Deliverable D4.1: Guidelines and Tools for Baseline
WP4, Task 4.1

Date of document
14/02/2022, Revised 26/04/2022

Deliverable Version:	D4.1, V.3
Dissemination Level:	PU[1]
Author(s):	*Torben Esbensen (DEM)*

[1] PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

Document History

Project Acronym	**HAPPI**
Project Title	**H**ousing **A**ssociation's Energy Efficiency **P**rocess **P**lanning and **I**nvestments
Project Coordinator	Torben Esbensen On behalf of ProjectZero te@dem.dk
Project Duration	1st March 2018 – 28th February 2022

Deliverable No.	D4.1 Guidelines and Tools for Baseline	
Diss. Level	Public	
Deliverable Lead	DEM	
Status		Working
		Verified by other WPs
	x	Final version
Due date of deliverable	31/07/2018	
Actual submission date	31/07/2018. Rev. 14/02/2022, Rev. 26/04/2022	
Work Package	WP4 Data Management and Monitoring	
WP Lead	B42	
Contributing beneficiary(ies)	DEM ProjectZero	

Date	Version	Person/Partner	Comments
26/04/2022	V3.0	Torben Esbensen	Revised after PR2 Assessment
14/02/2022	V2.0	Torben Esbensen	Revised after rejection
26/02/2020	V1.2	European Commission	Rejected by Commission
26/07/2018	V1.0	Torben Esbensen	1st draft for comments
31/07/2018	V1.2	Henrik Bielefeld	Proofread

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

Table of content

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

1. Executive summary

The document describes, how it is possible to establish a baseline for the energy consumption (heating and electricity) before implementing energy saving measures and renewable energy in the involved housing departments in the six social housing associations in Sonderborg Municipality.
The baseline will be expressed in MWh (energy) as well as in CO2-emission.
The baseline will be used to evaluate the result of the energy saving measures planned to be implemented in the housing departments.

The energy consumption (heating and electricity) is recorded in all involved housing departments in the project.
There are differences, how the data is recorded, and how it can be used in the baseline.
The big differences are between apartment blocks and townhouses, and all the involved housing associations have both type of departments.

The apartment blocks have normally a main district heating meter and a main electricity meter in each block, which measure the energy consumption per block consisting of 20 -30 apartments.
The housing association administration has access to these data per block from the energy supply companies.
The energy consumption in the individual apartments in a block is measured by submeters, which are handled by the housing association administration.
In the majority of apartment blocks it is therefore possible to get access to the existing heating and electricity consumption, both per block and per individual apartment.

The townhouses have normally their own individual meters and contracts with the energy supply companies, both for heating and electricity.
Therefore, it is not possible to get access to the consumption for the individual townhouses.
However, the administration can get information from the supplier about the total energy consumption for all the townhouses in a specific department, and on basis of this, it can be calculated what the average energy consumption is for a townhouse in a specific housing department.

The conclusion is, that it is possible to establish a specific baseline for all the involved departments in the housing associations.

The document furthermore describes a plan for energy data registration after retrofitting and a plan for evaluation of the energy balances after the retrofitting.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

2. Introduction

The aim is to describe a procedure for determining baselines for the buildings energy consumption before implementing energy retrofitting measures in order to determine achieved energy savings as a result of the energy retrofitting projects.
Records of historical annual energy consumption for heating, hot water and electricity will serve as basis for establishing the baseline.

There are six social housing associations involved as partners in the HAPPI project, and the energy consumption is recorded by use of different measuring methods in the six housing associations.
The differences are especially between the apartment blocks and the townhouses.
The different measuring methods are described in this document.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

3. Baseline for Heating Consumption.

3.1 Apartment blocks.

The social housing departments with apartment blocks are normally divided into several individual blocks. All apartment blocks in Sonderborg Municipality are connected to district heating, and each block has an energy flow meter from the district heating supply company.
The total heating consumption for the whole department is calculated by summing the recorded district heating consumption from the energy flow meters in the individual blocks.

The heating consumption of the individual apartments in the blocks is calculated on basis of internal electronic radiator meters installed on each of the radiators in the apartments and on basis of electronic individual hot water meters in the apartments.
In the calculation of the distribution of the total district heating consumption for the department it is normally assumed, that 20 % of the heating consumption is used for domestic hot water, and 80 % is used for space heating.
The 20 % for hot water is distributed among the apartments on basis of the individual hot water meters in each apartment.
The 80 % for space heating is distributed on basis of the individual meters on the radiators.

3.1.1 Baseline

The administration of the social housing associations has access to the district heating consumption for the individual blocks as well as to the distribution of the heating consumption among the individual apartments.
The baseline for the heating consumption in apartment blocks can be the average of the consumption for the three-years period 2015-2017 provided by the housing associations.

3.1.2 Apartment blocks with individual district heating meters.

If the heating system in the apartment blocks is renovated, the heating system is normally rebuild to a new system, where each of the apartments get a new central district heating unit installed in the apartment.
Both the space heating through radiators and the domestic hot water is supplied by the district heating unit similar to the systems in the townhouses described below.
With these district heating units the baseline is calculated similar to the townhouses described below in section 3.2

3.2 Townhouses.

A number of the housing association departments include one-storey townhouses.
The majority of the townhouses are heated by public district heating, and some of them have individual natural gas boilers.

3.2.1 Baseline

The townhouses have their own individual contracts with the district heating companies or with the natural gas supply company.
Therefore the administration of the social housing associations does not have access to the heating meters or to the accounting for the individual townhouse.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

However the administration can get information about the sum of the total heating consumption for the total number of townhouses in a department.
The baseline for the heating consumption in townhouses can be the average of the total consumption for the period 2015-2017, and the average for the individual townhouse can be calculated on basis of the total consumption and the number of townhouses in a department.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

4. Baseline for Electricity Consumption.

4.1 Apartment blocks.

The housing departments with apartment blocks normally have an official main electrical meter in each of the blocks with central registration by the electrical supply company.
These main meters measure the sum of the electrical consumption for the 20-30 apartments in each block, and on basis of these main meters the electrical distribution company charges for the total consumption of the whole department.
In each of the apartments there are installed a separate submeter, which measures the electrical consumption in the individual apartment, and the total consumption measured by the official main meters are distributed among the apartments on basis of the measurements from the submeters.

4.1.1 Baseline

The administration of the housing associations has access to the main meters from the electricity company and also access to the submeters, because normally the administrators handle the records of these submeters.
The baseline for the electricity consumption in apartment blocks and in the apartments can be calculated as the average of the consumption for the three-years period 2015-2017 provided by the housing association.

4.1.2 Apartment blocks with individual main meters in each apartment.

In combination with retrofitting the electrical systems in the apartments, the systems are often changed to individual main electricity meters in each apartment similar to the individual electricity meters in townhouses described in section 4.2 below.

4.2 Townhouses.

All the townhouses in the housing associations have their own individual electricity meter connected directly to the electricity distribution company.

4.2.1 Baseline

The townhouses have individual contracts with the electricity distribution company.
The administration of the social housing associations therefore does not have access to the electricity accounting for the individual townhouses.
However, the administration can get information about the total electricity consumption for the total number of townhouses in a department.
The baseline for the electricity consumption in townhouses can be the average of the total consumption for the period 2015-2017, and the average for the individual townhouse can be calculated on basis of the total consumption and the number of townhouses in a department.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

5. Energy Data Registration after Retrofitting.

In connection with energy retrofitting in a number of the involved housing departments, among other energy saving measures, they will have installed solar photovoltaic plants for production of electricity. Furthermore, some of the departments will have installed heat pumps instead of their existing natural gas boilers.

After implementation of the energy saving measures, the following energy consumption can be measured:

- District heating consumption for the departments.
- Electricity consumption for the departments.
- Production of electricity produced by the solar photovoltaic plants.
- Distribution of the solar production, how much is used directly in the buildings, and how much is transferred and sold to the public grid.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.

6. Evaluation of Energy Balances.

Based on the energy data measured, it might be possible to register and evaluate the following energy balances:

- The total heating consumption before and after implementation of energy retrofitting measures and thereby evaluate the saved heating consumption and CO2 reduction.
- The total electricity consumption before and after installation of the solar photovoltaic plants and other electricity saving measures and thereby evaluate the saved electricity consumption and the performance of the solar photovoltaic plants.
- The distribution of the produced solar photovoltaic electricity among the direct utilization in the buildings and the amount to be sold to the public grid in periods with low demands in the buildings. This is important for the economical balance, because the amount of solar electricity used directly has a much higher economical value (4 times higher value), than the amount sold to the grid.
- The electricity used in installed heat pumps and the heat produced by heat pumps in order to evaluate the performance and efficiency of the heat pumps.

This project has received funding from the European Union`s Horizon 2020 research and innovation programme under grant agreement No 785147.