Socio-economic benefits of bioenergy systems
Case examples from Pielinen Karelia

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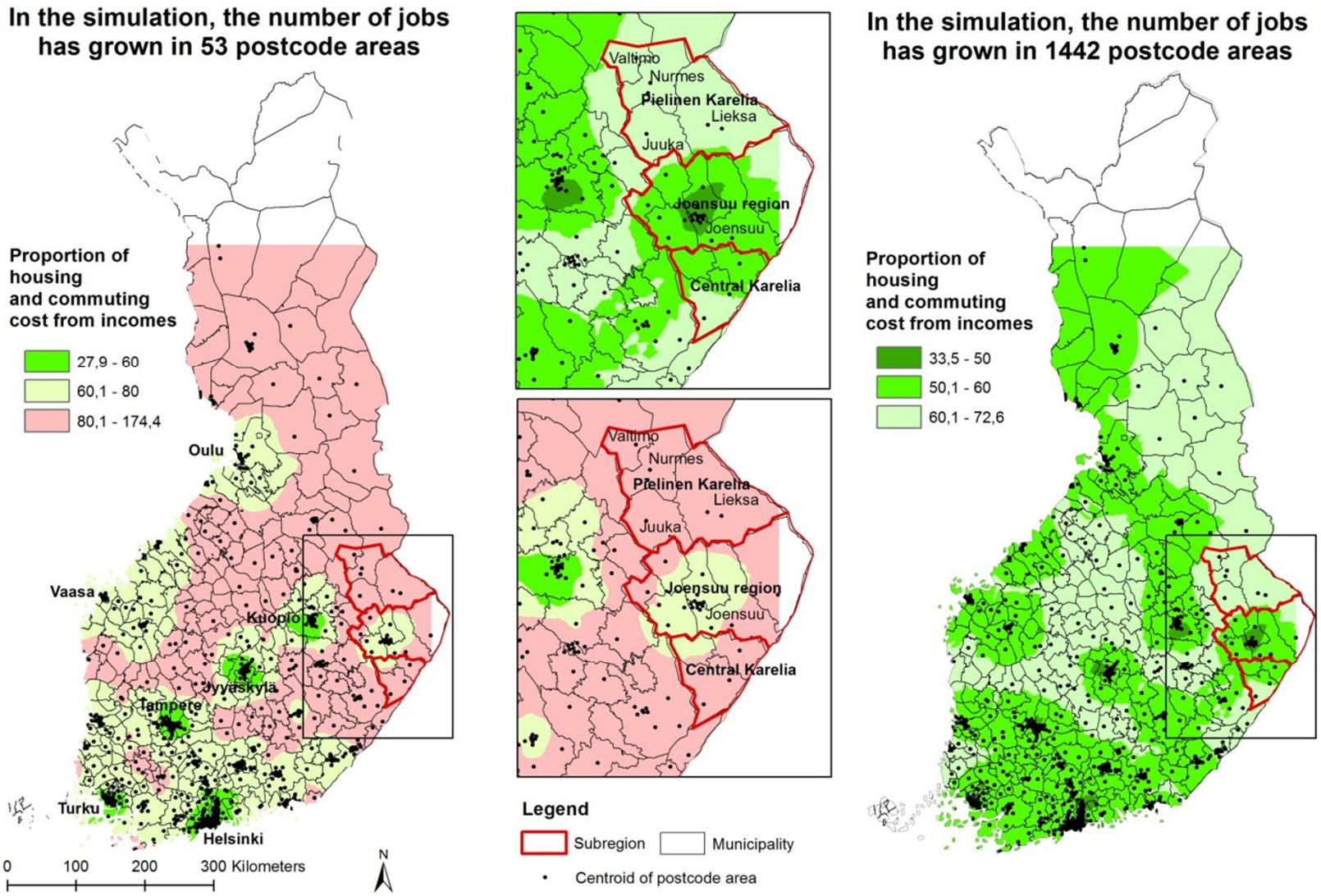
Local Development Project

- Pielinen Karelia Bioenergy (2011-2014)
  - Coordinated by the local development company PIKES Ltd.
  - Development of bioenergy-based businesses (mostly SMEs) in Nurmes, Lieksa and Valtimo
  - Farm-scale bioenergy systems (chp based on local forest fuels, farm-scale biogas), pre-studies on bio char production, chopped firewood, heating based on woodchips etc.

  - On-going task: Analysis of socio-economic impacts of the bioenergy systems

Local Development Project



Lehtonen & Tykkyläinen 2013; Lehtonen & Okkonen 2013

Case 1:
Combined production of Heat and Power in a local farm

- Kuittila farm, located in Nurmes, established a small-scale heat and power production (chp) plant in December 2012. Aim is to reduce the energy cost, improve the security of energy supply and eventually become self-sufficient.

- A company, Kuittila Power Ltd., was established to provide energy for the farm, and co-located engineering works. In the Pielinen Karelia context, the farm is a large-scale having 160 dairy cows, the same number of young cattle, and two milking robots.

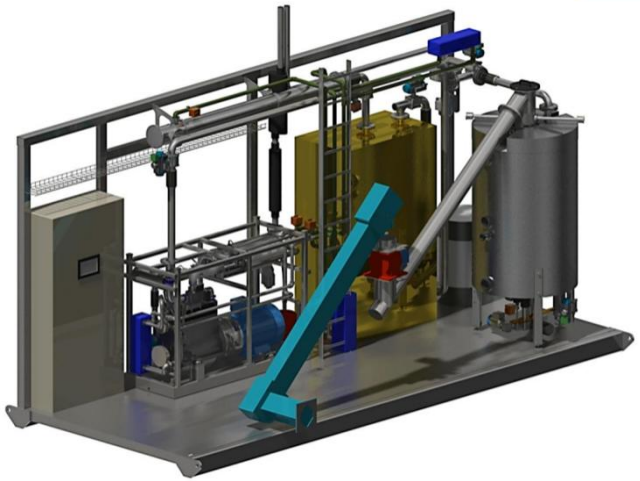
Co-production of Heat and Power in a local farm

Table 1. The energy numbers (kWh/a) of Kuittila farm and co-located activities.

	Electricity	Heat
Barn	250 000	100 000
Engineering works of Ylä-Karjalan Korjaamo Ltd	25 000	25 000
Dryer	0	295 000
Farm buildings	25 000	30 000
Feeding to the public grid	26 000	0
Own use of the chp plant	13 140	0
Drying of woodchips	0	250 000
Total	339 140	700 000

Table 2. Small-scale CHP -unit of Volter Ltd.

Model	Volter 40
Fuel	Forest chips (birch, spruce, pine)
Fuel moisture	<18 %
Fuel particle size	8mm ≤ P ≤ 50mm, fines (<3,15mm) <1%, all <63mm
Container	Length 6m, Width 2.5m, height 3m, mass about.10tn
Container structure	Steel structure, insulation
Colours	According to contract
Fuel feeding	Spring agitator outside the container
Engine	AGCO Sisu Power
Power	Generator 40kW, heat power 100kW
Power input	1,5-2kW
Fuel consumption	Approx.4,5 loose-m^3/24h



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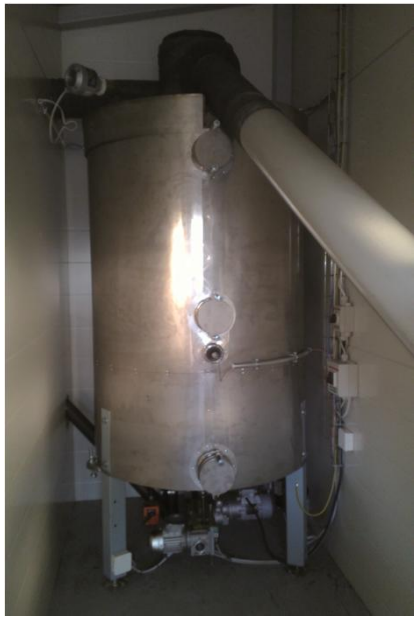
Co-production of Heat and Power in a local farm

- 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 1200 MWh of energy.
- Woodchips are gasified to process gas (incl. CO, H_2, CH_4) that is used in combustion engine (AGCO Sisu Power).
- The plant uses annually about 1400 loose cubic of wood chips that are dried by using natural drying and excess heat from the plant.



Gasification reactor

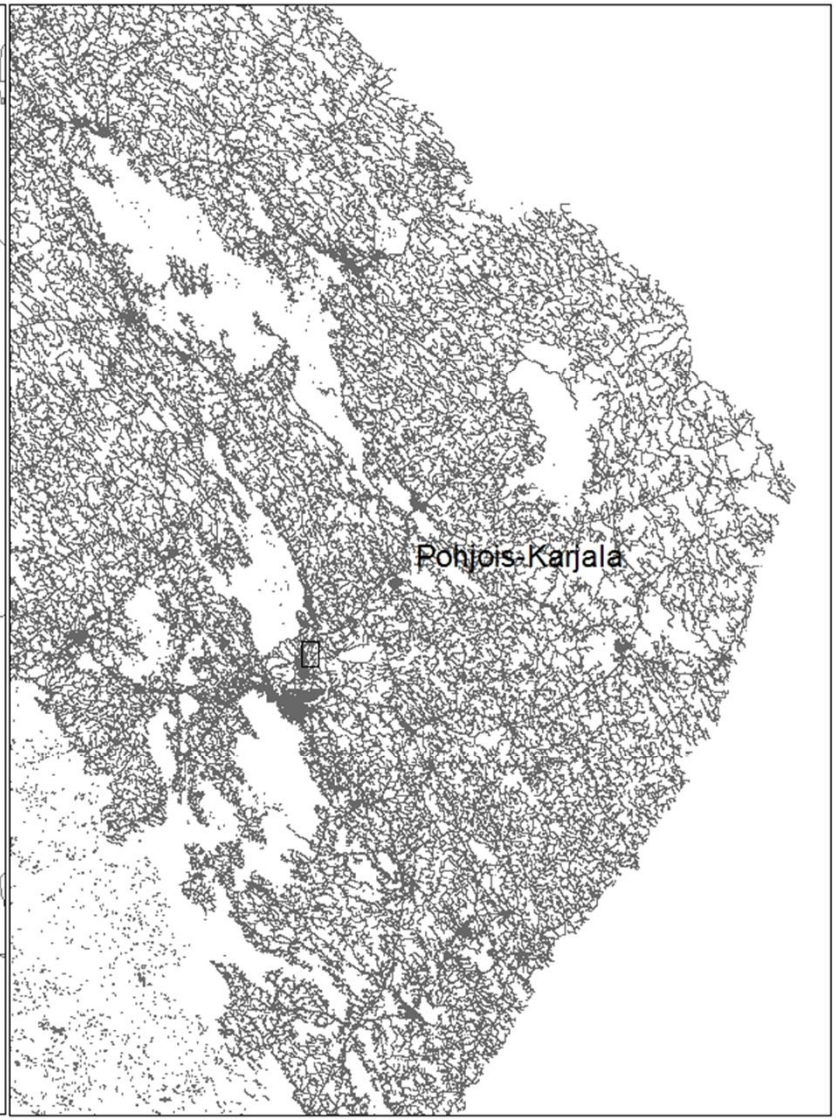
Dryer for woodchips, using excess heat of chp-plant

Fuel storage/silo

Estimated impacts of Kuittila-CHP -plant

- Employment impacts:
  - Investment: 1,25 direct jobs, and 0,8 indirect jobs, total of 2,05 jobs
  - District heat and electricity production: 0,2 jobs
- Regional income impacts (multiplied income of the households):
  - Total income impact of operation, approx. 50 000 €/a
  - And, avoided electricity from the markets, saving of 25 000 €/a, generating additional impact in farming (32 000 €/a as regional income impact)

1st impression of minor impacts…



When bioenergy is utilized in the whole region of Pielinen Karelia, already the impacts of supply-chains are significant (Lehtonen & Tykkyläinen 2010):

If 65% of unutilized forest energy raw-materials are utilized:

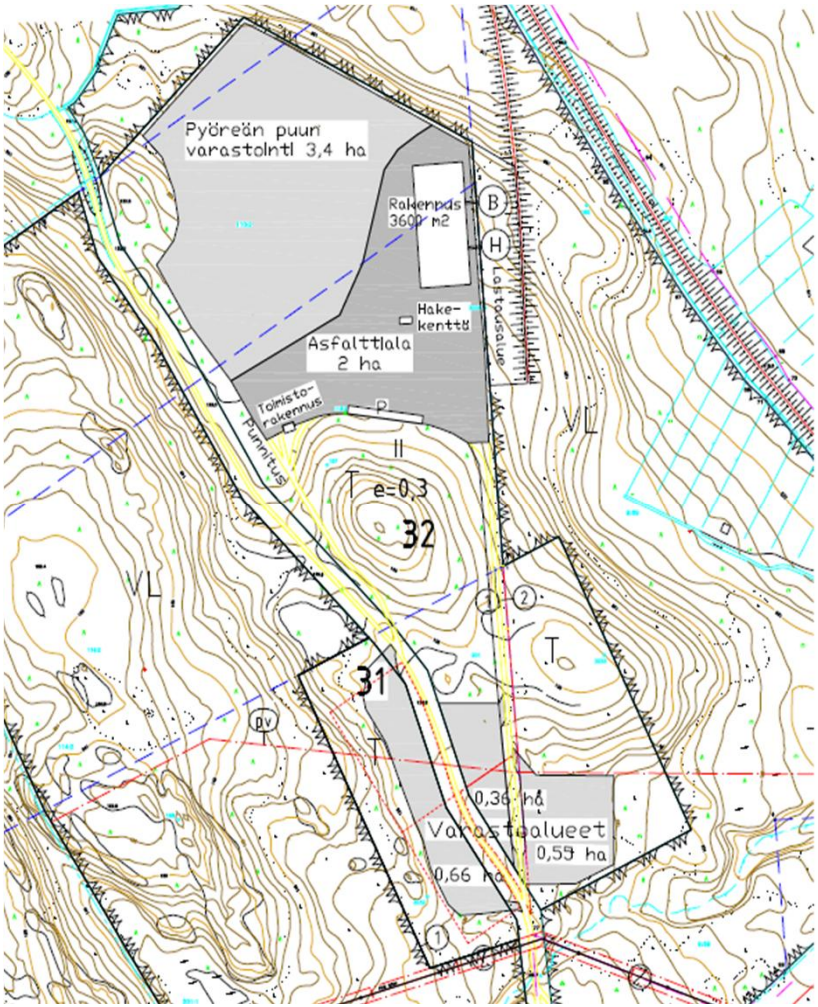
Supply-chain	*Raw-material*	*MWh/ employee*	*Employment need*		*Indirect employment impact*		**Total**	
			Max harv.	*00-05 harv*	*Max harv.*	*00-05 harv*	*Max harv.*	*00-05 harv.*
Residual bundles	Forest residues	~12000	164	111	79	53	243	164
Chipping at the roadside	Forest residues	6153	320	217	154	104	474	321
Integrated harvest	Wood from thinnings	5714	344	234	166	112	510	346
Motor-manual	Wood from thinnings	3582	550	373	264	179	814	552

Case 2) Planning biochar production in Nurmes

- Biochar and Bisel:
  - Biochar is produced by raising the temperature of wood raw material from up to 500 C (slow pyrolysis process). Condensing gases are utilized in bio-oil (bisel) production and non-condensing gases as process energy

- Simulated biochar factory:
  - Need of 350.000 cubics of woodchips, produces about 66.000 tons of biochar and 65.000 tons of bio-oil

Initial location plan for a large scale unit (350 000 cubics of forest raw material)

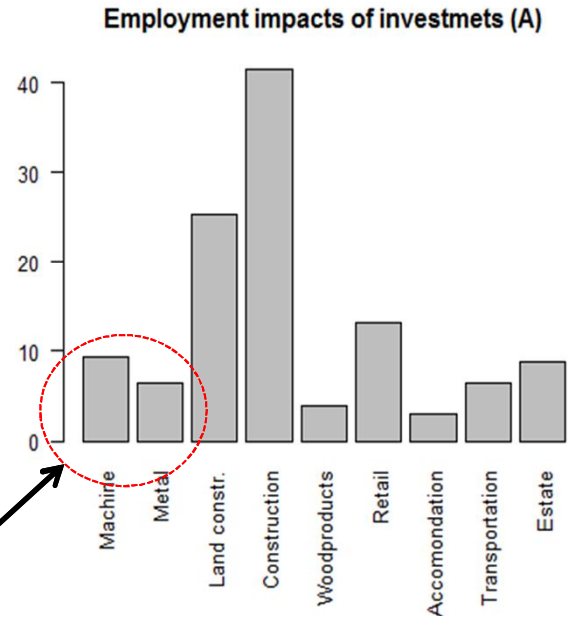


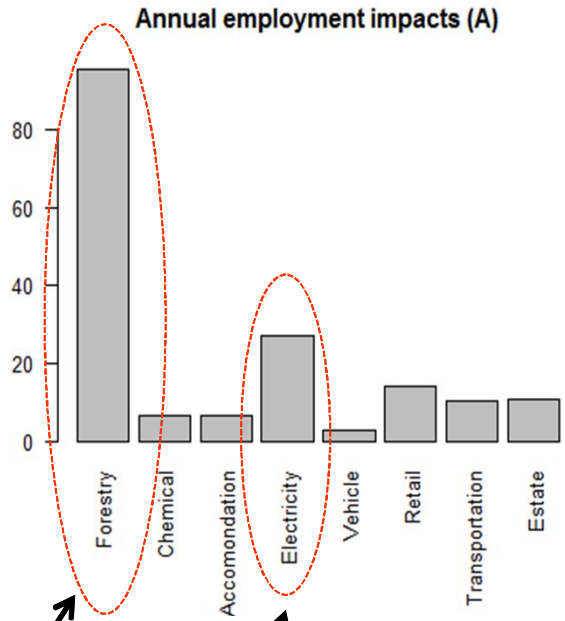
Initial layout of Nurmes biochar production factory. © City of Nurmes. Planning: Jarmo Ylinen, FSO Oy; Lasse Okkonen & Anna-Maija Kontturi, Karelia UAS.

22-30 MEUR investment, turnover annually about 32 MEUR

Local economy: significant total impact, increased local ownership is essential

Impacts of the investment and annual employment impacts, Biochar and bioenergy industry using 350 000 cubics of round wood





Local metal industry
SME cluster

Roundwood supply-chains
incl. terminal operations

Plant operation

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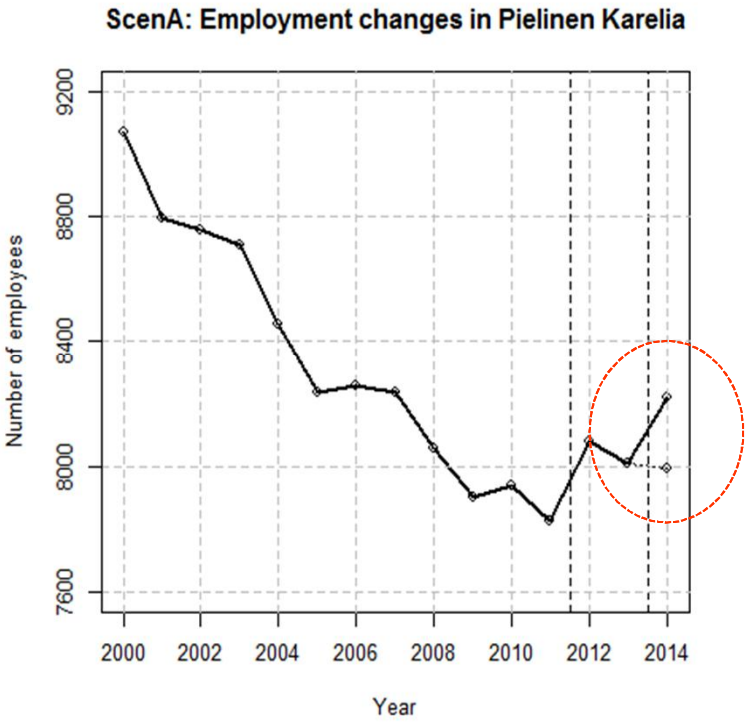
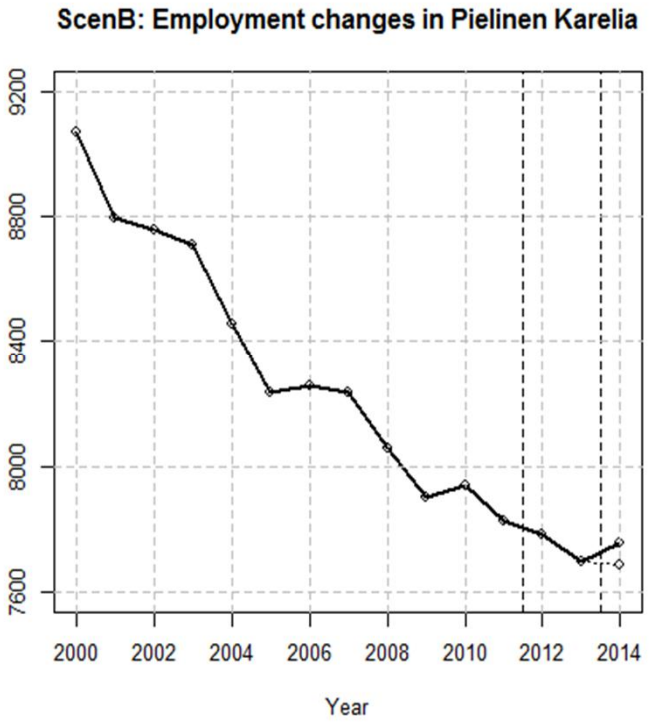
Employment impacts

- The annual employment impacts of the municipality bioenergy strategy mostly concentrate on forestry due to extensive use of local forest resources in charcoal production.
- The total increase of jobs could be up to 215 which is about 7 % from the total employment in Nurmes. If the production volume is 350 000 t of roundwood used, project would generate 95 jobs in supply-chains.
- Second largest impact is directed to the charcoal production plant generating 26 jobs Other considerable industries are retail and sale, transportation and real estate which all have 10-12 new jobs.

- Economic impact currently in simulation stage, significant stimulus expected for the regional economy (22 MEUR inv. + 12 MEUR raw material supply could generate approximately 40-60 MEUR income impact, continuing as 20-25 MEUR impact as operational impact of supply-chains). Impact could be further raised by local ownerships, and the use and upgrading of manufactured biochar and bio-oil.

Employment development trends





- Biochar and bioenergy industry, scenario a) 350 000 cubics of roundwood, and b) 50 000 cubics of roundwood. Bioenergy sector development has potential to break the negative development path in Pielinen Karelia District.

Thank you!

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