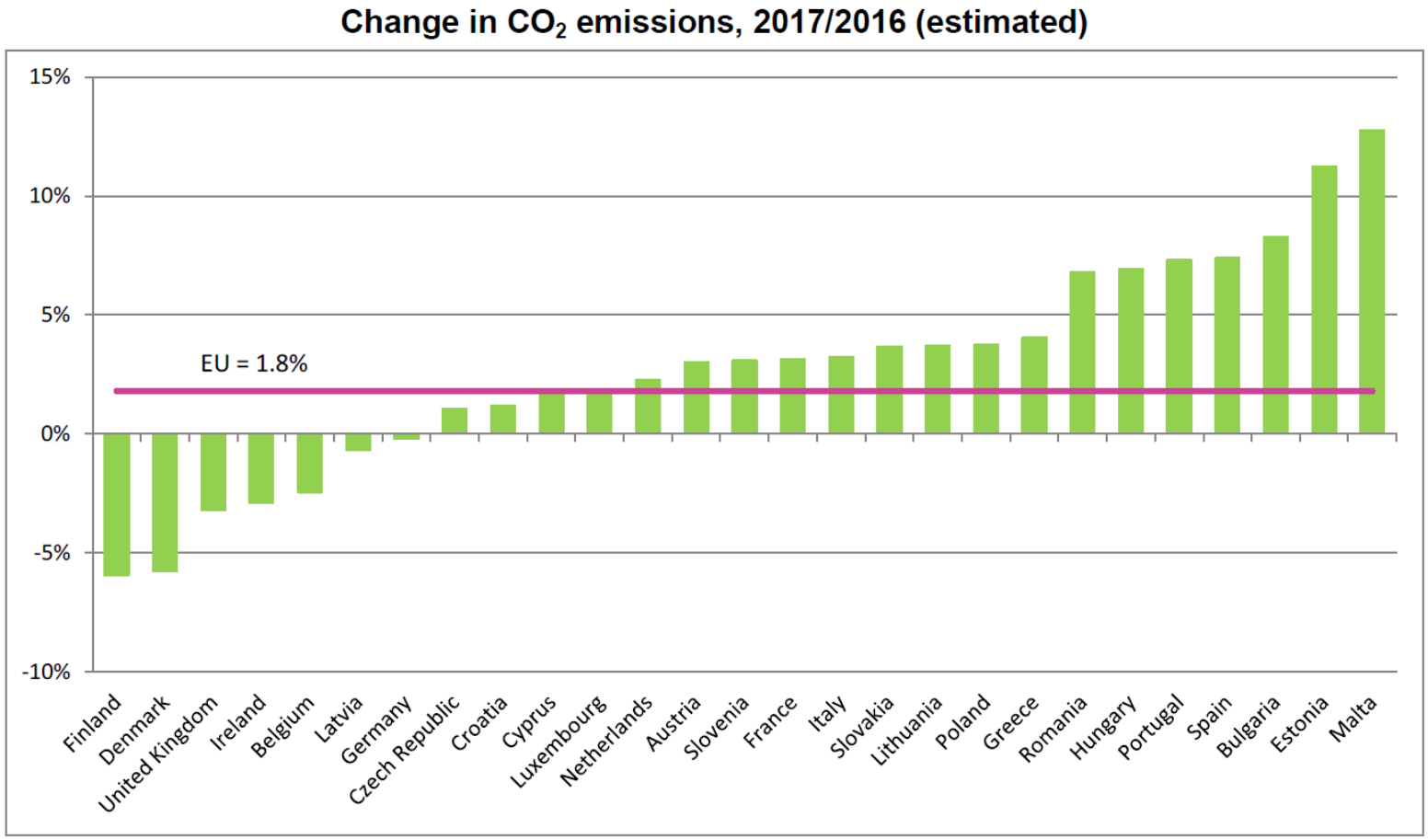
Sirkkala Energy Park

Sirkkala Energy Park in Joensuu, Finland is a real-life R&D environment at Karelia UAS. It is located near the campus area and offers an easily-accessible learning and benchmarking environment for students and visitors.
Sirkkala Energy Park provides a large set of technical solutions for testing and development, such as:

- Mobile Volter CHP unit with real-time monitoring and 3D- modelling
- Combined wood log/pellet boiler
- Nano-CHP wood pellet boiler (single household size!)
- Large collection of solar collectors and panels
- Wood fuel dryer
- A wide variety of laboratory equipment and analyzers

Luke's International Wood Energy Projects

Finland cuts its emissions despite rapid GDP growth



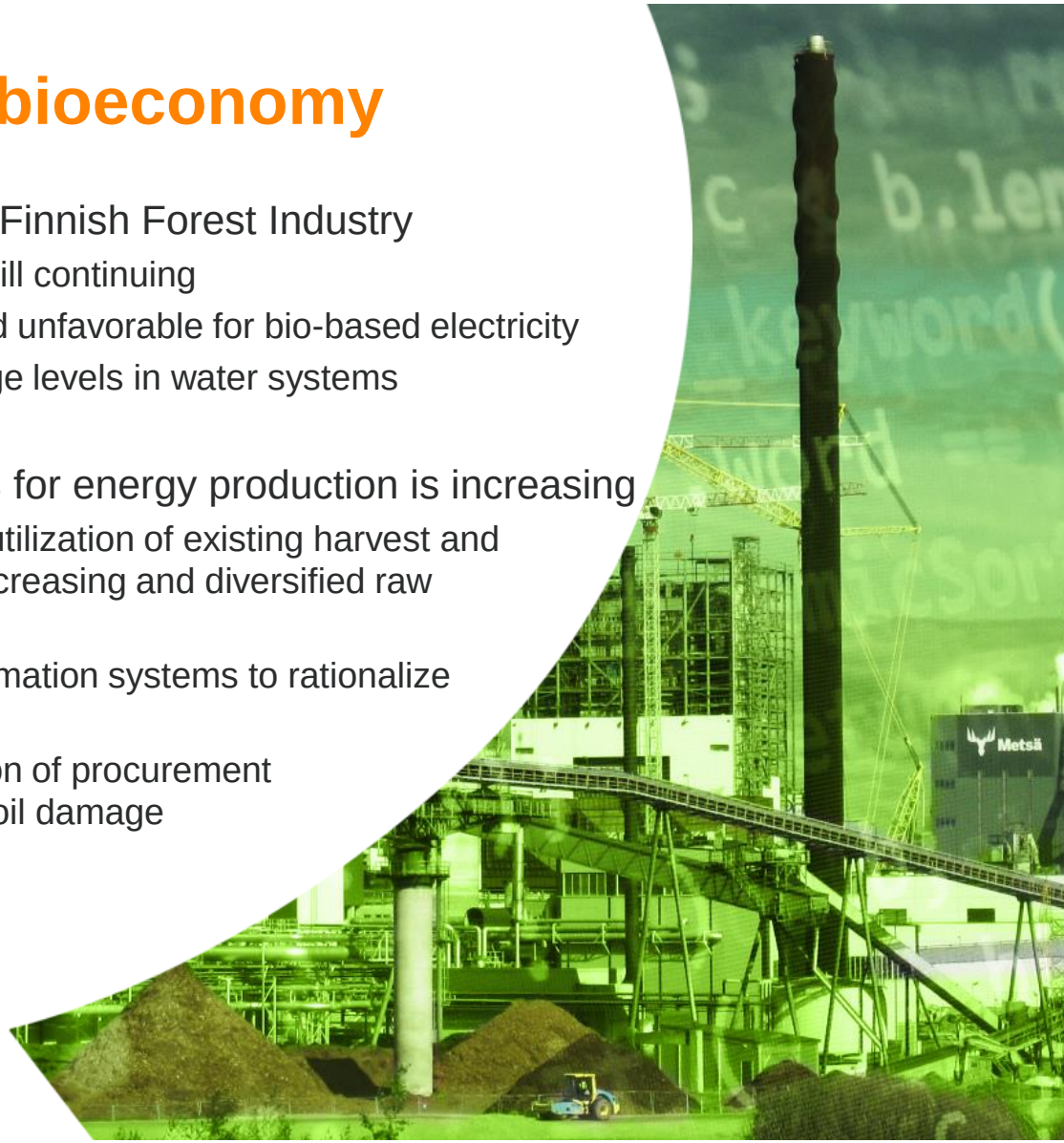
From bioenergy of bioeconomy

2010’s trend: Renaissance of the Finnish Forest Industry

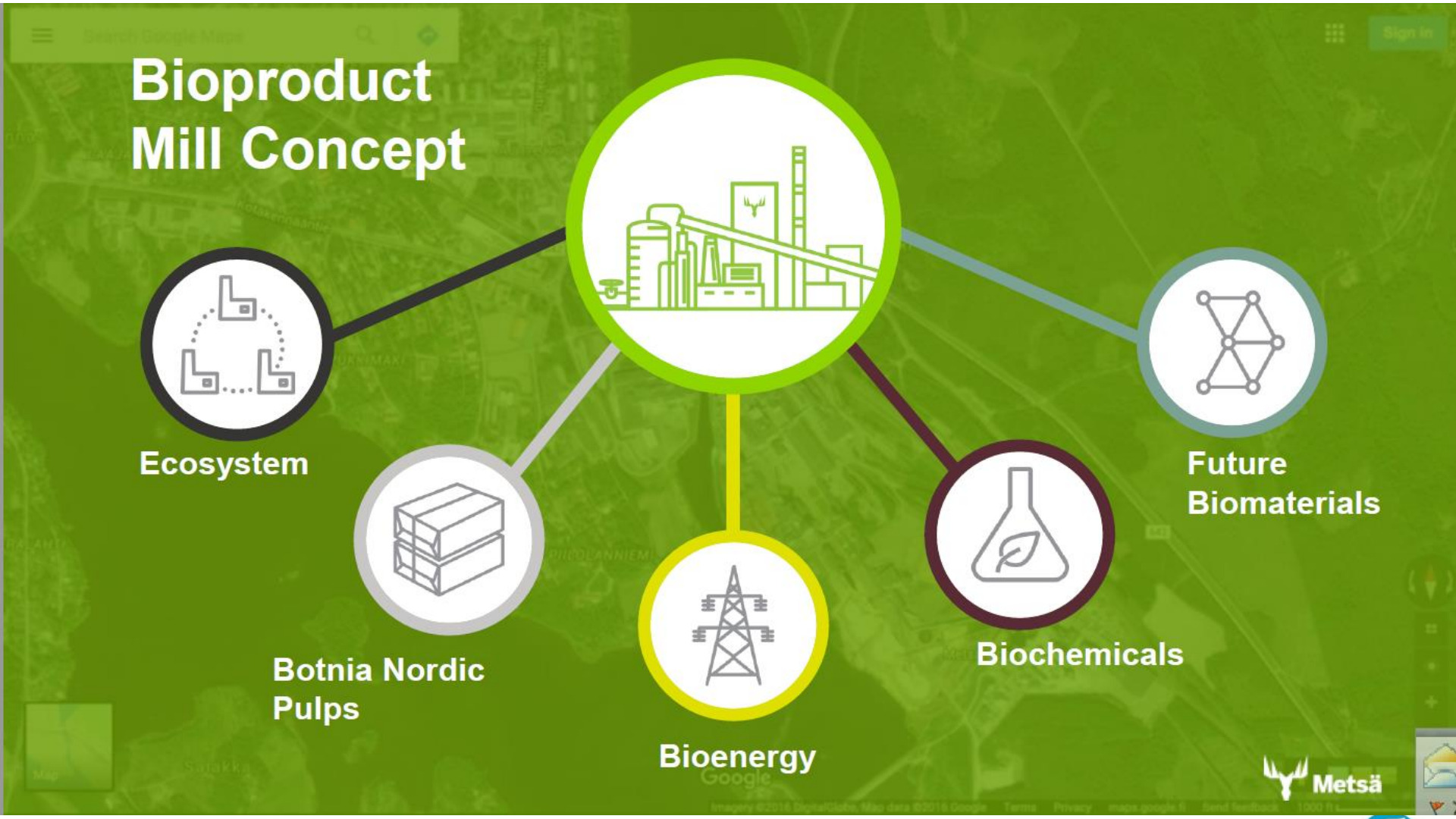
- Bioenergy investments are still continuing
- **Electricity** market has turned unfavorable for bio-based electricity
  - Wind power, high storage levels in water systems
  - In 2019 prices are rising

Use of **industrial wood residues** for energy production is increasing

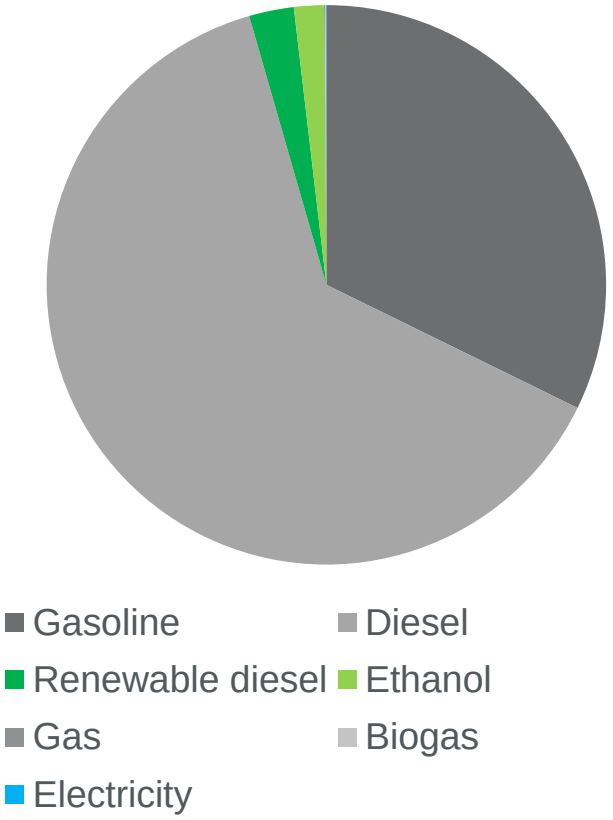
- Cost efficiency by improved utilization of existing harvest and transport fleet responds to increasing and diversified raw material demand
- Integration of dispersed information systems to rationalize the logistic of operations
- Balancing seasonal fluctuation of procurement operations and reducing of soil damage

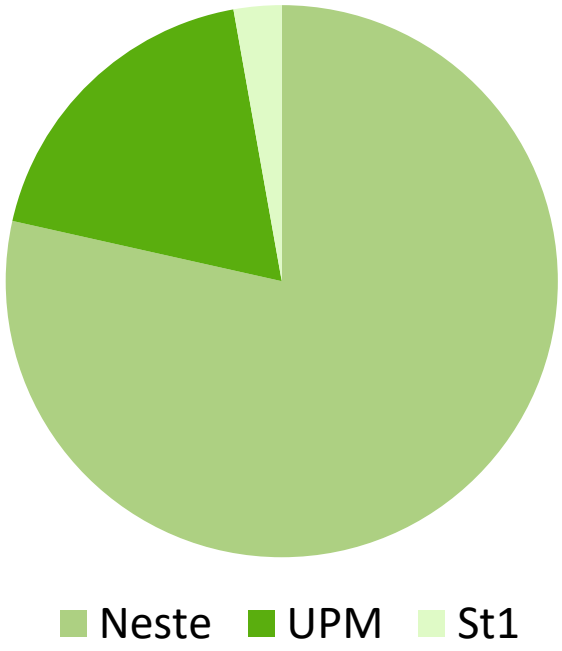


Bioproduct mill concept – Metsä Group

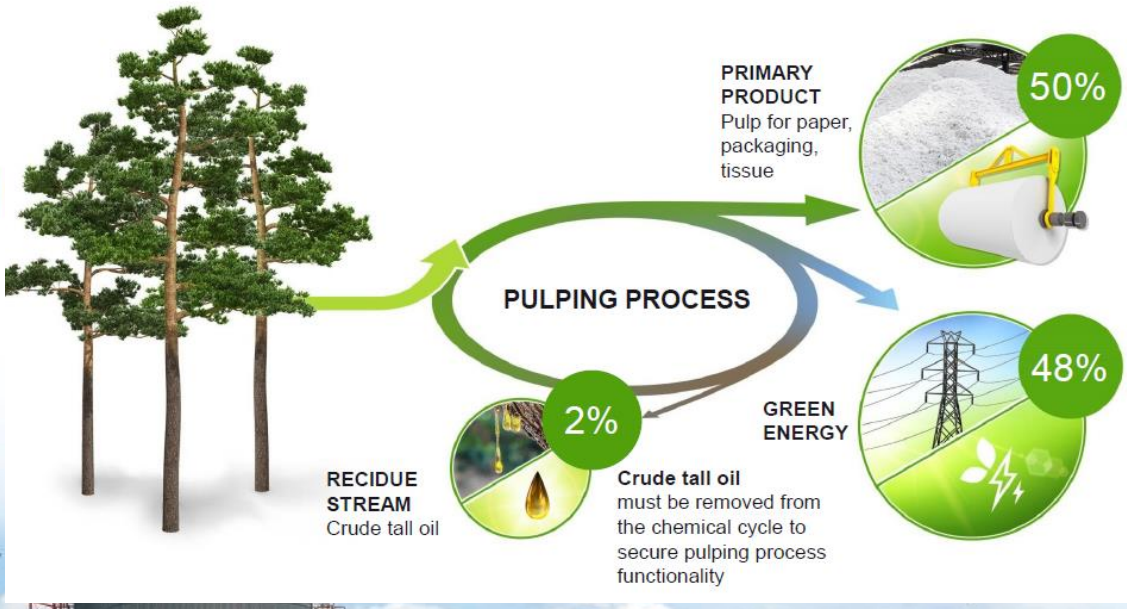


Only 5% of transport is green in Finland, production in 2016 totalled 535ktoe





Wood-based diesel – UPM Concept



The Biofore Company UPM

Key facts:

- Product: Renewable diesel
- UPM investment: 175 M€
- Capacity: 120 million litres/a
- UPM Patents & Applications: 200
- Employment: 200 persons
- Contributes approximately 25% of Finland's biofuel target 2020

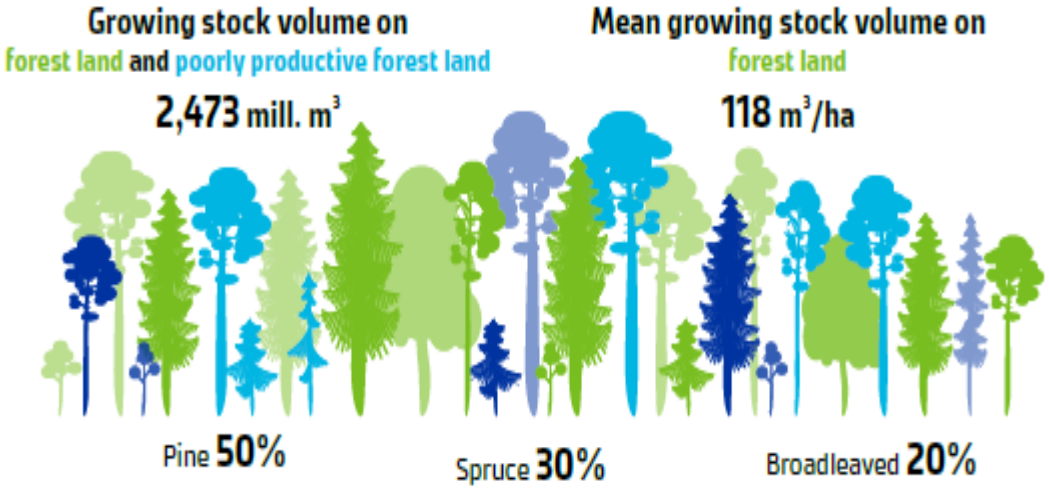
Pyrolysis oil concept – Fortum&Valmet

- Annual production capacity 50 000 tonnes of oil (Joensuu unit)
- Annual wood use 250 000 solid m^3 per year (100 000 dry tonnes)
- Overall energy efficiency of the integrated system: 90%
- Investment cost: 32M€, subsidised 8M€ by state.

Forest fires and forest management in Finland

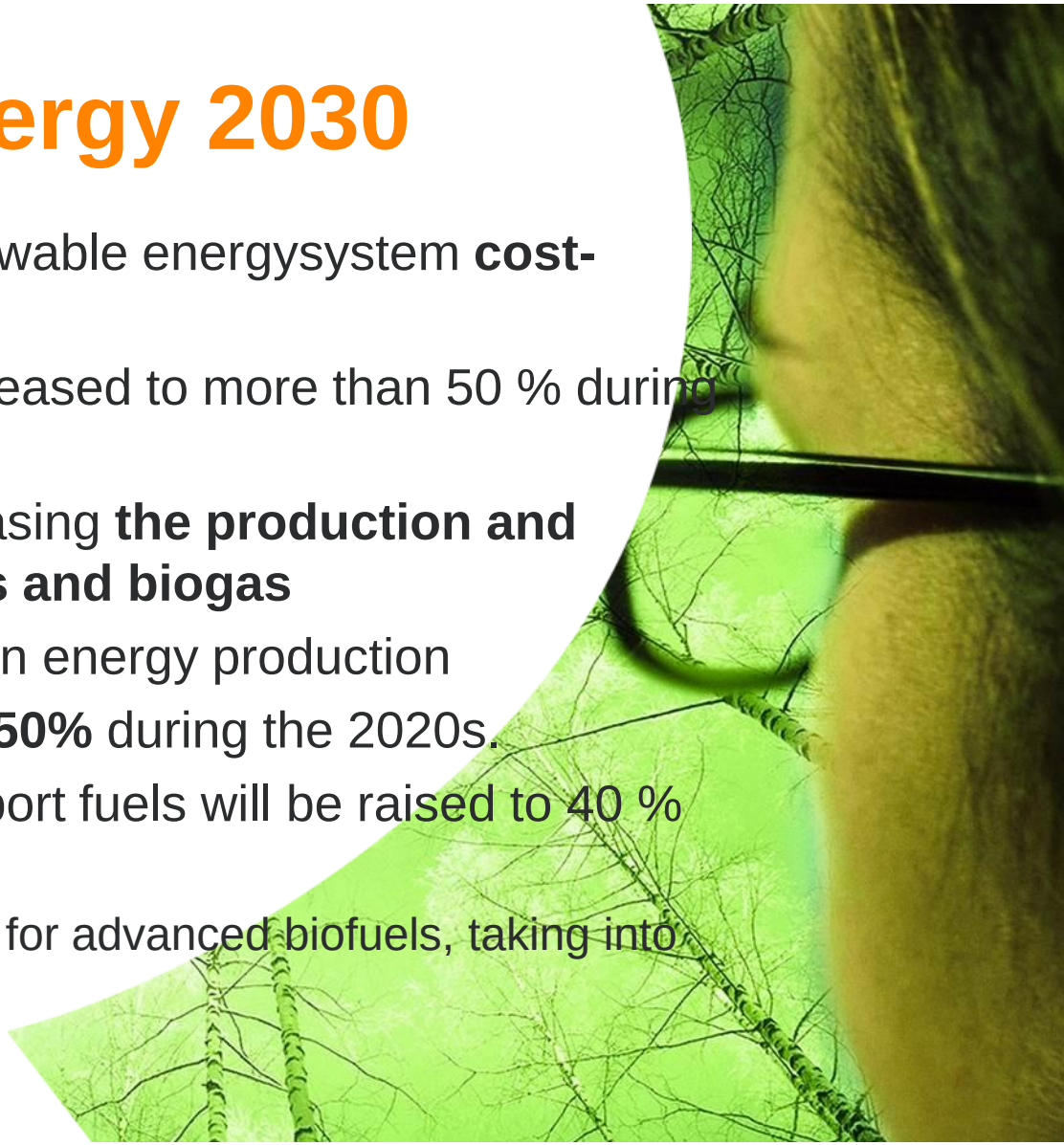
- Use of thinnings in forest management
  = Nordic forest fuel treatment
- Forest fire prevention system
  - Early detection
  - Effective forest fire suppression
    - Forest road network

Siitonen et al 1995



Finnish bioenergy 2030

- Towards carbon-free and renewable energysystem **cost-efficiently**
- Renewable energy will be increased to more than 50 % during the 2020s
- This will be achieved by increasing **the production and technology of liquid biofuels and biogas**
- **Coal will no longer be used** in energy production
- **The use of oil will be cut by 50%** during the 2020s.
- The share of renewable transport fuels will be raised to 40 % by 2030.
  - Clarification: Double counting for advanced biofuels, taking into consideration also electricity

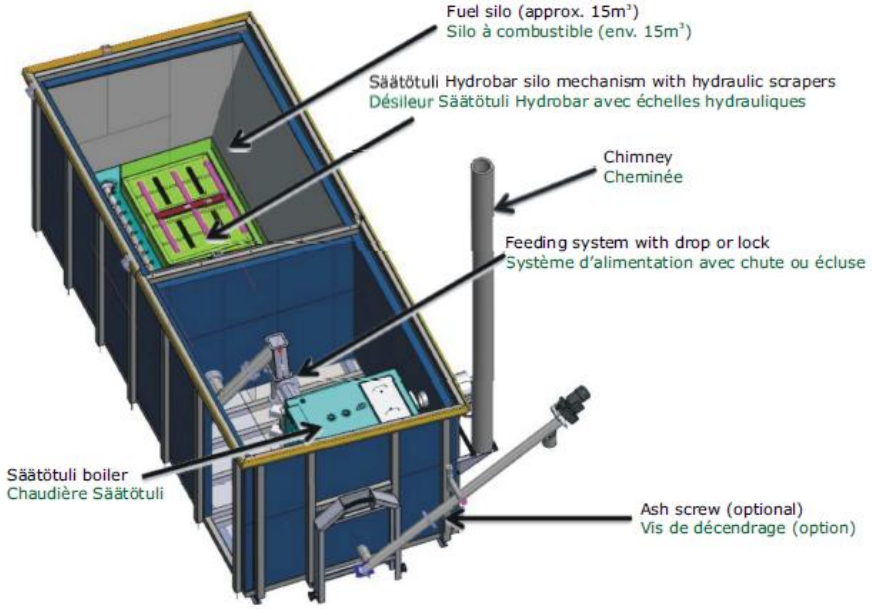


Heat 80-150 kW

Laho_sm... saatotuli-biocont.pdf ×

80 - 150kW multi-fuel series
Gamme 80 - 150kW poly-combustible

Extra-fast delivery:
Livraison extra-rapide:



Heat 2 MW

Veto Cont L and D-models
- Nominal rating: 500-2 000 kW
- Silo volume: 40-120m³
- Outer dimensions: (height 4.5 m)

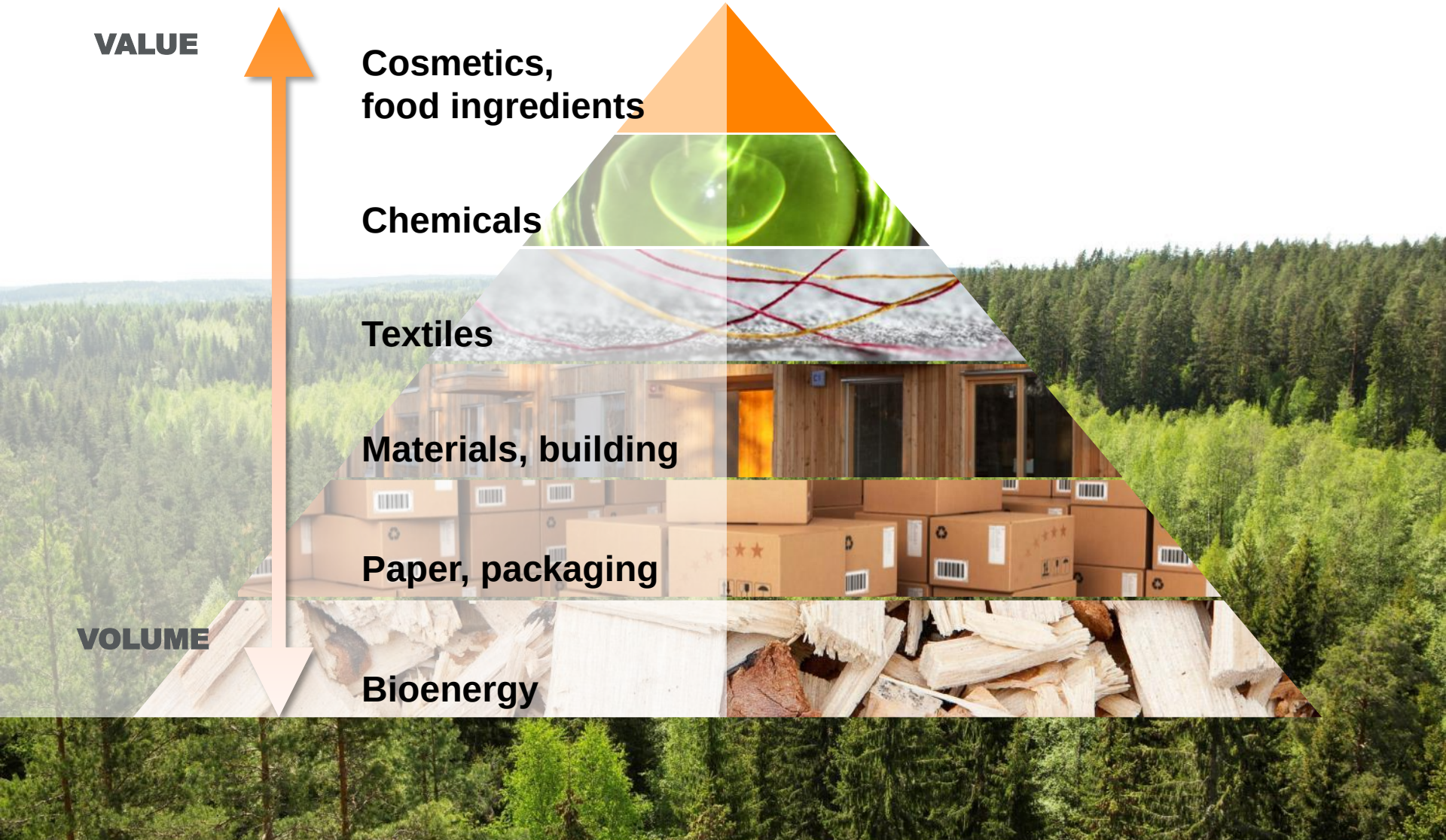
Electricity 40 kW, heat 225 kW

VOLTER

YOUR OWN ELECTRICITY FROM WOOD

Towards a multiproduct bioeconomy

Sustainable utilization of the raw materials to various products with different values, no waste production




Merci – Thankyou!
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