

# ZEROCO2

Interreg Europe

ZEROCO2 aims at implementing near zero CO2 emission buildings due to energy use and improving regional energy policies with regard to environmental sustainability and mitigation of climate change risks.

[www.interregeurope.eu/zeroco2](http://www.interregeurope.eu/zeroco2)

An interregional cooperation project for improving low-carbon economy policies

#### Project Partners

European Institute for Innovation (DE)  
Mediterranean Agronomic Institute of Chania (EL)  
Thermopolis Ltd. (FI)  
A.VI.TE.M – Agency For Sustainable Mediterranean Cities and Territories (FR)  
Molise Region (IT)  
Municipality of Kaunas District (LT)  
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Low-carbon  
economy



1.23 M  
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European Regional  
Development Fund

# Promotion of near zero CO<sub>2</sub> emission buildings due to energy use

## **ACTION PLAN**

**Thermopolis Ltd. –**

The Regional Strategy of South Ostrobothnia

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## 1. INTRODUCTION

The aim of the project is to improve regional energy policies with regard to environmental sustainability and mitigation of climate change risk, with a special focus on greening the building sector through enhancement of various eco-friendly energy sources and technologies, stressing its importance as an incubator for new markets in the field of energy, technologies, services and business models.

The project represents and implements NEAR ZERO CO<sub>2</sub> EMISSION BUILDINGS DUE TO ENERGY USE in policies addressed at the same level as had been done for NEAR ZERO ENERGY BUILDINGS, which means that the buildings do not produce CO<sub>2</sub> emissions due their use. EU, national and regional policies do not define near zero CO<sub>2</sub> buildings due to energy use.

### **Thermopolis Ltd.**

Thermopolis Ltd. Is the ZEROCO<sub>2</sub> partner from Finland. By addressing the Regional Strategy of South Ostrobothnia, Thermopolis will improve the policy on regional level.

Finland is a northern country of forests (72 % of area), lakes (10 % of area is water), long distances and a low population density. Finland also has an energy intense industrial sector. With this as the setting it is not surprising that the three largest energy consumers are industry (45 % of all primary energy consumed in Finland), heating of buildings (26 %) and transport (17 %).

South Ostrobothnia is situated in Western Finland. 17 municipalities make up the region. The area has a large number of small and medium sized enterprises. Agriculture is important. The landscape is made of open fields and rivers. The region represents about 4 % of Finland's area and about 3,5 % of Finland's population lives in the region.

The region consumes 40 % of its energy consumption for heating buildings. The three main sources of energy are oil (43 %), wood fuels (22 %) and nuclear Energy (10 %). Regional values do not include rail transport. There are no large forest industry plants, thus there is no consumption of black liquor or other consecrated liquors that are by-products of the pulp and paper industry.

In South Ostrobothnia, oil is the most used source. The difference comes from the fact that there are no large pulp and paper factories in the Region, thus one category of wood fuels is not used.

## 2. REGIONAL ANALYSIS

### 2.1 Presentation of the region

Name of the region	South Ostrobothnia
Country	Finland
<b>Area</b> (region/country)	13 999 km <sup>2</sup> / 338 440 km <sup>2</sup>
<b>Population</b> <sup>1</sup> (region/country)	
- Number	192 476 / 5 493 577
- <b>Density</b> (resident/km <sup>2</sup> )	14,3 / 18,1



Figure 1. Map of Finland with South Ostrobothnia highlighted in red. Source: public domain.

Finland is a northern country of forests (72 % of area), lakes (10% of area is water), long distances and a low population density. Finland also has an energy intense industrial sector. With this as the setting it is not surprising that the three largest energy consumers are industry (45 % of all primary energy consumed in Finland), heating of buildings (26 %) and transport (17%). [Statistics Finland 8]

To produce the needed energy Finland uses a diverse palette of resources. The three main sources are wood fuels (25 %), oil (23 %) and nuclear power (18 %). Wood fuels include black liquor and other concentrated liquors (10.5 %), wood fuels used in industry and energy production (10 %) and small-scale combustion of wood (5 %). [Statistics Finland 4]

The use of other renewables is marginal. Hydro power produced 4 % of the consumed energy in 2014. Wind power's share was around 0.4 % in 2014 and with an increased to 0.6 % in the year 2015. All other renewables are very marginal on the overall scale. [Statistics Finland 4 and 5]

South Ostrobothnia is situated in Western Finland. 17 municipalities make up the region. The area has a large number of small and medium sized enterprises. Agriculture is important. The landscape is made of open fields and rivers. The region represents about 4 % of Finland's area and about 3.5% of Finland's population lives in the region.

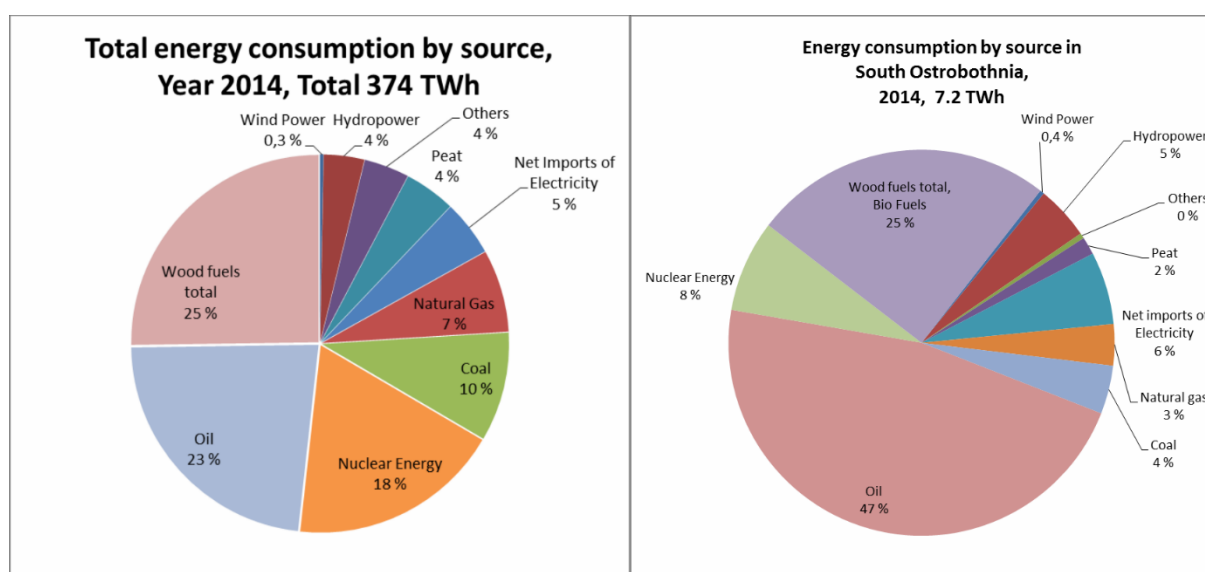
The region consumes 40 % of its energy consumption for heating buildings. The three main sources of energy are oil (43 %), wood fuels (22 %) and nuclear Energy (10 %). Regional values do not include rail transport. There are no large forest industry plants, thus there is no consumption of black liquor or other consecrated liquors that are by-products of the pulp and paper industry.

[Statistics Finland 1-3, 11-13; Finnish Energy 1-5; Lipasto]

## 2.2 Use of energy

The main source of energy in Finland in 2014 was wood fuels (25 %). Wood fuels include black liquor and other concentrated liquors, wood fuels used in industry and energy production and small-scale combustion of wood. Figure 2 presents the division of energy consumption in the whole of Finland and in South Ostrobothnia for the year 2014.

In South Ostrobothnia, oil is the most used source. The difference comes from the fact that there are no large pulp and paper factories in the Region, thus one category of wood fuels is not used.



**Figure 2. The total energy consumption in Finland and in South Ostrobothnia by source for the year 2014. [Statistics Finland 1-5,11-14; Finnish Energy 4; Lipasto]**

Table 1 presents the energy consumption in Finland and in the region of South Ostrobothnia by source for the year 2014. Of all the consumed energy in

Finland about 2 % is consumed in the region of South Ostrobothnia. For each person in Finland, 68 MWh of energy is consumed yearly. In South Ostrobothnia, this value is 38 MWh/a. The lack of large industry plants contributes to the Region's below average consumption.

For buildings Table 1 presents the energy consumption for space heating. The regional data has been calculated using estimations of building type specific heat coefficients created by Statistics Finland. Presented values are estimations as real data is not recorded at this level. The electricity used for non-space heating purposes in buildings cannot be reliably extracted from available statistics. Data on space heating for commercial and public buildings could be reliably extract for the whole of Finland, but not for the region.

**Table 1. Energy consumption in Finland and in South Ostrobothnia by source and building type for the year 2014. [Statistics Finland 1-5,11-14; Finnish Energy 1-5; Lipasto]**

Energy source	Region Country GWh <sup>1</sup>	Building sector space heating GWh <sup>2</sup>	Residential space heating GWh <sup>2</sup>	All non- residential space heating GWh <sup>2</sup>	Commercial and public space heating GWh
RES	1 764 <b>124 000</b>	1 009 <b>38 613</b>	632 <b>30 029</b>	3770 <b>8 584</b>	- <b>5 892</b>
Oil	3 384 <b>86 120</b>	1 117 <b>12 098</b>	628 <b>4 815</b>	490 <b>7 283</b>	- <b>3 227</b>
Natural gas	250 <b>26 493</b>	42 <b>9 990</b>	21 <b>5 320</b>	20 <b>4 670</b>	- <b>3 131</b>
Coal	294 <b>35 047</b>	61 <b>8 704</b>	32 <b>5 089</b>	29 <b>3 615</b>	- <b>2 652</b>
Nuclear Energy	557 <b>68 624</b>	175 <b>4 987</b>	90 <b>3 651</b>	85 <b>1 336</b>	- <b>533</b>
Peat	885 <b>16 463</b>	803 <b>5 358</b>	504 <b>3 128</b>	299 <b>2 701</b>	- <b>1 687</b>
Net import of Electricity	440 <b>17 966</b>	138 <b>3 703</b>	71 <b>2 886</b>	67 <b>1 056</b>	- <b>421</b>
Others <sup>3</sup>	33 <b>14 698</b>	6 <b>1 358</b>	3 <b>775</b>	3 <b>583</b>	- <b>440</b>
Total Energy Consumption	7 607 <b>374 000</b>	3 352 <b>85 050</b>	1 981 <b>52 694</b>	1 371 <b>29 828</b>	- <b>17 983</b>

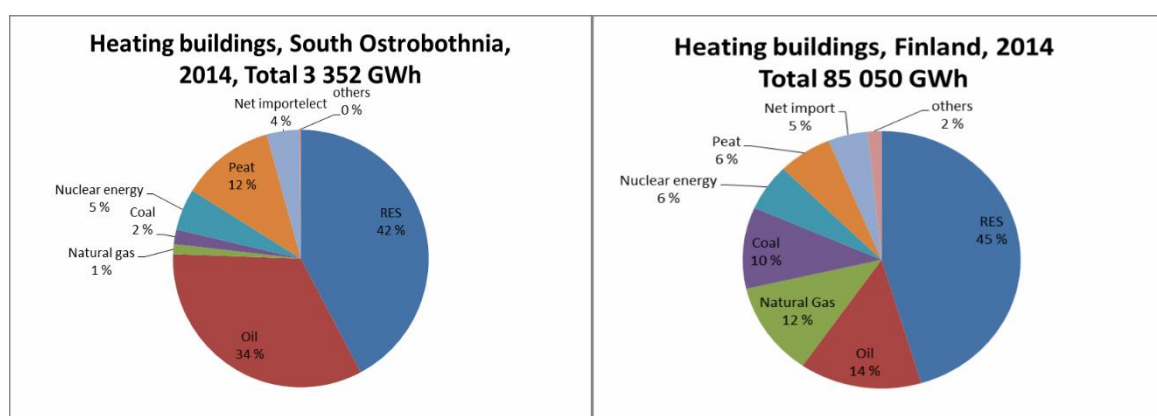
<sup>1</sup>Regional data does not include rail transport.

<sup>2</sup>Regional data does not include summer cottages or buildings that are used in agriculture. For the country total agriculture buildings are not included. Regional data is calculated from estimations of building type specific heat coefficients. The estimations have been done by Statistics Finland. Data for the whole of Finland is from table 7.3. Energy sources for space heating by type of building, Statistics Finland, [Referred: 30.8.2016].

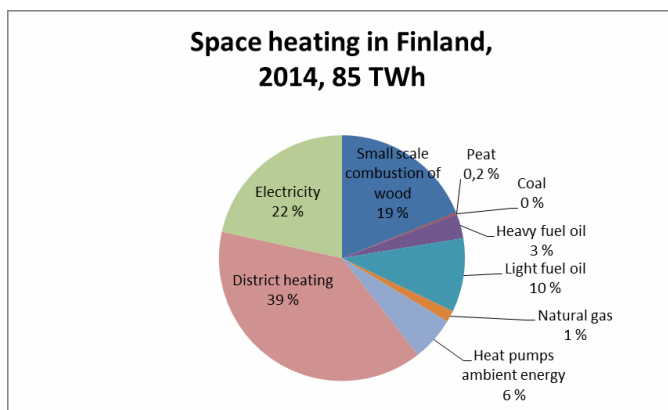
<sup>3</sup>Includes vegetables-based fuels, animal-based fuels, landfill gas, biogas from wastewater treatment, industrial gas, other biogas, liquid biofuels, recovered fuels, demolition wood, impregnated wood (chemically treated), other mixed fuels, gasified waste, plastics waste, rubber waste, hazardous waste, other waste, exothermic heat from industry, electricity, used in electric boilers and heat pumps, hydrogen, other non-specified energy sources.

Heating of buildings covers around 41 % of the energy use in the South Ostrobothnia region and in the whole of Finland around 22 %. Residential buildings consume over half of this heating energy. The share of renewables in space heating is high, 45 % in the whole of Finland and 42 % in South Ostrobothnia (see Figure 3).

Almost all cities and towns have district heating plants. Some of them are combined heat power plants (CHP) and others only produce heat. Heating form district heating plants covers almost 40 % of the consumed space heating in Finland [Statistics Finland 14].

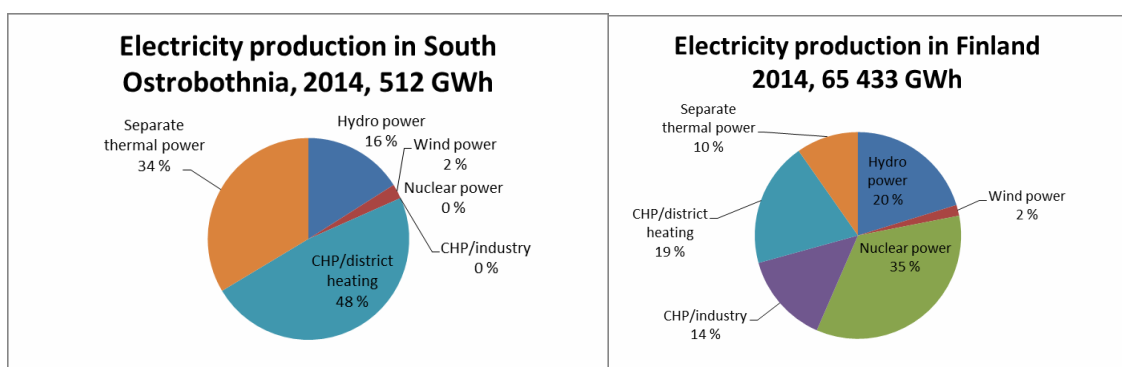


**Figure 3. Heating buildings by energy source in South Ostrobothnia and in Finland, Year 2014. [Statistics Finland 1-5,11-14; Finnish Energy 1-5].**

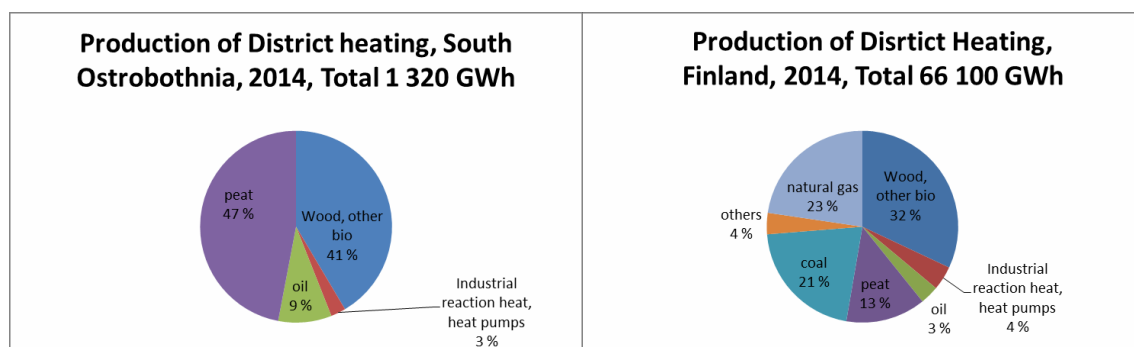


**Figure 4. Space heating in Finland for the year 2014. District heating holds the largest share. [Statistics Finland 14]**

So far the data we have been dealing with has been about energy consumption. The following figures present some data on energy production. Figure 5 and Figure 6 present electricity and district heating production by source for the year 2014. The graphs serve as a mean to see how South Ostrobothnia differs in energy production from the whole of Finland. The main differences are that natural gas pipelines do not extend to the Region, there are no nuclear power plants, coal is not used and peat is a significant resource in the Region.



**Figure 5. Electricity production by source in South Ostrobothnia and Finland for the year 2014. [Finnish Energy 4]**



**Figure 6. Production of district heating by source in South Ostrobothnia and Finland for the year 2014. Includes data from both CHP and separate heat production. [Finnish Energy 3]**

## 2.3 Use of energy

Energy source	Country GWh	Building sector GWh	Residential GWh	Non-residential GWh
RES	7.489,72	6.346,67	5.955,00	391,67
Heating oil	25.379,17	3.583,06	2.236,39	1.346,67
Natural gas	5.691,39	1.630,28	1.299,72	330,56
Coal	550,56	/	/	/
Electricity	12.310,83	6.463,61	3.125,00	3.338,61
Heat	2.109,17	1.541,11	1.000,83	540,67
Non-Renewable industrial waste	395,28	/	/	/
Total	53.926,11	19.564,72	13.616,94	5.947,78

## Wood Fuels

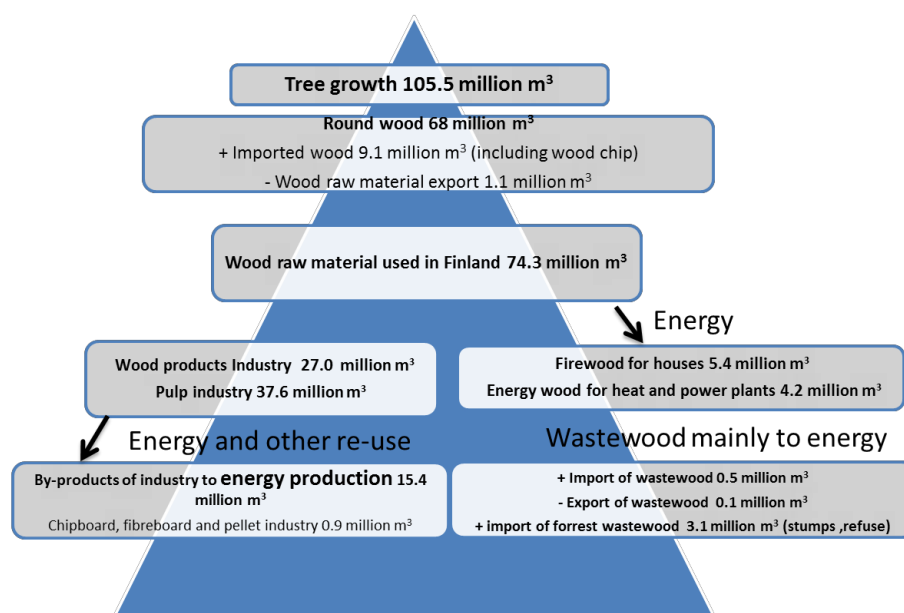
Wood fuels are generally included in biomasses. However, as they hold a significant role in the Finland's energy palette, they are reported in their own section.

Wood fuels contain the more common forms of wood fuels such as wood chip, pellets, logs, firewood etc. The grouping also includes the not so usual forms

such as black liquor (a by- product of the pulp industry) and other concentrated liquors (other by-products from the wood industry) that are used to produce electricity and heat.

Forests cover 73 % of Finland's land area. In the whole of Europe, 33 % of the land area is covered by forests. It has been calculated that the Finnish forest resources are currently 2.4 billion cubic meters, with an annual growth of 105.5 million cubic meters. The forest resources and the annual increase make the versatile use of forest material possible. The main consumers of this resource are the pulp- and paper industry, the wood products industry, and the energy industry. The way forest materials are consumed is guided by political decisions as well as economical drivers. Figure 7 presents the wood flows in the year 2015. [Luke 1]

**WOOD FLOWS IN FINLAND 2015** (Source:Luke)



**Figure 7. Wood Flows in Finland in the year 2015.** [Luke 2]

The forest industry has a central role in using forest resources. The industrial use of wood raw material in 2015 was 64.7 million cubic meters (figure includes imported materials), which is 87 % of harvested forest resources (including imports). The direct energy use of the harvested forest resources accounts for the remaining 13 %. The re-use of by-products from the wood products and pulp industries increase the total amount of wood fuels used for energy significantly as over 23 % of the used material can be recover for energy purposes. [Luke 1]

The sustainable harvesting limit for the use of national forest material is around 81 million cubic meters a year and in the years 2012-2030 this value is foreseen to increase to over 86 million cubic meters a year. There are plans in the pulp industry to increase the intake of raw wood material by 14 million cubic meters a year by the year 2025. The Finnish government has set a goal that by the year 2020 the consumption of forest chips in the energy industry should be 13,5 million cubic meters. The Natural Resource Institute has calculated that both of these goals can be achieved if half of the material for wood chips is forest waste wood and stumps left behind from felling. [Luke 1]

The sustainable harvesting upper limit in Finland is 81 400 000 m<sup>3</sup>/year. This equals around 162 800 GWh using a conversion factor of 2 MWh/k-m<sup>3</sup>. The energy need for the year 2014 was 374 304 GWh of which wood fuels covered 25 % (94 324 GWh). Wood fuels include black liquor and other concentrated liquors 10.5 % (39 450 GWh), wood fuels used in industry and energy production 10 % (37 584 GWh) and small-scale combustion of wood 5 % (17 289 GWh).

**Table 2. An estimation of the upper limit for sustainable use of forest raw material. [Luke 1]**

Estimation of maximum sustainable yearly harvesting for the years 2011 – 2040 (million m <sup>3</sup> /year)			
	2011 – 2020	2021-2030	2031-2040
Logs	33.9	34.5	34.4
Pulpwood	41.2	43.2	43.5
Energy wood total	20.5	20.9	20.9
-Of which logs (amount of logs in the industrial size)	6.2 (5.0)	8.3 (6.9)	8.2 (7.3)
- Branches	7.9	7.3	7.5
- Stumps and roots	6.5	5.3	5.2
Total roundwood	81.4	86.0	86.1

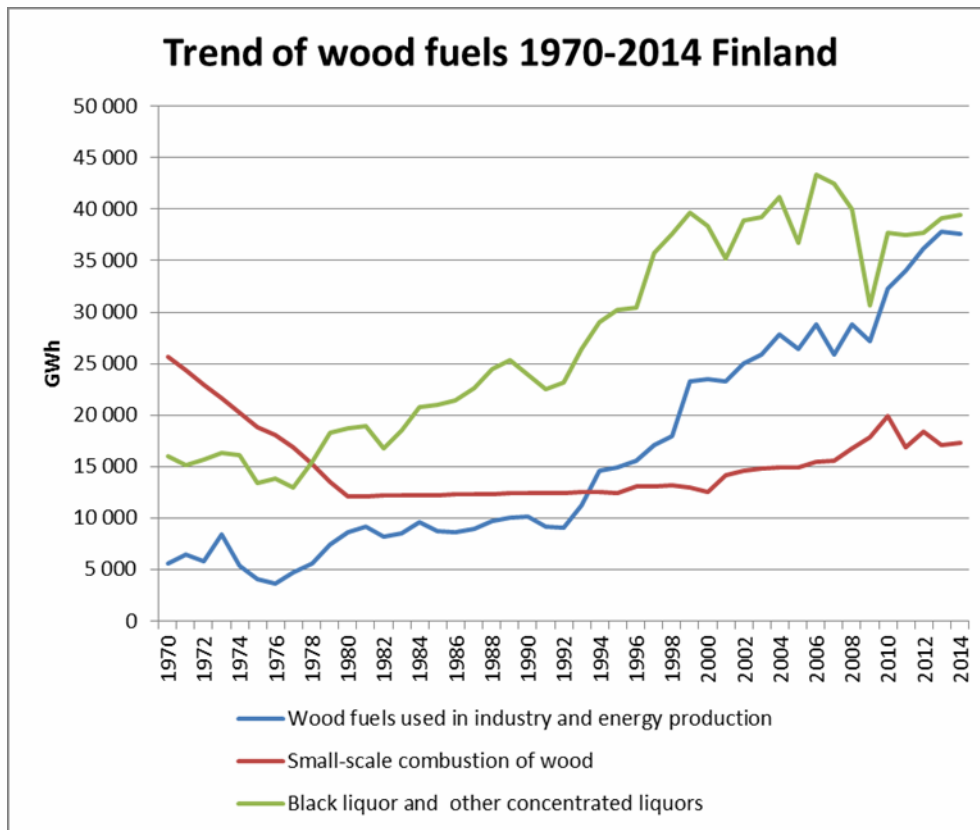
The use of energy wood (not including by-products such as black liquor) could be increased from the current level of 9.6 million cubic meters by around 3.9 million cubic meters (7 800 GWh) to the set target of 13.5 million cubic meters and the harvesting would still be within the sustainability limit at least according to the estimation above. If the planned industrial investments are not completed as for seen then there will be more growth potential for the forest energy industry.

**Table 3. Total use of wood in Finland and in South Ostrobothnia. Year 2015. [Luke 3]**

Year 2015	Raw wood (1 000 m <sup>3</sup> )			Forest industry by-products and waste wood (1 000 m <sup>3</sup> )		
	Forest industry	Energy production	Total	Forest industry	Energy production	Total
Finland	64 670	9 605	74 275	8 915	15 398	24 313
South Ostrobothnia	1 063	572	1 635	94	374	468
Share	1.6 %	6 %	2.2 %	1 %	2.4 %	1.9 %

South Ostrobothnia does not have large paper or pulp factories. The forest industry is typically small saw mills, furniture factories etc. Table 3 presents the total use of wood in Finland. The total share of raw wood used in South

Ostrobothnia is only 2.2 %. However, 6 % of the raw wood used for energy production is used in South Ostrobothnia. Wood chips are a significant fuel in the region's district heating and CHP plants.



**Figure 8. The trend of wood fuels in Finland. [Statistics Finland 16]**

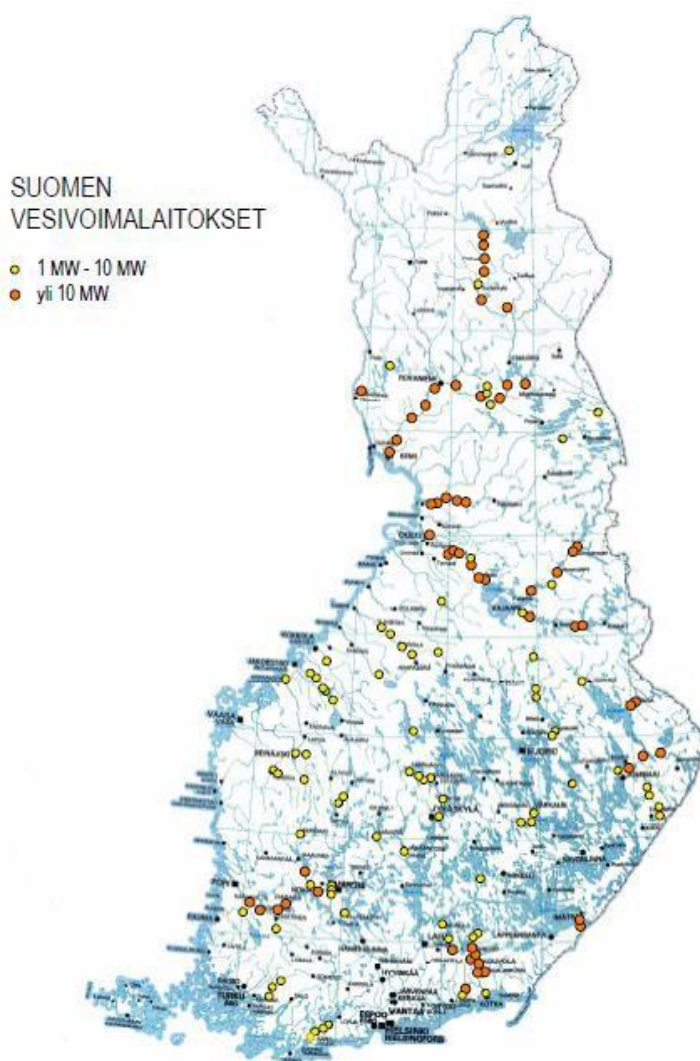
Figure 8 presents the historic trend of wood fuels in Finland for the years 1970-2014. In earlier years small-scale combustion of wood was the most important method of using wood fuels. From 1970 however the amount of wood fuels used in small-scale combustion started to decrease. This happened as buildings switched from wood fuelled boilers to other heating systems such as oil boilers, electric heating and district heating. At the beginning of millennium small-scale combustion of wood started to increase as wood fuelled boilers and fireplaces became popular again.

The industrial and energy use of wood fuels have growing trends. The use of black liquors and other concentrated liquors follows the economic development as it is directly related to industrial production.

### **Hydro power**

Hydro power holds a significant role in the production of electricity in Finland. In 2014, 15.9 % (13 260 GWh) of the consumed electricity was hydro power. It also is the second most used renewable energy source in Finland after wood fuels, producing 4 % of the all the energy need in 2014. The share of hydro power in electricity production varies yearly from 10% to 20 % depending on the water storage levels. [Hydropower]

In South Ostrobothnia 14 % of the produced electricity is from hydro power. The region's hydro power plants are small scale hydropower plants (<10 MW).



**Figure 9. Hydro power plants in Finland. Yellow dots: 1MW-10 MW, Red dots over 10 MW. [Voimaa vedestä]**

There are over 220 hydro power plants in Finland with a total power of 3 100 MW. Figure 9 presents a map of Finland onto which plants that are 1MW or larger have been placed. In 2008, a report on hydro power and its future in Finland was completed. According to a report on hydro power, published in 2008, there remains about 1 700 MW of potential hydro power that has yet to be harnessed. The report estimated that by 2020 it would be possible to increase the hydro power capacity to 470 MW. About a fourth of this potential could be

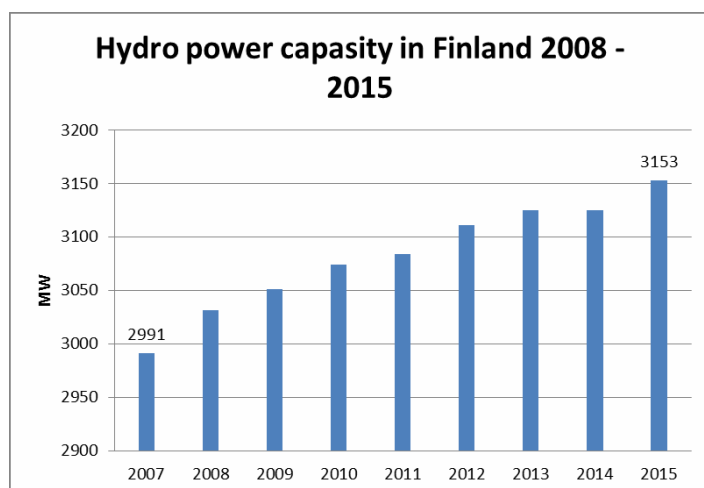
achieved by updating existing plants. For small scale hydro power (less than 10 MW) there is a potential of around 60 MW. [Voimaa vedestä]

Since the report was completed there has been an increase in hydro power capacity of around 162 MW mainly through the updating of existing plants. This is more than the predicted increase of 117 MW. This increase is shown in Figure 10. [Statistics Finland 10]

There has been hardly any increase in small scale hydro power and hardly any foreseen.

The largest hydro power plant is Imatra (185 MW, 1000GWh/a, 25 m) in the south-east part of Finland. The rest of the larger hydro power plants are located in the northern part of Finland. In the region of South Ostrobothnia, there are only small scale hydro power plants (less than 10 MW). [Statistics Finland 10]

Protection of nature will prevent most new hydro power investments in Finland.



**Figure 10. Hydro power capacity in Finland 2007-2015. [Statistics Finland 10]**

## Wind Power

Wind Power is still marginal on the overall energy production of energy in Finland and in the region of South Ostrobothnia (see Figure 2 and Figure 5). In spite the relatively low figures, there has been a surge in installed wind power capacity (see Figure 11). This is largely due to the feed-in tariff that was implemented in 2011. The impact of the feed-in tariff can be seen in the increase of installed capacity starting from the year 2013. New wind turbines can be added to the system until 2500 MW of installed wind capacity has been reached. Currently the amount of placed applications to join the feed-in tariff system is more than the set upper limit. [Statistics Finland 10]

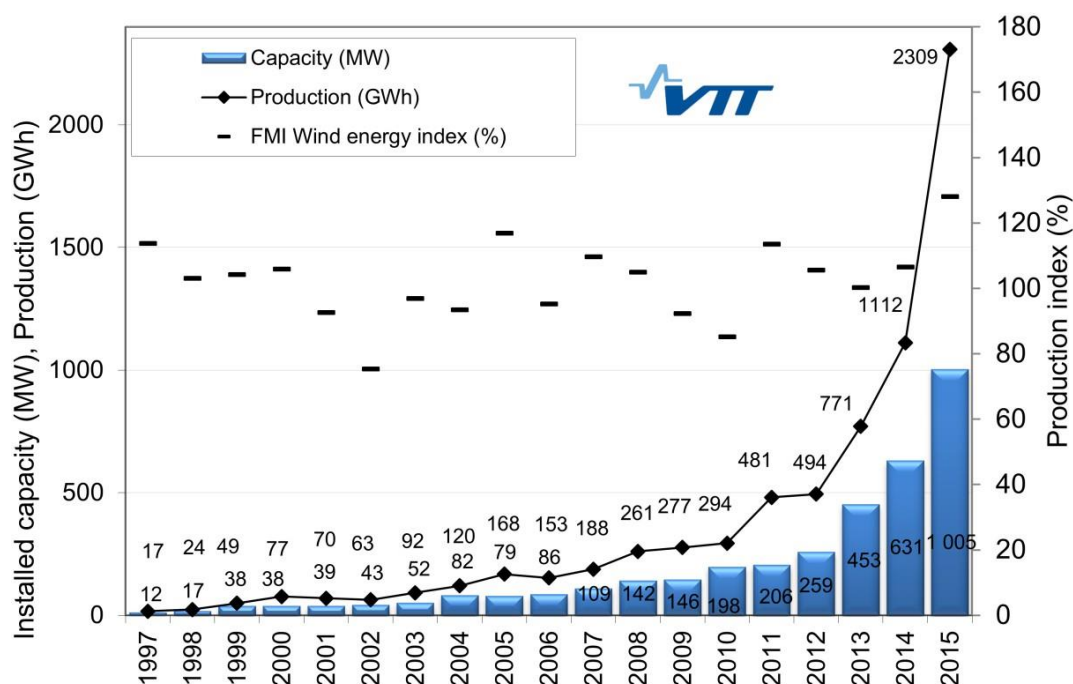


Figure 11. Wind power data for the whole of Finland. [VTT]

The goal of the feed-in tariff is to increase annual wind power production to 6 000 GWh by 2020. That is almost 3 times the wind power production of 2015. The set goal is likely to be met by 2018. According to the Finnish Wind Association's yearly survey of wind power projects, at the beginning of April 2016 nearly 13 000 MW of wind power projects had been announced in Finland. Planned offshore projects accounted for 2 000 MW. [Finnish Wind Association]

Finland's first off-shore wind farm is under construction and will be completed in 2017. The farm will consist of 10 x 4 MW turbines. The annual energy production is estimated to be 155 GWh. The cold and icy conditions have required special technical solutions. [Hyötytuuli]

The Regional Council of South Ostrobothnia has mapped the larger potential wind farm sites in its ongoing regional land use planning. [Land use plan]

### **Field Biomass**

Field biomasses are only a marginal source of energy in Finland. Reed canary grass has been the most important energy crop grown in Finland. The cultivation of reed canary grass peaked in 2007, when the produced crop equalled 500 GWh [Mikkola]. In 2015, Reed canary grass was grown on 4 600 ha, which equals only 120 GWh in produced crop (24,4 MWh/ha). [Lukkarinen 1]

In 2015, Finland had 2 273 300 ha of agricultural land, of which 271 300 ha was fallows. The Finnish Ministry of Agriculture and Forestry has estimated that around 500 000 ha of field area could be used for energy crop production. If reed canary grass was grown on the estimated 500 000 ha that would amount to 12,2 TWh of energy. That would be around 3 % of the primary energy consumed in Finland, in 2014. [MMM]

It is also possible to use the by-products of crop to produce energy. Pahkala &

Lötjönen (2012) estimated that the technical energy potential in crop by-products is 11,9 TWh, of which the economically viable potential is 2,4 TWh. [MTT]

**Table 4. Energy potential of farming by-products. [MTT]**

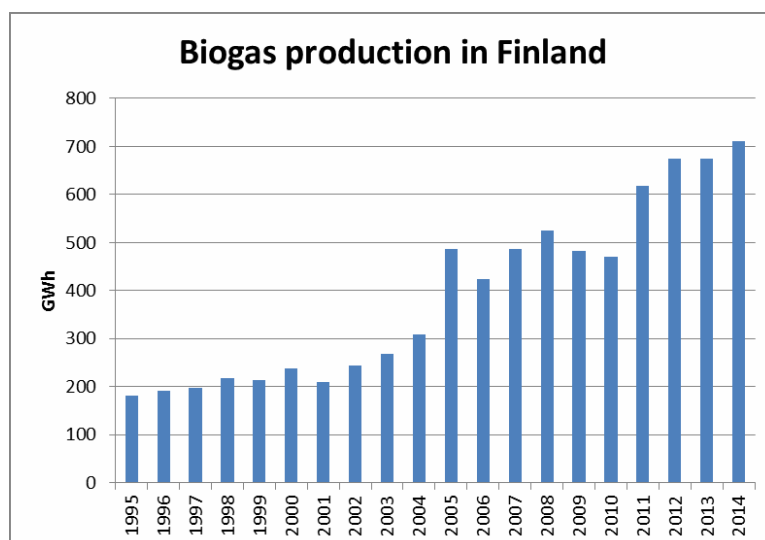
Plant	Technical potential TWh	Technical and economic potential TWh
Grain	10.6	2.1
Oil plants	0.6	0.1
Potato	0.4	0.1
Pulse crops	0.0	0.0
Sugar beet	0.3	0.1
	11.9	2.4

## Biogas

In 2014, around 710 GWh of biogas was produced [Statistics Finland 16]. The goal set for biogas production by the Finnish government is 1,2 TWh by the year 2020. To reach this goal new biogas plants that produce electricity can apply to join the feed-in tariff system. The plant must have a nominal electric power of 100 kW.

Figure 12 shows how the production of biogas has increased over the years 1995-2014. There has been a more or less steady increase in biogas production.

Biogas is used to produce heat and electricity and some of it is refined to be used in gas powered vehicles. In 2014, biogas was used by transportation (17 GWh), to produce 455 GWh of heat and 158 GWh of electricity. 101 GWh was burned without use. The main source for biogas in Finland is landfills. [Huttunen & Kuittinen]



**Figure 12. Biogas production in Finland 1995-2014. [Statistics Finland 16]**

There still remains a large potential for biogas. Tähti & Rintala have estimated the potential to be 9.2 TWh/a (see Table 5). The greatest potential is in field biomasses and manure. There is potential for biogas in the region of South Ostrobothnia. However, financing has proven to be a problem in larger biogas plant investments.

**Table 5. Biogas potential in Finland [Tahti & Rintala]**

Biogas raw materials	Technical potential TWh	Technical and economic potential TWh
Landfill gas	0.5	0.5
Bio waste	0.5	0.3
Sewage sludge	0.4	0.2
Manure <sup>1</sup>	3.5	1.4
Field biomass <sup>2</sup>	17.8	5.8
Food industry waste	0.6	0.3
Industrial wastewater sludge	0.7	0.6
Industrial wastewaters (pulp, paper and food)	1.6	-
Others <sup>3</sup>	0.4	0.09
<b>Total</b>	<b>26 TWh/a</b>	<b>9,2 TWh/a</b>

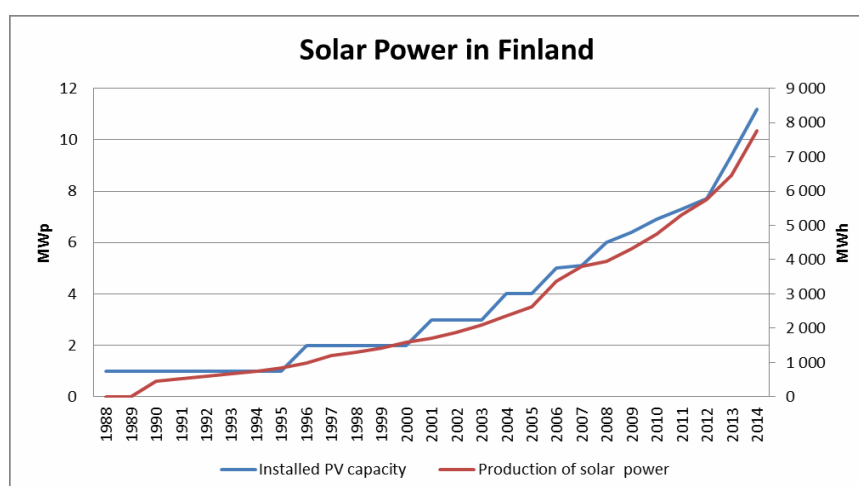
<sup>1</sup>Manure, litter and wash water

<sup>2</sup>Fallow + straw + second harvest of grass (for silage)

<sup>3</sup>Includes animal waste from reindeer and fur farming, as well as waste and inventory losses from cultivation of vegetables and grains.

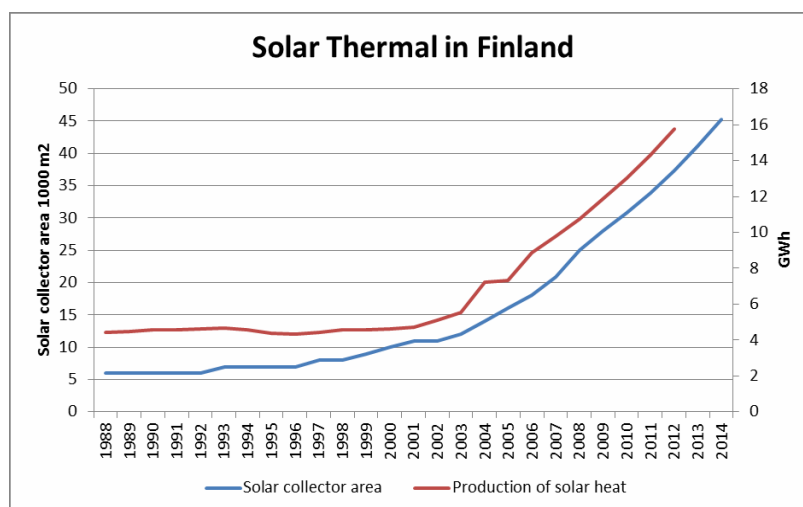
## Solar power and thermal

The use of solar energy in Finland is marginal. In 2014, a total 24 GWh of solar energy was produced. From Figure 13 and Figure 14 the increasing of installations and energy production can be seen. In 2014, the installed solar power capacity was 11 MWp and production was 7 752 MWh. This equals a production of 690 MWh for each installed MWp. In 2015, around 7.9 MW of solar power had been connected to the grid. [Statistics Finland 18; Finsolar]



**Figure 13. Solar power in Finland. Installed capacity and produced electricity. Years 1988 – 2014. [Statistics Finland 18]**

In 2014, there were 45 000 m<sup>2</sup> of installed solar collector area and the thermal energy production was 16 GWh. That equals 34.8 kWh per collector m<sup>2</sup>.



**Figure 14. Installed solar thermal collector area and produced heat in Finland. Years 1988-2014. [Statistics Finland 18]**

Table 1 presents the yearly total electricity production and received irradiation on an optimally inclined and free-standing 1 kWp PV system at different locations in Europe. The data is from PVGIS, which differs from measured values, but gives a good enough estimation for this comparison. It is interesting to see that the difference in irradiation and production values between Helsinki, Kaunas and Berlin are not that great. Yet Germany is considered a much better location for solar energy. In cooler temperatures the efficiency of traditional PV-panels increases, so it is likely that the actual production of PV in Finland could be even closer to the yearly production in Germany.

**Table 1. Yearly total electricity production and received irradiation on an optimally inclined and free-standing 1 kWp PV system at different locations in Europe. [PVGIS]**

	Optimal inclination angle (degrees)	Yearly total production 1 kWp estimated losses 14 % (kWh/a)	Yearly total of global irradiation received by modules (Wh/m <sup>2</sup> /day)
Lapua, Finland	44	851	1100
Helsinki, Finland	41	870	1120
Kaunas, Lithuania	36	888	1170
Berlin,	37	962	1260

Germany			
Ptuj, Slovenia	35	1160	1510
Marseille, France	37	1470	1940
Chania, Greece	29	1560	2130
Msida, Malta	32	1680	2240

There is potential for solar energy in Finland and there have been some larger PV installations on industrial buildings. However, the foreseen growth in both the region of South Ostrobothnia and in Finland is mainly in small systems installed on private homes. At the moment there are no governmental financial supports that would increase interest in solar energy.

### **Geothermal**

The energy company ST1 has started a drilling the first bore hole for the first geothermal heating plant in Finland. On the 1.8.2009 the holes depth was 3 000 m. The final depth will be 7 km. A total of two holes will be drilled. The plant should be operational in 2017. Depending on the success of this first plant ST1 is planning on investing in future geothermal plants in Finland. The estimated power capacity of the plant is 40 MW of heating. The produced heat will be used in the district heating of the Espoo area. (Source: <http://www.st1.fi/deepheat>)

### **Transport biofuels**

The Finnish national goal is to raise the use of transport biofuels to 7 TWh by 2020. In 2014 the use of transport fuels was 6 TWh. Examples of transport fuels are biodiesel, bioethanol, bio methanol, bio oil, biogas, wood gas etc. [Motiva, Statistic Finland 16]

### **Recovered biofuels**

Recovered biofuels are the biodegradable part of fuels produced from municipal waste or comparable fuels produced from waste of retail shops and industry. These

fuels are used to produce both heating and electricity. In 2014, the amount of recovered fuels was 2 499 GWh. [Statistics Finland 20]

### 3. USE OF RENEWABLE RESOURCES IN BUILDINGS IN FINLAND

#### Renewables used in buildings

Table 2 presents the different types of renewables used in Finland and their share. As can be expected the most significant renewable source is wood fuels.

**Table 2. Break down of use of renewable resources for the year 2014. Renewables accounted for 33 % of all energy consumed in Finland in 2014. [Statistics Finland1-3,10-14, 16; Finnish Energy 1-5; Lipasto]**

RES	Region Country %	Building sector space heating %	Residential space heating %	Non- residential space heating %	Commercial and public space heating %
Hydro power	17 <b>11</b>	7 <b>4</b>	5 <b>7</b>	11 <b>9</b>	- <b>5</b>
Wind power	1 <b>1</b>	1 <b>0,35</b>	0 <b>1</b>	1 <b>1</b>	- <b>0,43</b>
Wood fuels total <sup>2</sup>	77 <b>76</b>	87 <b>43</b>	88 <b>74</b>	83 <b>80</b>	- <b>82</b>
Small-scale combustion of wood	- <b>14</b>	- <b>24</b>	- <b>49</b>	- <b>16</b>	- <b>14</b>
Black liquor and other concentrated Liquors	- <b>32</b>	- -	- -	- -	- -
Wood fuels used in industry and energy production	- <b>30</b>	- <b>19</b>	- <b>25</b>	- <b>64</b>	- <b>68</b>
Heat pumps <sup>1</sup>	4 <b>4</b>	4 <b>9</b>	5 <b>18</b>	2 <b>10</b>	- <b>12</b>
Recovered fuel (bio-fraction)	- <b>3</b>	- -	- -	- -	- -
Transport biofuels	- <b>5</b>	- -	- -	- -	- -

Other	1	1	1	3	-
	-	-	-	-	-

<sup>1</sup> Ambient heat

<sup>2</sup> Small-scale combustion of wood+ Black liquor and other concentrated Liquors+ Wood fuels used in industry and energy production

### 3.1 Heating and domestic hot water

Space and the domestic hot water are usually heated by the main heating system. Sometimes different heating systems are combined to create hybrid heating systems. Figure 1 presents the heating degree days for the normal period 1981-2010. The space heating need follows the presented graph. The domestic hot water heating load follows water consumption.

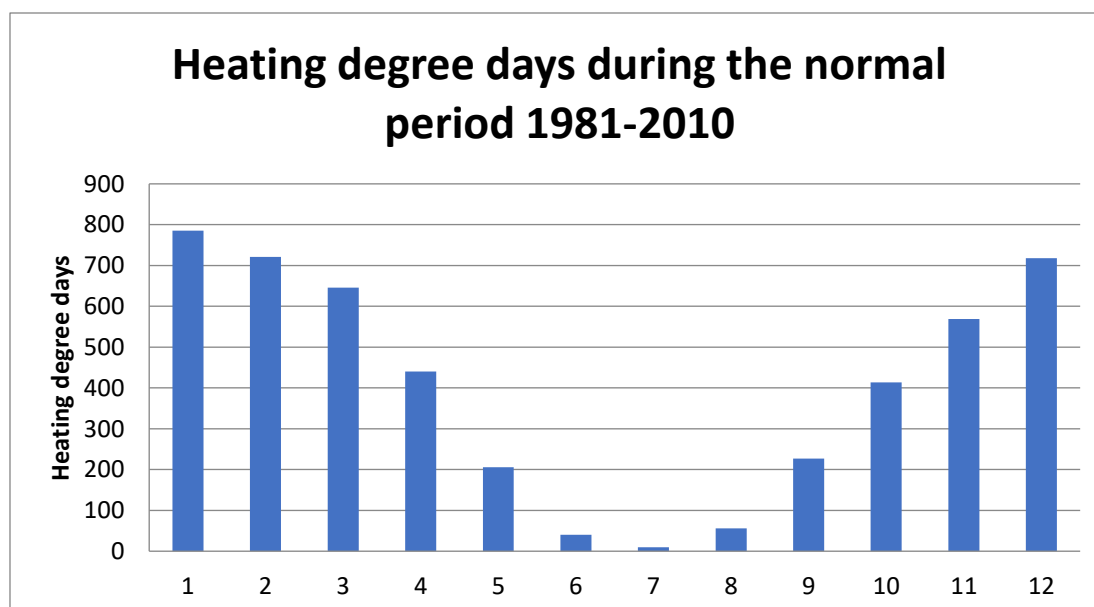


Figure 1. Heating degree days during the normal period 1981-2010. [Ilmatieteenlaitos]

#### District heating

39 % of buildings in Finland are heated using district heating (see **Napaka! Vira sklicevanja ni bilo mogoče najti.** on page **Napaka! Zaznamek ni definiran.**). The country average for district heating produced using renewables is 36 %. For South Ostrobothnia the average is 44 %. (See **Napaka! Vira sklicevanja ni bilo mogoče najti.** on page **Napaka! Zaznamek ni definiran.**)

For buildings in Finland district heating accounts for the use the category of “wood fuels used in industry and energy production” presented in Table 2. For Non-residential buildings this is the main type of wood fuel.

Some district heating plants use only renewable fuel, usually wood. For houses connected to fully renewable district heating applying the ZEROCO2 concept could be easy. They would have to concentrate on electricity use only. Perhaps install PV on their roof.

For buildings that are connected to district heating that is not 100 % renewable, applying the ZEROCO2 building concept could mean that they disconnect from the district heating network and opt for their own renewable energy source in heating. This is not necessary advisable as having several district heating customers leave the network will decrease the energy density along the district heating network. This will increase the ratio of heat losses per delivered heat and decrease the efficiency of the district heating. Also, providing supplement heat (via a fireplace or other renewable heating source) will cause a decrease in the energy density along the district heating network. For such buildings a ZEROCO2 option could be to install a surplus of electricity production units to cover not only the yearly electricity need, but also produce enough renewable electricity to counter the produced CO2 emissions created by heating. They could aim at being nearly ZEROCO2 buildings.

Those connected to district heated should also try to influence their heating supplier to increase the share of renewables used in the district heating plant. For example the district heating and electricity company in Helsinki (Helen LTD) aims at increase the share of renewables in their district heating production to 20 % by 2020. Helen also offers their clients the option of purchasing renewably produced district heating, thus providing a method to influence the company. [Helen]

### **Oil boilers and natural gas boilers**

Around 16 % of buildings use oil and natural gas as their source for heating (see Figure 6 on page 12)

Buildings that have oil boilers and natural gas boilers to provided space heating can apply the ZEROCO2 concept by using supplement heat sources e.g. fireplaces, solar thermal systems, air-to-air heat pumps etc. The other option is to switch the heating system completely and opt for a ground source heat pump, wood pellet or wood chip boiler or some other combination of renewable heating.

### **Electric heating**

22 % of buildings in Finland use electric heating (see Figure 6 on page 12). The share of renewables in electricity production is 39 % [Finnish Energy 2].

Applying the ZEROCO2 concept to buildings heated using electricity would mean installing renewable electricity production on site. Also adding supplemental heating systems (e.g. fireplace, solar thermal, air-to-air heat pumps) should be part of the process. Depending on the method of heat distribution in the building pellet and wood chip boilers could also be considered. These require a central heating system in the building.

### **Heat pumps**

Heat pumps are gaining popularity in Finland. In 2014, heat pumps provided 6 % of the heating used in buildings from ambient heat sources (see Figure 6 on page 12).

Table 3 presents data on heat pumps used in residential, commercial and public buildings. The most popular heat pump is the air-to-air heat pumps (air heat pumps), which have been used to provide supplement heating in buildings for several years. Ground-to-water (ground source) heat pumps are usually installed in new buildings

and even in larger building complexes such as shopping malls. Air-to-water (air-water) heat pumps have been gaining popularity, as the Finnish building code is driving new buildings closer to zero energy buildings. Air-to-water heat pumps are slightly cheaper to install than ground source heat pumps. Exhaust air heat pumps serve best in places where the needed fresh air volumes are great. 94 % of all heat pumps are installed in residential buildings [Statistics Finland 17].

**Table 3. Heat pumps of residential, commercial and public buildings in 2014 in Finland. [Statistics Finland 17]**

	Quantity, Number of heat pumps (share, %)	Capacity, MW	Production and recovery of heat, GWh (share, %)	Use of electricity, GWh	Primary energy production <sup>1</sup> , GWh
Ground-to-water heat pump	93 817 (15 %)	882	2 687 (31 %)	776	1 911
Air-to-water heat pump	10 871 (2 %)	127	290 (3 %)	160	130
Air-to-air heat pump	496 836 (79 %)	2 365	5 657 (65 %)	3 143	2 514
Exhaust air heat pump	24 733 (4 %)	83	134 (2 %)	43	91
<b>Heat pumps total</b>	<b>626 257</b>	<b>3 457</b>	<b>8 768</b>	<b>4 122</b>	<b>4 646</b>

<sup>1</sup>Primary energy is the energy taken from the heat source (production and recovery of heat - use of electricity = primary energy).

### Wood fuelled boilers and fireplaces

Small-scale combustion of wood has a 29 % share in the renewables used in buildings (See Table 2 on page 26). This includes fuels burned in small scale wood chip, pellet, firewood and wood briquette boilers, and fireplaces.

Boilers can be used as a main heating system. Depending on the type of fuel they use they can be fully automatized (e.g. wood pellet burners) or require a lot of manual labour (e.g. firewood burners). Wood fuelled boilers are available from a nominal capacity of a few kilowatts. The smaller wood fuelled boilers for smaller

residential buildings have a yearly efficiency of around 75 %. Larger wood fuelled boilers for larger buildings have a yearly efficiency of around 84 %. [D5]

Fireplaces are a viable supplement heating method especially in residential buildings. Most detached single family homes in Finland have fireplaces.

Hybrid boilers are also an option for providing heating in buildings. The traditional form of a hybrid boiler combined the possibility to use oil or firewood. Modern hybrid boilers offer many different combination options for example oil, firewood, wood pellets and electricity.

### **Solar thermal**

In Finland, solar thermal is usually used as a supplement heating system. For example it can be combined with a wood fuelled boiler to produce the needed heating during the summer months of June, July and August. During these months the boiler usually works at lower efficiency as its nominal capacity is designed to be sufficient for even the coldest days. On average solar thermal system produce 0.5 MWh/m<sup>2</sup> [Statistics Finland 18].

## **3.2 Electricity**

### **Solar power**

Solar power installations on buildings are increasing. The largest solar power installation in the whole of Finland is around 420 kWp (2015) [Finsolar]. Solar power is mainly growing in smaller installations at the moment.

Grid companies are required by law to allow small electricity production units to connect. However, the sales of excess electricity have to be agreed on between producer and buyer. Net metering is not available.

### **Small wind power and small CHP**

Small wind power (less than 50 kW) systems could be used to produce all of the buildings electricity need. However, getting permits for small wind power in cities can be difficult. The main focus in wind power has been on industrial sized installations.

Small CHP is an interesting yet still minor form of energy production for buildings in Finland. For example Volter produces a CHP plant with a electricity production of 40 kW and a heating power of 100 kW of heated water and 20 kW of heated air. The used fuel is wood chip (4.5 lose m<sup>3</sup>/24 h). The size of the unit is as follows: length 4,8m, width 1,2m and height 2,5m. [Volter]

### **Renewable energy bought from the grid**

In Finland consumers have the possibility to choose who they buy their electricity from. It is possible to specify that you want to by only renewable energy. Even though this option is a bit outside the scope and target of this project, it is important to note that choosing renewably produced electricity from the grid encourages electricity producers to invest in renewables.

## **3.3 Cooling**

### **Space Cooling**

The need for cooling is increasing in Finland, as new buildings are built to be near zero energy buildings.

### **Night ventilation**

The ventilation system is put on maximum settings during the night to cool down the building structures. This provides cooling in the day. In buildings with large mass structures night time ventilation can decrease the cooling power up to 40 % and the used energy for cooling up to 20 %. [TTY]

### **District cooling**

A relatively new form of cooling is district cooling. District cooling is provided in very restricted areas. In 2014 a total of 435 buildings in Finland were connected to district cooling and the sold energy amounted to 190 999 MWh. District cooling is produced by absorption heat pumps (13 %), heat pumps (56 %), compressors (6 %) and free cooling (24 %). [Finnish Energy 6]

### **Heat pumps**

Air-to-air heat pumps are often used to provide cooling as well as heating. Also ground sourced heat pumps are used to provide both active and free cooling.

### **Free cooling in air ventilation**

Free cooling and pre-heating for ventilation air can be provided by coupling bore holes to heat exchangers in a buildings ventilation system. A refrigerant is circulated in through the bore holes and heat exchangers. As the ground temperature remains relatively steady during the year the fresh air can be preheated or cooled as needed.

### 3.4 CO2 emissions

**Table 4. CO2 Emissions by source and type of building for 2014 (preliminary data). Regional and building CO2 emissions calculated from energy consumption data. [Statistics Finland 1-5,11-15, 21; Finnish Energy 1-5; Lipasto],**

CO2 Emission in ton/year					
Source	Region Country	Building sector space heating	Residential space heating	Non-residential space heating	Commercial and public space heating
Oil	926 000 <b>9 700 000</b>	257 000 <b>3 310 000</b>	157 000 <b>1 317 000</b>	100 000 <b>1 992 000</b>	- <b>883 000</b>
Transport <sup>1</sup>	526 000 <b>10 900 000</b>	- -	- -	- -	- -
Coal	114 000 <sup>2</sup> <b>8 100 000</b>	23 800 <b>3 386 000</b>	12 000 <b>1 980 000</b>	11 000 <b>1 406 000</b>	- <b>1 032 000</b>
Natural Gas	50 000 <sup>2</sup> <b>5 300 000</b>	8 300 <b>1 978 000</b>	4 300 <b>1 053 000</b>	4 000 <b>620 000</b>	- <b>620 000</b>
Peat	39 000 <b>6 300 000</b>	146 000 <b>1 966 000</b>	60 000 <b>1 148 000</b>	85 000 <b>991 000</b>	- <b>619 000</b>
Mixed fuels and other fossil fuels	- <b>700 000</b>	- -	- -	- -	- -
<b>TOTAL Fossils</b>	1 654 000 <b>43 400 000</b>	435 000 <b>10 640 000</b>	234 000 <b>5 498 000</b>	200 000 <b>5 314 000</b>	- <b>3 153 000</b>

4. <sup>1</sup>Regional data does not include train transport data.

5. <sup>2</sup>These CO2 emissions are actually produced outside of the region where the electricity imported into the region is produced.

The building sector is responsible for 29 % of the CO2 emission in Finland. Encouraging ZEROCO2 buildings would have a significant impact on the CO2 emissions. Regionally the largest shares of CO2 emissions from buildings come from oil and peat. Nationally the largest shares of CO2 emissions from buildings come from coal and oil.

Since 1990 the CO2 emissions from residential, commercial, service and public building has been decreasing. Replacing fossil fuelled energy with renewables will encourage this trend.

Wood fuels release CO<sub>2</sub> when burnt to produce energy. However, they are considered net zero CO<sub>2</sub> fuels. That is trees store the same amount of CO<sub>2</sub> as is released when wood fuels are used for energy production. For this reason their CO<sub>2</sub> emissions are not presented in this report.

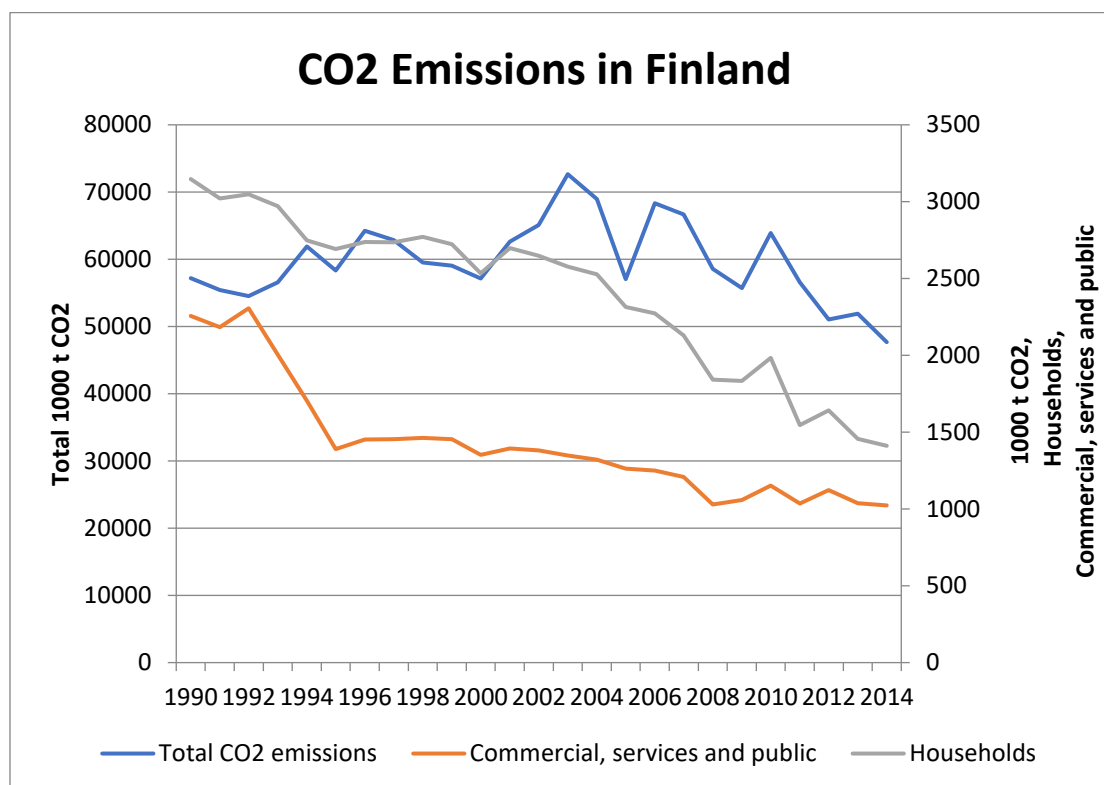


Figure 2. CO<sub>2</sub> emissions in Finland. [Statistics Finland 21]

## 6. POTENTIAL OF USING RES IN SOUTH OSTROBOTHNIA AND FINLAND

Some estimates of potential growth have been stated in the previous section.

### Finland

Policies drive the direction of energy production. The Energy and Climate Strategy 2016 for Finland is being prepared and the main focus for renewables will be on the promotion of bioenergy and biofuels for transport. The goal will be to stop the use of coal completely and cut the use imported oil consumption by half by the year 2020. [TEM]

Wood fuels are the most significant renewable energy source used in Finland. And both nationally and regionally the largest growth will be seen in the use of these fuels.

Nationally, the Finnish government has set a goal that by the year 2020 the consumption of forest chips in the energy industry should be 13,5 million cubic meters. The use of energy wood (not including by-products such as black liquor) could be increased from the current level of 9.6 million cubic meters by around 3.9 million cubic meters (7 800 GWh) to the set target of 13.5 million cubic meters and the harvesting would still be within the sustainability limit at least according to the estimation above. If the planned industrial investments are not completed as for seen then there will be more growth potential for the forest energy industry [Luke 1].

The installed wind power capacity is increasing rapidly as the current government was planning on closing the feed-in tariff system, for wind power, early. At the moment the applications to be admitted into the feed-in tariff system more than full fill the maximum capacity of 2 500 MW. It is likely that when the feed-in tariff closes for new applications, the growth in wind power installations will slow down. However, it is unlikely to stop completely. A new area in the wind power industry might be off-shore installations.

Solar energy will increase steadily as equipment prices drop. However, at the moment it is unlikely to become very significant in overall energy picture.

The use of other biomasses has a lot of potential for growth both regionally and nationally. Estimation of growth has been stated in the previous section.

### **South Ostrobothnia**

The Council of South Ostrobothnia has published the Energy and Climate Strategy for South Ostrobothnia 2014 – 2020. This report states that in the energy sector the future main focus will be on forest and field biomasses as well as wind power. [EPLiitto]

Regionally the increase of wood based fuels will depend on the local district heating companies and their technical possibilities to replace peat with wood chip. For example the district heating company in Kauhava invested in a new 10 MW forest chip fuelled heat plant. The plant was completed in 2015.

Regionally the land use plan has increased the number of wind turbines in the region. The goal is to replace the 1 270 GWh/a of electricity imported into the region at least partially by wind power. To encourage instalments in the region wind power has been included in the regional land use planning. [Regional partial land use plan 1]

The effect of the feed-in tariff can be seen regionally. For example the wind power production in South Ostrobothnia in 2014 accounted for 2 % of electricity produced in the region. In 2015, wind power held a share of 6% and this is likely to increase even more in the year 2016.

Field biomass has great potential in South Ostrobothnia as agriculture is important to the region. The effective use of this potential will require policies that encourage the use of field biomass and agricultural by-products.

## 7. Policies already promoting use of RES and EE

Name of the policy	Area that it covers (Local, regional, national)	Actions that are promoted	For which sector is it meant	Type of support (subsidy, ...)
Energy support	National	Introduction of new energy technology to the market and to use	Companies, municipalities and other communities	Varies between 30 % -60 % of eligible costs
Feed-in tariff	National	New renewable energy power plants	For power plants fuelled by wind, biogas, forest chips and wood-based fuels meeting the prescribed preconditions	The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances.
Energy support for homeowners	National, application from municipality	Increase energy efficiency of detached single family homes or installing of a heating system that uses renewables	For private homeowners of low income	25 % of eligible costs

Household tax reductions	National	Bought services to upkeep, Maintain or improve your owned residential building (e.g. household cleaning services, the work done to install a new heating system)	Encourage households to buy services and thus create jobs	Tax reductions up to 2400 €/year/person. Calculated from wage costs only (15 to 45 %).
The Finnish building code and related legislation	National	After 2020 new buildings will be near zero energy	all	
Energiatohokkuuslaki (The law on energy efficiency)	National	Energy audits, cost-benefit analysis, and responsibility to guide clients towards energy efficiency	Grid owners, Power producers and sellers, large companies, district heating and cooling producers and network owners, industrial companies that produces energy by-products	
The Regional Strategy of South Ostrobothnia and related documents	Regional	Promotion of low carbon economy	All	Guidelines

Regional partial land use plan 1, accepted 11.5.2015	Regional	Wind energy production	Wind energy companies	Set apart locations that are fit for wind farms of over 10 turbines
Ongoing municipal partial land use plan	Local, City Of Ilmajoki	Wind energy production	Wind energy companies	Set apart all areas fit for wind energy production in the City of Ilmajoki

**Energy support** can be applied for by companies, municipalities and other communities that undertake investment and/or implementation research projects:

- to increase the use or production of renewable energy, to increase energy savings or energy efficiency of energy production or consumption,
- to increase energy savings or energy efficiency in energy production or consumption
- to decrease the environmental impacts of energy production or consumption

The amount of support varies depending on the applicants status (company, municipality other community) and the type of project. The maximum available support varies between 30%-60 % of eligible costs. Smaller shares can be used. Projects eligible for the feed-in tariff cannot receive energy support. [Energy Support]

**The feed-in tariff** was implemented in 2011. New wind (nominal power > 500kW), bio gas (electricity production nominal power > 100 kW), forest chips (electricity production nominal power > 100 kW) and wood-based fuel (100 kW < electricity production nominal power < 8 MW) power plants that have not received any governmental support can apply.

The feed-in tariff will close for wind power when the sum of the nominal power of all the wind power plants in the feed-in tariff system reaches 2 500 MW. For biogas power plants the feed-in tariff will close when the sum of nominal power reaches 19 MW. For wood-based fuels the feed-in tariff will close when the sum of nominal power reaches 150 MW and there are more than 50 plants. Forest chip power plants have no limit.

The subsidy varies on the basis of a three-month electricity market price or the market price of emission allowances. The target price is 85.50 € + extras that have prerequisites. Power plants accepted in the feed-in tariff system will receive support for 12 years. [Finlex]

**Energy support for detached single family home owners** of low income has a maximum support limit of 25 % of eligible costs. Brute income limits for single person households is 1760 €, for 2 person households 2940 €, for 3 person households 3920 €, for 4 person households 4995 € and for households larger than 4 persons +850 € for each additional person. Support can be given for adding insulation to building envelop, for changing windows to more energy efficient ones, installing a ground source heat pump, an air-to- water heat pump, a wood pellet or other wood fuelled boiler or a hybrid renewable energy system. [Ara]

**Household tax reductions** are 45 % of wage costs, if you hire a company to preform maintenance, upkeep, or installation services at your home. If you hire a private person the available tax reduction is 15 %. The total maximum deductible sum is 2 400 €/person/year.

**The Finnish building code** has been directing the construction of buildings towards zero energy building since 2008. Currently the ongoing updates to the building code will mean that new houses that apply for building permit after the start of 2018 will be

zero energy buildings. If the renovation of older buildings requires a permit, the national building code has regulations on the required energy efficiency state that the renovation must achieve. [Finnish Building Code]

**The law of energy efficiency** is focused on grid owners, power producers and sellers, large companies, district heating and cooling producers and network owners, industrial companies that produce energy by-products. It has requirements for energy audits, cost-benefit analysis, and responsibility to guide clients towards energy efficiency. [Energy efficiency law]

**The Regional Strategy of South Ostrobothnia** and related documents serve as guideline for political decisions and admitting funding in the region. One of the stated goals is the promotion of low carbon economy. [Regional strategy]

**The Regional Partial Land Use Plan 1** maps out the best locations for wind farms with several turbines. The goal is to increase the amount of wind power produced in the region. [Regional partial land use plan 1]

**Ongoing municipal partial land use plan** in the city of Ilmajoki will map out the exact locations of wind turbines. In spite of the regional partial land use plan, municipality land use plans must also be completed before wind turbines can get building permits. Usually the land use plan for wind turbines is put in motion when potential wind turbine investors are interested. The city of Ilmajoki has taken initiative in the matter and is updating their land use plan so that wind turbine investors can skip one step if they choose Ilmajoki as their location. [Ilmajoki]

## 8. MARKET NEEDS REVIEW WITH RESPECT TO ENERGY EFFICIENCY IN PUBLIC BUILDINGS

### 3.1 Current Funding Opportunities

Business Finland (formerly TEKES) is the most important publicly funded assistance organisation for financing research, development and innovation in Finland. One of its streams for public sector funding covers procurement and while this is not energy efficiency specific it could offer an option to support procurement which encourages or promotes energy efficiency or zero CO<sub>2</sub> within other projects. Business Finland could meet up to 50% of eligible costs.

Energy Aid is a Finnish Government run fund with a budget for 2018 of €55 million. Priority is given to new technology projects and demonstration or pilot projects. Energy Aid also targets investments related to energy efficiency agreements, and investment in decentralized energy production and renewable transport fuels in the non-emissions trading sector.

ERDF is potentially available through Finland's structural funds programme – Sustainable growth and jobs 2014 to 2020 –which offers potential for public building projects to apply for ERDF under Priority 2. This includes “Developing solutions based on renewable energy and energy-efficient solutions”. This aims to increase RDI connected with renewable energy, energy efficiency and material efficiency, allowing an increase in the proportion of renewable energy sources in energy production and the development of business based on renewable energy solutions and energy and material-efficient solutions.

The European Agricultural Fund for Rural Development (EAFRD) is a funding mechanism under the Common Agricultural Policy (CAP). One of the priorities of the EAFRD for 2014-2020 is the promotion of resource efficiency and support of the shift towards a low carbon and climate resilient economy in agriculture, food and forestry

sectors. This fund offers some opportunities for energy efficiency, renewable energy and research into energy issues in traditional farming areas.

ARA is the housing finance and development center of Finland which provides funding for municipalities to produce special needs and care homes and is currently placing an increased emphasis on energy efficiency and renewable energy within the homes being built with their financial assistance.

The European Investment bank provides Intermediated loans to local banks with the condition of transferring them to small and medium-sized businesses. These loans can be provided for purposes such as improving environmental sustainability of SMEs and supporting a competitive and secure energy supply.

### 3.2 Policy Background

There are policies at national and regional level relating to both buildings and funding but there is a feeling that there could potentially be improved co-ordination and linkages between the two especially on the regional level. The Regional Strategy sets targets to 2040, with the Regional Program 2014-2017 section updated during the year 2017 to the Regional Program 2018-2021; this guides how the European funds should be used in the region. There was a lack of detail in this strategy on how buildings contribute to the carbon reduction targets. In the updated section for 2018-2021, there is a short mention of buildings relating to carbon emissions, but this link could be stronger. In addition, there is a Regional Energy and Climate Strategy for South Ostrobothnia, but the goals are currently less bold with weak linkages to the Regional Strategy which could potentially direct funding towards the Energy and Climate Strategy.

The Building Code is a national level guidance that rigidly directs the construction of new buildings (design, energy efficiency demands etc.) and influences the renovation

of existing buildings (energy efficiency). The national level of guidance is heavily weighted towards near zero energy buildings and often causes regional level authorities to be reluctant to deal with buildings directly in their policies. City planning guides the spatial use of land as well as sets limits to the type, direction, location, size and even colour of used facade materials of a building, thus limiting the choice and possibly the use of new materials. City planning can be influenced on a regional and local level.

There is policy encouragement to develop new technologies and provide innovative solutions in the renewable energy sector. However, to secure funding support through Business Finland there would need to be an export angle. Purely domestic technologies will not attract support. This is potentially relevant to a growing concern over indoor air quality and humidity problems.

Current research and policy is unclear whether the problems with air quality are due to poor quality construction in the 1970's or 1980's, lack of proper maintenance, too much use of disinfectants, to something implemented more recently or even all of these. This is a cause for lots of research and debate. Currently there are different policies and regulations for different types of buildings e.g. residential buildings follow the Decree of the Ministry of Social Affairs and Health on health-related Conditions of Housing and Other Residential Buildings and the Qualification Requirements for Third-party Experts, and buildings that are used for working places follow the Occupational Safety and Health Act. There appears to be uncertainty within existing knowledge which needs to be addressed to assist future policy recommendations.

The rapid development of the Building code towards near zero energy buildings has caused many to be concerned that the current building norm will end up causing all new buildings to grow mouldy. Thus, society will end with only rotten buildings. The two-main construction research institutions have presented opposite opinions on the

matter. Therefore, there is great division on indoor air quality issues. The research bodies currently have different opinions on issues such as humidity and air quality in well insulated buildings.

There has been funding for air quality and problematic public buildings, but this ended in 2014, despite continuing problems in schools and other public buildings. Lack of policy to encourage such investment has led to a subsequent lack of funding making it difficult for some municipalities which should develop within fixed budgets.

In terms of policy support for larger scale renewable energy projects, there is a regional land use plan which designates an area for a regional scale biodiesel plant. To date there is no developer support and there appears to be a gap between policy and implementation. There is also a Regional land use plan, which points out all potential locations for wind farms with 10 or more turbines. Some of these sites have already been developed and are operational.

There is also changing policy regarding financial support for renewable energy investments. Feed in Tariffs for wind powered projects had become higher than needed, and through working with EU recommendations, the FIT regime is changing. But there still appears to be a lack of policy and funding support for solar projects. This may in part be due to Finland's seasonal extremes with long hours of daylight in summer but limited light in winter. Research into seasonal storage or energy prediction during periods of darkness should be encouraged before solar could become more attractive. In spite of these limitations, more private companies, homeowners and even municipalities have chosen to invest in solar power.

## 9. POLICY CONTEXT

The Action Plan aims to impact:

- ☐ Investment for Growth and Jobs programme
- ☐ European Territorial Cooperation programme
- ☒ **Other regional development policy instrument**

Name of the policy instrument addressed: **The Regional Strategy of South Ostrobothnia**

### 9.1 ACTION 1

#### Background

It was noticed during the project that the targets in the Regional Strategy of South Ostrobothnia especially in relation to renewable energy and energy efficiency lacked depth due to lack of indicators that could be followed. The objective of the region is to further renewable energy and energy efficiency but the impact of the implementations is not followed by enough specific indicators. As for example after refurbishments of public building, the impact of the new heating system is not followed in terms of greenhouse gases. Therefore, this action will improve the following of renewable energy and energy efficiency measures in South Ostrobothnia.

ZEROCO2 project has enabled the change of good practices, which hopefully will further the implementations of sustainable and energy efficient implementations and give new alternatives to consider in South Ostrobothnia. Buildings consume approximately 40 % of the consumed energy in South Ostrobothnia, therefore each sustainable and energy efficient solution decrease the impact of building sector regarding the regional energy consumption or the amount of greenhouse gases. More detailed following will allow more specific analyses of the impact of energy efficiency implementations. Thermopolis will do the following of above mentioned indicators and provide the information for the Regional Council of South Ostrobothnia.

## **Action**

To tackle this problem different types of indicators have been proposed by Thermopolis during the project phase 1 to the authority (the Regional Council of South Ostrobothnia) responsible for the Regional Strategy of South Ostrobothnia. The first step was to help the regional authority choose relevant indicators to be included in the Regional Strategy update for 2018-2021. Following indicators were chosen during the cooperation and currently the indicators are represented in the Regional Strategy of South Ostrobothnia 2018-2021: 1) Electricity consumption (GWh/a), 2) use of solid fuels in power plants and in heat only boilers (m<sup>3</sup>), 3) greenhouse gases (1,000 tons of CO<sub>2</sub>e). The second step will be to help with the first year of following the indicators.

## **Players involved**

The main player will be the Regional Council of South Ostrobothnia. The Regional Council of South Ostrobothnia is a statutory federation of municipalities consisting of 18 municipalities. The Regional Council of South Ostrobothnia is doing the best to achieve the goal set forth by the Regional Strategy as they are the responsible body of the strategy. Thermopolis will assist the indicator following especially in collecting the data from the first year of evaluating the indicators. To collect specific energy related information stakeholders have an important part in providing information. Thermopolis and other players like Seinäjoki university of Applied sciences (higher education in South Ostrobothnia), municipalities and such that can provide regional information and data for the chosen indicators.

## **Timeframe**

The action started in the first phase of the ZEROCO2-project with helping the Regional Council identify indicators that relate to their set targets of becoming a low carbon economy, increasing the use of renewable energy etc.

During the second phase of the ZEROCO2 project step 2 will take place. The action should take off during the second phase of the project and then become a continuous action in estimating the success of the Regional strategy. Yearly collected indicators will partly represent the impact of the energy efficiency and sustainable implementation that have been done in the region. The data for the year 2018 will be available in late fall 2019, so the second step will take place then. If 2018 data is not completely available before the end of the project, then data will be gathered for the year 2017. This will depend on the updating of official statistics and cannot be influenced by Thermopolis.

### **Costs**

The cost is related to working hours when monitoring that the indicators are followed by the Regional Council of South Ostrobothnia. Monitoring is strongly based on cooperation as Thermopolis will help the Regional Council of South Ostrobothnia with data collection.

### **Funding sources:**

Thermopolis will assist in collecting the data from the first year of evaluating the indicators within the ZEROCO2 project funds. Further costs will need to be covered by the budget of the Regional Council of South Ostrobothnia.

## **9.2 ACTION 2**

### **Background**

To implement the Regional Program 2018-2021 a Regional Implementation Plan is created. This plan is valid for two years. The current Regional Implementation plan is for the years 2017-2018 and relates to the Regional Programme 2014-2017. The Regional Implementation Plan 2019-2020 will be a plan to implement the updated Regional Program 2018-2021 (a section of the Regional Strategy). The Regional

Strategy of South Ostrobothnia 2018-2021 states that decentralized energy production is one of the objectives that the region is aiming for in the field of energy. Therefore, near zero CO2 emission buildings should be implemented in South Ostrobothnia as the implementation of ZEROCO2 content buildings will further the sustainability of the region. The Regional Council usually asks for expert advice on creating this document.

### **Action**

If invited by the Regional Council to participate in the expert group, Thermopolis will partake in the creation of the next Regional Programme implementation plan for 2019-2020. The action could be attending workshops and commenting on different written versions of the paper. The Regional Implementation Plan includes evaluation of the implementations and alignments of the Regional Strategy.

### **Players involved**

Regional Council and invited expert organisations. As regional energy agency, Thermopolis is a potential energy expertise to be invited in the expert group.

### **Timeframe**

Most likely time frame is the year 2018.

### **Costs**

Cost will relate to working hours on monitoring the implementation plan.

### **Funding sources:**

The Regional Council of South Ostrobothnia is responsible for the Regional Implementation Plan. The implementation itself will be funded from the budget of The Regional Council of South Ostrobothnia. Thermopolis will use ZEROCO2 fund in monitoring the implementations referring to ZEROCO2 content.

### 9.3 ACTION 3

#### **Background**

The Regional Strategy of South Ostrobothnia has in part been updated (the Regional Program section) for the years 2018-2021 during the year 2017. The updating was organized by the Regional Council of South Ostrobothnia. Thermopolis participated in the expert group that was invited to assist in the development and updating. A sentence stating that the Region of South Ostrobothnia has the possibility to be a forerunner in creating buildings that do not produce CO<sub>2</sub> emissions was added to the program. This can be seen as a great victory for the ZEROCO<sub>2</sub> project in our region as there was some resistance towards using the translation of the term ZEROCO<sub>2</sub> building and as the Regional Strategy tends to leave building related topics to be dealt with by the national government.

Now that the statement has been included in the policy, it would be important to follow what actual actions will come from it. Thermopolis will monitor how many new ZEROCO<sub>2</sub> related projects (national, regional, international funds) will be developed in the region after the new statement that endorse ZEROCO<sub>2</sub> buildings.

#### **Action**

The Regional Council of South Ostrobothnia has usually invited a team of experts to participate in a mid-term evaluation of the Regional Strategy. Thermopolis hopes to be invited and will participate in the evaluation process and provide ideas for putting the policy in relation to the ZEROCO<sub>2</sub> buildings into action.

#### **Players involved**

The Regional Council of South Ostrobothnia as the responsible authority.

Thermopolis as energy expertise and advisor. Thermopolis will monitor whether ZEROCO<sub>2</sub> buildings will be constructed/renovated in the region. Other expert

organizations invited by the Regional Council of South Ostrobothnia, field of expert may vary.

### **Timeframe**

The Regional Council of South Ostrobothnia has not yet published the timeframe for evaluating the regional strategy, especially the part Regional Programme 2018-2021. It is to be expected that the midterm evaluation will start close to the end of second phase of the project ZEROCO2.

### **Costs**

The costs are mainly related to working hours and travel costs for attending the expert evaluation events.

### **Funding sources:**

The Regional Council of South Ostrobothnia is responsible for the updating. Thermopolis will use ZEROCO2 fund in monitoring of the near zero CO2 implementations in the region of South Ostrobothnia. Monitoring will be important after the added sentence that will endorse the ZEROCO2 concept.

## **9.4 ACTION 4**

### **Background**

The Finnish National Government is working on reconstructing the structures and responsibilities of Regional Councils. Many tasks currently belonging to municipalities are planned to be given for the regional operators. It is estimated that this change will take place in 2020. However, before the official change is made background work is being put into the new structure.

**Action**

Thermopolis will follow the updating process closely and try to influence the new Regional Organisation to keep working on energy related issues. This will be done through the actions 1,2 and 3 and possible other actions, if there is an opening for them.

**Players involved**

This is one of the largest changes governmental structural changes in Finland to ever take place. It involves the whole health care system, all regional decision making organisations and offices, all municipalities and on whole will affect all Finns. Thermopolis hopes to be a voice for energy efficiency and renewable energy in the Region of South Ostrobothnia, during this process.

**Timeframe**

The change is to take place in 2020.

## 9.5 ACTION 5

### Background

The heating of the buildings in Finland consumes a significant amount of energy. According to the studies completed during the ZEROCO2 project, 34 % of the buildings in South Ostrobothnia are heated by oil boilers. Combined with the fact that covering the heating load with renewables is easier than covering the electricity load, The first step towards a region with ZEROCO2 buildings would be to replace these oil boilers with renewable energy heating options.

The figure 34 % of buildings housing oil boilers, has been calculated based on “the number of buildings by intended use and heating fuel” kept by Statistics Finland, Official statistics of Finland. These statistics are based on the building permits of buildings. If the building owner has not informed municipal officials of a change of heating systems, this register will have faulty information. So the figure has some error to it.

Five municipalities in the region are working together to implement a common Climate strategy that they completed in and approved as an official document in the municipalities at the beginning of 2013. Thermopolis has the expert adviser and activator role for these municipalities. Each municipality that is participating has written their own Sustainable development plan that has or is going to be presented to each town council to become an official part of each municipalities strategy.

The Sustainable action plans include reaching a 7,5 % energy savings between the years 2017 -2025. Examples of actions to reach these goals are improving heat recovery in air ventilation systems, training staff on energy efficiency and changing all oil heated buildings to renewable heated.

The sustainable development plans are based on a common climate strategy that the municipalities wrote together during an ERDF funded project. The municipalities continue to work together under the title Kestävät. This co-operation has been suggested as a good practice in the project ZEROCO2.

**Action**

As an action for this action plan Thermopolis will follow the progress of each municipality and use their progress to encourage other municipalities in the region to suite.

**Players involved**

Five municipalities (Alavus, Kuortane, Kurikka, Lapua and Kauhava). Each municipality has written their own Sustainable development plan that has or is going to be presented to each town council to become an official part of each towns strategy. Thermopolis is the energy expert adviser and activator for these municipalities. Thermopolis is also following the energy efficiency measures that have been done in the participating municipalities.

**Timeframe**

Deadlines set by each municipality to reach their goals.

**Costs**

The time used to report the achievements of the municipalities referring to ZEROCO2 project will be reported as staff costs for the ZEROCO2 project.

**Funding sources:**

Kestävät will be operated with its own funding (municipalities are funding Kestävät). Monitoring of the following of sustainable implementations in the municipalities will be operated within the ZEROCO2 project budget.

**9.6 ACTION 6****Background**

This action is related to the previous action at least it shares the same background. And though the action is focussed on single family homes it is within the scope of the

ZEROCO2 project. For example in the application it is stated that housing sector will be included: “ZEROCO2 addresses the regional policies in environmental and energy fields and will represent support actions and investments to increase levels of energy efficiency, including public buildings and the housing sector” (ZEROCO2 project application page 26 section C.2).

The national building code set up the constraints for new buildings. However, there are e.g. several heating alternatives to choose from and the guidance and support to make decisions regarding heating systems is not sufficient enough. There are many different sources to find information and several aspects that have to be included in the building process. Therefore it has been foreseen to be useful to compile all the good guidelines and cooperation networks to be found on one portal.

### **Action**

Seinäjoki University of Applied Science (SeAMK) is working on building a platform portal for people who are going to build single family homes. The platform can be used for project control, connecting all relevant companies and officials to the house project. One section in the platform will include helping the builders decide on a heating system for their building. Thermopolis will provide information for the platform during the second phase of the ZEROCO2 project. The portal will encourage people to take steps towards ZEROCO2 buildings. Thermopolis will provide SeAMK useful heating system advices that should be taken into consideration when building a new house. These advices and other heating system related links will be added to the portal. The end user of the portal will be able to find information from directed links by himself/herself. SeAMK foresee that the portal will be used in future as a tool when building a new house. After successful implementation, this portal could be a useful monitoring tool to find out how many ZEROCO2 buildings or similar low emission buildings have been constructed in South Ostrobothnia annually. Due to the high standards in the field of construction, it's difficult to evaluate how close the new buildings are to ZEROCO2 buildings.

### **Players involved**

SeAMK is the developer and operator of the portal. Thermopolis will be the supporting energy expert and monitoring whether the portal will find its end users or not.

### **Timeframe**

This work will take place during the year 2018.

### **Costs**

Cost will relate to working hours and possible travel costs.

### **Funding sources:**

SeAMK is working on the platform with-in the frame work of an ERDF funded project. Other funders are SeAMK and the Regional Council of South Ostrobothnia. With ZEROCO2 fund Thermopolis will monitor how many ZEROCO2 or similar low emission buildings have been constructed in the region with help of SeAMK's tool.

## **9.7 ACTION 7**

### **Background**

Energy and Climate Strategy of South Ostrobothnia 2014-2020 is a document in which supports the Regional Authority in taking into consideration energy and climate related issues. Though the strategy was accepted in 2014 the indicators state in the document have not been actively followed. The Regional Council of South Ostrobothnia is responsible of the Energy and Climate Strategy of South Ostrobothnia. Many of the envisaged indicators are related to ZEROCO2 content, therefore following of these indicators will indicate the sustainable development in the region.

## **Action**

Thermopolis will help the Regional authority with starting to follow the stated indicators. Thermopolis will also comment and give feedback of the indicators, including improvement factors and recommendations for indicator adjustments. Such indicators are envisaged as: Electricity consumption and production in South Ostrobothnia, wind power share of regional electricity production, hydro power share of regional electricity production, wood fuels share of regional district heating production, indicators of energy efficiency investments in agriculture, volunteer energy efficiency agreements (municipalities and companies), amount of projects that are furthering the objectives of the strategy, transportation and other energy related contents. Thereby, Thermopolis will help the Regional Council of South Ostrobothnia to calculate and collect the above mentioned indicators if necessary. The Regional Council of South Ostrobothnia is the responsible body of the Energy and Climate Strategy of South Ostrobothnia 2014-2020. As administrative body they are in charge of following the indicators presented in the strategy. This action is strongly related to Action 1 as some of the same indicators are used in both documents.

## **Players involved**

The Regional Council of South Ostrobothnia is the responsible body for the strategy. The Regional Council of South Ostrobothnia prepare all the documents. Thermopolis will work as an energy expertise, helping with the following of the indicators and giving feedback and comments regarding the followed indicators. Thermopolis will especially monitor that the chosen indicators are followed appropriately.

## **Timeframe**

The action will take off during the second phase of the project and then become a continuous action in estimating the success of the Regional strategy. The data for the

year 2018 will be available at in late fall 2019, so the second step will take place then. If 2018 data is not completely available before the end of the project, then data will be gathered for the year 2017. This will depend on the updating of official statistics by Statistics Finland and cannot be influenced by Thermopolis.

### **Costs**

The costs are mainly related to working hours and travel cost used attending the expert evaluation events.

### **Funding sources:**

Thermopolis will follow the indicators. Monitoring of the chosen indicators will be operated by ZEROCO2 fund. Otherwise, the strategy is done with by the Regional Council of South Ostrobothnia.

Project: ZEROCO2

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