Northern Periphery and Arctic Programme
2014–2020

EUROPEAN UNION
Investing in your future
European Regional Development Fund

LECo

Local Energy Communities

Report on available statistical data and available studies on local renewable energy sources.

Northern Periphery and Arctic Programme 2014–2020

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Contents

Centria University of Applied Sciences · Renewable Energies Agency · Jokkmokk · Luleå Tekniska Universitet · Údarás na Gaeltachta · WDC · UiT Norges Arktiske Universitet

ABSTRACT

A report has been made on the information on statistical data and available studies on local energy systems in Sweden, Finland, Norway and Ireland that was available from open data. The study shows that almost all data are available on national level but the availability decreases gradually if we go forward to regional, county, municipality and community level. Sweden has good national and energy statistics down to municipality level, Finland at county level. Norway has statistics to municipality level for a part of the country but only to county level for the northernmost areas. Ireland has statistics on some data on local level. Important data sources, availability maps etc. are described in some details. A separate list data of availability for each of the four countries is included. Experience of energy simulation from some previous projects has been described. It can be summarized as follows: There is always some data missing. The structure of those "information holes" was different for each case. However, it was possible to get around this by choosing different evaluation roads. These roads were also different for each case.

A comparison of these experiences with the data found in this report indicates the available data should be sufficient to start modeling pilot communities if:

- we know the geographical area and position of the chosen pilot communities
- and have a general description of their properties and what they want to do

The main object of the assessment in next step (delivery T.2.4.3) should be to supply those data

Luleå January 6, 2019

Carl-Erik Grip

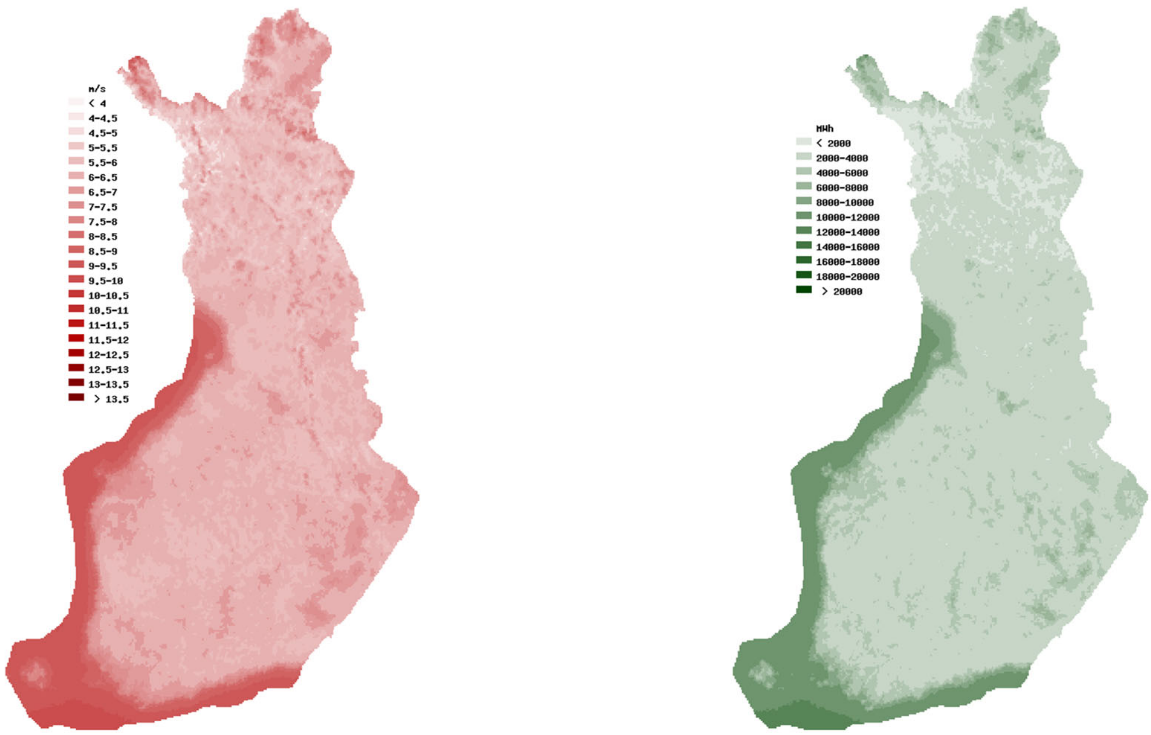
1. INTRODUCTION

The aim of this deliverable, according to LECO: s project plan is: "Statistical data and available studies on local energy systems (use and supply, local resources) will be compiled into a report." The study was made focusing on both yearly mean data and the distribution of hourly values over the year. The later ones are necessary as the intensity of availability and consumption are seldom in phase and an evaluation model must handle that.

2. AVAILABLE OPEN DATA

2.1 Wind Energy

Figure 1 shows maps on wind speed and expected electricity production from Finnish Wind Atlas [1]

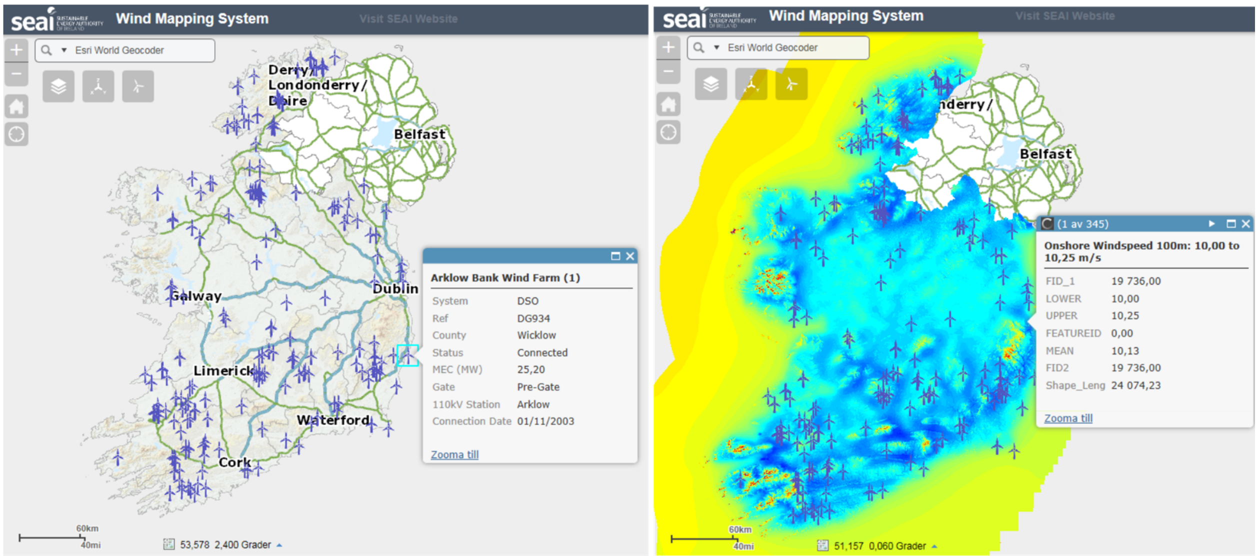


a) Wind speed at 50 m (Year) **b) Calculated production at a height of 50 m (year)**

Figure 1 Wind speed and calculated production at 50M according to Finnish Wind Atlas [1]

The maps can be set to give a yearly mean value or the mean value for a chosen month at a height of 50, 100 or 200 m. The map in Figure 1 a shows the yearly mean of the wind speed for a height of 50m. The map in Figure 1 b shows the calculated yearly production of a WinWord WWD-3, 3 MW wind Turbine at a height of 50 m.

Figure 2 shows pictures from SEAI: s Irish Wind Mapping System [2].

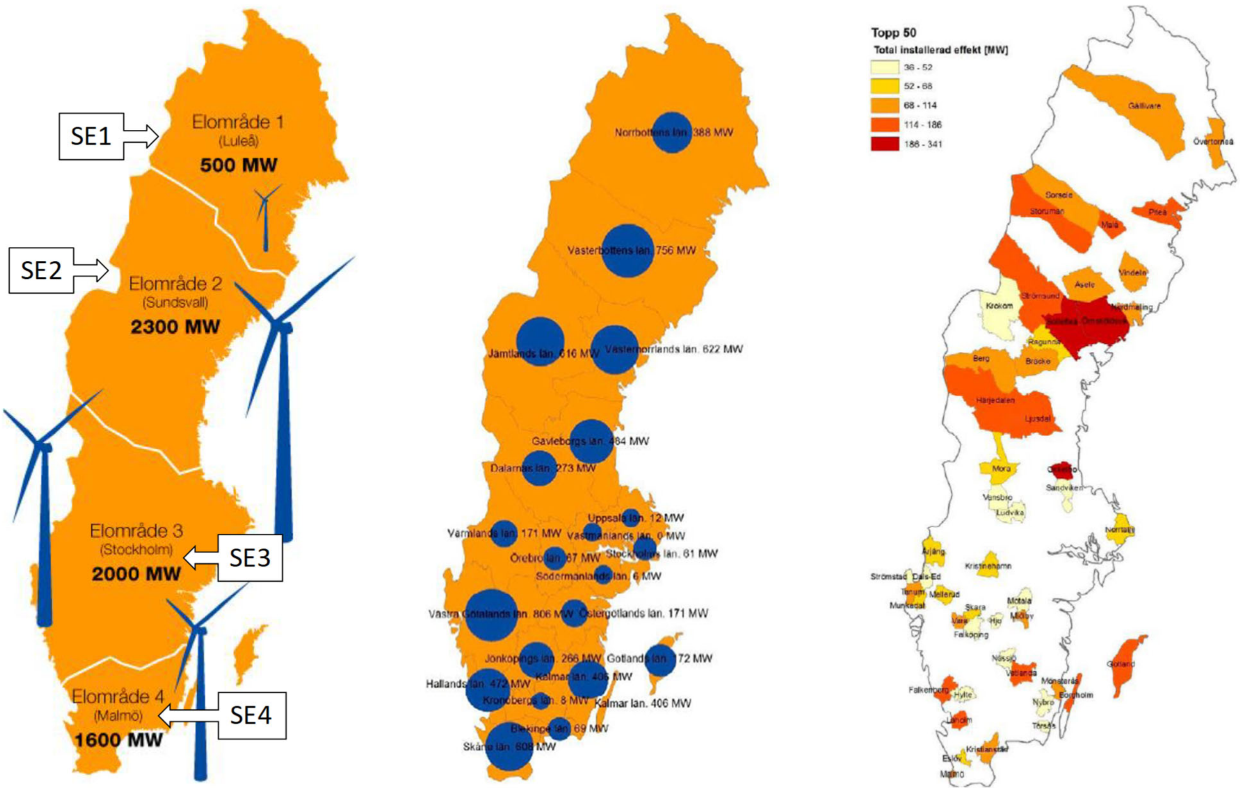


a) Wind farm Layer **b) With wind speed layer**

Figure 2 SEAI: s Wind Maps [2].

Wind farm data are extracted by pointing at the Wind farm map in Figure 2a. and wind data by pointing at the wind speed map in Figure 2 b. One example for each map is shown of the output after pointing at a chosen location

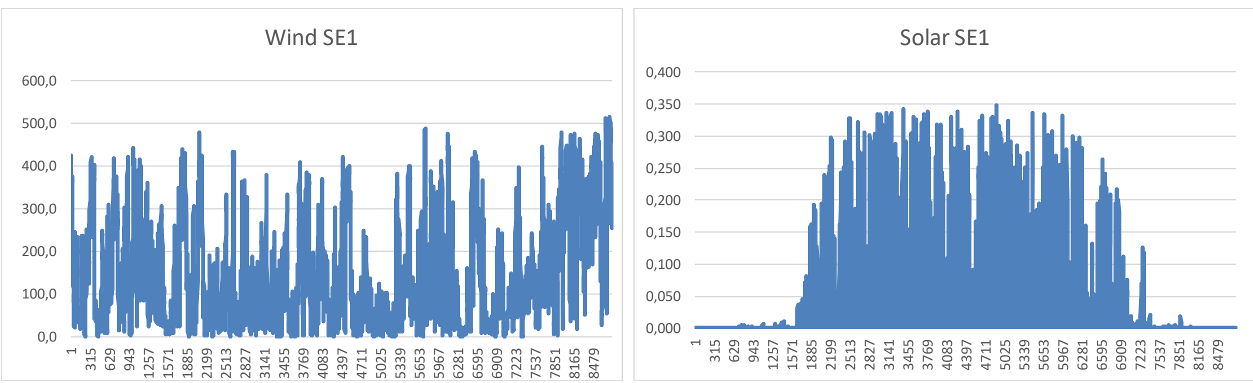
Figure 3 shows wind power data from different Swedish areas according to the report Vindkraftsstatistik 2016 (Wind Power Statistics 2016) from the Swedish Energy agency [3]



a) **Electric areas (SE1-SE4)** b) **County data** c) **Top 50 municipalities**

Figure 3 Local and regional Wind power, Sweden [3]

The maps shows yearly production data for The Electric areas SE1-SE4 (Figure 3 a), all counties (Figure 3 b) and the 50 Municipalities with the highest wind Power volume (Figure 3 c). Hourly values of wind power production and total electricity production can also be found at both Nordpool [4] and the Swedish National Grid Statistics [5]. The latter one also includes Hourly production from Water power, Wind Power, Nuclear power, CHP plants, Gas turbines + diesel generators, Solar power and unspecified producers. Figure 4 shows examples of t hourly logs of Wind power and Solar power in region SE1 (Northernmost Sweden, see Figure 3 a) from the Swedish National Grid Statistics.



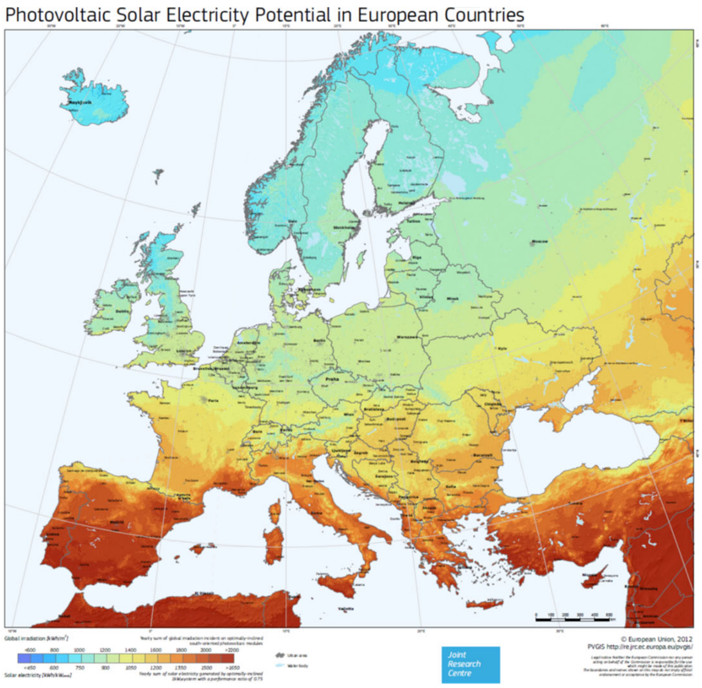
a) **Wind power 2016 Area SE1** b) **Solar power 2016 Area SE1**

Figure 4 Swedish National Grid Statistics [5]: Examples of hourly data for the northern electric area (SE1)

The Nordpool statistics on Norway includes hourly vales of electricity production and consumptions for the Electric Areas NO1 – NO4, where NO4 is the northernmost one. However, no data separated on wind power, and solar power were found.

2.2 Photovoltaic energy

The maps in Figure 5 show the photovoltaic solar potential in Europe and in Finland. They were published by the European commission’s Joint research Centre. They show the incident radiation and expected PV electricity for a south oriented optimally inclined solar panel.



a) **Map showing Europe’s potential of solar radiation and PV electricity [6]**

b) **Map on Finland’s potential of solar radiation and PV electricity [7], [8]**

Figure 5 Example of Maps showing solar Energy potential

The map in Figure 5 a shows the incident radiation and expected PV electricity for a south oriented optimally inclined solar panel. The PDF file of that map also includes two side maps that are not shown here. One of them shows the optimal inclinations for the mapped geographical positions. The other one shows the improvement if the panels are moving with a one axis tracking system. The map in Figure 5b shows the incident radiation and expected PV electricity for Finland. A similar map for Sweden (not shown here) can be found in reference [9] (not shown here). In addition, a more extensive study on the PV potential can be found in the VTT report No 217: “The role and opportunities for solar energy in Finland and Europe”, reference [10].

There is also the STRÅNG model [11] which covers the Nordic countries. It is run by SMHI and can deliver instantaneous fields of global radiation, photosynthetically active radiation, UV radiation (CIE weighted) and direct radiation at a horizontal resolution of about 2.5 x 2.5 km and a temporal resolution of one hour. It has been tuned and validated using SMHI: s data on direct solar radiation and global radiation.

Historical data as time series, fields or charts with a time resolution down to hourly values can be extracted using the link of reference [12].

2.3 Historic hourly data from the National Weather services

The Swedish Meteorological Institute (SMHI) has a database with the possibility to get hourly data of measured temperature, wind speed and solar radiation from all weather stations [13]. Figure 6 shows the available data from different locations

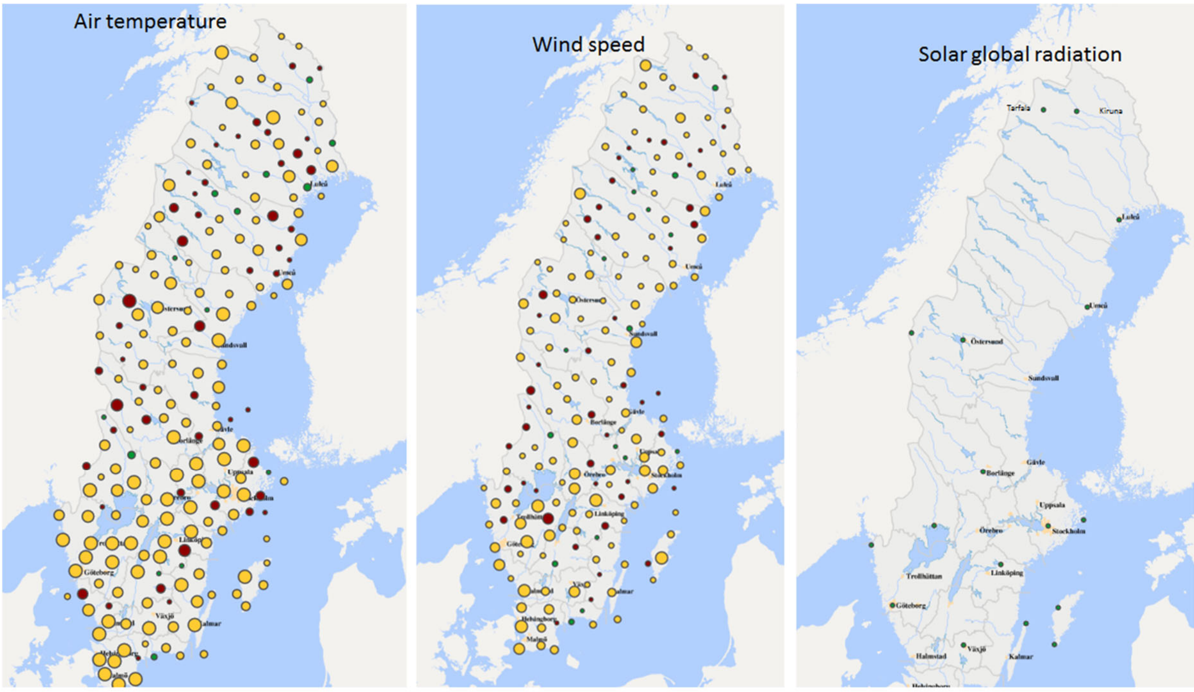
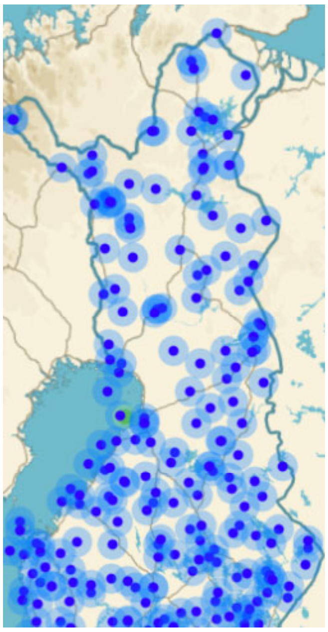
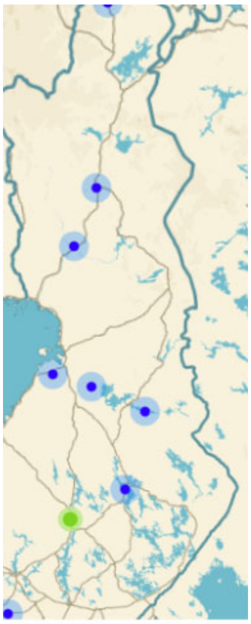
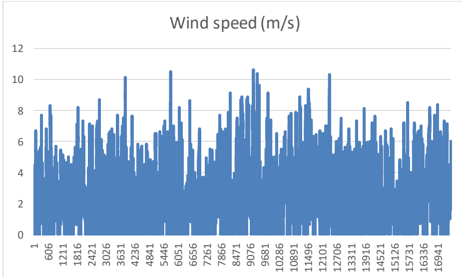


Figure 6 Open data from SMHI, Sweden. Available hourly measurements of temperature, wind and global radiation [13]

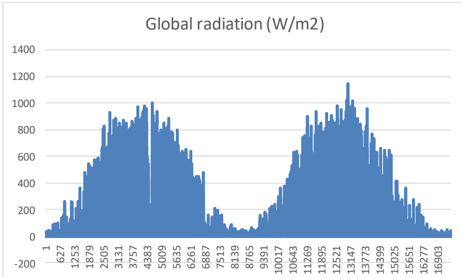
Figure 7 shows the weather stations of the Finnish Meteorological Institute (FMI) [14]. (Only the northern part of Finland is shown, as the webpage only showed part of the maps.) Two examples of hourly wind and solar observations are included in the picture (location shown with green circle on the maps).







Wind 2016-2917: Hailuoto Keskikylä



Weather (Wind, Temp etc.) Radiation Measurement Solar 2016-2917: Jyväskylä lentoasema

The maps and the authors experience with the data show that measured hourly data for to get time distributions on wind and temperature are available almost everywhere in Sweden and Finland, but similar data on global radiation are only available on a few stations in these countries.

The Norwegian Weather service [15] has a possibility to find weather data at a certain time and place. There seems to be no easy way to get hourly time series. However, they can give diagrams for the last 13 months, so probably they have the data (see example for Oslo in reference [16]).

The Irish weather service has a service for getting hourly data from different stations by pointing at a map. A test on downloading the whole data series for Newport gave a table of the following parameters since its start 2005: Date and Time (utc), rain mm, Air Temperature (C), Wet Bulb Temperature (C), Dew Point e (C), Vapor Pressure (hPa), Relative Humidity (%), Mean Sea Level Pressure (hPa), Mean Wind Speed (kt), Predominant Wind Direction (deg). A check for the early years showed several missing data, but data for recent years were very complete.

2.4 Biofuel availability, general

The "S2Biom project" has published an extensive map on biomass availability in EU and some other countries, see 3.4 below and reference [17]. SEAI has published a Bioenergy map system for Ireland [18]

2.5 Biofuel availability (forest)

Thuresson [19] made a study on the availability four Balance areas in Sweden, where Balance area 1 is the northernmost one and Balance area 1 is the southernmost one. He made for each of these areas he evaluated the availability of four types of forestry by products: **Grot** (Branches and tops), **Långtopp** (logs from long tops), **Klengallr** (Whole trees from small thinning), **Övr Röjn**, (Whole trees other clearing), **Stubbar** (stumps).

Finland has a very good forest statistics "METLA" [20]. Ireland has a good forest statistic. Planted areas are given also per county, the other data are for Ireland as a whole [21]

2.6 Hydropower

Finland does not have much potential left. Sweden has a lot left, but the Environmental Code prevents continued expansion of large-scale hydropower, small-water power is also not profitable and, in addition - has similar negative effects as a large hydropower plant, according to research. In Norway, small hydropower has been extensively developed after 2000, it is currently, but slower and the discussion about Norway as Europe's Energy Battery is ongoing. that is, there is a lot of potential left, but there is also a lot of resistance to continued expansion, especially against large-scale hydropower and also the backbone (conflict about "monster master" - "Battle of Hardanger"). Ireland has good hydropower potential, even for hydro pump storage [22].

2.7 Peat

Peat is sometimes looked upon as a "slowly" renewable resource, however it is usually treated as a fossil energy. Finland and Ireland use a lot of peat. In Finland it is used for district heating was used. In Ireland it is also used for the heating of small houses [22].

2.8 Data from the EnergyPLAN homepage

The homepage of the EnergyPLAN project [23] includes a list of country models that have been developed within the project.

For **Germany** two models are named, the "2015 Model" and the "Models for Solar Thermal in Future Energy Systems". The same information is given for both of them: a full set of hourly distributions for Germany 2010. They are probably enough for good simulation of German cases.

For Finland there are two models: the "2012 Model" and the "2050 RES". A full set of distributions specific for Finland are included. These could be used for modelling. However, for local simulation, it is recommended that the ones for solar energy from the arctic energy project are used (locations see Figure 10b)

For Ireland two models are described, the "2007 Model" and the "2020 Model". They contain the same set of distributions. The ones for heat demand, export hydro, wind, and wave power are specific for Ireland, but not the ones used for solar energy. However, the information for **United Kingdom** contains a full set of distributions, which could probably be used for the ones missing for Ireland. The simulation for Ireland is described in some detail by David Connolly in EnergyPLAN: s "Fide Guide" [24].

For **Norway** two models are mentioned: the "2009 Model" and the "2015 Model". The information contains a set of Norway specific distributions for most parameters except solar. For wind and solar it is recommended that the ones developed in Arctic Energy are used.

For **Sweden** there is one model mentioned: "2009 Model". There are no Swedish specific distributions except some from Nordpool for the whole country.

3. DATA FROM PROJECTS

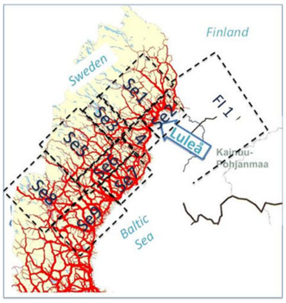
3.1 Biofuel availability

Thuresson [19]made a study on four balance areas Where Balance area 1 is the four northernmost counties in Sweden and Balance area 4 is the southernmost part

3.2 BioDRI

The BioDRI project [25] aimed to study the possibility to produce steel or iron powder using gasified biomass as a raw material for reduction of iron ore. For that purpose, it was necessary to deliver a considerable amount of forest by products (up to around ½ million metric tons) to one location. Two cases were studied, a direct reduction plant in Northern Sweden and one in Southern Sweden (Halmstad or Höganäs). This created both a combined availability and transport problem. For this reason, an evaluation of the availability of forest biomass in the nearby region, separated in smaller areas had to be made. The main outcome is shown in Figure 8 below

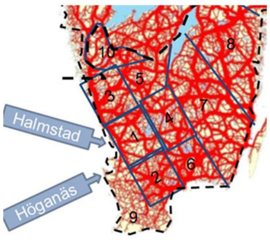
Northern case (User in Luleå)



Area nr	SE1	SE2	SE3	SE4	SE5	SE6	SE7	SE8	SE9	FI1	Sum
Grot	0,098	0,488	0,098	0,293	0,146	0,780	0,975	0,244	0,780	0,876	3,9
Långtopp	0,005	0,025	0,005	0,015	0,008	0,040	0,050	0,013	0,040		0,2
Klengallr	0,005	0,025	0,005	0,015	0,008	0,040	0,050	0,013	0,040		0,2
Övr röjn	0,013	0,063	0,013	0,038	0,019	0,100	0,125	0,031	0,100		0,5
Stubbar	0,065	0,325	0,065	0,195	0,098	0,520	0,650	0,163	0,520	0,196	2,6
Totalt	0,185	0,925	0,185	0,555	0,278	1,480	1,850	0,463	1,480	0,000	7,4
Medelavst Terminal km	97,5	48,75	48,75	48,75	73,13	48,75	48,75	78	48,75	49	
Medelavst Luleå km	170,6	73,13	170,6	73,13	316,9	316,9	292,5	560,6	536,3	273	

Branches and Tops
Stems of long tops
Trees of small thinning
Trees of other clearing
Stumps

Southern case (User in Halmstad and/or Höganäs)



Area nr	1	2	3	4	5	6	7	8	9	10	Sum
Grot	0,066	0,066	0,066	0,066	0,066	0,077	0,319	0,308	0,033	0,033	1,1
Långtopp	0,024	0,024	0,024	0,024	0,024	0,028	0,116	0,112	0,012	0,012	0,4
Klengallr	0,036	0,036	0,036	0,036	0,036	0,042	0,174	0,168	0,018	0,018	0,6
övr Röjn	0,024	0,024	0,024	0,024	0,024	0,028	0,116	0,112	0,012	0,012	0,4
Stubbar	0,210	0,210	0,210	0,210	0,210	0,245	1,015	0,980	0,105	0,105	3,5
Total	0,360	0,360	0,360	0,360	0,360	0,420	0,625	0,625	0,075	0,125	6,0
Medelavst terminal km	25	25	25	25	25	25	25	25	25	25	
Medelavst Höganäs km	96,42	91,6	192,8	178,4	207,3	163,9	229	347,1	91,6	255,5	

Branches and Tops
Stems of long tops
Trees of small thinning
Trees of other clearing
Stumps

Figure 8 BioDRI Project Evaluation of local availability of forest biproducts as Energy source

The evaluation used the data of Thuresson [19] (see section 2.4) for balance area 1(Luleå case) and balance area 4 (Höganäs/Halmstad case). Each area was divided in 10 sub areas. These areas were projected on to a transport map published by Andersson-Frisk (reference [26]). This map showed forestry transport as red lines and the line with was proportional to the transported volume. We assumed that the intensity of forestry transports in those areas was approximately proportional to their intensity of forestry. The percent of "redness" in each area was measured and used as an expression of transport and forestry intensity. This intensity and the measured area of each subarea was then used to interpolate the Thuresson´s data into each subarea. The tables of Figure 8 show the resulting biofuel availability, expressed as TWH/year, separated on subarea and type of forestry biomass. The map of the northern case also includes an area in northern Finland. This was suggested by a project partner from the paper industry, as they themselves used raw material from that area.

3.3 BeWhere projects

[27] is a techno-economic engineering model for renewable energy systems optimization. It identifies the optimal localization, size and technology of the renewable energy system that should be applied in in a specific region. BeWhere was developed at IIASA and Luleå University of Technology, Sweden, from 2006 onwards. In 2010 it was

expanded by IIASA from the local and national levels to the EU27 level.
BeWhere uses a Regional map with a grid of user's resources etc. Examples of those maps and grids for the regional projects of BeWhere Sweden [28] and BeWhere Finland [27] are shown in Figure 9.

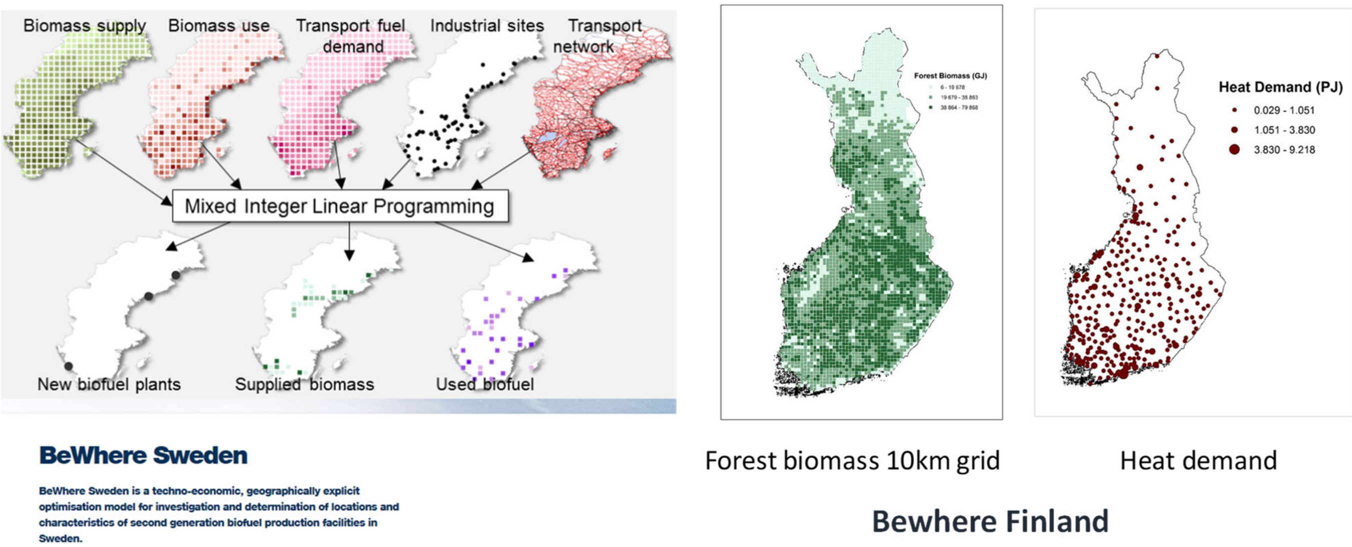


Figure 9 Maps and grids from the regional developments of BeWhere Sweden [28] and BeWhere Finland [27]

BeWhere Sweden and Finland are focused particularly on forest biomass, biofuel production and design of forest-based value chains, with a high degree of detail regarding the biomass supply and industrially integrated biofuel production, where potential plant hosts are largely modelled individually. The model is primarily used to analyze how future bio-based value chains can be implemented cost-effectively from a system perspective, what role the existing energy infrastructure (industry and energy facilities) can play, and how different parameters affect, for example, the choice of conversion technologies, localization, and integration, in a system where the same limited resource (biomass) is also in demand from other sectors. The parameters considered include e.g. policy instruments, future scenarios for energy market conditions, technological development and industrial investment opportunities [28].

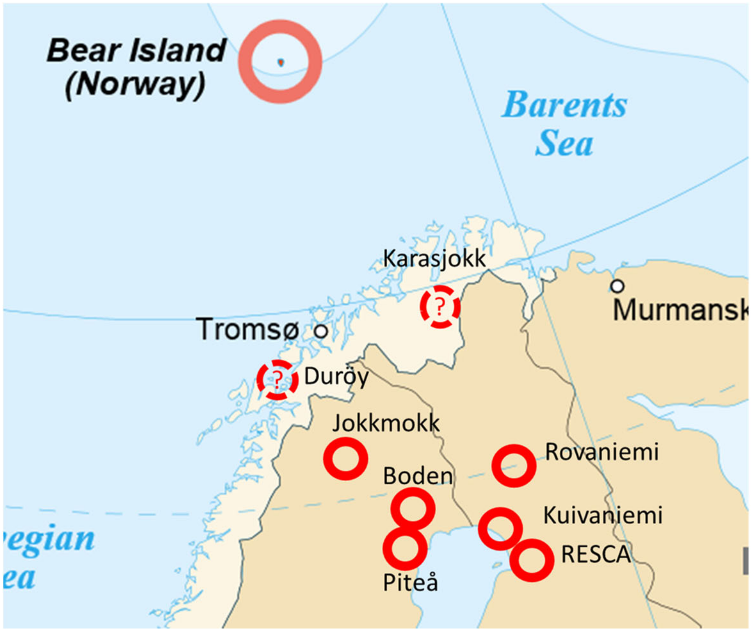
The initial focus with BeWhere Sweden was to find the optimal location for production of renewable vehicle fuel. One important tendency that was found during the work was that more industrial branches, e.g. the Steel industry have a big interest in using the same biomass resources. This will cause a n intense competition on those resources. A new project BioMetInd (Forest biomass in metal industry-possible possibilities and consequences) [29] was started together with partners from steel and forestry branch to study the impact of that competition on biomass availability.

3.4 The S2Biom project – Delivery of sustainable supply of non-food Biomass to support a "resource-efficient" Bioeconomy in Europe [17].

The S2Biom project is a European project, granted within the 7th Framework program. It supports the sustainable delivery of non-food Biomass feedstock at local, regional, and pan European level. One product is the "Atlas with regional cost supply biomass potentials for EU28, western Balkan countries, Moldavia, Turkey and Ukraine". This report contains high class availability spatial data regarding availability and costs of different biomass products from both agriculture and forestry, covering those countries. The Agricultural maps that show the supply of *Straw and stubble, pruning supply, Grassland cuttings and Unused grassland cuttings* are interesting for our project. On the forestry side a map showing the potential for *Primary residues* (logging residues and stumps), see is of special interest, as well as maps on *Secondary residues.* Some data on waste resources *(Biowaste and post-consumer wood)* can perhaps also be of interest [17].

3.5 Arctic Energy project and evaluation of local energy data

The arctic Energy project is a three-year Finnish- Swedish- Norwegian INTERREG project. It has been executed during the years 2016 -2018. The aim was to model and evaluate the possibility to create energy independent communities in the arctic region. Figure 10a shows the communities that were studied in the project. NORUT carried out a series of simulations for the locations shown in Figure 10b



a) Communities studied in Arctic energy Full circle=Detailed case studies and simulations

b) Data from NORUT: simulation and hourly distributions, Wind; hourly distributions

Figure 10 Arctic energy project. Studied communities and some data

The starting situation was the one that is usual in projects of this type: There was a lack of data for all locations. The data that were available or missing was different between all of them, and different roads had to be used to evaluate the heat consumption for the different communities. They are summarized below as they could be of interest for similar situations in the LECo project.

Evaluation of Heat consumption for RESCA community: The RESCA energy community is situated close to Oulu. According to the project plan, was chosen as a first test and illustration of the use of the EnergyPLAN model. A problem was a limited availability of data. No local data were available from Statistics Finland. However, there was a report: "HIUKKAVAARA A northern winter city – a human-sized, sustainable forerunner" [30], that showed the expected development and population over time and the amount of different types of buildings. The expected situation 2020 was chosen as case and the population and amount of different buildings that year was estimated from the report. The Swedish Energy Agency had published data on specific yearly heat consumption of small houses [31] , apartment buildings [32] and premises [33]. These data were used together with the building data to calculate the total Heat consumption for that community 2020

Evaluation of Heat consumption for Boden: Boden is s a city situated just over 30 km inland from the Gulf of Bothnia. It has small heat and CHP plants producing District heating and Electricity. The municipality also owns some of small Hydropower plants. There is also a larger Hydropower plant owned by the Stockholm based national company Vattenfall. The electricity from that plant goes to the national net and does not contribute neither to Boden's Energy Balance nor its Economy. Boden excluding the Vattenfall plant was chosen as case. The home page of Boden also contains an extensive Area Description of the amount av all Building types in both Boden as a whole and its suburbs. The home pages and yearly reports of Boden and its subsidiary energy business companies also have an extensive statistic of the District heating and production and the heat plants, CHP and Hydropower plants. This made it possible to calculate the heat consumption along two parallel roads:

- **Road One:** Swedish Energy Agency's data on heat consumption small houses [31] , apartment buildings [32] and premises [33] where used together with the building data in the extensive Area Description to calculate a yearly heat consumption of the whole community. This is similar to the method used for RESCA.

- **Road Two:** The Energy data from the District heating statistics was extrapolated to the users outside that network. These data were added to get the total consumption.
- The data from the two roads were then compared to validate the calculation

Evaluation of Heat consumption for Jokkmokk: Jokkmokk is a city with the center just over 110 km inland from the Gulf of Bothnia. Jokkmokk has few inhabitants (c.a. 5100) but a large area: (219477 km2). Around half of that area is National parks. The big rivers in the municipality produce over 10 TWh electricity/year. However, that production and its economy belong to the governmental company Vattenfall in Stockholm. The city center has a district heating network, using heat created from forestry fuel in a local heat plant. LTU and the municipality agreed to study a community consisting of Jockmokk except Vattenfall's river- and power system. No direct data were available regarding the heat use outside the district heating network. For small houses the DoA statistics [34] showed the number of small houses heated through district heating during 2016. The total number of households in small houses during the same time could be found in statistics Sweden [35]. The difference was assumed to be small houses outside the network. This gave a district heating ratio of 20.46% for small houses. A similar approach was made for apartments. The number of apartment buildings connected to district heating were found in the DoA statistics [34]. The total number of households in Apartment buildings during the same time could be found in statistics Sweden [35]. The number of residential buildings was estimated by assuming 8 households per apartment building. A district heating ratio of 70,97% for these buildings could be calculated from that. The district heating ratio in nonresidential buildings and others was assumed to be the same as for apartment buildings. The total heat use outside the network was then estimated by proportioning with the district heating ratio.

Distributions for heat consumption in Luleå and Jokkmokk. Logged hourly data from the district heating networks in Luleå and Jokkmokk were used to create distributions for heat consumptions. This distribution was used also for the users outside the network. (It can be assumed that a certain building needs the same amount of heat whether or not it is connected to the district heating net). A map in reference indicate that there are several district heating networks in Sweden, Finland and Germany, and at least some in Ireland. It might be of interest try to get similar data for the other member countries.

Di**stributions for Photovoltaic energy.** The partner from NORUT made simulations on solar energy for a number of locations within the member countries Some examples are shown in Figure 11 (Copied on to the map of in Figure 5 a)

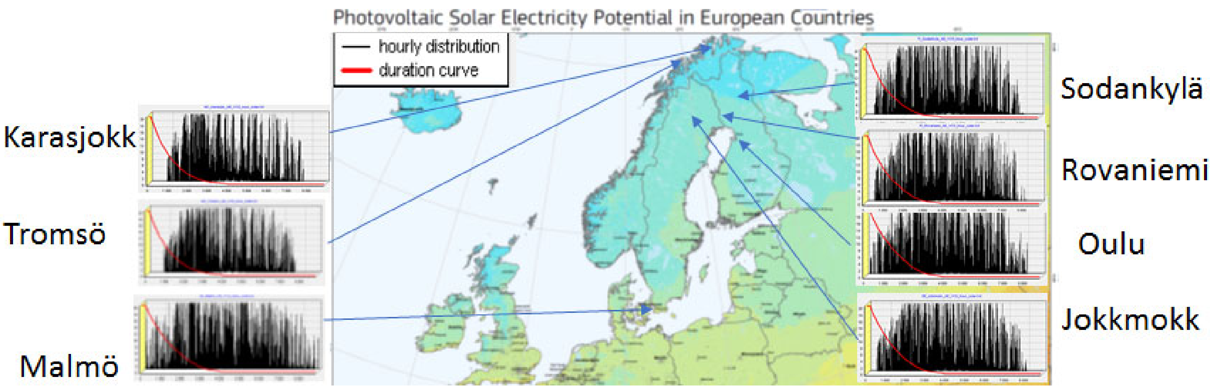


Figure 11 Examples of solar energy distributions calculated in the arctic Energy project.

3.5.1 Consumption: Hourly distributions

Hourly data on electricity consumption for Sweden Norway and Finland are available from Nordpool and can be used to create distributions for the EnergyPLAN model. Figure 12 shows examples for 2016 a

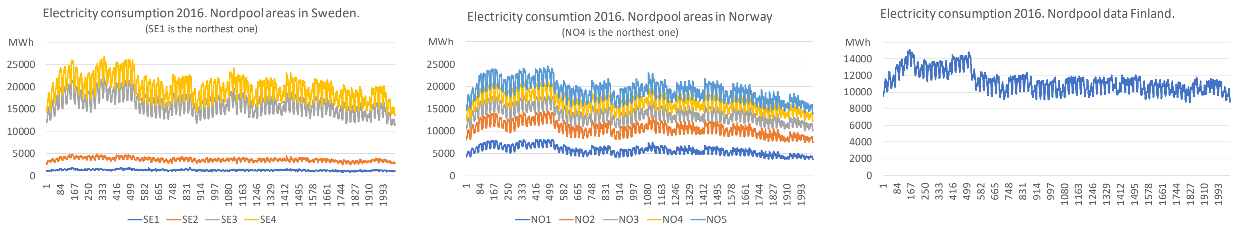
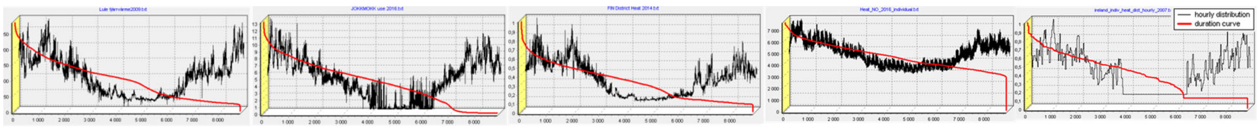


Figure 12 Hourly distribution of Electricity consumption In Sweden Norway and Finland 2016

Data are available for four Nordpool regions in Sweden and 5 in Norway. For Finland there is only data for the whole country

For Heat consumption we have not found any open hourly statistics. In the Swedish projects we were able to get logged data from local District heating distributors in Luleå and Jokkmokk. Distributions calculated from them are shown in Figure 13 a and b. We did not have those data for the other partner countries. However, the homepage of Energyplan has a section" Existing Country Models", where files for Finland, Norway and Ireland could be found [36]. These are shown in Figure 13 c, d and e.



a) Luleå b) Jokkmokk c) Finland [36] d) Norway [36] e) Ireland [36]
Figure 13 Hourly distribution of local heat consumption (from data logged by District heating Distributors).

The distribution for Jockmokk has a period of extremely low consumption in summer. There were also missing data in that period. A discussion with the heat plant showed that there were some measurement problems at very low flows, so those data are perhaps not perfect. The country profile for Finland is very similar to the one for Luleå. The one for Norway is quite different. It might be because of coastal climate and less difference between winter and summer. The one fore Ireland is more similar to the Swedish and Finnish ones, except that there is a constant value instead of measurement data in the middle summer period. Maybe this indicates measurement problems like in Jokkmokk. Maybe a similar solution could be good also for the Jokkmokk curve.

The distribution for Finland (Figure 13c) is very similar to the Swedish one. Figure 13Figure 13Figure 13

These distributions from Luleå and Jokkmokk show a very high difference between summer and winter. This is because of the arctic climate in northern Scandinavia. The distribution for

4. COUNTRY SUMMARY OF DATA AVAILABILITY

A rough summary on the availability of local data in the memory countries is included below.

4.1 Statistics and data in Finland

- National statistics (StatFin)
  - Energy statistics: whole Finland
  - Housing statistics: Buildings and gross floor area by Year, Area, intended use of building, heating fuel/ source of heat and Information: Regional data, includes district heating could be used with other statistics to calculate regional heating demand
  - Income and consumption Households consumption: Data for major regions on cost for energy data on cost consumption of electricity, gas and other fuels (23 subgroups) + car fuel. (Expressed in cost so it would need some recalculation to get e.g. GWh)
- Forestry statistics (METLA): Regions. Includes forest fuel
- Solar potential: VTT report 2015 and FinSolar aurinkoenergiatietoa: Maps on potential
- Wind Energy
  - Statistics: Finnish Wind Power Association 2017& VTT2014
  - Wind and icing atlas: map on wind rate and possible production

4.2 Statistics and data in Ireland

- CSO - Central Statistics Office.
  - Energy statistics only whole Ireland
  - Building stock housing stock per county per city and county
  - Census 2016 Small Area Population Statistics: Number of households heated by Oil, Natural Gas, Electricity, Coal, Peat, LPG or Wood, as well as size of housings for chosen county
  - Forest statistics: Forest areas (ha) per county otherwise for Ireland as a whole
- Energy atlases:
  - SEAI WIKI map of local data on Wind farms, windspeed and bioenergy
  - SOLARGIS: map of local values of radiation and PV potential

4.3 Statistics and data in Norway

- SSB Statisics sentralbyrå (statistics Norway) together with Norwegian Water Resources and Energy Directorate
  - Energy national data
  - Electricity county and municipality, Finnmark only County
  - Energy use some municipalities, Finnmark only County level: Coal, coke, Wood, Gas, Petrol, Kerosene, Diesel, Gasoline and light oils, Heavy fuel oil, waste oil, Waste
  - Data on water power
- Data collected in Arctic energy, e.g. on solar and wind

4.4 Statistics and data in Sweden

- Statistics Sweden (Statistikmyndigheten SCB) [35]
  - Good general and energy statistics is available down to Municipality level
- Swedish Energy agency (Energimyndigheten)
  - Energy statistics for buildings (small houses, multi-dwelling buildings and non-residential premises): Heat use/unit or m2, total or divided on energy source [31], [32], [33]
  - Wind power statistics (country county and municipality level)
  - Solar cells number and effect county level
- Swedish Meteorological and Hydrological Institute (SMHI) Statistics for weather station data on measured temperature wind and radiation available online (down to Hourly level)
- Data on sustainable energy from cooperative projects, e.g. BioDRI, Arctic Energy, Energyplan different levels

5. DISCUSSION

5.1 Different calculation roads. How much information is actually needed?

The description of recent projects in section 3 shows examples of how available data have been used to create Energy models of different communities. The experiences can be summarized as follows:

There is always some data missing. The structure of those "information holes" was different in the different cases. However, there was always a possibility to get around this by choosing different evaluation roads. These were also different between the cases.

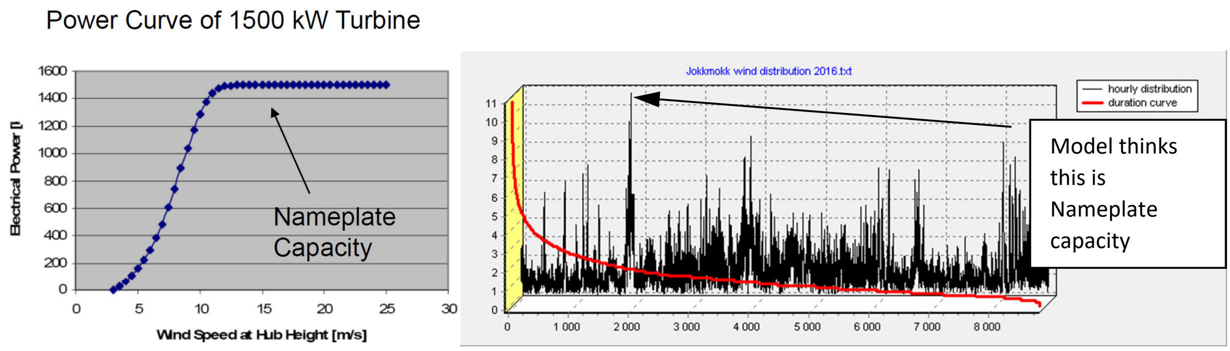
A comparison of these experiences with the data found in this report indicates the available data should be sufficient to start modeling if:

- if we have the location of the pilot communities
- and get a general description of their properties and what they want to do

The main task for the next step (delivery T2.4.3) should be to describe those data for the chosen pilots

5.2 EnergyPLAN modelling of wind turbines. Motivation and need of correction factor

Figure 14 a shows a typical power curve of a wind turbine. Figure 14 b illustrates and how it will influence modelling using data on fluctuations of Wind speed



a) Theoretical power curve [37] **b) Wind speed distribution curve (Example)**

Figure 14 Effect of power curve if wind power is evaluated from a wind speed distribution

The power curve becomes flat above a certain wind rate. I.e., the power output for the windspeeds of would not look that diagram, instead all peaks would be cut off when the wind speed corresponding to the nameplate capacity is reached. The EnergyPLAN model uses a version, normalized between 0 and 1, of the distribution. It then calculates the instantaneous effect by multiplying the instantaneous value in the distribution with the nameplate capacity. This will create an output effect that is below the real one. EnergyPLAN has a correction factor that decreases the peak effect to correct for that. The FIDE Guide [24], published by the EnergyPLAN group, illustrates how the correct factor can be calculated using production data from actual windmills. It would be good if the local partners could get such data from local producers.

Another conclusion is that if we have or can get a distribution of the power output instead of the wind speed it would be better as the flattening effect of Figure 14 a would then be included in the distribution curve. better to use that one instead of using wind speed + correction factor. For Sweden the data from National Grid Statistics could probably be used, see Figure 4a). The best would be if it would be possible to use local contacts and try to get logged data from nearby windmill. If neither of that works we would have to live with Wind Speed distribution + Correction factor.

6. CONCLUSIONS

- A rough survey on available data sources and experiences from previous projects have been made. General data on national level are OK. Especially for Energy balances the availability of data on a "lower" level (county, municipality and community) are less sufficient. That availability differs between countries.
- However, a comparison of the documented data availability and the experiences from recent projects indicates that the available energy data should make it possible to model the example communities if we know:
  - o the geographical area and position of the chosen pilot communities
  - o and have a general description of their properties and what they want to do
- The main object of the assessment in next step (delivery T.2.4.3 should be to supply those data

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LECo

Local Energy Communities

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