Energetic Neutrality
Template Instructions

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1. Introduction

This explanatory paper offers a common approach for RURENER network members and other interested communities to help them record data about energy production, conversion and use at a community level. Recording this data through a common tool is the first step to enabling communities to monitor their energy usage and to measure their progress towards energy neutrality.

A basic technique of energy planning is to record the state of a given energy system at a certain time. An energy balance gives a simple, generic and clear view of the different energy sources and energy uses within a community, to provide a year to year comparison. The proposed measurement grid will be simple and easy to use, presenting the main elements of energy consumption and energy production on a single page.

The aim of this tool is to be applicable not only by the members of the RURENER project but also to other communities willing to measure their performance and take future actions in the matters of energy and environmental protection. It is hoped that the tool provides a framework which can be expanded upon according to individual community needs.

The next chapter summarizes the philosophy of this measurement grid, and also gives some useful information on how to use it and where you can collect valuable data.

2. The Method

The first step in planning is to understand where and how energy is currently produced and being used. The inventory is the most time-consuming part, but the most difficult aspect is to collect complete and accurate information. How a community uses energy must be understood before we begin to find ways for energy saving and efficiency, and energy production from renewables.

The aim of this tool is to assess the staring point of a community but also to measure progress. The initial step is to collect data and measure energy needs and supply at a community level, making clear the end use (eg. agriculture, residential) and ways in which energy is generated (from both renewable and non-renewable sources). The aim is also to allow a year-by-year comparison and to monitor the success over the longer term.

The Energetic Neutrality Template is an Excel spreadsheet which is mainly an overview of the energy production, import and consumption in an area, with a breakdown of energy type (electricity, heat or transport fuel) per end use.

The basic criteria and requirements for the Energetic Neutrality Template are given below:

- Simple structure, concise, web based in a simple form (eg excel worksheet)
- Flexible (easy to update or add new subcategories by the user)
- Applicable in several communities despite their diversity and characteristics
- A structure which is easy to understand and enables data to be entered easily
- The spreadsheet must be based on a minimal amount of data in order to be as practicable as possible.
- Combination of bottom-up and top-down approach.
- Inputs can by based on detailed measurements or general estimates

This method has been designed to gain and present information on the main activities of a community in order to outline useful but initial figures for future planning and analysis.

3. The basic spreadsheet

The Energetic Neutrality Template presents the energy use in the following sectors:

- Residential
- Commercial
- Public Services
- Industry
- Transport
- Agriculture
- Forestry
- Fishing
- Other Uses.

Most of the sectors are included as they can be present and be affected directly at a community level. The spreadsheet can be expanded in cases where additional data can be gathered (such as energy use within the sectors).

The spreadsheet contains basic but useful information about the community uses of energy for a certain year. Every year the sheet can be updated showing the changes on community energy mix or improvements. In practice this data rarely exists, so taking an annual snap-shot builds a valuable record. Furthermore, year to year this spreadsheet can be further developed giving more detailed figures and analysis.

3.1 How to get started

In order to create the Energetic Neutrality Template for a specific community you need to:

- Define the responsible person to gather data and create the community energy Profile.
- Define the year of the study.
- Define the physical boundaries of the community (even if something like that is not so clear) and the type of analysis you want.
- Map local and imported energy resources and energy end uses (a basic flowchart is useful).
- Collect data from electricity and fuel suppliers.
- Collect data from energy users.
- Collect data about conversion factors and energy content.
- Use the data to create the Balance sheet, some graphs and even a simple report.

The physical boundaries define the study area (eg. the community itself, a part of it, the Municipality). One factor that helps to define it is to consider whether the target deals with all aspects of energy production and use or only a specific issue or area. Once the boundaries are defined the data collection can start.

3.2 Collecting data

The input of the energy Balance method consists of data such as:

- Number of inhabitants
- Supply of fuels (local and imported)
- Sectors within the community and energy end uses.

Depending on the level of detail of input data, the outputs can refer to more detailed categories. Data availability and the use of the results are crucial factors in order to develop a more sophisticated and detailed spreadsheet (future use).

Data maybe obtained from the:

- National statistics
- The utilities and the owner or the manager of the electricity grid
- National, Regional or Local Energy Centres
- Independent energy producers
- Fuel companies
- Municipality Departments
- Enquiries from inhabitants, companies, farms
- National statistics (for comparison)

Main steps:

- List all or at least the most known fuels and sources of fuels that the Community uses for its needs.

Fuel type examples

Electricity	Wave power
Coal	Biomass
Pet coke	Biogas from Wastewater
Heavy oil	Treatment Plants (WWTP)
Light Oil	Straw
Diesel Oil	Landfill gas
Petrol	Waste Combustion
Jet Fuel	Solar energy
Liquefied Petroleum Gas (LPG)	Solar heating
Kerosene	Energy crops
Natural gas	Wood
Wind	Geothermal energy
Hydropower	Photovoltaic (PVs)

- Identify the fuel suppliers (eg. agencies, individuals). Start with the power plant and gather data arising from the utilities concerning electricity consumption in an appropriate level. Make assumptions if necessary to fit within the data at the community level.
- Gather data about the local and imported fuels, being careful not to double count or include the same fuel or source of energy twice (eg. if a wind park generates electricity into the national grid and the electricity supplier gives you figures about electricity consumption in the area, don't count renewable electricity again in the total energy consumption).
- Basically, the more a community imports, the more their fuel and energy comes from plants or resources outside the territory. Map local and imported energy resources and energy end uses (a basic flowchart is useful). Use specific sources like reports or fieldwork and questionnaires for a clearer picture.
- Make assumptions or even basic surveys to find out or calculate the Energy Balance figures (eg. if the community uses wood for heating you have to gather data from the wood suppliers but also estimate the wood that the citizens cut on their own. Another difficulty is to estimate the proportion of local and imported wood). Even if the estimations can't be accurate, make clear notes and explain the assumptions and the estimation method.

- For a more elaborate Energy Balance, more detailed information and data are needed. In such a case you can add spreadsheets in the basic Template and create a more detailed file.
- Use as many national, regional or local statistics as you can. This helps you to track the data every year and simplifies the work.

3.3 Enter Data

The excel tool is divided in two main parts:

- The cover sheet
- The energy data sheet

Cover sheet
Please specify the community name and the study year

The Energy data sheet
This sheet is divided in 3 main parts:

- General data
- Energy Consumption part
- Local Energy Production

General Data
Please specify the community name, the country, the study year and the community population.

Energy Consumption part
This part summarises the amount of electricity, fossil fuels and renewable energy consumed in the community by the end uses (sectors like residential, commercial etc).

The rows refer to the different fuel types that are consumed (electricity, heat and transportation). Communities get most of their energy from imported, non-renewable fossils fuels. In some cases also use some renewables.

- **Electricity** refers to the total electricity consumed by the end users, irrespective of the production source. Rows 8 and 9 can be used for more than one electricity suppliers (more rows must be added in the case of more than 2 suppliers). This category includes the electricity consumption within the community and represents also local or other interconnected RES (it excludes auto-producers that can be figured out in the next cell). Thus, row 10 represents the Electricity consumed by

sites not connected to the grid (eg. photovoltaic, wind power...). Be careful of the next cells for double counting.

- **Fossil fuels** refer to the fuels like coal, oil and gas consumed by the end-users mainly used for heating and transportation. Fossil fuels that are used for electricity generation should be included under the "electricity" rows, especially if it concerns large units.
- **Renewable Energy** refers to sources that are consumed by the end users, such as biomass, solar thermal, geothermal etc and are mainly used for heat/cooling purposes. Electricity generation falls under the "electricity" rows.

Columns C-E categorize the energy consumption in three usage categories (electricity, heat and transportation use). **Column F** calculates the total energy amount as a Sum of Columns C-E (use the same units). If you don't know exactly the fuel use just put the total fuel in the appropriate cell (Column F). Then multiply the fuel amount (eg. kWh, m^3, litres etc) with the Energy Content (Calorific Value) and/or conversion Factor (**Column H**) to measure all the fuels in the same unit (eg. 1 kWh=3.6 MJ, 1 lt propane=25.3 MJ, 1 BTU=1,055 J, 1 lt diesel = 36.5 MJ). Use values and factors that apply to your country according to the fuel type the community use. Common energy units are the following:

Conversion Factors

Energy

From : \ To :	TJ	Gcal	Mtoe	GWh
	multiply by			
TJ	1	238,8	2.388×10^{-5}	0,2778
Gcal	4.1868×10^{-3}	1	1×10^{-7}	1.163×10^{-3}
Mtoe	4.1868×10^{4}	1×10^{7}	1	11630
GWh	3,6	860	8.6×10^{-5}	1

Source: EU Energy in Figures 2010

Average Calorific Values, Energy Content			
		kJ (NCV)	**kgoe (NCV)**
Hard coal	1 kg	17 200 - 30 700	0.411 - 0.733
Recovered hard coal	1 kg	13 800 - 28 300	0.330 - 0.676
Patent fuels	1 kg	26 800 - 31 400	0.640 - 0.750
Hard coke	1 kg	28 500	0,681
Brown coal	1 kg	5 600 - 10 500	0.134 - 0.251

Average Calorific Values, Energy Content			
Black lignite	1 kg	10 500 - 21 000	0.251 - 0.502
Peat	1 kg	7 800 - 13 800	0.186 - 0.330
Brown coal briquettes	1 kg	20 000	0,478
Tar	1 kg	37 700	0,900
Benzol	1 kg	39 500	0,943
Oil equivalent	1 kg	41 868	1
Crude oil	1 kg	41 600 - 42 800	0.994 - 1.022
Feedstocks	1 kg	42 500	1,015
Refinery gas	1 kg	50 000	1,194
LPG	1 kg	46 000	1,099
Motor spirit	1 kg	44 000	1,051
Kerosenes, jet fuels	1 kg	43 000	1,027
Naphtha	1 kg	44 000	1,051
Gas diesel oil	1 kg	42 300	1,010
Residual fuel oil	1 kg	40 000	0,955
White spirit	1 kg	44 000	1,051
Lubricants	1 kg	42 300	1,010
Bitumen	1 kg	37 700	0,900
Petroleum cokes	1 kg	31 400	0,750
Other petro. products	1 kg	30 000	0,717
Electrical energy	1 kWh	3 600	0,086

Source: EU Energy in Figures 2010

In **Column L** the efficiency (electricity, heat or process) can be inserted for the calculation of the Final Energy Consumption – the "End Use". For example Import Electricity or Photovoltaic has Electricity Efficiency 100%, busses 33%.

Columns P – X is a break down of Column L in different end users / sectors.

Usually the output from the power plants is expressed in energy units (eg. MWh). However, the inputs to the plant (coal, oil, etc.) are often reported in physical units, e.g. tonnes for coal and tonnes or litres for petroleum products. It is also important that the fuel input data are also reported in energy units. The conversion from volume or mass to energy is explained above (mostly related to oil, natural gas, solid fossil fuels and renewables).

Gross inland consumption describes the total energy needs of a community. It represents the Final energy Consumption, the energy sector consumption and distribution and

transformation losses (see glossary). The share of renewables in gross inland energy consumption is defined as the percentage share of renewables in gross inland energy consumption.

On the Contrary ***Final energy consumption*** represents the energy consumption of all users except the energy sector itself (whether for deliveries, for transformation, and/or its own use).

In the case of the Energetic Neutrality Template it includes energy consumption by Residential, Commercial, Public Services, Industry, Agriculture, Forestry, Fishing and other Uses:

- Final energy consumption in households, commercial, etc. covers quantities consumed by private households, commerce, public administration, industry, agriculture, forestry and fisheries.
- Final energy consumption in transport covers the consumption in all types of transportation, i.e., rail, road, air transport and inland navigation.

Residential sector: this sector consists of private households. Common uses of energy associated with this sector include water heating, air conditioning, space heating, lighting, refrigeration, cooking.

Commercial and Public Services: these sectors consist of service-providing facilities and non-manufacturing business establishments like hotels, restaurants, businesses, state, regional and local governments, private and public organizations, social, and educational institutions, hospitals, banks. Common uses of energy associated with this sector include water heating, air conditioning, space heating, lighting, refrigeration, cooking and other equipments. This category can be divided in two main categories: Commercial (services sector) and Public sector services.

Industry: The figures reported in the industry sector for the consumption of fuels by enterprises should include quantities used in branches of the industry sector, such as iron and steel, chemical, glass, pottery, food, drink and tobacco, paper and printing, textile, leather and clothing.. Where possible, exclude fuels used for transportation of goods (which should be reported under Transport).

Transport: At least four transport modes are identified: road, rail, air and national navigation. The Energy plans usually do not include energy used outside the community, so this category can cover mainly road and rail transport. The spreadsheet usually does not include truck and air transport that brings and carry goods into the community. The energy consumption can be based on actual consumption data in case of municipal fleets, public transport or other commercial fleets) or estimations (eg. private transport).

Agriculture: The category "Agriculture" covers agriculture, forestry and fishing. A split into these categories is preferable depending on the community activities.

Local Energy Production

This part includes the total energy production in the territory. It is split into 2 categories: Energy produced from renewables and Energy produced from non-renewable fuels like fossil and nuclear fuels (only fossil fuels extracted on the territory, including peat, coke, petrol and uranium otherwise must be stated and separated).

Important notes:

- In Row 41 Biomass imported (-) from the territory for energy purposes must be calculated. For example a CHP plant that uses biomass can gather wood far away from the territory and thus use input outside the community. In this case the imported fuel will increase the RES ratio and in fact the RES consumed in the territory. The same case is when there are uses of biomass, such as by households (eg. imported wood, pellets, woodchips).
- In Row 42 Biomass exported (+) from the territory for energy purposes must be calculated. For example wood can be collected on the community and be used outside the boundaries of the territory. This amount can be used for the Local RES production although the energy consumption takes place outside the territory.
- In this part of the template all the RES must be calculated, irrespective of their final use. This means that if, for example, a Wind park of 5MW is located in the territory of the community this must be included in this analysis despite the consumption of the generated electricity taking place far away of the territory (in the case of an interconnected plant).
- Cell M50 represents the total energy produced by RES in the community. If we divide it by the total energy consumption in the area (cell M29) the energetic ratio can be calculated.

3.4 Results

This Balance can describe:

- Which fuels the community uses to produce energy (eg. Electricity, heat), whether these resources are local or imported and how much energy the community uses each year.
- How independent the community is in terms of Renewable Energy Sources exploitation and clean energy use.

- How much energy the community spends in sectors like agriculture, forests, residential sector, transportation etc.
- Basic ideas on what can be done in the future and in which sectors and direction.

A number of figures can be extracted form the Energetic Neutrality Template, like:

- Energy consumption per fuel (I8-I28).
- Total fuel consumption (I29).
- Total Local Energy Production (I55).
- Total Local RES Production (I50)
- Percentage of fuel consumption by fuel (K8-K28)
- Percentage of Local energy production by fuel (K34-K53)
- Total end-use of energy (M29)
- Final Energy consumption per fuel (M8-M28).
- Percentage of final fuel consumption by fuel (O8-O28)
- Energy consumption per capita (I30) and final energy consumption per capita (M30).
- Local energy production per capita (I56) and final local energy consumption per capita (M56).
- Neutrality rate (F58).

Glossary

Conventional thermal power: Technology for the production of electricity by combustion. May or may not include biomass use, which is also considered a renewable source of electricity.

Final Energy Consumption (FEC): Final energy consumption is the energy finally consumed in the transport, industrial, commercial, agricultural, public and household sectors. It excludes deliveries to the energy transformation sector and to the energy industries themselves.

Gross Calorific Value (GCV): The gross calorific value is the total amount of heat released by a unit quantity of fuel, when it is burned completely with oxygen, and when the products of combustion are returned to ambient temperature. This quantity includes the heat of condensation of any water vapour contained in the fuel and of the water vapour formed by the combustion of any hydrogen contained in the fuel.

Gross Inland Consumption (GIC): Gross inland consumption is the quantity of energy consumed within the borders of a country. It is calculated using the following formula:
primary production + recovered products + imports + stock changes - exports - bunkers (i.e. quantities supplied to sea-going ships)

Net Calorific Value (NCV): The net calorific value is the amount of heat released by a unit quantity of fuel, when it is burned completely with oxygen, and when the products of combustion are returned to ambient temperature. This quantity does not include the heat of condensation of any water vapour contained in the fuel nor of the water vapour formed by the combustion of any hydrogen contained in the fuel.

Primary energy production is the extraction of energy from a natural source. The precise definition depends on the fuel involved:

Solid fuels: Hard coal, lignite
Quantities of fuels extracted or produced, calculated after any operation for removal of inert matter. In general, production includes the quantities consumed by the producer during the production process (e.g. for heating or operation of equipment and auxiliaries) as well as any quantities supplied to other on-site producers of energy for transformation or other uses.

Crude oil:
Quantities of fuels extracted or produced within national boundaries, including off-shore production. Production includes only marketable production, and excludes any quantities

returned to formation. Production includes all crude oil, natural gas liquids (NGL), condensates and oil from shale and tar sands, etc.

Natural gas:
Quantities of dry gas, measured after purification and extraction of natural gas liquids and sulphur. The production includes only marketable production, and excludes any quantities re-injected, vented and flared, and any extraction losses. The production includes all quantities used within the natural gas industry, in gas extraction, pipeline systems and processing plants.

Nuclear heat:
Quantities of heat produced in a reactor. Production is the actual heat produced or the heat calculated on the basis of the gross electricity generated and the thermal efficiency of the nuclear plant.

Hydropower, Wind energy, Solar photovoltaic energy:
Quantities of electricity generated. Production is calculated on the basis of the gross electricity generated and a conversion factor of 3600 kJ/kWh.

Geothermal energy:
Quantities of heat extracted from geothermal fluids. Production is calculated on the basis of the difference between the enthalpy of the fluid produced in the production borehole and that of the fluid disposed of via the re-injection borehole.

Biomass / Wastes:
In the case of municipal solid wastes (MSW), wood, wood wastes and other solid wastes, production is the heat produced after combustion and corresponds to the heat content (NCV) of the fuel. In the case of anaerobic digestion of wet wastes, production is the heat content (NCV) of the biogases produced. The production includes all quantities of gas consumed in the installation for the fermentation processes, and excludes all quantities of flared gases. In the case of biofuels, the production is the heat content (NCV) of the fuel.In the case of biofuels, the production is the heat content (NCV) of the fuel.

Renewable Energy Sources (RES):
Renewable energy includes hydroelectricity, biomass, wind, solar, tidal and geothermal energy.

Tonne of oil equivalent (toe)
The tonne of oil equivalent is a conventional standardised unit for measuring energy, defined on the basis of a tonne of oil with a net calorific value of 41868 kilojoules/kg.

Source: EU Energy in Figures 2010

Useful web-sites:

Energy Glossary
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Category:Energy_glossary

European Commission > Energy > Publications > Statistics
http://ec.europa.eu/energy/publications/statistics/statistics_en.htm

European Commission > Eurostat > Statistics
http://epp.eurostat.ec.europa.eu/portal/page/portal/statistics/themes

European Environmental Agency's Publications
http://www.eea.europa.eu/publications#c9=all&c14=&c12=&c7=en