

# Regional and local use of forest energy in North Karelia, Finland



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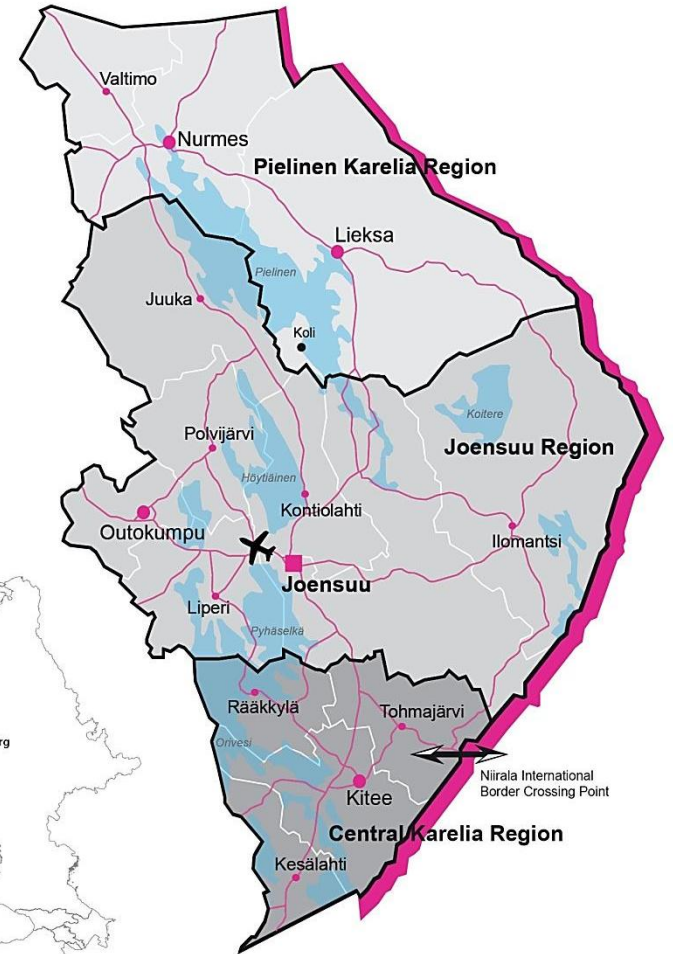
**If ever Finland was the wood energy country, it certainly is now... while mean solid biomass consumption per capita was 1.4 toe, which is by far and away the highest ratio of any EU country.**

*EU report 2012: The State of Renewable Energies in Europe*



# North Karelia

- One of the 18 provinces in Finland
  - Area 21,585 km<sup>2</sup>
  - 166,000 inhabitants
  - Density 7.7 persons/km<sup>2</sup>
- The easternmost region in the continental EU
- 300 km common border with Russia
- Three regions
  - Pielinen Karelia
  - Joensuu
  - Central Karelia



# Province of forests & forestry

- Forested area 1.49 million ha
- 89.7 % of the total land area
- 57 % private, 20 % companies, 20 % state, 3 % public
- Forest annual growth over 8 Mm<sup>3</sup>
- Annual felling 4.2–5.4 Mm<sup>3</sup>
- Forest industry
  - Enocell pulp mill (StoraEnso)
  - UPM plywood mill
  - Pankaboard board mill
  - Sawmills
  - Wood product companies
  - Forest technology & machinery
    - John Deere, Kesla, Pentin Paja, OM-Waratah*



# Strong in forest energy and bioeconomy

- Joensuu is acknowledged as the forestry capital of Europe
  - Education and research institutes
  - A wide range of companies
  - Wenet network

## **Wenet key members & partners**

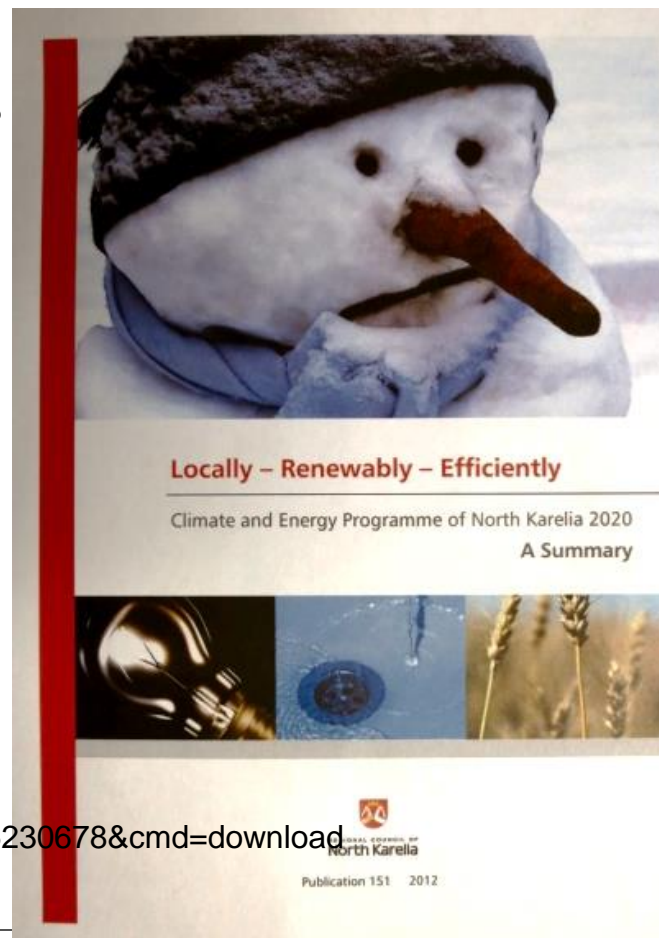
- Finnish Forest Research Institute (Metla)
- Karelia, Savonia and Mikkeli Universities of Applied Sciences
- Joensuu Science Park Ltd
- University of Eastern Finland (UEF)
- Lappeenranta University of Technology (LUT)
- Kajaani University Consortium
- Finnish Forest Centre, North Karelia Unit
- European Forest Institute (EFI)
- VTT
- Regional development companies in Eastern Finland
- Companies within wood energy business
- Power plant and boiler manufactures

# Climate and Energy Programme of NK 2020

- Previously three Bioenergy Programmes since 1991
- “Energy” emphasises renewables and energy efficiency in the new one
- Sustainable use of forest resources based on reliable statistics
- Includes also
  - Land use planning and Construction
  - Transport
  - Forestry
  - Agriculture
  - Waste Management

Available:

[www.pohjois-karjala.fi/dman/Document.phx?documentId=jx03212095230678&cmd=download](http://www.pohjois-karjala.fi/dman/Document.phx?documentId=jx03212095230678&cmd=download)



# Statistics

- Regional Council has collected data on energy use and CO<sub>2</sub> emissions in 2004, 2008 (*and 2013, in operation*)
  - Total energy use 10,4 TWh
  - Share of RES 63 % of total energy use in NK
  - Wood based energy 82 % of RES

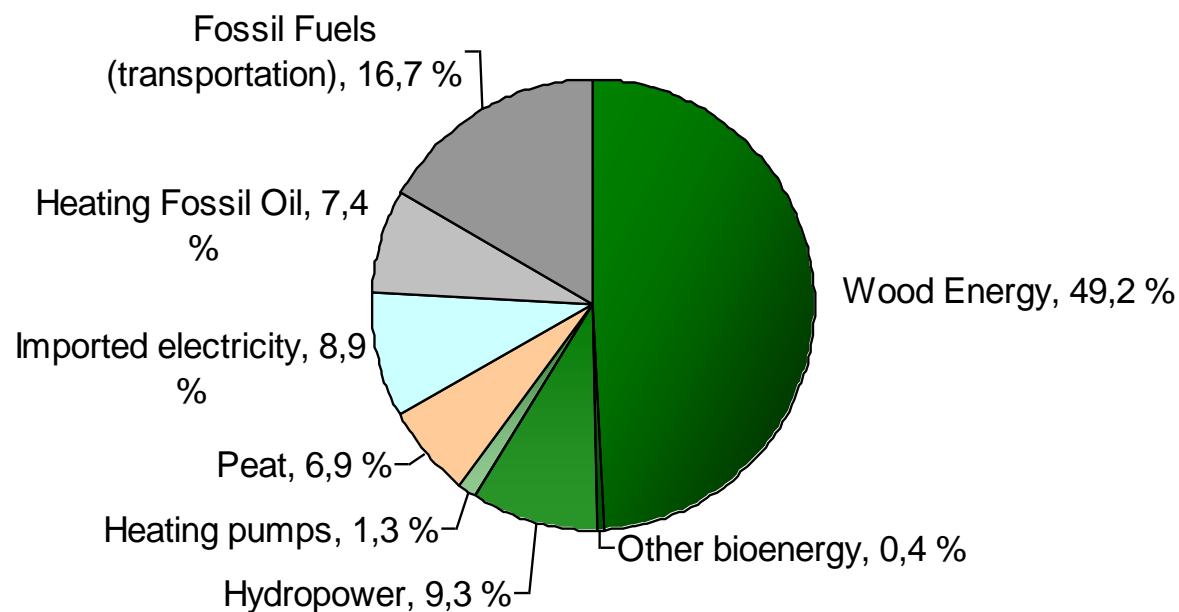




# Energy use by sources in North Karelia

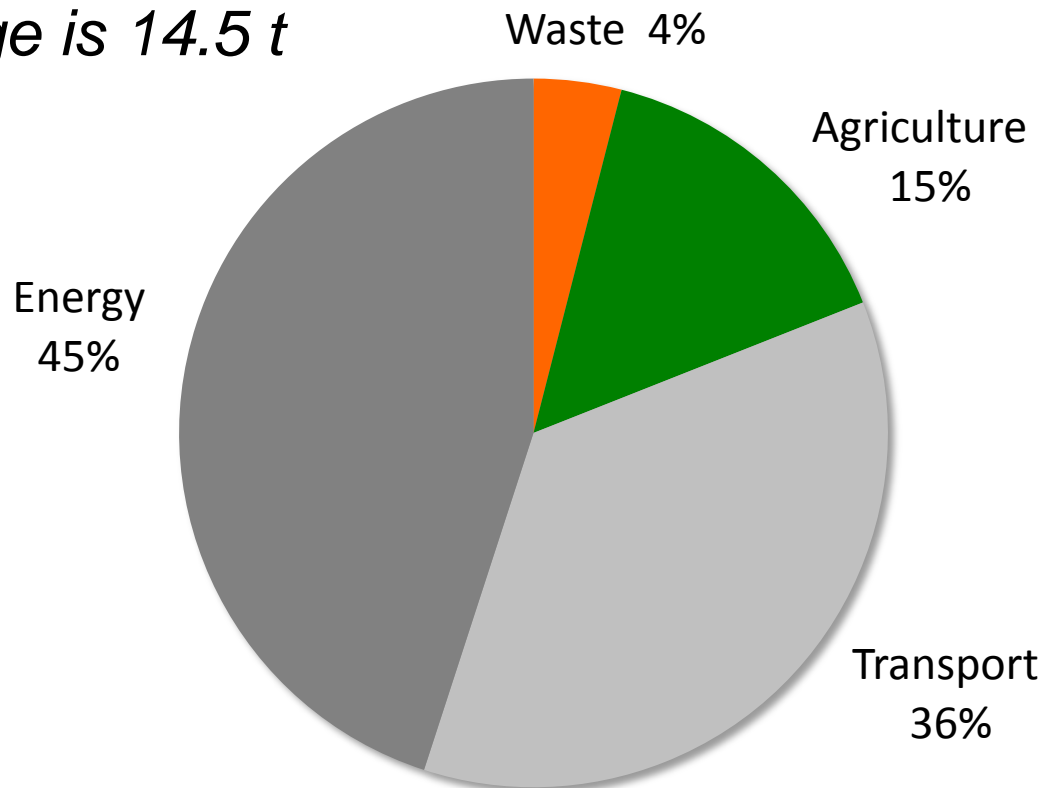
## North Karelia Energy Use in 2008

(Renewables 63 %)



# CO<sub>2</sub> emissions in NK

- Greenhouse gas emissions in North Karelia accounted for 1.6 million tons of CO<sub>2</sub> ekv, e.g. 9.5 t per capita (2007)
- *In Finland the average is 14.5 t*



# Economical and social impact of the RES in NK



- The growth of employment was 60 % and of turnover 140 % within RES sector in 2004–2010
- Number of companies: over 120 (2008)
- Turnover: ca 200 M€ (2010)
- Employment: 1300 man-year (2010)
- More than 30 on-going projects within bioenergy or energy efficiency



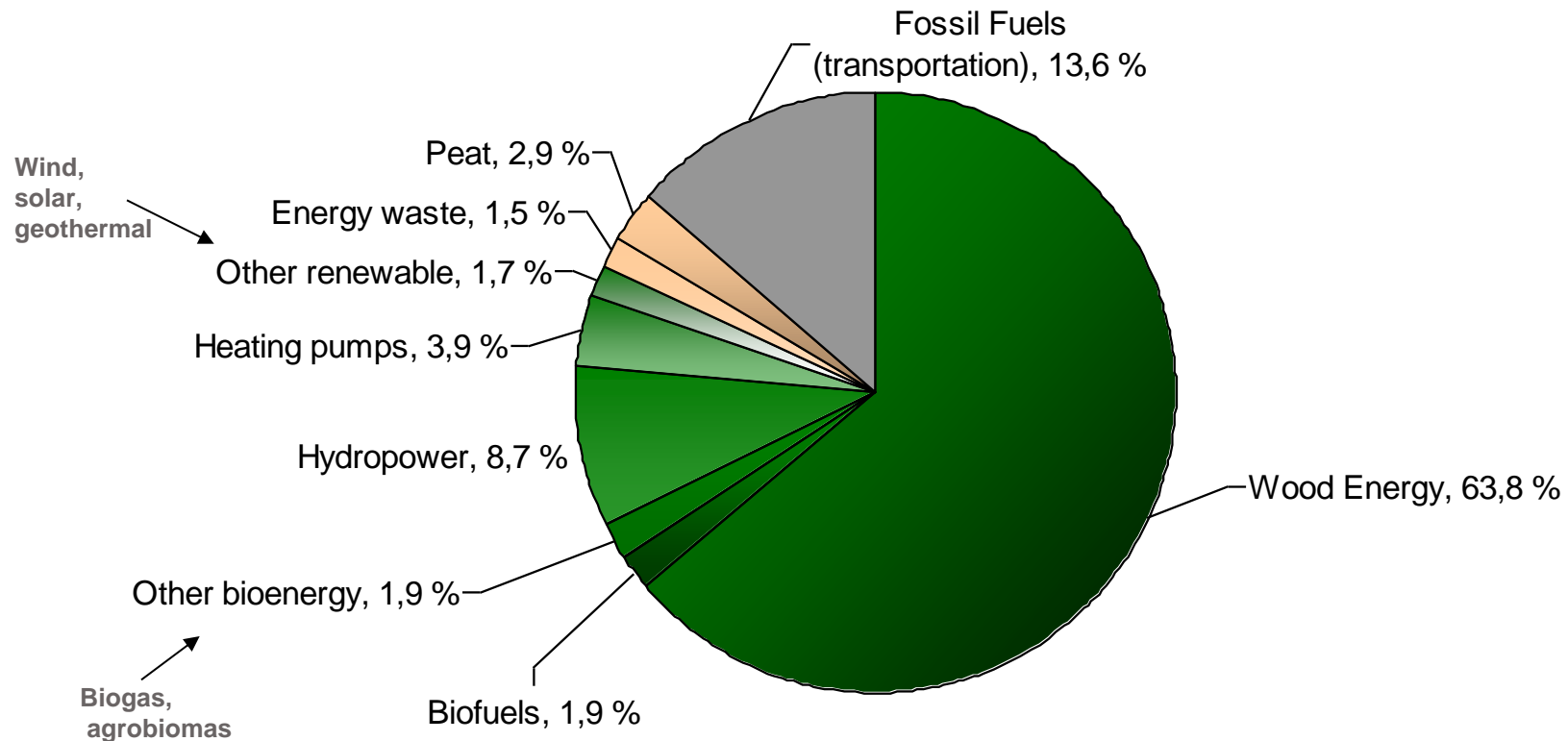
# North Karelia's main target 2020/2030

## *Fossil Oil Free Region in heat and power generation 2020 and Fossil Oil Free Region 2030*

- Improve energy efficiency
- Increase the use of RES, especially forest energy
- Decrease of CO<sub>2</sub> emissions
- Promote of regional and local measures/implementation
- Strengthen businesses within RES in the region
- Further development of the transfer of Finnish know-how and technology to other countries (Wenet activities)
- **Benefit: support of regional and local economy**

# Target for energy use in 2020

## North Karelia Energy Use TARGET 2020 (Renewables 82 %)



# Targets to decrease the use of fossil oil



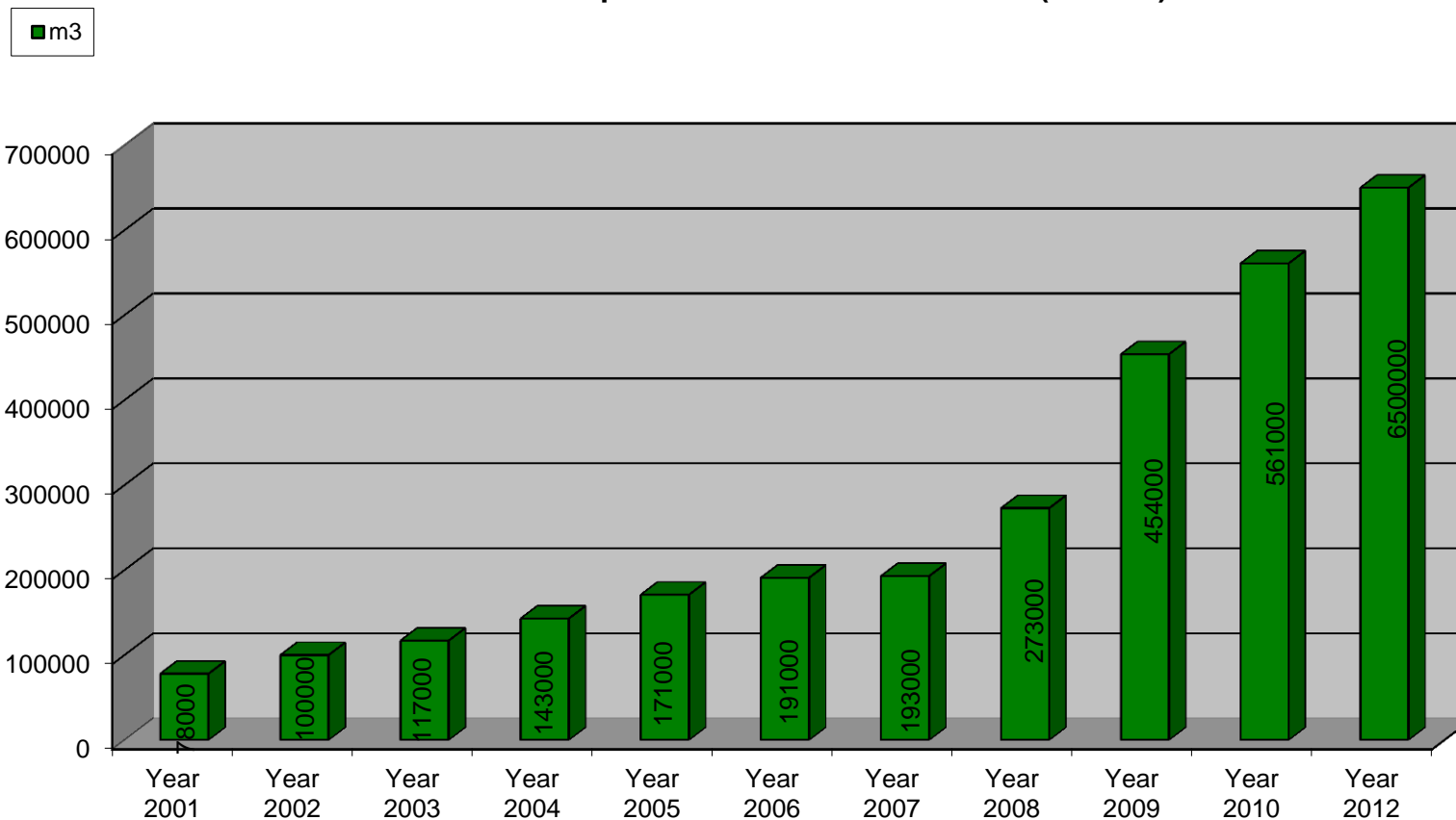
- The energy consumption 10 TWh
- The share of RES over 80 % of total energy use
- Heat is generated almost totally by RES
  - Today: 5200 single family houses and 1100 detached houses heated by oil in NK
- Power is generated by RES exceedingly (more than energy self-sufficient region)
- The production of traffic biofuels is more than 20 % of the energy used for transport in NK

# Use of wood chips in NK

2013: 1.3 TWh, 13 % of total energy use

2020: 2.0 TWh, 20 % of total energy use

The use of wood chips in North Karelia 2000-2012 (MetInfo)



# Large scale investments in biofuel production

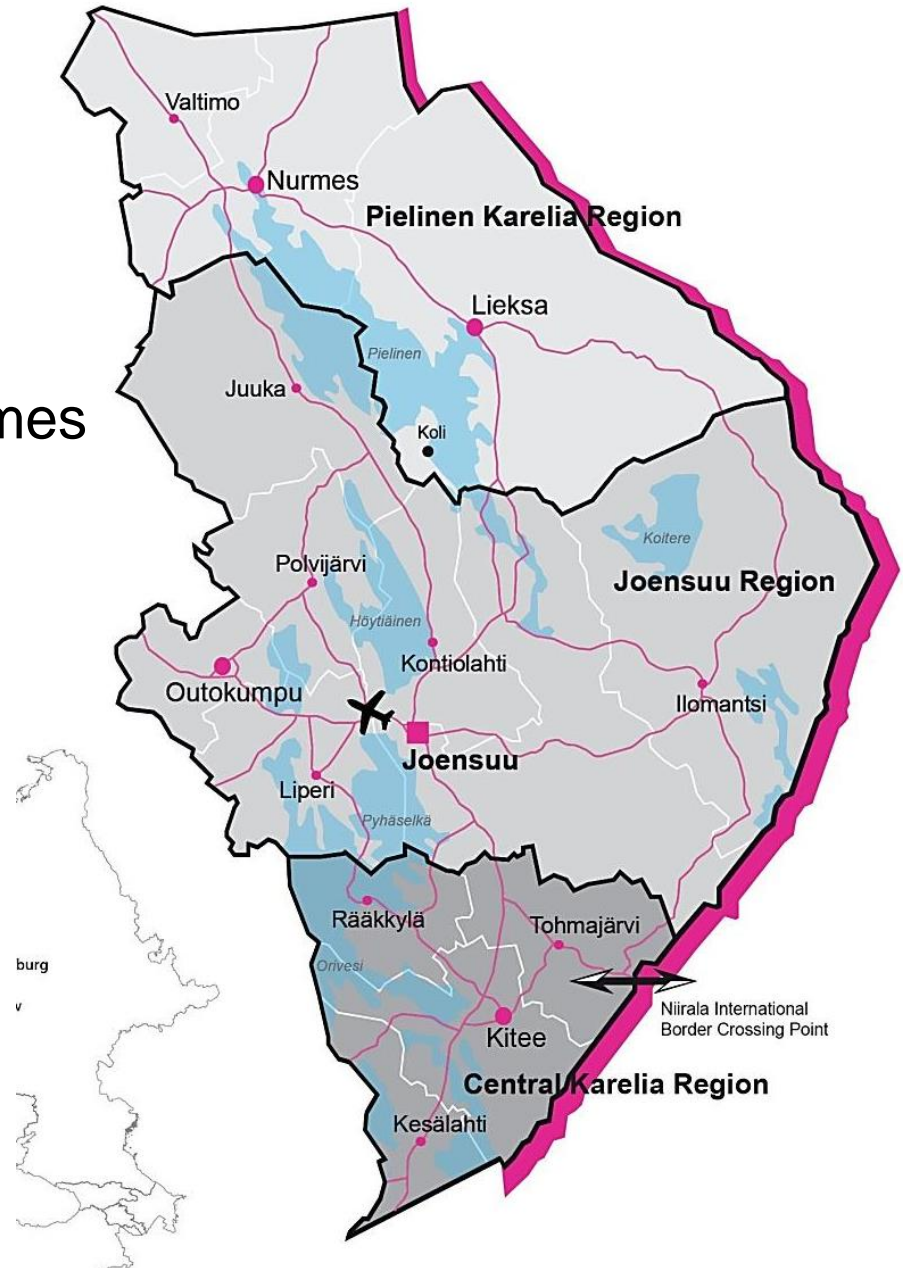


- Fortum is building a **pyrolysis oil** plant in Joensuu
- Integrated to a 200 MW CHP plant (chips & peat)
- Ready for production November 2013
  - Bio oil production capacity 50,000 t/a
  - Additional need for wood chips 225,000 s-m<sup>3</sup>/a
  - Recent use of wood chips 300,000 s-m<sup>3</sup>/a
- 60-70 new jobs



# Pielinen Karelia

- Northernmost region of NK
  - Land area 5820 km<sup>2</sup>
  - 23,000 inhabitants
  - Density 4 persons/km<sup>2</sup>
- Distance from Joensuu to Nurmes is 130 km



# Large scale investments in biofuel production



Green Fuel Nordic Biojalostamo  
Lehtomäentie 166  
11300 LIEKSA 74120  
Puhelinnumero: 044 20000000  
Pöytänumero: 044 20000000  
Sähköposti: info@greenfuel.fi  
www.greenfuel.fi  
10.7.2013

- Green Fuel Nordic has planned to invest ca 130 M€ in three fast **pyrolysis oil** plants in Eastern Finland, including Lieksa in Pielinen Karelia
- Ready for production in 2015?
  - Bio oil production capacity 90,000 t/a
  - Need for wood 300,000 s-m<sup>3</sup>/a (equal to 450 GWh/a)
- 70 new jobs

# Large scale investments in bio coal production

- FeedStockOptimum has planned to invest 20-30 M€ in **bio coal & bio oil plant** in Nurmes in Pielinen Karelia
- Ready for production in 2015-16?
  - Bio coal production capacity 100,000 t/a
  - Bio oil production capacity 90,000 t/a
  - Need for forest wood ca 800,000 s-m<sup>3</sup>/a (1.9 Mm<sup>3</sup>/a chips)
- 270 new jobs + 400 indirect jobs



# LOCAL MEDIUM SIZE CASE: Eno Energy Co-operative



# Case Eno: From oil to wood chips



- Idea to replace heating oil by wood chips was born in 1996
- Eno Energy Coop (EEO) was established 15.9.1999
- Members 12 (today the number over 50)
- Operation started in 2000 with fuel supply for the Eno Upper village heating plant (0,8 MW boiler) owned by the municipality
- Next two heating plants with DH network systems were invested by the EEO
- Uimaharju, 2002, 1 MW and 2006, 1 MW
- Eno Lower village, 2004, 0,8 and 1,2 MW
- EEO manages altogether 8 biomass boilers by total capacity of 9,66 MW in Eno and other villages

# Case Eno

- Today EEO runs all the three heating plants in Eno
- Total volume of the heated buildings: 266 000 m<sup>3</sup>
  - Need for heat production: over 16 000 MWh
  - Corresponds with 800 single-family houses
  - Length of pipelines totally almost 9 km
- Need for wood chips: 27 000 l-m<sup>3</sup>
  - 25 % from the cooperative members
  - Rest from other local forest owners
  - 80–90 % from thinnings of young forests
  - 10–20 % is residues from final fellings



# Benefits in Eno

## Ecology

- 2 million litres of heating oil is annually replaced by local wood fuel
  - Oil use as back-up is less than 10.000 l/a
  - Pellets are used as back-up at the Uimaharju plant
- CO<sub>2</sub> emissions have decreased by more than 5,000 tonnes per year
- Productivity of local forests has increased as well as their ability to act as carbon sinks

## Economy and Social

- 7–10 jobs have been created by the EEO
- Over 2 M Euro is annually used to support the local economy
- The price of wood based heat for customers is cheaper than that of oil (65 € vs. 110 €/MWh; VAT incl.)

# First farm-scale CHP based on forest biomass

- The Kuittila farm, located in Nurmes, established a small-scale combined heat and power (CHP) plant in December 2012.
- Aim is to reduce the energy cost, improve the security of energy supply and eventually become self-sufficient.
- The farm has 160 dairy cows, the same number of young cattle, and two milking robots.





## Farm-scale CHP in Nurmes

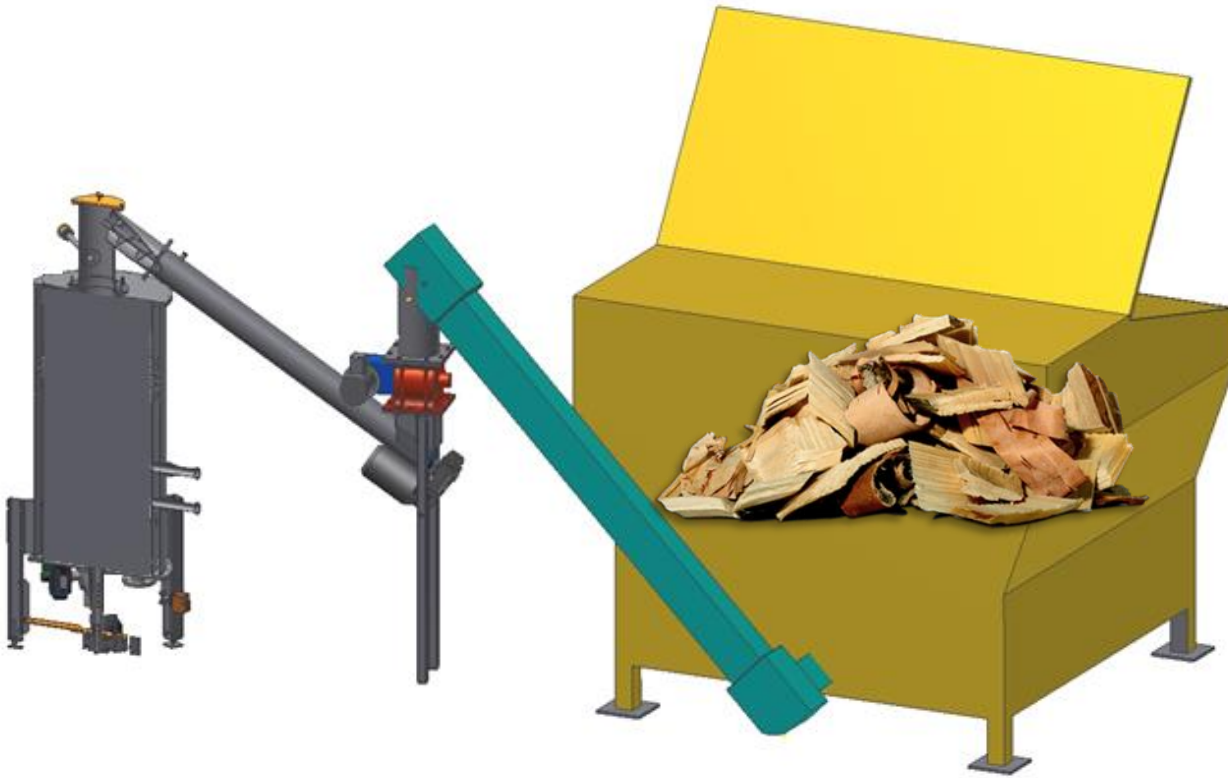
- The CHP plant is based on the gasification of wood chips.
- The 140 kW (40 kW electricity and 100 kW heat) plant can produce annually up to 1,200 MWh of energy.
- Wood chips are gasified to process gas (incl. CO, H<sub>2</sub>, CH<sub>4</sub>) that is used to run a combustion engine (AGCO Sisu Power) to produce electricity.
- The plant uses annually about 1,400 m<sup>3</sup> of wood chips dried (less than 20 % of moisture) by using natural drying and excess heat from the plant.



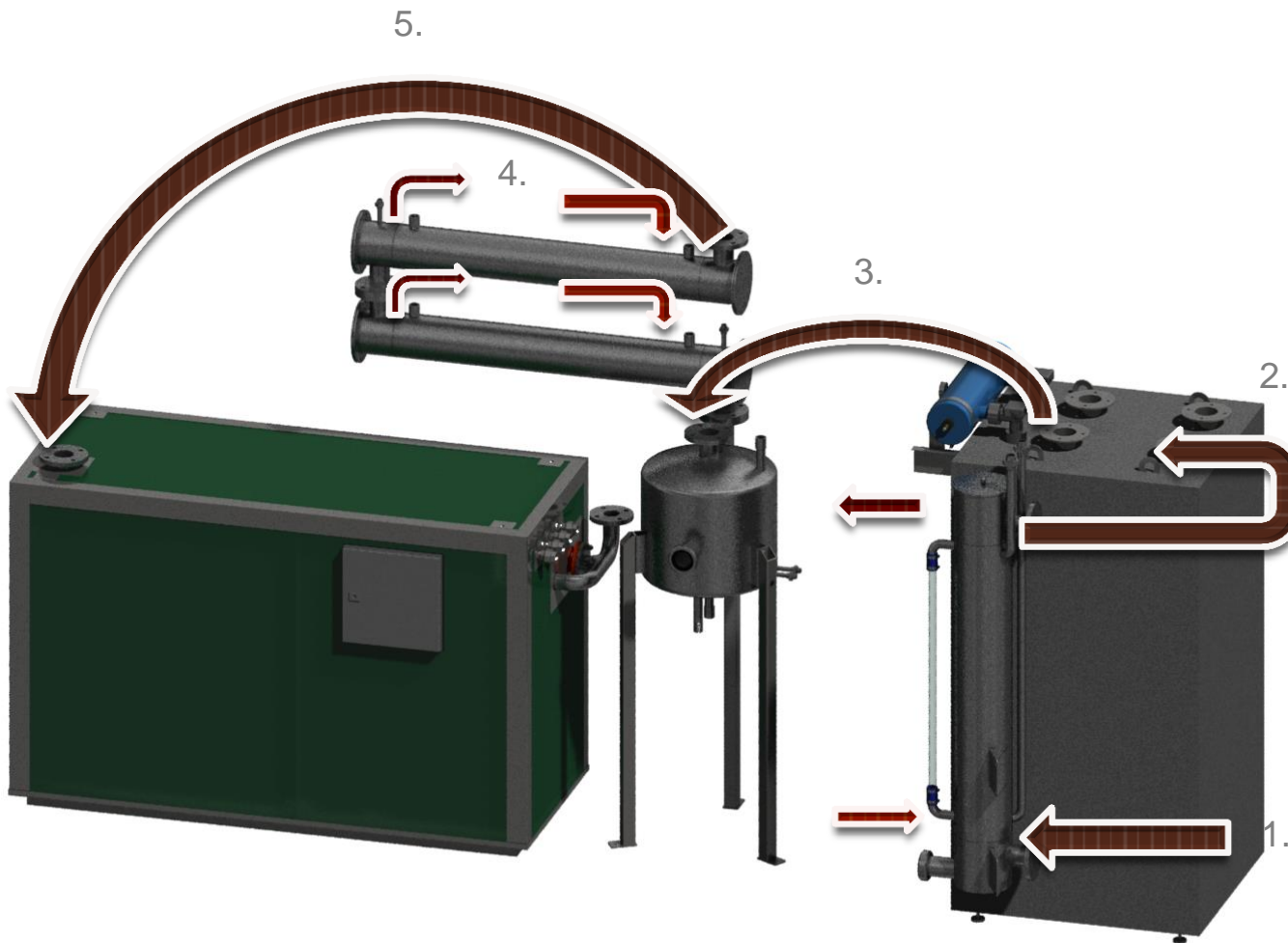
# Gasification and small scale CHP



- Wood chips are fed from the silo by screw and chain conveyors

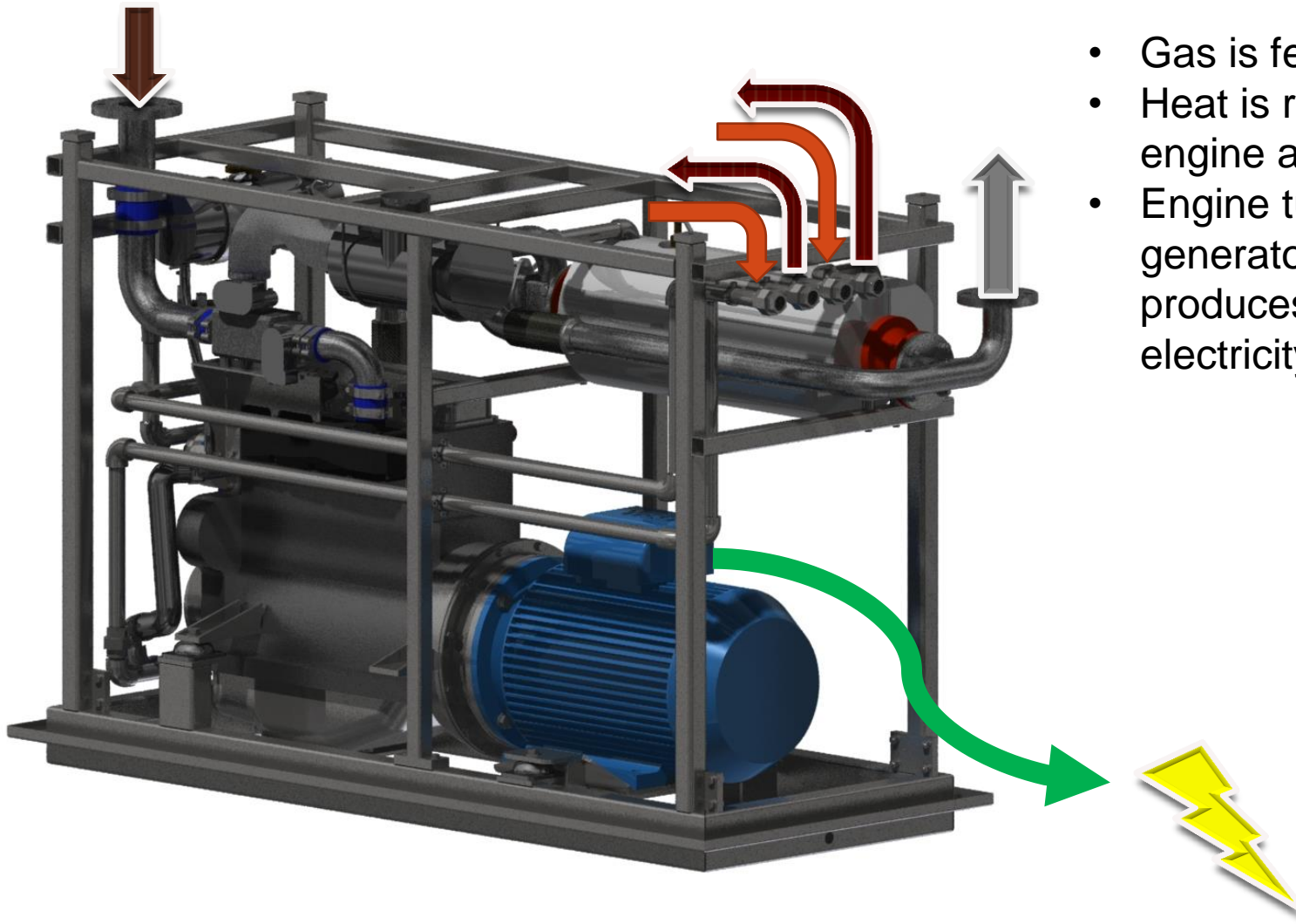


# Gas cooling and filtering



1. Cooling before the filtering phase (heat recovering)
2. Dry filtering system
3. Washing the gas
4. Cooling to the final product gas (heat recovering)
5. Cooled and filtered gas to the motor

# Heat and electricity from the gas



- Gas is fed to the engine
- Heat is recovered from engine and exhaust gas
- Engine turns the generator which produces clean electricity

# Thank you for your attention!

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