CONCERTO Premium

CONCERTO Technical Monitoring Guide

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This document has been elaborated by CONCERTO Premium on the basis of the outcomes from the site visits and project partner meetings in 2011.

The guide is based on the “Agreement: Collaboration between CONCERTO communities and CONCERTO Plus regarding monitoring and impact assessment” (CONCERTO Plus, 04.12.2006), on the “Guidance Note for CONCERTO proposers” (Version 1.5, April 2008) and on the “Leitfaden für das Monitoring der Demonstrationsbauten im Förderkonzept EnBau und EnSan” (Fauenhofer ISE, ChN/BAS, Rev. 17.10.2006).

1. Objectives of the Technical Monitoring Guide

The intention of the present guide is to define a common approach and standardised methodology which will be applied by all CONCERTO projects to ensure a comparable presentation, evaluation, assessment, analysis and dissemination of the individual measures realized by the CONCERTO communities. The guide provides assistance and specifies the parameters of the minimum monitoring requirements of CONCERTO demonstration projects. The minimum monitoring requirements are defined in order to enable the analysis of the overall energy performance of a CONCERTO area and possible improvements. The overall generated, delivered and consumed energy of the whole energy system of a CONCERTO area needs to be metered and collected. The guide is not intended to provide instructions and references to the use of measurement technology. Figure 1 shows what kind of data is needed for the evaluation of a CONCERTO area to satisfy the varying Information needs for different target groups.

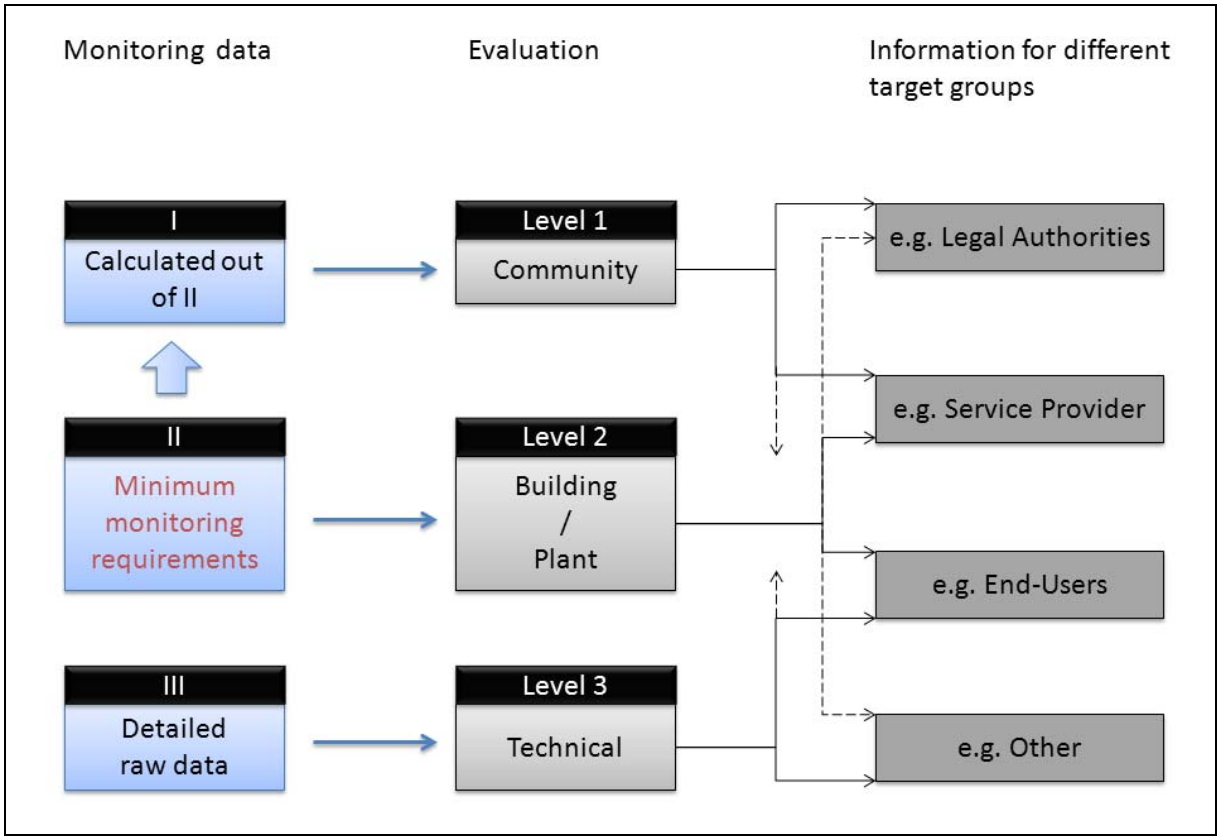


Figure 1: Monitoring data – Evaluation – Information

2. Data requirements and timeframe for metering

Figure 2 explains the timeframe of the project progress of a CONCERTO project. Ideally there should be one common metering period where all energy flows in the Concerto area are metered.
Monthly metered values of energy production and energy consumption should be provided ideally for at least two years to CONCERTO Premium. This means to add up the metered values at the specific metering points to a monthly value. If there is no automated data transfer to a central point of data storage the data values need to be read off by hands. It is therefore very important to read off the data on the same day of each month (e.g. 1st of January, 1st of February, 1st of March, etc.).
The data should be specified as described in the Excel data collection sheets (-> See chapter 6: Cooperation and data transfer to CONCERTO Premium). Furthermore the aggregated data should be final energy (delivered energy to the end user) on a monthly basis.
Comparing actual energy consumption figures of a given building in different years or energy efficient buildings in warm and cold climates requires normalising the energy performance figures by mean of a factor characterising the climate conditions. Traditionally, climate conditions are characterised by heating (HDD) and cooling degree days (CDD) which indicate how many days or hours heating or cooling energy is required to heat or cool buildings. Because european countries traditionally use different definitions of HDD and CDD CONCERTO Premium asks for unprocessed data without weather correction to allow for comparison. A common metholodogy for weather correction and the calculation of HDD and CDD is defined in the “Handbook for assessment”.

Timeframe

Project year 1-3

In this stage the monitoring concept of each demonstration project [buildings and plants] should be defined and documented according to the minimum monitoring requirements. In case of refurbished/retrofitted buildings it is important to meter all energy consumption data of the building before construction works start: Final energy demand for heating, domestic hot water, cooling, electrical appliances in kWh/month. In new and refurbished buildings meters should be installed ideally during construction works of the energy system.

Project year 4

In year 4 of the project progress it is highly recommended to implement a community energy management system, which facilitates metering and data collection activities. The 1st year of monitoring will support the implementation progress of the energy system and is important for the analysis and optimization of the operating system. Furthermore the experiences from the system in this phase can be very useful in order to replicate and improve the planning and implementation process. Monthly metered values of energy consumption and energy generation should be provided.

Project year 5

The purpose of the last project year (ideally the 2nd year of monitoring) is to demonstrate the energy performance of the CONCERTO area. Therefore it is important to collect all sampled data at the same time period in a consistent way. Now it is possible to check the actual consumption against expected, calculated data and to analyse and evaluate the energy performance. In case of refurbishments it is possible to compare the data collected/metered before refurbishment against the data metered after refurbishment.

Three stages of monitoring

1. Defining the monitoring concept
2. Implementing the monitoring measures
3. Monitoring the energy supply and consumption

Figure 2 explains the ideal timeframe of the project progress of a CONCERTO project.

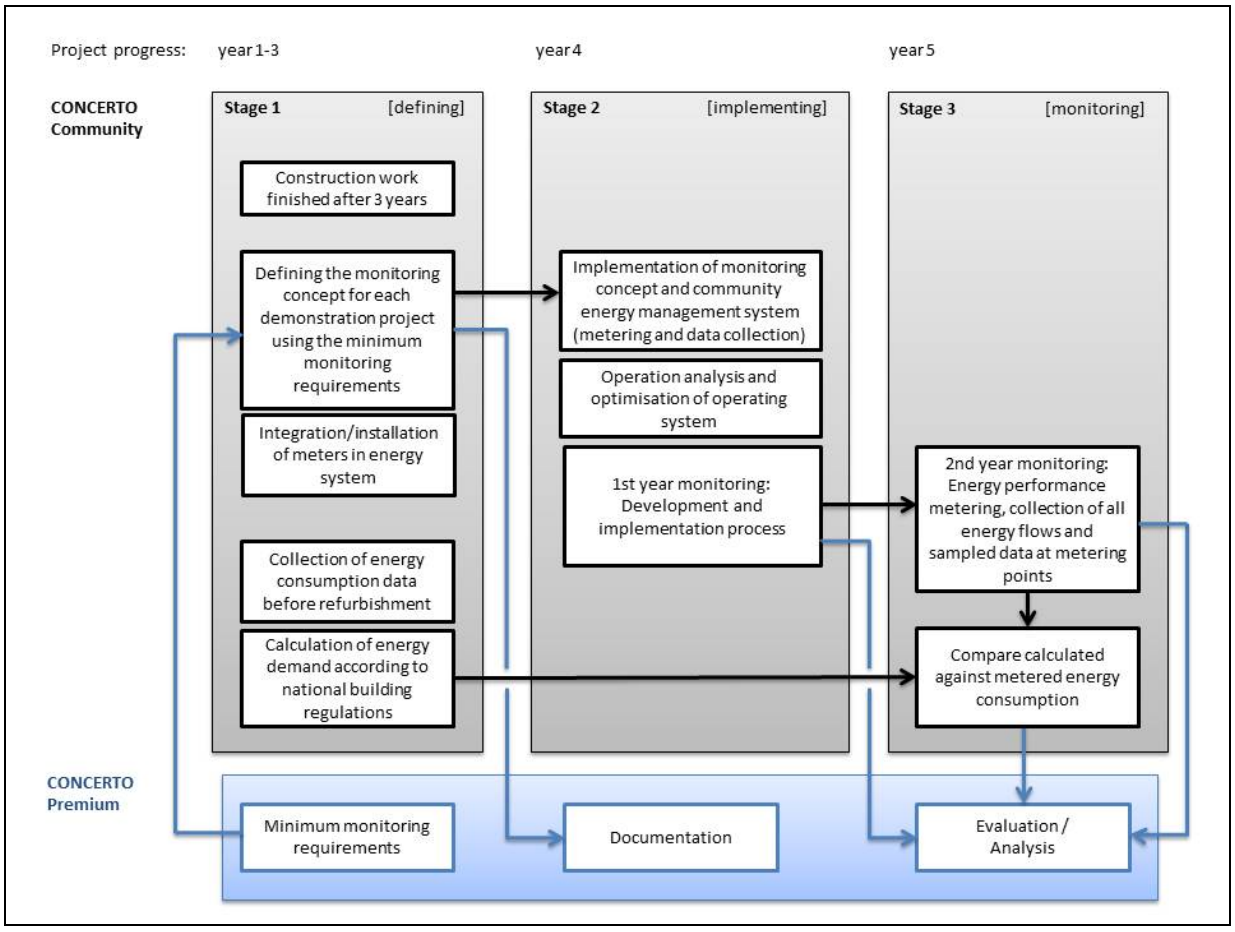


Figure 2: Three stages of monitoring

3. Definitions

3.1 CONCERTO community

CONCERTO communities are cities participating the CONCERTO project.

3.2 CONCERTO area

The CONCERTO area is a restricted area including all the CONCERTO demonstration projects and buildings concerned by awareness campaigns.

3.3 Demonstration projects

Demonstration Buildings

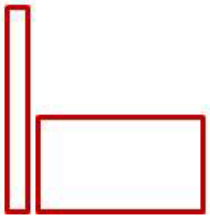
Demonstration buildings are new and refurbished/retrofitted buildings where financial support by the CONCERTO project is guaranteed.
There are minimum consumption levels set for the demonstration buildings of CONCERTO communities. The calculated energy consumption of the demonstration buildings of CONCERTO projects will be compared to the national regulations for new buildings applicable to the country of the CONCERTO community based on the standards in force in the year of the project start following the European Performance of Buildings Directive.
In the case of the **new** CONCERTO buildings, their energy consumption should be at least 30% lower than the calculated using the national regulations for **new** buildings in the year of the project start.
In case of the CONCERTO **refurbished / retrofitted** buildings, their energy consumption should be at least the one foreseen by the national regulations for **new** buildings in the year of the project start.
CONCERTO Premium developed data collection sheets for new and refurbished buildings containing general data as well as aggregated monitoring data (-> See chapter 6: Cooperation and data transfer to CONCERTO Premium). The CONCERTO projects should complete these sheets for each different type of demonstration building.

Demonstration Energy Systems

All new installed generation and transformation units using Renewable Energy Source [RES] as well as polygeneration are eligible for support.
CONCERTO Premium developed data sheets for Community Energy Systems (CES) and Building Integrated Energy Systems (BIES) (-> See chapter 6: Cooperation and data transfer to CONCERTO Premium). The CONCERTO projects should complete these sheets for each different type of energy system.

3.4 Energy system definition

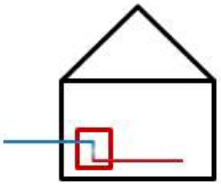
Community Energy Systems



Community energy systems are large Scale energy transformation units supplying a set of houses or the whole CONCERTO area.

e.g. Biomass CHP, Solar thermal collector field supplying a district heating net, …

Building Integrated Energy Systems



Building integrated energy systems are small scale transformation units integrated in a specific building supplying this specific building.

e.g. Biomass boiler, Photovoltaic or Solar Thermal Collectors on rooftop, …

3.5 Floor area definitions

Specific energy performance ratings expressed as ratios to a unitary floor area is commonly being used to rate building energy performance mainly because it allows for comparisons between buildings of different sizes. European countries traditionally use different floor area definitions. The choice of a floor area definition therefore has to be specified in order to really be able to understand whether the building energy performance is satisfying or not and to enable comparison of the energy performance between different buildings.

In the data collection sheets (-> See chapter 6: Cooperation and data transfer to CONCERTO Premium) CONCERTO Premium asks for dimensions to be taken as indicated by the drawings below. The floor area definitions refer to the DIN EN 15221-6.

Gross floor area (external), [m²]

is defined by the outside borders of the building. All floor areas in all levels including secondary rooms and the external walls are considered. Note: area of balconies, patios and open parking spaces are excluded.

Residential building

Non residential building

Figure 3: Example floor plan for gross floor area [external]

Gross volume (external), [m³]

is defined by the outside borders of the building envelope. The whole building volume including all areas and external walls are considered. Note: area of balconies, patios and open parking spaces are excluded. Take into account Figure 3 and Figure 4.

Residential building

Non residential building

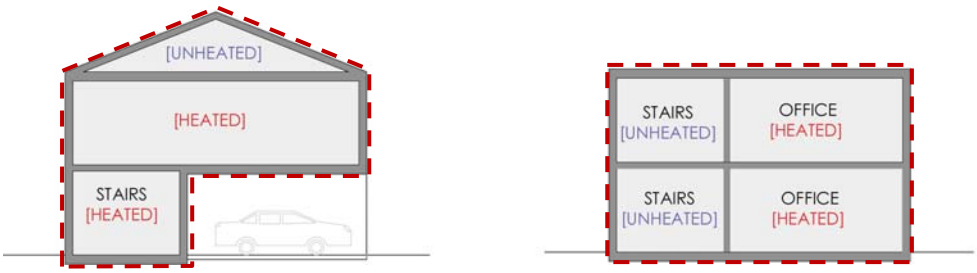
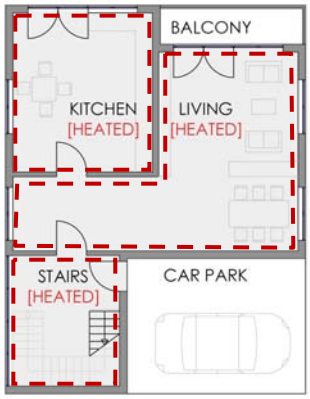


Figure 4: Example section for gross volume [external]

Heated/cooled net room area (internal), [m²]

is defined by the inside borders of the envelope of the heated/cooled spaces. All internal heated/cooled floor areas are considered. External walls, roofs, footprints of internal partition walls and unheated/cooled floor areas are excluded.

Residential building



Non residential building

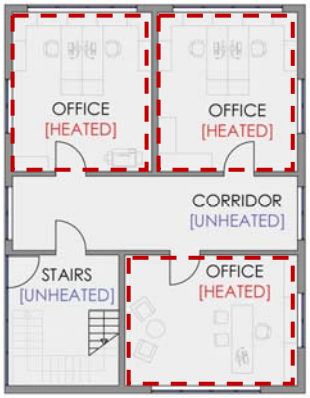
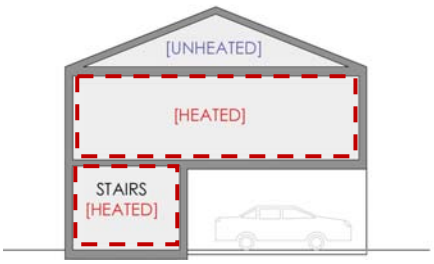


Figure 5: Example floor plan for heated/cooled net floor area [internal]

Heated/cooled net volume (internal), [m³]

is defined by the inside borders of the envelope of the heated/cooled spaces. All internal heated/cooled spaces are considered. Walls, roofs, floors, ceilings and unheated/cooled spaces are **excluded**. Take into account Figure 5 and Figure 6.

Residential building



Non residential building

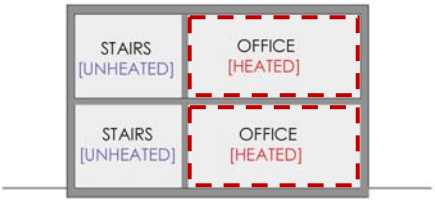


Figure 6: Example section for heated/cooled net volume [internal]

4. Where to meter?

It is highly recommended to implement a community energy management system, which facilitates metering and data collection activities as well as the integration of renewable energy sources [RES] and energy efficiency [EE] measures.

Each building and each generation plant has its own characteristics. Therefore it is important to develop a specific monitoring plan for each demonstration project.

To obtain reliable data out of the monitoring process it is important to measure the energy input and output of all transformation units of the energy system.

4.1 Community energy systems – metering points

- Input and output of each plant should be metered separately
  - RES, non-RES, auxiliary energy input
  - Heating, cooling, electrical or fuel energy output
- After every "junction" when an energy flow supplies different energy services
- Input and output of inter seasonal stores

4.2 Building integrated energy system – metering points

- Photovoltaic [PV]: the amount of electrical energy delivered by the inverter
- Solar thermal collectors: the amount of energy delivered directly by the collectors to the primary circuit (and not at the output of the storage unit)
- Boilers and combined heat and power [CHP]: input of final and auxiliary energy and amount of thermal energy delivered directly at heat exchanger level and electrical energy at output of CHP
- Heat pumps: auxiliary energy input, the input of a renewable energy source and the amount of thermal energy delivered by the condenser (heating mode) or dispersed in the evaporator (cooling mode)
- Sorption chillers: input of electrical and heating energy and the amount of thermal energy dispersed in the evaporator

4.3 Metering in Demonstration Buildings

All energy consumption data in demonstration buildings should be specified as final energy. Final energy consumption covers energy supplied to the final consumer for all energy uses.

- **Domestic hot water**
  - If domestic hot water is prepared with another system as the one used for space heating (e.g. electrical or separate gas boiler), the corresponding energy consumption should be metered separately.

- **Electricity consumption**

  The metering of electricity should be implemented in a way that allows the separate metering of the electricity consumption for different appliances.
  Ideally, it is recommended for large demonstration buildings to split the electricity consumption for:

  - Heating (including all auxiliary systems needed for heating: pumps, fans for ventilation systems if inlet air is heated, also with heat recovery)
  - Domestic hot water (if not combined with heating, including all auxiliary systems needed)
  - Cooling and dehumidification (including all auxiliary systems needed for cooling and dehumidification: pumps, fans for ventilation system if inlet air is cooled down, heat reinjection systems [fans and pumps])
  - Ventilation and humidification (if not combined with heating and cooling, i.e. for the time the ventilation works without heat recovery or buried air pipe)
  - HVAC total
  - Lighting
  - Auxiliary energy
  - Other applications (e.g. cooking, white appliances, computer)

- **Gas consumption**

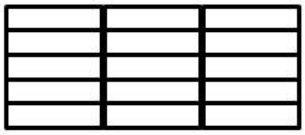
  If a building is supplied by domestic gas it should be clearly defined for what kind of appliances it is used. Gas for domestic hot water and cooking should be metered separately.

- **Buildings with different zones**

  If the demonstration building consists of different zones (e.g. supermarket in the basement of a residential building) and is provided by different heating, cooling and ventilation systems, every single zone should be metered separately, as if they would be part of different buildings.

- **Sampling of dwellings among buildings**

  If the demonstration building is a large multi-family building, it is recommended to meter the whole building and NOT only a sampling of the dwellings. The common parts of the building e.g. an entrance hall should ideally be metered separately.



4.4 Metering/collection of data in non demonstration buildings – the overall building stock -

Non demonstration buildings will not be metered in detail. To characterise the overall building stock it is important to indicate the number of buildings, the building type, construction year and area. The overall building stock will include demonstration buildings and non demonstration buildings which are included in the CONCERTO area.

5. Documentation of monitoring concept

In terms of a consistent evaluation and description of the energy flows it is important to standardize the way of documentation.

Therefore the energy flows in a **CONCERTO area** and in **Demonstration Buildings** will be displayed schematically and the measuring points will be marked. CONCERTO Premium will prepare these schemes in collaboration with the CONCERTO Project Partners.

5.1 Energy flow: CONCERTO area

To picture the energy supply system of a **CONCERTO area** it is important to demonstrate the **energy carriers** used in the CONCERTO area, Energy **transformation units** and how the **demonstration building** are being supplied in one diagram.

The diagram in Figure 7 follows the following rules:

- **Energy carrier**

  The energy carriers are displayed in coloured boxes in the left part. Depending on the supply system possible energy carriers are: domestic gas, oil, biomass, biogas, solar radiation, geothermal energy, etc.

- **Transformation units**

  The transformation units are displayed in grey boxes in the middle part. For example: CHP, heating generation plant, cooling generation plant, hydropower plant, PV system, solar thermal system, etc.

- **Demonstration Buildings**

  The demonstration buildings are displayed in the right part. To keep the diagram clearly arranged not every single demonstration building is displayed in the diagram, but the most representative ones.

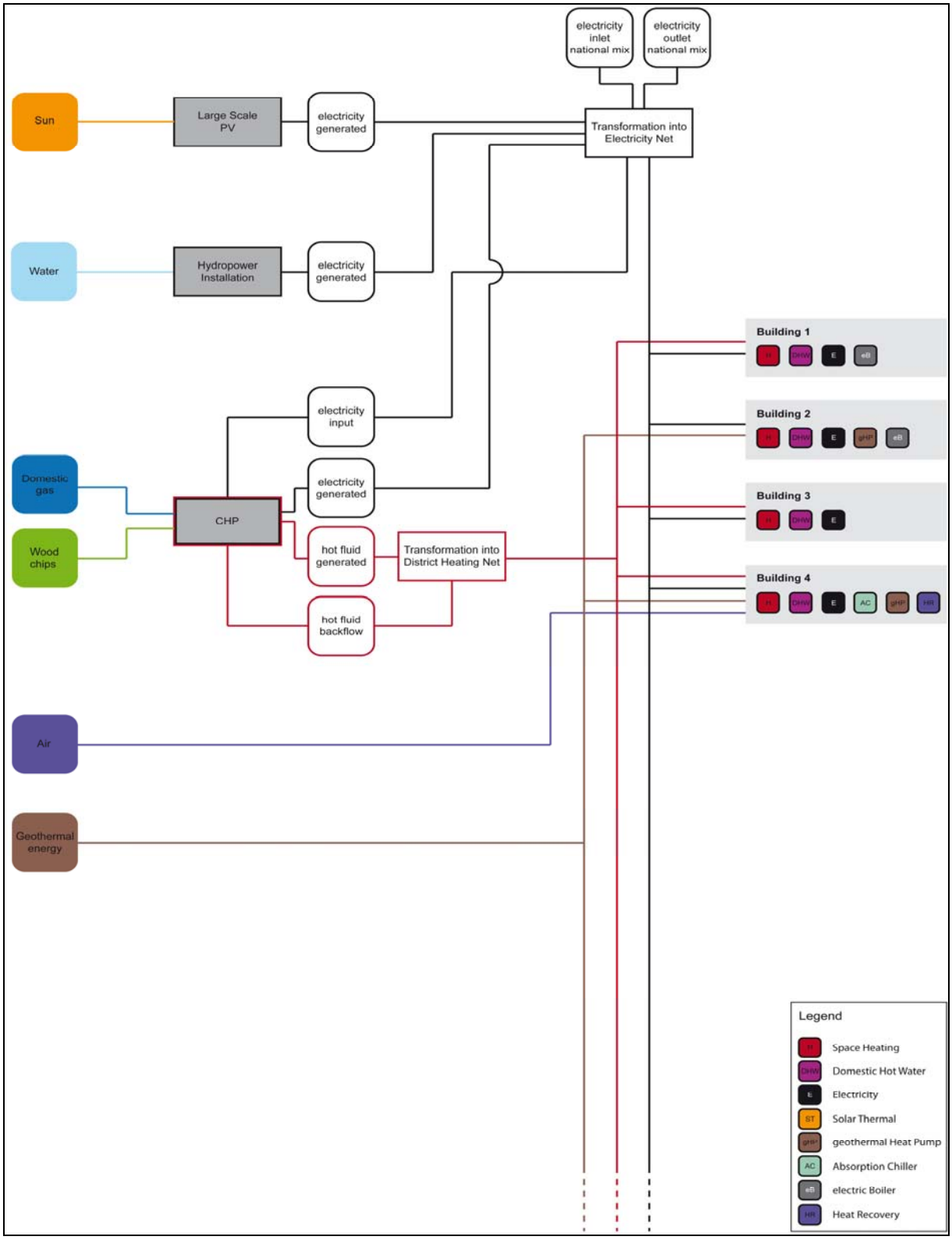


Figure 7: Example documentation diagram for energy flow: CONCERTO area

5.2 Energy flow: Demonstration Building

To picture the energy supply chain of a **demonstration building** it is important to include on the one hand **community energy systems** and on the other hand **building energy systems** in one diagram.

The diagram in Figure 8 follows the following rules:

- **Input Community Energy System**
  - The **delivered energy carriers** are displayed in horizontal lines in the upper part. Depending on the supply system possible energy carriers are: domestic gas, oil, biomass, biogas, district heating, district cooling, electricity [national mix].
  - Below the delivered energy carriers, **the environmental energy** is displayed as well as horizontal lines. Examples are: soil, groundwater, external air, waste heat from buildings/industry, solar radiation.

- **Output Building Integrated Energy Systems**
  - The **end use energy** is displayed in horizontal lines at the bottom part. Examples are: domestic hot water, space heating, space cooling, electricity.

- **Generation / Transformation**
  - In the middle part of the diagram the generation/transformation units are displayed. For example: Development of environmental energy, CHP, heating generation, cooling generation.
  - The energy supply is always displayed from top and the delivered energy downwards. In general the energy flow is displayed from top to bottom.

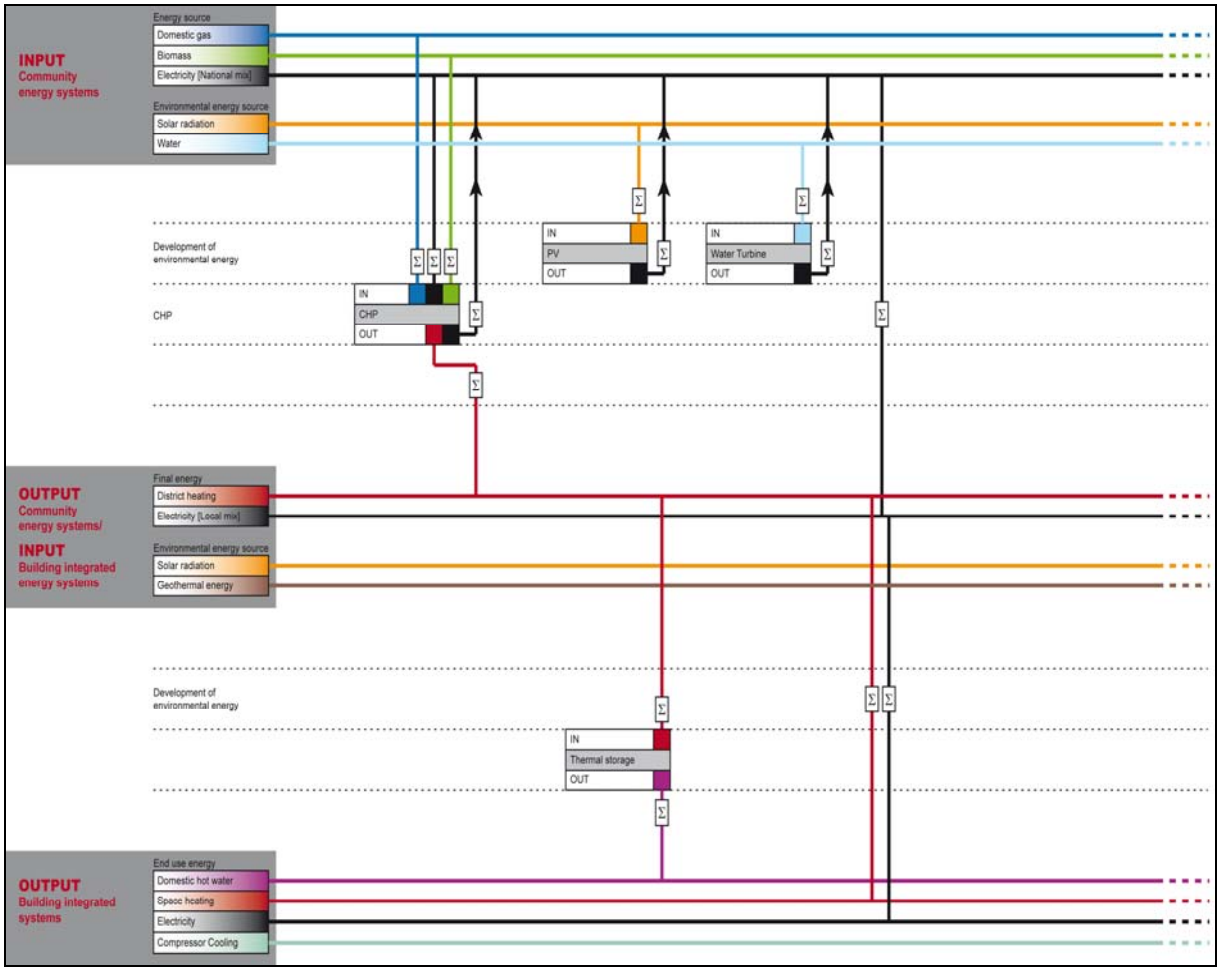


Figure 8: Example documentation diagram for energy flow: Demonstration Building

6. Cooperation and data transfer to CONCERTO Premium

- **Excel Data Collection Sheets**

  CONCERTO Premium will provide Excel templates for the collection of data on different levels of spatial aggregation – on country level, on community level, on CONCERTO area level and for the different demonstration projects within the CONCERTO area like newly constructed, refurbished and reference buildings, community energy systems and building-integrated energy systems. The data sheets on country and community level will be filled in by CONCERTO Premium from adequate sources. Furthermore, CONCERTO Premium will prepare and pre-fill the data sheets for each CONCERTO area and the corresponding CONCERTO demonstration projects with existing data of the CONCERTO Plus database, published reports, CDS, BEST and handover certificates. The projects will then be asked to check the data and to complete the data sheets. This will include general data as well as aggregated monitoring data. With this Excel data sheets it will be possible to transfer the data automatically into the CONCERTO Premium Database. The access to the TMD will be made possible through a dedicated web-based graphical user interface that will be integrated into the new CONCERTO Premium web portal.

- If more detailed and raw data will be necessary for evaluations CONCERTO Premium will define possible data types and formats in collaboration with the CONCERTO communities to transfer the data.

- CONCERTO Premium will prepare schematic diagrams of the energy supply system of the CONCERTO areas for documentation and dissemination purpose in collaboration with the CONCERTO communities.

- The results of the CONCERTO Premium project will be presented on the new CONCERTO Premium website and can be used by the CONCERTO Communities for dissemination purposes.

7. Data Collection Experiences –

Please mind the following points for your data collection:

What is the originally planned number of buildings & energy systems in your project?
How many buildings & energy systems have actually been realised?

Buildings – please specify:

- the gross floor area **AND** the net heated floor area ideally
- the applied energy-related measures in the building in detail
- the date of the last refurbishment measures before CONCERTO and the construction year of the building
- the position to neighbouring buildings, the basement type, the attic type, the number of inhabitants and the number of occupants
- the type of the technologies used for energy generation in the building
- local primary energy & emission factors for biomass and district heat used in the building; either as calculated primary energy factor PLUS the calculation method used or as information about all energy supply units delivering heat to the network and the type and amount of energy carriers used for heat generation
- the energy carrier and technology used for energy generation before the CONCERTO refurbishment

Energy Systems – please specify:

- the energy demand separately for heating, domestic hot water (DHW) generation, cooling and electricity. If a separation of the energy demand for heating and DHW generation is impossible, please add this information on the data collection sheet
- **the monthly monitoring data for the CONCERTO demonstration projects!**
- the start and end date of the monitoring period(s)
- the monitoring data without heating/cooling degree day correction
- weather data like temperature and solar radiation in a daily resolution possibly
- if a secondary heating system is used
- local primary energy & emission factors for biomass and district heat used; either as calculated primary energy factor PLUS the calculation method used or

as information about all energy supply units delivering heat to the network and the type and amount of energy carriers used for heat generation

- for PV systems the type of cells and the values for tilt angle and azimuth

Economic data - please specify:

- if the economic data is containing VAT or not and the corresponding year of price level
- what is included in the total costs or investments by ticking the corresponding checkboxes
- the **energy-related additional costs** for buildings

8. List of Figures