Application of Energy Performance Indicators for Residential Building Stocks

Experiences of the EPISCOPE project

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EPISCOPE Project Team

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EPISCOPE website: www.episcope.eu

Contents

1 EPISCOPE Indicator Concept: General Approach

The focus of the EPISCOPE project (April 2013 … March 2016, supported by the IEE programme) is on mapping, monitoring and modelling of European housing stocks. Two branches were followed:

- The predecessor IEE project TABULA was continued during EPISCOPE. National building typologies were elaborated or improved.
- In case studies on national, regional or local level building stocks energy balance models were elaborated and scenarios for future energy saving and climate protection were calculated. Examinations are based on available empirical data, concepts for improving the information base were developed.

A major task of the project was to collect basic data on the building stocks concerned and to provide understandable information and calculation results. In this context, but also for the purpose of comparisons, energy performance indicators played a central role at different stages of the project. In particular, indicators for building stocks (and not for single buildings only) had to be considered.

Chapters 1.1 and 1.2 give an overview of the basic ideas and the concrete approaches which were followed in the EPISCOPE project. Some more details were already documented in an earlier report [EPISCOPE Project Team 2014]. In chapters 2 and 3 the concepts of "Summary Indicators" and "Average Buildings" are introduced which had not yet been elaborated in the former report.

1.1 Principles of energy performance indicators for residential building stocks

Energy performance indicators of residential building stocks can either describe existing empirical data of a building stock or the input and outcome of building stock modelling. In EPISCOPE both types of quantities are clearly separated by distinguishing monitoring indicators and scenario indicators:

- **"Monitoring Indicators"** are empirically justified. They are always based on reliable primary data on the observed building stocks. Due to a lack of empirical information they may draw an incomplete picture of the building stocks.
- **"Scenario Indicators"** describe the input data as well as the results of scenario analysis. Based on the monitoring indicators and additional assumptions they provide a complete picture of model analysis.

There is a direct link between monitoring and scenario indicators: A subset of the scenario indicators describes the building stock in its current state which is usually at the same the "basic case", i. e. starting point of model formation and scenario analysis. Those **basic case indicators** should as far as possible be based on the monitoring indicators (i.e. on reliable data), but often additional assumptions will be necessary to fill information gaps. The scenario indicators of future years of modelling will anyway largely be based on such assumptions.

The regular collection of reliable and representative primary data is seen as a key instrument of climate protection strategies: Those strategies are based on more or less uncertain projections and scenarios. Furthermore, the effect of climate protection instruments can hardly be predicted. Therefore, the whole process needs a regular "earthing" by observing the real development as shown in Figure 1: Monitoring is delivering necessary input data for model formation and calculation of (trend) scenarios. At the same time it is a success control of the effect of climate protection policies in the past.

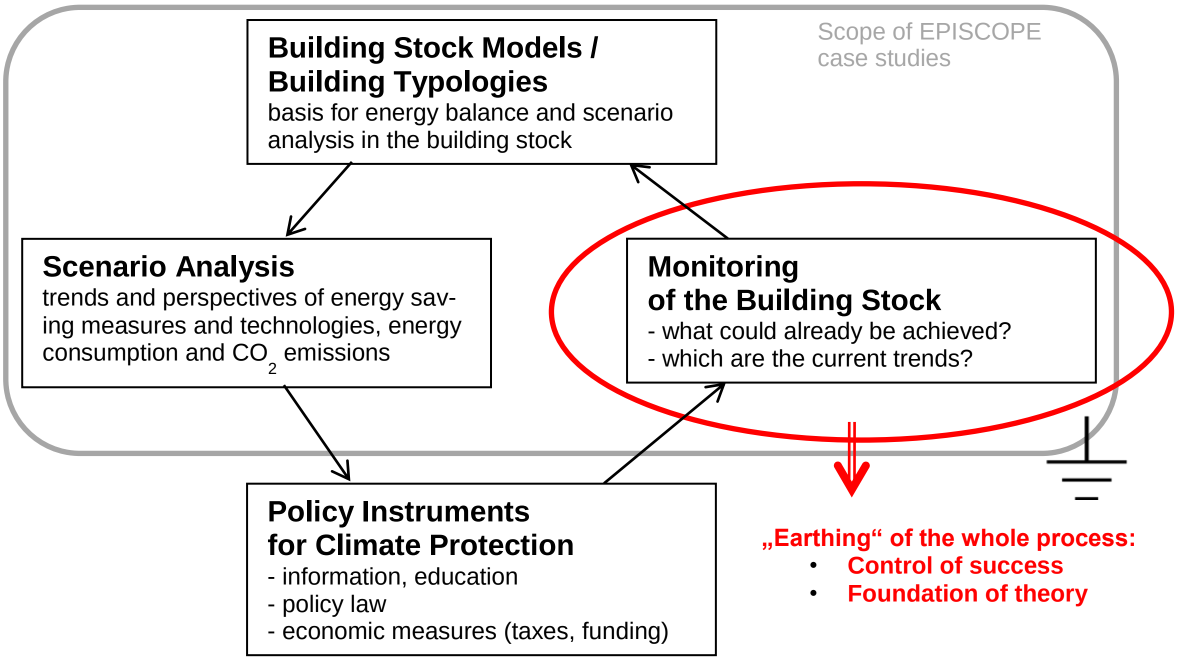


Figure 1: The role of monitoring in climate protection strategies

In the EPISCOPE Synthesis Report No. 4 the issue of collecting representative data and monitoring building stocks is discussed in general and in particular for the EPISCOPE case studies [EPISCOPE Project Team 2016a]. For the success of such approaches it is crucial to be transparent about which parts of the applied information are based on (completely) reliable primary data and which are (at least partly) based on model assumptions. This is the reason why the clear separation of monitoring indicators (which are based on empirical data) and scenario indicators (which are widely based on assumptions) is emphasised in the indicator scheme.

A further distinction is made between **structural indicators** and **energy balance indicators**. Structural data concerns the “physical” state of the building stock in general (like construction age bands, types of wall construction, for example) and in particular with respect to energy efficiency (fraction of insulated building elements, average quality of insulation, structure of applied main heating systems, fraction of solar thermal systems, see Figure 2). With regard to monitoring indicators, structural data is needed as input for model formation, but also for success control of climate protection strategies. Observing only the energy consumption of building stocks (e.g. consumption of the different energy carriers) would not provide the necessary information to assess the reasons of the development. Moreover data on energy consumption of building stocks are often difficult to handle because of uncertainties of weather correction, for example. In EPISCOPE structural as well as energy balance indicators were considered at the level of monitoring as well as scenario indicators.

Overview of necessary structural data

Basic data of the buildings
- Building location and type (construction period, single-/multi-family house, detached/ semi-detached/…)
- Additional information: wall construction type, roof type, historical monument, …

Information on building insulation
- Walls, roofs/upper floor ceiling, ground floor/cellar ceiling, windows
- Existing insulation
- Quality of insulation (thickness, U-values)

Information on heat supply
- Main heating systems (gas/oil/biomass boilers, heat pumps, district heating, …)
- Additional systems (solar systems, stoves)
- Domestic hot water supply
- Insulation of heat distribution pipes
- Ventilation / air conditioning systems

State indicators
Current state of the residential building stock
e.g. „How many walls have already been insulated?“
⇒ Starting point of scenarios
⇒ Success control: „What has been achieved in the past?“

Trend indicators
Current dynamics of the residential building stock
e.g. „How many walls are insulated per year?“
⇒ Trend scenario
⇒ Looking ahead: „Will we reach the future targets with that speed?“

Figure 2: Structural indicators / state and trend indicators

Especially among the structural indicators a further separation of **state indicators** and **trend indicators** is made. This concerns in the first place the monitoring indicators (as described below), but in principle it applies also to scenario indicators (also of future years and future time periods).

The state indicators describe the building stock in its actual state, for example answering the question “How many walls have already been insulated?” This kind of data delivers basic information for energy balance models of buildings stocks, defining the status quo and starting point of scenario calculations. At the same time the state indicators show which progress of energy efficiency measures could already achieved, i.e. they serve for success control of climate protection policies in the past.

On the other hand trend indicators answer questions like “How many walls are insulated every year?” They provide input for the definition of trend scenarios. From a more general point of view they show if the current speed of implementing energy efficiency measures or renewable energies in the building sector is sufficient to reach the future targets or if an acceleration will be necessary.

1.2 Application of energy performance indicators of building stocks in the EPISCOPE project

Figure 3 provides an overview of the application of energy performance indicators at different levels during EPISCOPE. In the following, the procedure will be explained step by step.

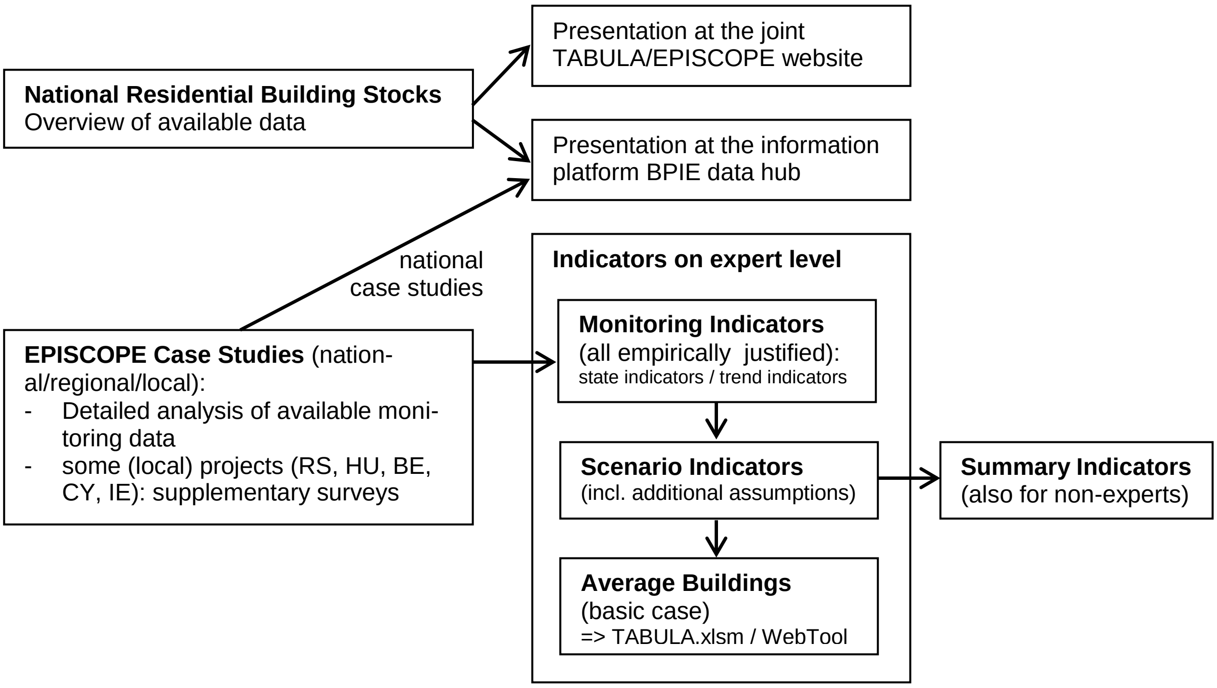


Figure 3: Overview of the EPISCOPE scheme of building stock energy performance indicators

Presentation of national empirical data at the TABULA website

Already in the predecessor IEE project TABULA which was focused on the elaboration of residential building typologies, national statistical data was collected and presented at the project website. In the "typology" branch of EPISCOPE, the TABULA project was continued by updating building typologies and extending the underlying concept to further countries. In that framework also new or updated statistical data of the national residential building stocks was collected. Both projects are presented on a common website[1]. The statistical data on national building stocks is documented at the TABULA country pages[2].

For data presentation a common scheme is applied distinguishing between different types of statistical data [TABULA Project Team 2010]. Even if under the given headlines the partners were very free to choose their own way of data presentation and indicators, the scheme can be seen as a first rough approach of a monitoring indicator concept.

Compiled during both projects, TABULA and EPISCOPE, statistical data from 20 European countries is now available at the project website.

Presentation of national empirical data at the BPIE data hub

The BPIE data hub is a comprehensive internet information platform about energy efficiency in European building stocks[3]. During the EPISCOPE project the data of the national residen-

1 www.episcope.eu

2 http://episcope.eu/building-typology/country/

3 http://www.buildingsdata.eu/

tial building stocks was transferred to this interactive tool. Those partners who carried out their EPISCOPE case studies on national (i.e. not on regional or local) level delivered more detailed supplementary data. The input from EPISCOPE / TABULA is presented in a separate section of the data hub ("EPISCOPE tool"[4]).

More information on the data hub and the data transfer is provided in [EPISCOPE Project Team 2016a, chapter 3].

Indicators on expert level

In the EPISCOPE case studies, which were applied to national, regional or local level, a detailed analysis of residential building stocks was carried out including evaluation of monitoring data, elaboration of building stock energy balance models and the implementation of scenario analysis. To make concepts of that type transparent and comparable on an expert level an indicator scheme was elaborated at an early stage of the EPISCOPE project. It is documented in detail in a separate report [EPISCOPE Project Team 2014]. The scheme includes all types of indicators (monitoring as well as scenario indicators, structural and energy balance indicators, state and trend indicators).

In contrast to the statistics scheme at the TABULA website the structural monitoring indicators are more precisely defined to facilitate comparison between the projects. Moreover, they are fairly harmonised with the scenario indicators which document the input and the results of scenario analysis.

Due to the large variety of individual characteristics of building stocks and scenario models it was not intended to predefine the exact data format of the concerned quantities and the way of partitioning the respective building stocks. So the harmonised concept is open for individual adaptations. Explanations should be provided to make such deviations transparent.

In future applications the original concept documented in [EPISCOPE Project Team 2014] can serve as a basis. During the EPISCOPE case studies experiences were made which leaded to some extensions and clarifications, for example:

- Ventilation heat recovery should be explicitly included as an additional line in the energy balance scheme [ibidem, chapter 3.3], either at the "demand-side" or at the "supply-side" (recommended) of the energy balance.
- A scheme for the documentation of some basic model parameters like the assumed mean indoor temperatures and climate parameters should be added to the scenario indicator scheme.

Further small modifications and adaptations were made. They have been considered in the final versions of the "EPI Tables" (see below).

Summary Indicators

The summary indicators form a simplified and condensed indicator scheme aiming at providing basic information of the scenarios at a glance and also easy to understand for "non-experts" – that means an audience which cannot get into details of the applied models, parameters and indicators. First ideas of such a scheme were already presented in [ibidem] and then concretised in the course of the project. It was decided to concentrate on the most relevant outcome of scenario analysis only to keep the scheme simple and illustrative: The CO_2 emissions (overall outcome), the total heat demand (= heat output of heat generators,

4 http://www.buildingsdata.eu/data-sources/episcope-data

solar systems and heat recovery) and the CO_2 emission factor of heat supply. The total heat demand is reflecting the quality of the building fabric the CO_2 emission factor the quality of the supply system including the processes for producing and transporting the energywares. A more detailed introduction to the summary indicators is given in chapter 2.

Connection to the "Average Buildings" Concept

The average buildings scheme is a special and more elaborated version of the structural scenario state indicators. Here the complete building stock is divided in a manageable number of subsets, each of which is represented by a synthetical building. These buildings represent average values of the building stocks' subsets and can be used for energy balance calculations and simplified model formation of building stocks.

The average buildings concept provides a link between model calculations for building stocks (e.g. the EPISCOPE case studies) and the TABULA typology approach.

In EPISCOPE this was carried out for the basic case, i. e. the starting point of the scenarios: All partners translated the basic case to the average buildings scheme. Then energy balance calculations of the average buildings were carried out with the TABULA tool. The results (weighted by the size of the subsets which were represented by the average buildings) were than compared to the results of the partners' individual model calculations.

Chapter 3 provides more detailed information of the definition and application of average buildings. The average buildings reflecting the basic case of all case studies can be viewed by means of the "Building Stock" area of the TABULA WebTool[5].

1.3 Published EPI-Tables

The energy performance indicators described above have been determined by EPISCOPE partners and are publicly available in form of "EPI Tables" for a number of case studies at the EPISCOPE website[6]. The "EPI Table" is a sort of data appendix for the national reports summarised in [EPISCOPE Project Team 2016b] and [EPISCOPE Project Team 2016c]. They also include textual explanations of individual adaptations and describe the quality of empirical data sources: To which extent is data reliable, representative and up-to-date? Are there remaining uncertainties?

The template for these EPI-tables is available at the download area of the EPISCOPE website[7] – for experts who wish to use the harmonised EPISCOPE structure for reporting the input and output numbers of their scenario calculations.

5 http://webtool.building-typology.eu/

6 http://episcope.eu/monitoring/case-studies/

7 http://episcope.eu/communication/download/

2 Summary Indicators

The summary indicators can give a first and basic overview of the results of scenario analyses of residential building stocks. In EPISCOPE they were applied to the case studies to make the results transparent and comparable. Figure 4 shows an example.

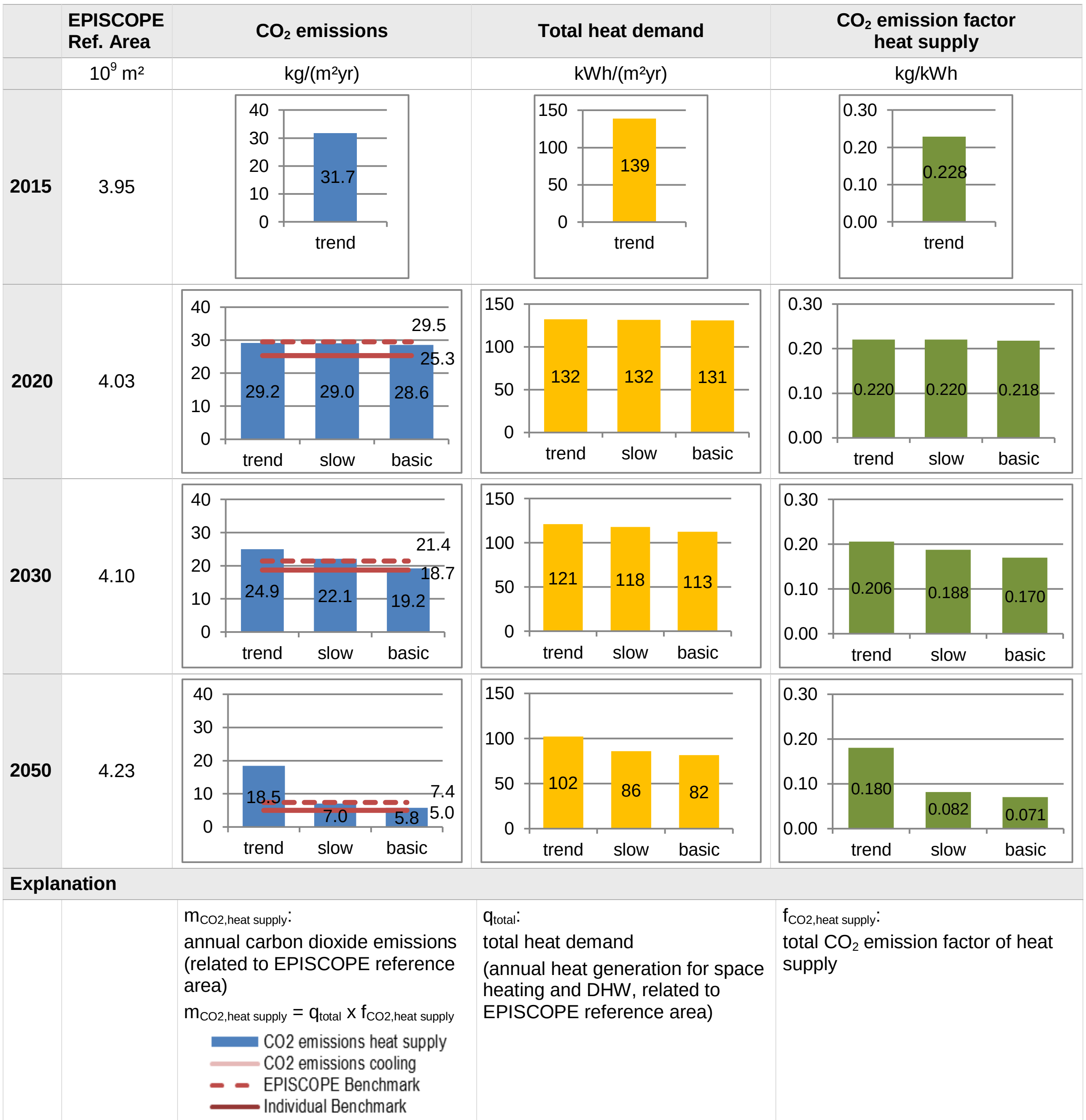


Figure 4: Summary Indicators: Example

The central indicator is $m_{CO2,heat\ supply}$, that means the CO_2 emissions (related to the EPISCOPE reference area) which are caused by heat supply (for heating and hot water, including auxiliary electric energy, also for ventilation). Not only the on-site CO_2 emissions of heating systems but also the CO_2 emissions for district heating and for electricity production (used for heat supply and auxiliary energy) are being considered. But only pure CO_2 emissions are taken into account, equivalents of other greenhouse gases are not included[8].

Further indicators are the total heat demand q_{total} (related to the EPISCOPE reference area[9]) and the total CO_2 emission factor of heat supply $f_{CO2,heat\ supply}$. They document the overall outcome of the buildings (demand-side) and the applied heat supply technologies (supply side) to the CO_2 emissions.

The three quantities are related by the following equation:
$f_{CO2,\ heat\ supply} = m_{CO2,heat\ supply} / q_{total}$

q_{total} is the sum of the energy need for heating and DHW and of the heat distribution and emission losses. It is equal to the total heat output of heat generators, solar systems and heat recovery.

In the diagram of $m_{CO2,heat\ supply}$ also benchmarks are shown:

- dashed lines: common EPISCOPE benchmarks (see explanations below)
- continuous lines (optional): individual benchmarks of the pilot actions

The CO_2-emissions $m_{CO2,cooling}$ for cooling / air conditioning are usually not included. They may optionally be added in the scheme as an additional bar (see example below for the trend scenario 2015. But the cooling energy demand and the CO_2 emission factor of cold generation are not considered in the concept so far. So q_{total} and $f_{CO2,heat\ supply}$ are always related to heat supply only (excluding cooling/air conditioning). If $m_{CO2,cooling}$ is added in the diagram, the benchmarks may be either related to the total CO_2 emissions ($m_{CO2} = m_{CO2,heat\ supply} + m_{CO2,cooling}$) or to heat supply only ($m_{CO2,heat\ supply}$). In the diagram additional information has to be provided about which of the two options applies.

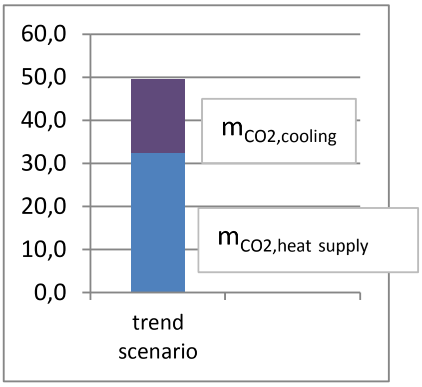


Figure 5: Introduction of CO_2 emissions for cooling to the summary indicators (optional)

EPISCOPE benchmarks

To enable comparisons between different scenarios and building stocks the following benchmarks are defined:

benchmark 2020 = 0,95 x m_{2015} x $A_{ref,2015}$/ $A_{ref,2020}$ ("2015 minus 5 %")
benchmark 2030 = 0,70 x m_{2015} x $A_{ref,2015}$/ $A_{ref,2030}$ ("2015 minus 30 %")
benchmark 2050 = 0,25 x m_{2015} x $A_{ref,2015}$/ $A_{ref,2050}$ ("2015 minus 75 %")

[8] In principle the scheme could also be applied to the total greenhouse gas emissions with CO_2 equivalents. But in the project it turned out that information of CO_2 equivalents might sometimes not be easily available.

[9] Because of differing national definitions of reference area (e. g. living space) a common TABULA / EPISCOPE reference area was introduced [TABULA Project Team 2013].

with: $m_{2015} = m_{CO2,heat\ supply,2015}$ (area-related CO_2 emissions of the year 2015)
$A_{ref,year}$ = EPISCOPE reference area of the building stock in the observed year

The benchmarks are derived from a rough and straightforward translation of general EU climate protection targets: EU has decided a 20 % emission reduction until 2020 and a 40 % reduction until 2030 (compared to 1990). A not officially decided but widely agreed minimum climate protection target for industry countries until 2050 is a reduction of 80 % (again related to 1990) [COM 2011].

According to [UBA 2014] the EU greenhouse gas emissions were reduced by around 12 % (energy-related emissions) or 15 % (all emissions without land use changes) in the period 1990 to 2012. Carrying out a short extrapolation one could assume that until 2015 an emission reduction of 13 % (energy-related) / 17 % (all) – or roughly speaking altogether of 15 % would be reached (related to 1990). So the gap to be closed until 2020 / 2030 / 2050 would be 5 % / 25 % / 65 % (related to 1990) – or (rounded) 5 % / 30 % / 75 % related to the emission level of the year 2015. This defines the EPISCOPE benchmarks above.

Of course the role of the benchmarks may not be over-interpreted (and that is the reason why they are called “benchmarks” and not “targets”): The straightforward breakdown of EU global emission targets to the CO_2 emissions of concrete (even local) residential building stocks does not consider the individual situation and reductions potentials compared to other countries with other climates, other sectors (like industry or traffic) or other building stocks. So a “really fair” burden sharing of emission targets – if it could ever be found – might lead to different numbers. But the EPISCOPE benchmarks provide the rough common scale which is necessary for getting a “quantitative understanding” of the situation in the observed international building stocks.

3 Concept of “Average Buildings”

The determination of energy performance indicators includes a certain effort of summarising and condensing. The EPISCOPE idea of "Average Buildings" is to take advantage of the existence of the scenario indicators from building stock models to set up a very simple calculation scheme: The total values of all relevant input, interim and output quantities (number of dwellings, floor area, envelope area, energy need for heating, final energy consumption, ...) are divided by the number of buildings counted in the building stock subgroup. So, "average buildings" are defined, which are theoretical (synthetical) buildings with geometrical and thermo-physical characteristics equal to the average of the building stock subset which they represent. The annual energy balances for heating and DHW of average buildings are calculated in the same manner as for real buildings. Projections to the building stock can be done by multiplying the single average building related figures with the total number of buildings included in the investigated stock.

The advantages of the definition and calculation of "average buildings" are:

- for the making of a model: The simplified parallel calculation enables plausibility controls of more complex models.
- for the communication of results: The statements about the total building stock are more seizable, large numbers can be pictured. The datasets can also be used in conventional EPC rating software.
- for the practical relevance of the model output: The results can be used as benchmarks to compare features and energy consumptions of distinct real buildings. Projections can be easily done for other subsets of the same building stock.

Against that background the EPISCOPE experts decided to use the average buildings concept for dissemination of parts of their results: For all case studies the basic case (existing state) was transformed to the TABULA data structure, entered in the TABULA.xlsm master file to be displayed in form of average buildings by the "Building Stocks" section of the TABULA WebTool[10]. Thus, the documented average buildings provide a rough picture of the starting point of scenario calculations.

The WebTool section "Building Stocks" includes the following areas

- Menu item "Overview": This table displays the key values of the observed building stocks in the present state. These are the scale level, the basic data (e.g. reference areas), the calculation results from the TABULA WebTool and from the individual building stock models.
- Menu items for the case studies of the different countries, subsumed under "National", "Regional" and "Local". Here the TABULA building stock calculation can be viewed – including all input and output data. This calculation is performed using standard TABULA boundary conditions. At the end the relation of the results from the individual building stock model and from the TABULA standard calculation is determined. Under the precondition that the scenario models are validated or calibrated by real consumption values the relation separate model to simplified TABULA provides ratios for the calibration of the TABULA calculation to the typical level of measured consumption (for the given average state of the building stock subgroups).

An example for the average buildings calculation can be found in Appendix B.

[10] http://webtool.building-typology.eu

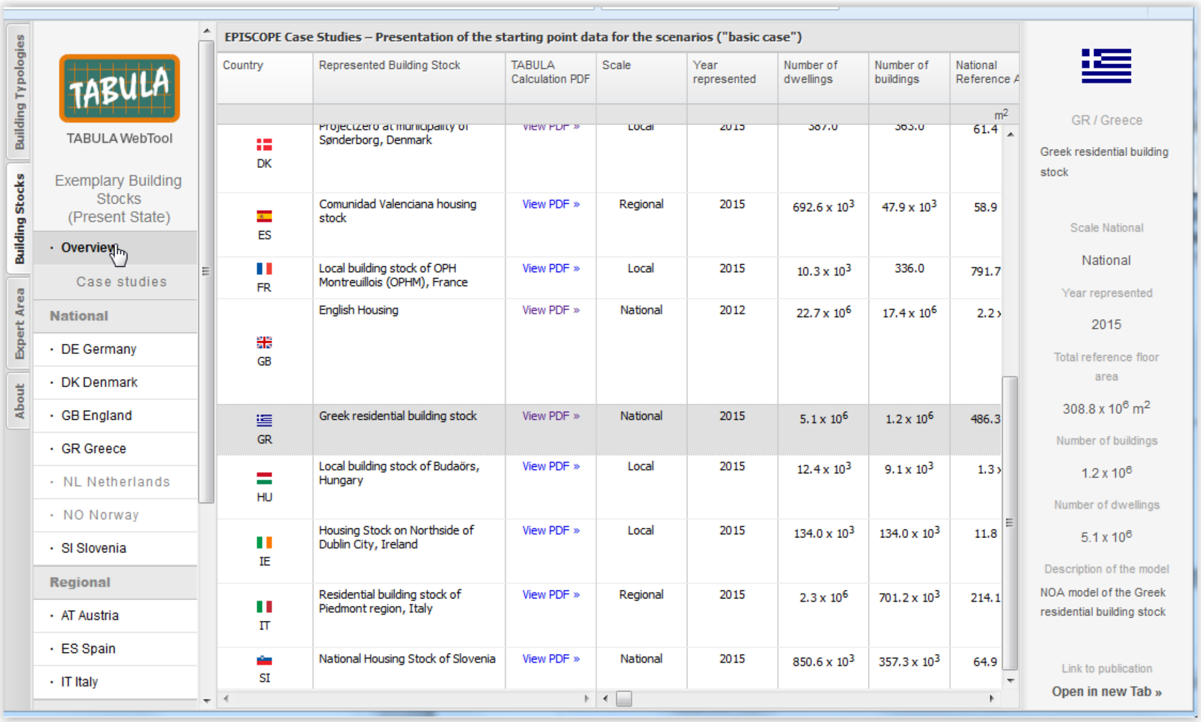
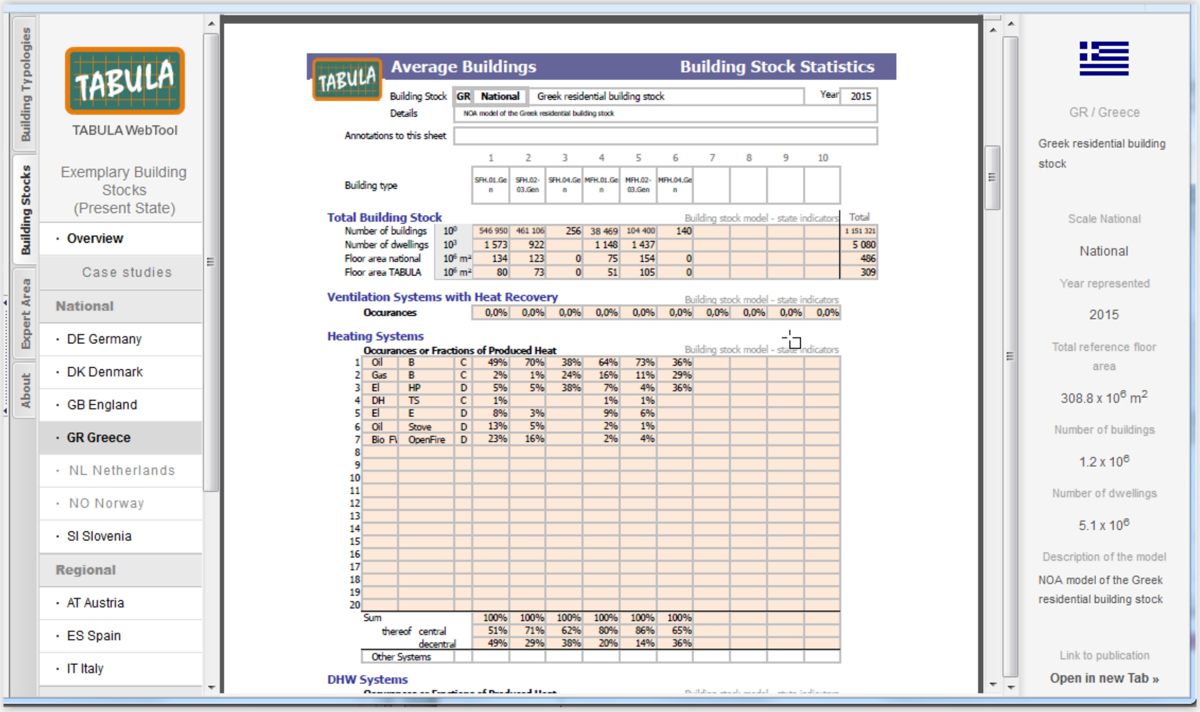


Figure 6: **Overview table of the "Building Stocks" section of the TABULA WebTool (http://webtool.building-typology.eu/)**



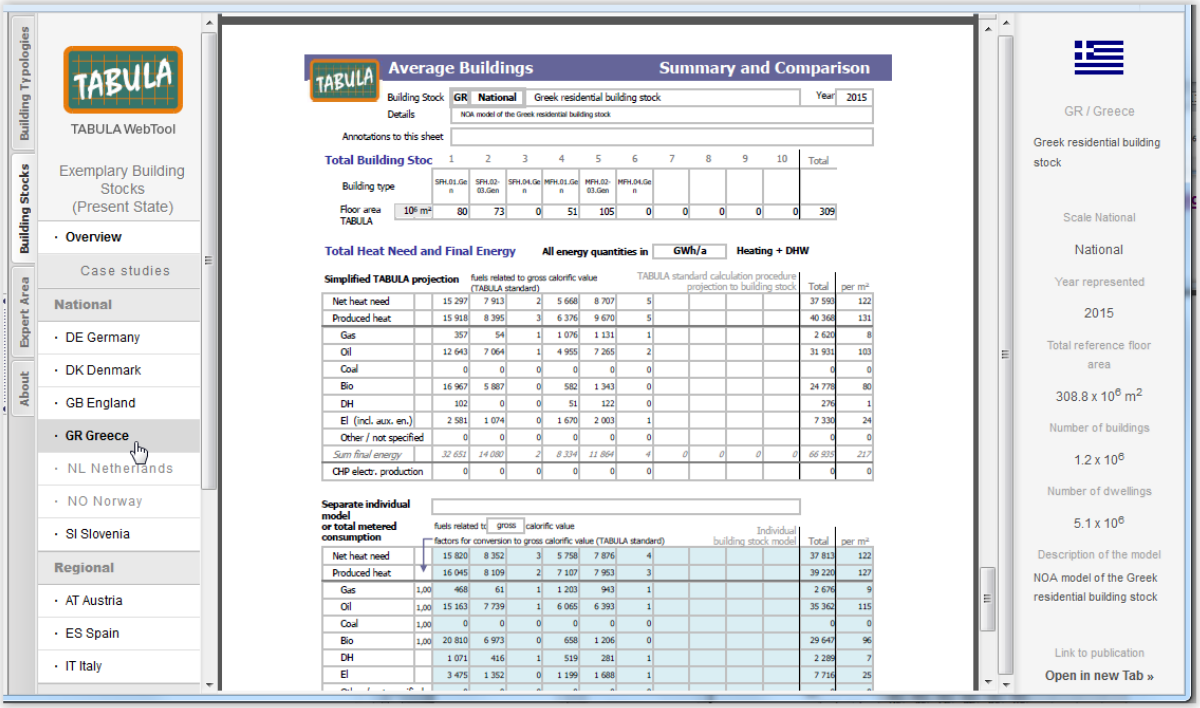


Figure 7: Example of an "Average Buildings" calculation in the "Building Stocks" section of the TABULA WebTool (http://webtool.building-typology.eu/)
Above: Building Stocks Statistics / scenario indicators (extract)
Below: Comparison of the simplified building stock calculation with the individual scenario model

4 References

Sources / References

Reference shortcut	Concrete reference (in respective language)	Short description (in English)
[COM 2011]	European Commission (2011): Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Roadmap for moving to a competitive low carbon economy in 2050. Available at: http://eur-lex.europa.eu/resource.html?uri=cellar:5db26ecc-ba4e-4de2-ae08-dba649109d18.0002.03/DOC_1&format=PDF [2015-06-08]	With its “Roadmap for moving to a competitive low-carbon economy in2050” the European Commission is looking beyond the 2020 objectives for climate and energy and sets out a plan to meet the long-term target of reducing domestic emissions by 80 to 95 % by mid-century.
[EPISCOPE Project Team 2014]	Diefenbach, N., Loga, T., Stein, B. (ed.) (2014): Energy Performance Indicators for Building Stocks. First version / starting point of the EPISCOPE indicator scheme, March 2014. Available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_Indicators_FirstConcept.pdf [2015-12-18]	EPISCOPE report (working paper) on energy performance indicators for building stocks, first version / starting point
[EPISCOPE Project Team 2016a]	Stein, B., Loga, T., Diefenbach, N. (ed.) (2016): Tracking of Energy Performance Indicators in Residential Building Stocks – Different Approaches and Common Results. EPISCOPE Synthesis Report No. 4, Institut Wohnen und Umwelt, Darmstadt; available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR4_Monitoring.pdf	EPISCOPE Synthesis Report No. 4 on the availability and quality of data sources with regards to the EPISCOPE case studies, suggestions for improvements and regular monitoring approaches
[EPISCOPE Project Team 2016b]	Stein, B., Loga, T., Diefenbach, N. (ed.) (2016): Scenario Analyses Concerning Energy Efficiency and Climate Protection in Local Residential Building Stocks. Examples from Eight European Countries – EPISCOPE Synthesis Report No. 2, Institut Wohnen und Umwelt, Darmstadt; available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR2_LocalScenarios.pdf	EPISCOPE Synthesis Report No. 2 on scenario analyses in local building stocks (portfolios of housing companies, municipalities, city quarters)
[EPISCOPE Project Team 2016c]	Stein, B., Loga, T., Diefenbach, N. (ed.) (2016): Scenario Analyses Concerning Energy Efficiency and Climate Protection in Regional and National Residential Building Stocks. Examples from Nine European Countries – EPISCOPE Synthesis Report No. 3, Institut Wohnen und Umwelt, Darmstadt; available at: http://episcope.eu/fileadmin/episcope/public/docs/reports/EPISCOPE_SR3_RegionalNationalScenarios.pdf	EPISCOPE Synthesis Report No. 3 on scenario analyses in regional and national residential building stocks
[TABULA Project Team 2010]	Loga, T.; Diefenbach, N. (ed.) (2010): Use of building typologies for energy performance assessment of national building stocks. Existent Experiences in European Countries and Common Approach. First TABULA Synthesis Report, Institut Wohnen und Umwelt, Darmstadt; Available at: http://www.building-typology.eu/downloads/public/docs/report/TABULA_SR1.pdf [2016-02-03]	TABULA Synthesis Report No. 1 summarising existing experiences, application fields and target groups for building typologies as well as a definition of a common typology structure used in the framework of the TABULA and EPISCOPE projects
[TABULA Project Team 2013]	Loga, T.; Diefenbach, N. (2013): TABULA Calculation Method – Energy Use for Heating and Domestic Hot Water. Reference Calculation and Adaptation to the Typical Level of Measured Consumption.Institut Wohnen und Umwelt, Darmstadt. Available at: http://episcope.eu/fileadmin/tabula/public/docs/report/TABULA_CommonCalculationMethod.pdf [2015-09-17]	Description of the calculation method developed in the course of the IEE project TABULA

Reference shortcut	Concrete reference (in respective language)	Short description (in English)
[UBA 2014]	Umweltbundesamt (2014): Treibhausgas-Emissionen der EU-15 nach Quellkategorien in Mio. t CO_2-Äquivalenten. Available at: http://www.umweltbundesamt.de/sites/default/files/medien/384/bilder/dateien/2_tab_thgemi-eu15_kategorien_2014-08-14.pdf [2015-06-08] Based on: European Environment Agency (EEA) (2014): Annual European Union greenhouse gas inventory 1990–2012 and inventory report 2014. Submission to the UNFCCC Secretariat, Publications Office of the European union, Luxembourg	Table summarising EU-15 greenhouse gas emissions in CO_2-equivalents by source categories; Results in- and excluding Land Use activities and Land-Use Change and Forestry (LULUCF) activities

Appendix A: Example of "EPI Tables"

EPISCOPE Case Study GB-N

Energy Efficiency Scenarios to 2050: England

Documentation of Energy Performance Indicators

More information about case studies at:
www.episcope.eu/monitoring/case-studies/

EPISCOPE Case Study:
Energy Efficiency Scenarios to 2050: England

"EPI Tables"

Documentation of
Energy Performance Indicators

Prepared in the framework
of the European project EPISCOPE
www.episcope.eu

February 2016

bre
BRE (Building Research Establishment, Garston, Watford, UK)

Co-funded by the Intelligent Energy Europe
Programme of the European Union

Template for Documentation of Energy Performance Indicators ("EPI Tables")

Template version: 2016-03-08

The template for documentation of energy performance indicators has been prepared in the framework of the project EPISCOPE which was mainly funded by the programme Intelligent Energy Europe. The purpose is to report in a concerted way on input and output data of the building stock models and scenario calculations.

The usage of the EPI concept as well of this workbook by third parties is intended and desirable.

EPISCOPE

Energy Performance Indicator Tracking Schemes for the Continuous Optimisation of Refurbishment Processes in European Housing Stocks

Co-funded by the Intelligent Energy Europe Programme of the European Union

Contract N°:	IEE/12/695/SI2.644739 – EPISCOPE
Coordinator:	Institut Wohnen und Umwelt, Darmstadt / Germany
Project duration:	April 2013 - March 2016

EPISCOPE Case Studies - Documentation of Energy Performance Indicators

General Information

General Information about the monitoring and scenario data documented in this workbook

Country	**GB/ENG**	**Great Britain (England only)**
Building stock	**National residential building stock**	
Person in charge	Jack Hulme	
Organisation	BRE, Building Research Establishment	
Address	Bucknalls Lane, Garston, Watford, Herts.	
Country	UK	
URL	www.bre.co.uk	
Date	2016-03-09	
Documented study		

EPISCOPE Pilot Project: England

http://episcope.eu/fileadmin/episcope/public/docs/pilot_actions/GB_EPISCOPE_NationalCaseStudy_BRE.pd

Explanations

Monitoring Indicators

The monitoring indicators are based on published data from the English Housing Survey (principally dating from 2011). This is a high quality dataset, used for National Statistics in the UK.

See https://www.gov.uk/government/collections/english-housing-survey

Scenario Indicators

Scenario <1> **National report scenario 1 (Trend scenario)**

The trend scenario is based on installing those measures which are currently being installed, and have been installed under current energy efficiency schemes and programmes. See National Report for more details

Scenario <2> **National report scenario 4 (Ambitious - Long Term Scenario)**

See National Report for details.

This scenario is the most ambitious modelled, and includes a comprehensive programme of energy efficiency improvements, including wide scale fuel switching to electric heat pumps accompanied by decarbonisation of the electricity grid.

See National Report for details.

Further scenarios not documented in this workbook

National report scenario 2 and 3 which are long-term scenarios including insulation and boiler upgrades, but without large scale fuel switching except for off-gas network properties.

Energy Balance Indicators

Figures correspond to the ouptuts from Scenarios 1 and 2 and include adjustments using "real ratio" technique.
See national report for details.

Basic Case Details - Scenario and Energy Balance Indicators by Building Type

Nine building types are used for the definition of the TABULA "average buildings".

Summary Indicators

Information about the summary indicators can be found in the description of the England national report.

References

[1] Summers, C & Hulme, J; EPISCOPE Pilot Project: England. September 2015.

http://episcope.eu/fileadmin/episcope/public/docs/pilot_actions/GB_EPISCOPE_NationalCaseStudy_BRE.pdf

[2] The English Housing Survey.

https://www.gov.uk/government/collections/english-housing-survey

M.1 Basic data of the building stock	Complete building stock
	bs...
number of buildings	N/A
number of apartments	~22 million
national reference area [$10^9 m^2$]	2.1
sources / remarks	EHS data (2010-2013).

M.2.1 Building insulation: Basic information state and trends of modernisation	
	Complete building stock
walls	
insulation improved (from original state)	~40%
insulation improved (area-weighted)	-
average thickness of improved insulation	N/A
annual rate of insulation improvement	2.00%
annual rate of insulation improvement (area-weighted)	-
average thickness of insulation (recent modernisation)	-
roofs / upper floor ceilings	
insulation improved (from original state)	~90%
insulation improved (area-weighted)	-
average thickness of improved insulation	Unknown
annual rate of insulation improvement	4.00%
annual rate of insulation improvement (area-weighted)	-
average thickness of insulation (recent modernisation)	270mm
ground floors / cellar ceilings	
insulation improved (from original state)	Very low
insulation improved (area-weighted)	Very low
average thickness of improved insulation	Very low
annual rate of insulation improvement	Very low
annual rate of insulation improvement (area-weighted)	Very low
average thickness of insulation (recent modernisation)	Very low
windows	
insulation improved (from original state)	~75%
insulation improved (area-weighted)	-
average quality of improved windows	
annual rate of insulation improvement	3.00%
annual rate of insulation improvement (area-weighted)	-
average quality of improved windows (recent modernisations)	
sources / remarks: EHS data (2010-2013). https://www.gov.uk/government/collections/english-housing-survey	

M.2.2 Building insulation: Detailed information of the actual state	
	Complete building stock
levels of wall insulation (area-weigthed):	
Cavity Uninsulated (U ~ 1.7)	~25%
Cavity Insulated (U ~ 0.5)	~40%
Solid Uninsulated (U ~ 2.1)	~30%
Solid Insulated (U ~ 0.5)	<0.5%
roofs / upper floor ceilings	
Flat roof or no loft	~10%
None	<5%
< 100mm	~15%
100 to 150mm	~25%
> 150mm	~50%
ground floors / cellar ceilings	
Insulated floors	Very low
windows	
Full double glazing	~75%
More than half double glazing (not full)	~10%
Less than half double glazing	~5%
No double glazing	~10%
sources / remarks EHS data (2010-2013). https://www.gov.uk/government/collections/english-housing-survey	

M.3.1 Main Heat Supply Systems for Space Heating		
		modernisation
	Complete building stock	Complete building stock
M.3.1.1 Centralisation of space heating system		net modernisation rates
district heating	Very low	Very low
building / apartment heating	95%	+ < 1% per annum
room heating	5%	- < 1% per annum
M.3.1.2 Main energy carrier for space heating		net modernisation rates
district heating	Very low	Very low
gas (natural / liquid gas)	~85%	+ < 1% per annum
oil	~5%	+ < 1% per annum
coal	Very low	Very low
wood/biomass	Very low	Very low
electricity	~10%	- < 1% per annum
M.3.1.3. Main heat generation system for space heating		gross modernisation rates
condensing boiler system	30%	+ approx 7% per annum
non-condensing boiler system	60%	- Approx 7% per annum
room heater	~5%	- < 1% per annum
storage radiators	~5%	Approx 0%
other (communal, warm air, other)	Very low	Very low
sources / remarks EHS data (2010-2013).		
https://www.gov.uk/government/collections/english-housing-survey		

M.3.2 Special Systems (additional systems of special interest for space heating, hot water supply, ventilation, including photovoltaics)		
		modernisation trends (gross rates)
	Complete building stock	Complete building stock
solar thermal systems	Very low	Very low
...for hot water supply only	Very low	Very low
...for heating and hot water supply	Very low	Very low
photovoltaic systems	Very low	Very low
ventilation systems *(for buildings/apartments, not only kitchen/WC ventilation)*	Very low	Very low
....with heat recovery	Very low	Very low
...without heat recovery	Very low	Very low
sources / remarks EHS data (2010-2013).		
https://www.gov.uk/government/collections/english-housing-survey		

M.3.3 Main System of Hot Water Supply apart from additional solar thermal systems (see above)	
	Complete building stock
M.3.3.1 Main Energy carrier for hot water supply	
district heating	Very low
gas	~85%
oil	~5%
coal	Very low
wood/biomass	Very low
electricity	~10%
M.3.3.2 Main heat generation system for hot water supply	
hot water generation combined with heating system:	
separate system of hot water generation:	
- direct electric heat generation	~10%
- electric heat pump	0%
- combustion of fossil fuels	~90%
- combustion of wood/biomass	0%
sources / remarks EHS data (2010-2013).	
https://www.gov.uk/government/collections/english-housing-survey	

M.4 Final Energy balance: Measured values energy consumption in TWh/a (10^9 kWh/a)	Complete building stock
district heating	5
gas	2465
oil	261
coal	74
wood/biomass	58
electricity	937

sources / remarks
Energy Consumption in the UK data (adjusted to England), 2011.
https://www.gov.uk/government/collections/energy-consumption-in-the-uk

Trend scenario (National report scenario 1)	Residential Buildings constructed before 2012		Remarks
	2012: Basic Case	2050	
	$bs_{2012} = bs_{...2012\|2012}$	$bs_{...2012\|2050}$	
Number of buildings	N/A	N/A	Analysis completed as dwellings
Number of dwellings	21.9	30.7	
National reference area [10^9 m²]	2.1	2.94	
TABULA/EPISCOPE reference area [10^9 m²]	2.1	2.94	
Building insulation: state of modernisation			
Walls			percentages related to ....
insulation installed	42%	61%	Number of dwellings
Roofs / upper floor ceilings			percentages related to ....
insulation improved (from original state)	83%	85%	Number of dwellings with some insulation
Ground floors / cellar ceilings			percentages related to ....
insulation improved (from original state)	0%	0%	Number of dwellings
Windows			percentages related to ....
insulation improved (from original state)	90%	90%	Number of dwellings with double glazing
Building insulation: Detailed information			
levels of wall insulation:			percentages related to....
Cavity insulated	40%	60%	Number of dwellings
Cavity uninsulated	28%	9%	
Solid insulated	2%	2%	
Solid uninsulated	28%	28%	
Other	2%	2%	
levels of roof/upper floor ceiling insulation:			percentages related to....
No loft	13%	13%	Number of dwellings
None	4%	3%	
0-99mm	15%	4%	
100-199mm	34%	10%	
200-300mm	25%	3%	
>300mm	9%	68%	
levels of window insulation:			percentages related to....
Double glazed	90%	90%	Number of dwellings
Single glazed	11%	11%	
Main Heat Supply Systems for Space Heating			
Centralisation of space heating system	2%		percentages related to....
district heating	2%	2%	Number of dwellings
building / apartment heating	95%	95%	
room heating	3%	3%	
Main energy carrier for space heating			percentages related to....
district heating	2%	1.8	Number of dwellings
gas (natural / liquid gas)	85%	84.7	
oil	4%	2.1	
coal	1%	0.3	
wood/biomass	0%	0.3	
electricity	9%	10.8	
Main heat generation system for space heating			percentages related to....
district heating	2%	2%	Number of dwellings
boiler system	88%	88%	
storage radiators	6%	6%	
warm air system	1%	1%	
room heaters	3%	3%	
heat pumps	0%	0%	
Special Systems			percentages related to....
solar thermal systems	1%	1%	Number of dwellings
photovoltaic systems	1%	1%	
remarks Modelling was undertaken to 2050 only (2020 and 2030 data not available)			

Trend scenario (National report scenario 1)	Residential Buildings constructed until 2012		
	2012: Basic Case	2050	
	$bs_{2012} = bs_{...2012\|2012}$	$bs_{...2012\|2050}$	
Internal and external boundary conditions for energy balance calculation			
Directly heated part of the reference floor area	100	100	in %
Daily operating time of heating system	8hrs weekday, 16hrs weekend	8hrs weekday, 16hrs weekend	h/d
Set-point temperature heating system	21	21	°C
Average temperature directly heated part	21	21	°C (heating period)
Average temperature not directly heated part	N/A	N/A	°C (heating period)
Climate dataset	SAP 2012	SAP 2012	
Length of heating period	8	8	Months
Adaptation factor final energy (for calibration to typical level of measured consumption)			
fuels	Variable factor	Variable factor	Factor varied based on energy performance of dwelling
district heating	Variable factor	Variable factor	Factor varied based on energy performance of dwelling
electric energy	Variable factor	Variable factor	Factor varied based on energy performance of dwelling

Ambitious Long Term (National Report Scenario 4)	Residential Buildings constructed before 2012		Remarks
	2012: Basic Case	2050	
	$bs_{2012} = bs_{...2012\|2012}$	$bs_{...2012\|2050}$	
Number of buildings	N/A	N/A	Analysis completed as dwellings
Number of dwellings	21.9	30.7	
National reference area [10^9 m²]	2.1	2.94	
TABULA/EPISCOPE reference area [10^9 m²]	2.1	2.94	
Building insulation: state of modernisation			
Walls			percentages related to ....
insulation installed	42%	94%	Number of dwellings
Roofs / upper floor ceilings			percentages related to ....
insulation improved (from original state)	83%	88%	Number of dwellings
Ground floors / cellar ceilings			percentages related to ....
insulation improved (from original state)	0%	0%	Number of dwellings
Windows			percentages related to ....
insulation improved (from original state)	90%	100%	Number of dwellings
Building insulation: Detailed information			
levels of wall insulation:			percentages related to....
Cavity insulated	40%	65%	Number of dwellings
Cavity uninsulated	28%	4%	
Solid insulated	2%	29%	
Solid uninsulated	28%	1%	
Other	2%	2%	
levels of roof/upper floor ceiling insulation (area-weigthed):			percentages related to....
No loft	13%	13%	Number of dwellings
None	4%	0%	
0-99mm	15%	0%	
100-199mm	34%	0%	
200-299mm	25%	0%	
>300mm	9%	88%	
levels of window insulation (area-weigthed):			percentages related to....
Double glazed	90%	100%	Number of dwellings
Main Heat Supply Systems for Space Heating			
Centralisation of space heating system			percentages related to....
district heating	2%	2%	Number of dwellings
building / apartment heating	95%	98%	
room heating	3%	0%	
Main energy carrier for space heating			percentages related to....
district heating	2%	1.8	Number of dwellings
gas (natural / liquid gas)	85%	19.6	
oil	4%	0	
coal	1%	0	
wood/biomass	0%	0.3	
electricity	9%	78.4	
Main heat generation system for space heating			percentages related to....
district heating	2%	2%	Number of dwellings
boiler system	88%	20%	
storage radiators	6%	0%	
warm air system	1%	1%	
room heaters	3%	3%	
heat pumps	0%	78%	
Special Systems			percentages related to....
solar thermal systems	1%	68%	Number of dwellings
photovoltaic systems	1%	68%	

remarks
Modelling was undertaken to 2050 only (2020 and 2030 data not available)

Ambitious Long Term (National Report Scenario 4)	Residential Buildings constructed until 2012		
	2012: Basic Case	2050	
	$bs_{2012} = bs_{...2012\|2012}$	$bs_{...2012\|2050}$	
Internal and external boundary conditions for energy balance calculation			
Directly heated part of the reference floor area	100	100	in %
Daily operating time of heating system	8hrs weekday, 16hrs weekend	8hrs weekday, 16hrs weekend	h/d
Set-point temperature heating system	21	21	°C
Average temperature directly heated part	21	21	°C (heating period)
Average temperature not directly heated part	N/A	N/A	°C (heating period)
Climate dataset	SAP 2012	SAP 2012	
Length of heating period	8	8	d/a
Average external air temperature during heating period			°C
Adaptation factor final energy (for calibration to typical level of measured consumption)	Variable factor	Variable factor	
fuels	Variable factor	Variable factor	
district heating	Variable factor	Variable factor	
electric energy			

Trend scenario (National report scenario 1)		2012: Basic Case	2050
		bs_{2012}	bs_{2050}
TABULA/EPISCOPE reference area [10^9 m²]		2.10	2.94
Required heat amounts			
Q_{nd}	Net heat need (space heating and DHW)*	132012.44	131062.31
Q_{total}	Supplied heat (space heating and DHW)**	190201.56	173649.91
Final energy demand by energy carrier (delivered energy, gross calorific value)			
1	natural gas	161166.58	150128.23
2	liquid gas	911.25	644.50
3	oil	8890.62	5091.80
4	coal	7349.05	4886.61
5	wood / biomass	419.88	418.15
6	district heating	294.19	293.78
7	electric energy (used for heat supply)***	11169.98	12186.83
Sum of energy carriers (1-7)		190201.56	173649.91
CO_2 emissions (e.g. in million tons / year)		124	86.2

Remarks:

*) Energy need for heating and DHW

**) Total amount of heat generated by technical installations in the building (for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems).

***) e.g. auxiliary electric energy for control, pumps, fans of heat supply and ventilation systems is included
Modelling was undertaken to 2050 only (2020 and 2030 data not available)

Indicators Related to the Reference Area in kWh/(m²a)		2012: Basic Case	2050
Trend scenario (National report scenario 1)		bs_{2012}	bs_{2050}
TABULA/EPISCOPE reference area [10^9m²]		2.1	2.94
Required heat amounts			
Q_{nd}	Net heat need (space heating and DHW)*	62.86	44.58
Q_{total}	Supplied heat (space heating and DHW)**	90.57	59.06
Final energy demand by energy carrier (delivered energy, gross calorific value)			
1	natural gas	76.75	51.06
2	liquid gas	0.43	0.22
3	oil	4.23	1.73
4	coal	3.50	1.66
5	wood / biomass	0.20	0.14
6	district heating	0.14	0.10
7	electric energy (used for heat supply)***	5.32	4.15
Sum of energy carriers (1-7)		90.57	59.06
CO_2 emissions (in kg / m² / year)		59.05	29.32

Remarks:

*) Energy need for heating and DHW

**) Total amount of heat generated by technical installations in the building (for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems).

**) e.g. auxiliary electric energy for control, pumps, fans of heat supply and ventilation systems is included

Ambitious Long Term (National Report Scenario 4)		2012: Basic Case	2050
		bs_{2012}	bs_{2050}
TABULA/EPISCOPE reference area [10^9 m²]		2.10	2.94
Required heat amounts			
Q_{nd}	Net heat need (space heating and DHW)*	132012.44	123645.04
Q_{total}	Supplied heat (space heating and DHW)**	190201.56	81883.31
Final energy demand by energy carrier (delivered energy, gross calorific value)			
1	natural gas	161166.58	29105.99
2	liquid gas	911.25	2.72
3	oil	8890.62	0.00
4	coal	7349.05	374.89
5	wood / biomass	419.88	376.06
6	district heating	294.19	290.08
7	electric energy (used for heat supply)***	11169.98	51733.56
Sum of energy carriers (1-7)		190201.56	81883.31
CO_2 emissions (in million tons / year)		124	16

Remarks:

*) Energy need for heating and DHW

**) Total amount of heat generated by technical installations in the building (for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems).

***) e.g. auxiliary electric energy for control, pumps, fans of heat supply and ventilation systems is included

Indicators Related to the Reference Area in kWh/(m²a)		2012: Basic Case	2050
		bs_{2012}	bs_{2050}
TABULA/EPISCOPE reference area [10^9m²]		2.1	2.94
Required heat amounts			
Q_{nd}	Net heat need (space heating and DHW)*	62.86	42.06
Q_{total}	Supplied heat (space heating and DHW)**	90.57	27.85
Final energy demand by energy carrier (delivered energy, gross calorific value)			
1	natural gas	76.75	9.90
2	liquid gas	0.43	0.00
3	oil	4.23	0.00
4	coal	3.50	0.13
5	wood / biomass	0.20	0.13
6	district heating	0.14	0.10
7	electric energy (used for heat supply)***	5.32	17.60
Sum of energy carriers (1-7)		90.57	27.85
CO_2 emissions (in kg / m² / year)		59.05	5.44

Remarks:

*) Energy need for heating and DHW

**) Total amount of heat generated by technical installations in the building (for heating and DHW: sum of net heat need + storage losses + distribution and emission losses + heat recovered by ventilation systems).

**) e.g. auxiliary electric energy for control, pumps, fans of heat supply and ventilation systems is included
Modelling was undertaken to 2050 only (2020 and 2030 data not available)

Year			2012	2050
Reference area	National reference area	[m²]	2 100 000 000	2 940 000 000
	EPISCOPE reference area	[m²]	2 100 000 000	2 940 000 000
CO_2 emissions	<1> Scenario "Trend"	kg/m²yr	42	25.0
	<2> Scenario "Target-oriented / basic"	kg/m²yr		5.0
	EPISCOPE benchmark	kg/m²yr		8.0
	National benchmark	kg/m²yr		9.0
Total heat demand	<1> Scenario "Trend"	kWh/(m²yr)	171	112
	<2> Scenario "Target-oriented / basic"	kWh/(m²yr)		52
CO_2 emission factor heat supply	<1> Scenario "Trend"	kg/kWh	0.246	0.223
	<2> Scenario "Target-oriented / basic"	kg/kWh	-	0.096

Values related to EPISCOPE Reference Area

Building Stock	GB	**National**	English Housing	Year 2012
Details	Main English building type and age merged into smaller type and age band to give 9 average building types, bre model			
Annotations to this sheet				

	Total	1	2	3	4	5	6	7	8	9	10	
Building type / label		TH.01	TH.02-03	TH.04-08	SFH.01	SFH.02-03	SFH.04-08	AB.01	AB.02-03	AB.04-08		
Building size category												
Construction time band												
General Data												
Number of buildings	17 428	2 771	5 601	4 020	522	1 305	2 862	135	76	137		10^3
Number of dwellings	22 720	2 970	5 800	4 270	570	1 430	3 070	930	1 120	2 560		10^3
Floor area national		305	511	344	113	195	413	67	67	148		10^6 m²
Floor area TABULA	2 163	305	511	344	113	195	413	67	67	148		10^6 m²

Building Insulation

Original state / not refurbished fraction of the envelope area

U-values of the original state	1	2	3	4	5	6	7	8	9	10	
Roof	0.88	0.64	0.52	0.88	0.64	0.52	0.32	0.32	0.19		W/(m²K)
Wall	1.93	1.77	0.93	1.93	1.77	0.93	1.93	1.77	0.93		W/(m²K)
Window	4.06	3.59	3.74	4.13	3.62	3.89	4.22	3.71	4.25		W/(m²K)
Floor	0.59	0.59	0.59	0.72	0.72	0.72	0.45	0.45	0.45		W/(m²K)

Refubishments (averages)

Refurbished fraction of envelope areas	1	2	3	4	5	6	7	8	9	10
Roof	42%	55%	56%	52%	56%	60%	7%	13%	19%	
Wall	11%	52%	54%	17%	55%	57%	7%	40%	46%	
Window	62%	76%	74%	57%	75%	81%	48%	86%	91%	
Floor										
Total (indicative)	*23%*	*43%*	*43%*	*26%*	*43%*	*46%*	*11%*	*41%*	*48%*	

U-values of the refurbished fraction (averages)	1	2	3	4	5	6	7	8	9	10	
Roof	0.16	0.15	0.15	0.16	0.15	0.15	0.12	0.12	0.10		W/(m²K)
Wall	0.74	0.47	0.31	0.74	0.47	0.31	0.74	0.47	0.31		W/(m²K)
Window	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58	2.58		W/(m²K)
Floor											W/(m²K)

Main Heat Supply Systems

Ventilation Systems with Heat Recovery

Occurances										

Heating Systems

Occurances or Fractions of Produced Heat

1	Gas	B_C	C	90%	100%	90%	50%	90%	90%	80%	85%	60%	
2	El	E_Storage	D	10%		10%	10%			20%	15%	40%	
3	Oil	B_C	C				40%	10%	10%				
4													
5													
6													
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19													
20													
	Sum			100%	100%	100%	100%	100%	100%	100%	100%	100%	
	thereof	central		90%	100%	90%	90%	100%	100%	80%	85%	60%	
		decentral		10%		10%	10%			20%	15%	40%	
	Other Systems												

DHW Systems

Occurances or Fractions of Produced Heat

1	Gas	B_C	C	90%	95%	90%	50%	80%	80%	80%	90%	60%	
2	El	E_Immersi	C	10%	4%	10%	10%	10%		20%	10%	40%	
3	Oil	B_C	C		1%		40%	10%	10%				
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
	Sum			100%	100%	100%	100%	100%	90%	100%	100%	100%	
	thereof	central		100%	100%	100%	100%	100%	90%	100%	100%	100%	
		decentral											
	Other Systems								10%				

Energy Balance

All energy quantities in **GWh/a** **Heating + DHW**

bre model of English housing

fuels related to gross calorific value

												Total	per m²
Net heat need		59 100	86 200	47 100	22 700	33 100	53 500	13 100	10 900	16 900	0	342 600	158
Produced heat		80 700	116 600	61 700	31 700	45 900	72 900	16 000	13 300	19 000	0	457 800	212
Gas	1.00	71 100	111 000	57 500	15 800	39 200	63 400	12 200	11 100	12 400	0	393 700	182
Oil	1.00	4 100	1 500	500	12 200	3 800	7 400	100	36	50	0	29 686	14
Coal	1.00	0	0	0	0	0	0	0	0	0	0	0	0
Bio	1.00	0	0	0	0	0	0	0	0	0	0	0	0
DH		0	0	0	0	0	0	0	0	0	0	0	0
El		3 300	2 200	3 300	1 500	1 400	1 200	3 000	1 400	5 400	0	22 700	10
Other / not specified		0	0	0	0	0	0	0	0	0	0	0	0
Sum final energy		*78 500*	*114 700*	*61 300*	*29 500*	*44 400*	*72 000*	*15 300*	*12 536*	*17 850*	*0*	*446 086*	*206*
per m²		*257*	*224*	*178*	*261*	*228*	*174*	*228*	*187*	*121*			
CHP electr. producti		0	0	0	0	0	0	0	0	0	0	0	0

Version: 2016-01-21

Appendix B: Example of “Average Buildings” Calculation

EPISCOPE Case Study SI-N

National Housing Stock in Slovenia

Simplified TABULA Building Stock Model

www.episcope.eu/monitoring/average-buildings

Average Buildings — Energy Need for Heating

TABULA

Building Stock	SI	National	National Housing Stock of Slovenia	Year 2015
Details	ZRMK model			
Annotations to this sheet				

	1	2	3	4	5	6	7	8	9	10
Building type	SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06				
Dataset	SI.National.2015.001.01	SI.National.2015.001.02	SI.National.2015.001.03	SI.National.2015.001.04	SI.National.2015.001.05	SI.National.2015.001.06				

Thermal Envelope Average Building

	1	2	3	4	5	6	7	8	9	10	Unit
Basic data							TABULA average buildings				
Floor area TABULA	**147,1**	**151,0**	**150,4**	**1940,0**	**3085,0**	**6080,0**					**m²**
Floor area national	133,7	137,3	136,7	1763,6	2804,5	5527,3					m²
Number of dwellings	1,53	1,34	0,89	39,80	60,51	98,28					
Thermal envelope areas (external dimensions)							TABULA average buildings				
Roof	129,1	121,7	115,6	279,5	357,6	1372,0					m²
Wall	143,0	115,8	230,5	1323,5	1522,9	2244,6					m²
Window	50,3	33,6	40,8	348,9	662,8	1018,8					m²
Floor	117,2	119,3	123,8	278,0	380,9	1187,1					m²
Original state / not refurbished fraction of the envelope area											
U-values of the original state							Building stock model - state indicators				
Roof	1,68	0,39	0,18	1,58	1,50	0,17					W/(m²K)
Wall	1,50	0,48	0,27	2,53	1,65	0,29					W/(m²K)
Window	2,45	2,20	1,21	2,65	2,75	1,34					W/(m²K)
Floor	1,68	0,61	0,26	1,55	0,93	0,25					W/(m²K)
Refubishments (averages)											
Refurbished fraction of envelope areas							Building stock model - state indicators				
Roof	74%	44%	3%	66%	46%	4%					
Wall	44%	17%	3%	37%	21%	4%					
Window	52%	19%	3%	52%	31%	4%					
Floor											
Total (indicative)	*42%*	*20%*	*2%*	*38%*	*24%*	*3%*					
U-values of the refurbished fraction (averages)							Building stock model - state indicators				
Roof	0,21	0,15	0,10	0,21	0,21	0,09					W/(m²K)
Wall	0,26	0,20	0,14	0,28	0,28	0,15					W/(m²K)
Window	1,30	1,30	0,90	1,30	1,30	0,90					W/(m²K)
Floor											W/(m²K)

Energy Need for Heating TABULA

	1	2	3	4	5	6	7	8	9	10	Unit
Utilisation							TABULA standard calculation procedure				
Utilisation dataset	EU.SUH	EU.SUH	EU.SUH	EU.MUH	EU.MUH	EU.MUH					
Internal temperature	20,0	20,0	20,0	20,0	20,0	20,0					°C
Reduction factor temp.	0,83	0,88	0,89	0,92	0,94	1,00					
Air exchange rate (use)	0,40	0,40	0,40	0,40	0,40	0,40					1/h
Internal heat sources	3,00	3,00	3,00	3,00	3,00	3,00					W/m²
Red. factor ext. shading	0,60	0,60	0,60	0,60	0,60	0,60					
Energy need for DHW	10,0	10,0	10,0	15,0	15,0	15,0					kWh/(m²a)
Climate							TABULA standard calculation procedure				
Climate dataset	national / whole country	national / whole country	national / whole country	national / whole country	national / whole country	national / whole country					
Base temperature	12,0	12,0	12,0	12,0	12,0	12,0					°C
Length of heating season	206	206	206	206	206	206					d/a
External temp. during HS	4,3	4,3	4,3	4,3	4,3	4,3					
Accum. temp. diff. ext. to int. temp.	3234	3234	3234	3234	3234	3234					Kd/a
Envelope							TABULA standard calculation procedure				
Heat transfer by transmission	440	224	197	3512	4358	2929					W/K
related to surface area	1,00	0,57	0,39	1,58	1,49	0,50					W/(m²K)
related to ref. floor area	2,99	1,49	1,31	1,81	1,41	0,48					W/(m²K)
Annual energy balance building							TABULA standard calculation procedure				
Transmission heat losses	193,4	102,0	90,5	129,7	102,7	37,5					kWh/(m²a)
Ventilation heat losses	33,0	35,0	26,4	36,5	37,1	29,7					kWh/(m²a)
Usable solar gains	-12,0	-7,5	-9,1	-6,7	-8,1	-6,4					kWh/(m²a)
Usable internal gains	-13,8	-14,1	-14,0	-14,1	-14,1	-14,3					kWh/(m²a)
Energy need for heating	200,6	115,4	93,8	145,4	117,5	46,5					kWh/(m²a)
recovered by vent. system											kWh/(m²a)
Net energy need for heating	200,6	115,4	93,8	145,4	117,5	46,5					kWh/(m²a)

Version: 2015-11-12

Average Buildings — Building Stock Statistics

TABULA

Building Stock	SI	National	National Housing Stock of Slovenia	Year	2015
Details	ZRMK model				
Annotations to this sheet					

	1	2	3	4	5	6	7	8	9	10
Building type	SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06				

Total Building Stock

Building stock model - state indicators

	Unit	1	2	3	4	5	6	7	8	9	10	Total
Number of buildings	10^0	140 509	164 741	44 631	4 262	2 800	366					357 309
Number of dwellings	10^0	214 701	221 186	39 684	169 624	169 426	36 008					850 629
Floor area national	10^6 m²	19	23	6	8	8	2					65
Floor area TABULA	10^6 m²	21	25	7	8	9	2					71

Ventilation Systems with Heat Recovery

Building stock model - state indicators

	1	2	3	4	5	6	7	8	9	10
Occurances	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

Heating Systems

Occurances or Fractions of Produced Heat

Building stock model - state indicators

No.				1	2	3	4	5	6	7	8	9	10
1	Bio	B_WP	C	31%	31%	30%	26%	26%	32%				
2	DH	TS	C	1%	2%	4%	3%	4%	0%				
3	El	HP_Air	C	15%	15%	14%	17%	15%	15%				
4	Oil	B_NC_CT	C	19%	19%	17%	16%	15%	18%				
5	Coal	B_NC_LT	C	8%	7%	9%	9%	9%	8%				
6	Gas	B_C	C	15%	15%	16%	18%	19%	17%				
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													
	Sum			90%	89%	90%	89%	88%	91%				
	thereof	central		90%	89%	90%	89%	88%	91%				
		decentral											
	Other Systems			10%	11%	10%	11%	12%	9%				

DHW Systems

Occurances or Fractions of Produced Heat

Building stock model - state indicators

No.				1	2	3	4	5	6	7	8	9	10
1	Oil	B_NC	C	18%	17%	17%	11%	11%	16%				
2	DH	TS	C	1%	1%	4%	2%	3%	0%				
3	Gas	B_C	C	2%	2%	4%	2%	2%	5%				
4	Gas	G_IWH_NC	C	1%	1%	1%	1%	1%	1%				
5	Bio	B_C	C	11%	10%	11%	10%	11%	9%				
6	Bio	B_WP	C	20%	19%	19%	15%	13%	17%				
7	Bio	B_WP	C	7%	8%	8%	3%	5%	9%				
8	El	HP_Grounc	C	1%	2%	2%	1%	1%	3%				
9	El	HP_Air	D	13%	13%	10%	11%	13%	17%				
10	Gas	G_IWH	C	1%	1%	1%	1%	1%	1%				
11	El	E	D	3%	4%	3%	13%	15%					
12	-	Solar	C	7%	8%	6%	6%	7%	5%				
13	Coal	B_NC_CT	C	7%	6%	9%	7%	7%	7%				
14	Gas	G_Tank	D	1%	1%	1%	8%	4%	4%				
15	Oil	B_NC_LT	C	5%	7%	5%	11%	6%	8%				
16													
17													
18													
19													
20													
	Sum			100%	100%	100%	100%	100%	101%				
	thereof	central		82%	82%	87%	69%	67%	80%				
		decentral		18%	18%	13%	31%	33%	21%				
	Other Systems								-1%				

Version: 2015-11-12

TABULA Average Buildings — Delivered Energy for Space Heating

Building Stock	SI	**National**	National Housing Stock of Slovenia	Year 2015
Details	ZRMK model			
Annotations to this sheet				

	1	2	3	4	5	6	7	8	9	10
Building type	SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06				

Heating Systems

Heat demand / heat generation — TABULA standard calculation procedure

		1	2	3	4	5	6	7	8	9	10	
Energy need for heating		200,6	115,4	93,8	145,4	117,5	46,5					kWh/(m²a)
Net en. need for heating		200,6	115,4	93,8	145,4	117,5	46,5					kWh/(m²a)
Distribution + storage losses (TABULA system indicators)												
Central systems	C	22,5	12,0	6,0	22,5	12,0	6,0					kWh/(m²a)
Decentral systems	D											kWh/(m²a)
Auxiliary energy (TABULA system indicators)												
Ventil. systems (average)												kWh/(m²a)
Central systems	C	2,7	2,7	2,7	2,7	2,7	2,7					kWh/(m²a)
Decentral systems	D											kWh/(m²a)

Energy expenditure factors (fuels: related to gross calorific value) — TABULA system indicators

				1	2	3	4	5	6	7	8	9	10
1	Bio	B_WP	C	2,00	1,20	1,20	2,00	1,20	1,20				
2	DH	TS	C	1,00	1,00	1,00	1,00	1,00	1,00				
3	El	HP_Air	C	0,36	0,36	0,36	0,36	0,36	0,36				
4	Oil	B_NC_CT	C	1,20	1,20	1,20	1,20	1,20	1,20				
5	Coal	B_NC_LT	C	1,10	1,10	1,10	1,10	1,10	1,10				
6	Gas	B_C	C	1,07	1,07	1,07	1,07	1,07	1,07				
7													
8													
9													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Delivered Energy — TABULA standard calculation procedure

				1	2	3	4	5	6	7	8	9	10	
1	Bio	B_WP	C	446,2	153,5	120,3	335,8	156,0	63,3					kWh/(m²a)
2	DH	TS	C	223,1	127,4	99,8	167,9	129,5	52,5					kWh/(m²a)
3	El	HP_Air	C	79,7	45,5	35,7	60,0	46,3	18,8					kWh/(m²a)
4	Oil	B_NC_CT	C	267,7	152,8	119,8	201,5	155,4	63,0					kWh/(m²a)
5	Coal	B_NC_LT	C	245,4	140,1	109,8	184,7	142,5	57,8					kWh/(m²a)
6	Gas	B_C	C	238,7	136,3	106,8	179,6	138,6	56,2					kWh/(m²a)
7														kWh/(m²a)
8														kWh/(m²a)
9														kWh/(m²a)
10														kWh/(m²a)
11														kWh/(m²a)
12														kWh/(m²a)
13														kWh/(m²a)
14														kWh/(m²a)
15														kWh/(m²a)
16														kWh/(m²a)
17														kWh/(m²a)
18														kWh/(m²a)
19														kWh/(m²a)
20														kWh/(m²a)

Delivered Energy - weighted by frequencies — TABULA standard calculation procedure

				1	2	3	4	5	6	7	8	9	10	
1	Bio	B_WP	C	138,2	47,4	35,9	86,8	40,5	20,2					kWh/(m²a)
2	DH	TS	C	2,9	2,0	4,0	5,1	4,7	0,3					kWh/(m²a)
3	El	HP_Air	C	12,1	6,9	4,8	10,2	6,9	2,8					kWh/(m²a)
4	Oil	B_NC_CT	C	51,7	28,7	20,8	32,1	23,6	11,6					kWh/(m²a)
5	Coal	B_NC_LT	C	19,2	10,1	9,8	17,1	13,4	4,6					kWh/(m²a)
6	Gas	B_C	C	36,9	20,6	17,6	32,9	26,5	9,7					kWh/(m²a)
7														kWh/(m²a)
8														kWh/(m²a)
9														kWh/(m²a)
10														kWh/(m²a)
11														kWh/(m²a)
12														kWh/(m²a)
13														kWh/(m²a)
14														kWh/(m²a)
15														kWh/(m²a)
16														kWh/(m²a)
17														kWh/(m²a)
18														kWh/(m²a)
19														kWh/(m²a)
20														kWh/(m²a)

Electricity production by CHP — TABULA standard calculation procedure

				1	2	3	4	5	6	7	8	9	10	
														kWh/(m²a)
														kWh/(m²a)
														kWh/(m²a)
														kWh/(m²a)

Version: 2015-11-12

Average Buildings — Delivered Energy for DHW

Building Stock	SI	National	National Housing Stock of Slovenia
Year	2015		
Details	ZRMK model		
Annotations to this sheet			

	1	2	3	4	5	6	7	8	9	10
Building type	SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06				

DHW Systems

Heat demand / heat generation — TABULA standard calculation procedure

		1	2	3	4	5	6	7	8	9	10	
Energy need for DHW		10,0	10,0	10,0	15,0	15,0	15,0					kWh/(m²a)
Distribution + storage losses (TABULA system indicators)												
Central systems	C	1,1	1,5	1,5	1,1	1,5	1,5					kWh/(m²a)
Decentral systems	D	0,8	1,2	1,2	0,8	1,2	1,2					kWh/(m²a)
Auxiliary energy (TABULA system indicators)												
Central systems	C		1,7	1,7	1,7	1,7	1,7					kWh/(m²a)
Decentral systems	D		1,7	1,7	1,7	1,7	1,7					kWh/(m²a)

Energy expenditure factors (fuels: related to gross calorific value) — TABULA system indicators

No.	Fuel	System	C/D	1	2	3	4	5	6	7	8	9	10
1	Oil	B_NC	C	1,35	1,35	1,35	1,35	1,35	1,35				
2	DH	TS	C	1,00	1,00	1,00	1,00	1,00	1,00				
3	Gas	B_C	C	1,18	1,18	1,18	1,18	1,18	1,18				
4	Gas	G_IWH_NC	C	1,18	1,18	1,18	1,18	1,18	1,18				
5	Bio	B_C	C	0,98	0,98	0,98	0,98	0,98	0,98				
6	Bio	B_WP	C	2,00	2,00	2,00	2,00	2,00	2,00				
7	Bio	B_WP	C	1,20	1,20	1,20	1,20	1,20	1,20				
8	El	HP_Ground	C	0,29	0,29	0,29	0,29	0,29	0,29				
9	El	HP_Air	D	0,36	0,36	0,36	0,36	0,36	0,36				
10	Gas	G_IWH	C	1,00	1,00	1,00	1,00	1,00	1,00				
11	El	E	D	1,00	1,00	1,00	1,00	1,00	1,00				
12	-	Solar	C										
13	Coal	B_NC_CT	C	1,20	1,20	1,20	1,20	1,20	1,20				
14	Gas	G_Tank	D	1,00	1,00	1,00	1,00	1,00	1,00				
15	Oil	B_NC_LT	C	1,10	1,10	1,10	1,10	1,10	1,10				
16													
17													
18													
19													
20													

Delivered Energy — TABULA standard calculation procedure

No.	Fuel	System	C/D	1	2	3	4	5	6	7	8	9	10	Unit
1	Oil	B_NC	C	15,0	15,5	15,5	21,8	22,3	22,3					kWh/(m²a)
2	DH	TS	C	11,1	11,5	11,5	16,1	16,5	16,5					kWh/(m²a)
3	Gas	B_C	C	13,1	13,5	13,5	18,9	19,4	19,4					kWh/(m²a)
4	Gas	G_IWH_NC	C	13,1	13,6	13,6	19,0	19,5	19,5					kWh/(m²a)
5	Bio	B_C	C	10,9	11,3	11,3	15,8	16,2	16,2					kWh/(m²a)
6	Bio	B_WP	C	22,2	23,0	23,0	32,2	33,0	33,0					kWh/(m²a)
7	Bio	B_WP	C	13,4	13,9	13,9	19,4	19,9	19,9					kWh/(m²a)
8	El	HP_Ground	C	3,2	3,3	3,3	4,6	4,7	4,7					kWh/(m²a)
9	El	HP_Air	D	3,9	4,0	4,0	5,6	5,8	5,8					kWh/(m²a)
10	Gas	G_IWH	C	11,1	11,5	11,5	16,1	16,5	16,5					kWh/(m²a)
11	El	E	D	10,8	11,2	11,2	15,8	16,2	16,2					kWh/(m²a)
12	-	Solar	C											kWh/(m²a)
13	Coal	B_NC_CT	C	13,3	13,8	13,8	19,3	19,8	19,8					kWh/(m²a)
14	Gas	G_Tank	D	10,8	11,2	11,2	15,8	16,2	16,2					kWh/(m²a)
15	Oil	B_NC_LT	C	12,2	12,7	12,7	17,7	18,2	18,2					kWh/(m²a)
16														kWh/(m²a)
17														kWh/(m²a)
18														kWh/(m²a)
19														kWh/(m²a)
20														kWh/(m²a)

Delivered Energy - weighted by frequencies — TABULA standard calculation procedure

No.	Fuel	System	C/D	1	2	3	4	5	6	7	8	9	10	Unit
1	Oil	B_NC	C	2,7	2,6	2,6	2,4	2,5	3,5					kWh/(m²a)
2	DH	TS	C	0,1	0,2	0,5	0,3	0,4	0,1					kWh/(m²a)
3	Gas	B_C	C	0,3	0,3	0,5	0,4	0,4	1,0					kWh/(m²a)
4	Gas	G_IWH_NC	C	0,1	0,1	0,2	0,2	0,2	0,1					kWh/(m²a)
5	Bio	B_C	C	1,2	1,1	1,3	1,5	1,7	1,4					kWh/(m²a)
6	Bio	B_WP	C	4,5	4,3	4,4	4,7	4,3	5,5					kWh/(m²a)
7	Bio	B_WP	C	0,9	1,1	1,1	0,6	1,0	1,8					kWh/(m²a)
8	El	HP_Ground	C	0,0	0,1	0,1	0,0	0,1	0,1					kWh/(m²a)
9	El	HP_Air	D	0,5	0,5	0,4	0,6	0,8	1,0					kWh/(m²a)
10	Gas	G_IWH	C	0,1	0,1	0,1	0,2	0,2	0,2					kWh/(m²a)
11	El	E	D	0,4	0,4	0,3	2,0	2,5						kWh/(m²a)
12	-	Solar	C											kWh/(m²a)
13	Coal	B_NC_CT	C	1,0	0,9	1,2	1,3	1,4	1,3					kWh/(m²a)
14	Gas	G_Tank	D	0,1	0,1	0,1	1,2	0,7	0,7					kWh/(m²a)
15	Oil	B_NC_LT	C	0,6	0,9	0,7	1,9	1,1	1,5					kWh/(m²a)
16														kWh/(m²a)
17														kWh/(m²a)
18														kWh/(m²a)
19														kWh/(m²a)
20														kWh/(m²a)

Electricity production by CHP — TABULA standard calculation procedure

				1	2	3	4	5	6	7	8	9	10	Unit
														kWh/(m²a)
														kWh/(m²a)
														kWh/(m²a)
														kWh/(m²a)

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TABULA Average Buildings — Simplified Building Stock Projection

Building Stock	SI	National	National Housing Stock of Slovenia	Year	2015
Details	ZRMK model				
Annotations to this sheet					

Total Building Stock

		1	2	3	4	5	6	7	8	9	10	Total
Building type		SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06					
Floor area TABULA	10^6 m²	21	25	7	8	9	2	0	0	0	0	71

All energy quantities in GWh/a

Heating Systems

Heat Demand for Heating — TABULA standard calculation procedure / projection to building stock

	1	2	3	4	5	6	7	8	9	10	Total
Energy need for heating	4 145	2 871	630	1 202	1 015	104					9 966
Net en. need for heating	4 145	2 871	630	1 202	1 015	104					9 966
Produced heat	4 564	3 135	666	1 369	1 106	116					10 956

Delivered Energy TABULA — TABULA standard calculation procedure / projection to building stock

No.	Carrier	System		1	2	3	4	5	6	7	8	9	10	Sum
1	Bio	B_WP	C	2 857	1 180	241	718	350	45					5 390
2	DH	TS	C	59	51	27	43	41	1					221
3	El	HP_Air	C	250	171	32	84	60	6					603
4	Oil	B_NC_CT	C	1 069	713	140	266	204	26					2 418
5	Coal	B_NC_LT	C	398	253	65	142	116	10					983
6	Gas	B_C	C	764	512	118	272	229	22					1 916
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														
17														
18														
19														
20														
	Not specified systems			410	325	62	127	120	10					1 053
	Auxiliary energy			50	60	16	20	21	5					172
	CHP electr. production													0

DHW Systems

Heat Demand for DHW — TABULA standard calculation procedure / projection to building stock

	1	2	3	4	5	6	7	8	9	10	Total
Energy need for DHW	207	249	67	124	130	33					810
Produced heat	228	285	77	132	142	37					901

Delivered Energy TABULA — TABULA standard calculation procedure / projection to building stock

No.	Carrier	System		1	2	3	4	5	6	7	8	9	10	Total
1	Oil	B_NC	C	55	64	18	20	21	8					186
2	DH	TS	C	3	4	3	3	4	0					17
3	Gas	B_C	C	7	8	3	3	3	2					26
4	Gas	G_IWH_NC	C	3	4	1	2	2	0					12
5	Bio	B_C	C	24	28	8	13	15	3					92
6	Bio	B_WP	C	94	106	30	39	37	12					318
7	Bio	B_WP	C	19	27	8	5	9	4					70
8	El	HP_Grounc	C	1	1	0	0	0	0					4
9	El	HP_Air	D	11	13	3	5	7	2					40
10	Gas	G_IWH	C	2	3	1	1	1	0					9
11	El	E	D	7	11	2	17	21	0					58
12	-	Solar	C	0	0	0	0	0	0					0
13	Coal	B_NC_CT	C	20	22	8	10	12	3					75
14	Gas	G_Tank	D	2	3	0	10	6	2					22
15	Oil	B_NC_LT	C	13	23	4	16	10	3					70
16														
17														
18														
19														
20														
	Not specified systems			0	0	0	0	0	0					0
	Auxiliary energy			0	42	11	14	15	4					86
	CHP electr. production													0

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TABULA Average Buildings — Summary and Comparison

Building Stock	SI	National	National Housing Stock of Slovenia
Year	2015		
Details	ZRMK model		
Annotations to this sheet			

Total Building Stoc

		1	2	3	4	5	6	7	8	9	10	Total
Building type		SFH-TH.01-02	SFH-TH.03-04	SFH-TH.05-06	MFH-AB.01-02	MFH-AB.03-04	MFH-AB.05-06					
Floor area TABULA	10^6 m²	21	25	7	8	9	2	0	0	0	0	71

Total Heat Need and Final Energy

All energy quantities in **GWh/a** **Heating + DHW**

Simplified TABULA projection fuels related to gross calorific value (TABULA standard)

TABULA standard calculation procedure projection to building stock

		1	2	3	4	5	6	7	8	9	10	Total	per m²
Net heat need		4 352	3 119	697	1 326	1 144	137					10 776	151
Produced heat		4 793	3 420	743	1 501	1 248	152					11 857	166
Gas		777	528	123	288	241	26					1 984	28
Oil		1 138	801	161	302	235	37					2 674	37
Coal		417	275	73	152	127	13					1 058	15
Bio		2 993	1 341	286	775	411	64					5 870	82
DH		62	55	30	45	45	1					237	3
El (incl. aux. en.)		320	297	65	140	123	18					964	14
Other / not specified		410	325	62	127	120	9					1 053	15
Sum final energy		*6 116*	*3 623*	*802*	*1 829*	*1 302*	*168*	*0*	*0*	*0*	*0*	*13 840*	*194*
CHP electr. production		0	0	0	0	0	0					0	0

Separate individual model or total metered consumption

fuels related to gross calorific value

factors for conversion to gross calorific value (TABULA standard)

Individual building stock model

		1	2	3	4	5	6	7	8	9	10	Total	per m²
Net heat need		2 906	2 721	284	868	736	97					7 611	107
Produced heat		3 192	2 970	314	1 006	794	103					8 379	117
Gas	1,00	420	506	136	167	201	54					1 485	21
Oil	1,00	443	533	144	178	214	58					1 570	22
Coal	1,00	1	1	0	0	0	0					2	0
Bio	1,00	1 477	1 778	480	653	786	212					5 385	75
DH		250	301	81	101	121	33					886	12
El		287	346	93	122	147	40					1 036	15
Other / not specified		136	164	44	32	38	10					425	6
Sum final energy		*3 013*	*3 628*	*979*	*1 253*	*1 509*	*407*	*0*	*0*	*0*	*0*	*10 789*	*151*
CHP electr. production		0	0	0	0	0	0					0	0

Ratio of individual model or total metered consumption to simplified TABULA projection (TABULA balance calibration factors)

		1	2	3	4	5	6	7	8	9	10	Total
Net heat need		67%	87%	41%	65%	64%	71%					71%
Produced heat		67%	87%	42%	67%	64%	68%					71%
Gas		54%	96%	110%	58%	84%	208%					75%
Oil		39%	67%	89%	59%	91%	156%					59%
Coal		0%	0%	0%	0%	0%	1%					0%
Bio		49%	133%	168%	84%	191%	330%					92%
DH		405%	548%	269%	222%	272%	4467%					373%
El		90%	116%	143%	87%	119%	221%					108%
Other		33%	50%	71%	25%	32%	113%					40%
Sum final energy		49%	100%	122%	69%	116%	242%					78%
CHP electr. production												

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