Building renovation strategy in Austria

1. Basic principles of the building renovation strategy

In accordance with the individual paragraphs of Article 4 of the Energy Efficiency Directive
(EED) 2012/27/EU, the following documents are presented:

a) an overview of the national building stock based, as appropriate, on statistical sampling:
The national building and housing stock (2011) is a component of the scenario specified in section 3.2.1 of the National Energy Efficiency Action Plan (NEEAP) pursuant to the EED and is described in detail in this document (Chapter 2);

b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone:
Renovation on a large scale is only possible if – in addition to incentives, such as those provided by the Austrian residential building subsidies and other funding instruments, e.g. the Austrian Climate and Energy Fund – cost optimality can be achieved (within the meaning of the Directive, which requires a consideration of the cost optimality based on a life-cycle assessment).
The cost optimality of new construction and renovations was described in detail in the 'OIB document demonstrating the cost optimality of the requirements of OIB Guideline 6 and of the National Plan pursuant to Article 4(2) of Directive 2010/31/EU'. The National Plan was initially drawn up for residential buildings, but it was already anticipated at that stage that similar solutions could also be applied for non-residential buildings. It now transpires that the cost optimality proofs have in fact produced a similar result to that for residential buildings, thus enabling the notified solution to be used for the National Plan.
The National Plan and cost optimality are therefore compatible, which is one of the essential foundations for a significant renovation rate. http://ec.europa.eu/energy/efficiency/buildings/doc/at_cost-optimal_2013_en.zip

c) policies and measures to stimulate cost-effective and deep renovations of buildings, including staged deep renovations, and

d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions:
In addition to the building regulations of the provinces, the 'residential building subsidies' represent the main instrument for the implementation of these measures in the residential building sector and – via the continuous further development of the specifications, e.g. pursuant to an

agreement in accordance with Article 15a of the Austrian Federal Constitution (see below) – for the development of forward-looking perspectives. For the purposes of this agreement, the term 'residential building subsidies' should be interpreted broadly and understood to include all types of support that incentivise new residential building or renovation, irrespective of the responsible funding body. A significant proportion of dwellings in Austria are supported financially by 'residential building subsidies', both in terms of new construction and in the case of major renovation projects. This support was originally intended for the reconstruction of dwellings, but has increasingly become transformed – especially since 1968 – into an effective instrument for improving the energy quality of buildings. The provinces had applied residential building subsidies in different ways, depending on local circumstances, e.g. reflecting the large differences between urban types of building development in Vienna or the federal state capitals and building development outside urban areas.

In recent years, the provinces have increasingly included incentives in the residential building subsidies for energy-saving measures and the use of renewable energy sources. Although most of the provinces have thus far focused on the area of new residential construction, there have also been pioneering examples of residential building subsidies being used to promote thermal/energy renovations. The essential characteristics of a residential building subsidy oriented towards energy efficiency and climate protection include:

- a consistent emphasis on energy and environmental criteria in new construction by means of special incentives for the use of renewable energy sources (especially biomass and solar thermal systems) and the achievement of energy indicators exceeding the standard values in building regulations,
- the use of environmentally beneficial construction materials (especially for the reduction of greenhouse gases) via an effective supplement model,
- the realignment of subsidies for major renovation projects ('deep renovation') by the use of minimum energy and environmental standards as an essential criterion for approval; the achievement of these standards is to be demonstrated by qualified energy advice or the issuing of expert reports and energy performance certificates,
- incentives for climate-friendly building services engineering measures to increase the efficiency of energy transformation (redimensioning, regulation, higher annual efficiency etc.),
- use of renewable energy sources or energy sources with lower CO_2 emissions,
- product-neutral (in some cases mandatory) energy advice by qualified experts with the aim of improving efficiency and increasing the use of renewable energy sources

Residential building subsidies have placed, and continue to place, significantly higher requirements on the energy quality of buildings than the building laws of the provinces. This also applies to requirements on the increased use of renewable energy sources; in some provinces, fossil energy sources have for a number of years only been permitted to a very limited extent, while conversely the use of solar energy, for example, has been made mandatory.

The aforesaid 'Agreement pursuant to Article 15a of the Austrian Federal Constitution' in
2009 (a binding agreement between the federal government and the provinces as provided for by the Austrian constitution) harmonised the previously very different regulations in the provinces and created a minimum standard for the energy quality of subsidised residential buildings.

(Agreement pursuant to Article 15a of the Austrian Federal Constitution between the federal government and the provinces on measures in the building sector for the purpose of reducing greenhouse gas emissions, original version: Federal Gazette II No 251/2009).

A detailed list of residential building subsidies in the provinces has already been produced as part of the response to the reasoned opinion of the European Commission of 26 September 2013, decision 2012/0316, in the context of the infringement proceedings initiated against the Republic of Austria for failure to communicate measures implementing Directive 2010/31/EU of the European Parliament and of the Council of
19 May 2010 on the energy performance of buildings.
Since individual provisions of the residential building subsidies in the provinces may continue to change in response to new circumstances, e.g. the required reduction in emissions from heaters or changing conditions in the capital market etc., albeit exclusively within the scope of the aforesaid agreement pursuant to Article 15a of the Austrian Federal Constitution, links are given in Chapter 4 to the individual funding agencies and funding conditions of the provinces.

e) an evidence-based estimate of expected energy savings and wider benefits:
This is an essential component of the scenario document (Chapter 2).
In this document and in the calculation matrix (Chapter 3),
residential buildings are subdivided according to the following
distinguishing characteristics:

- 6 building age classes (before 1919, 1919–60, 1961–80, 1981–90, 1991–2000, 2001–13)
- 3 building types (detached and semi-detached houses, apartment buildings with 3 to 10
  housing units and those with more than 10 housing units)
- 7 heating systems (wood/wood chips/pellets, coal, fuel oil, natural gas, electricity, district heating, heat pump). The heating systems were broken down in order to be able to determine the final energy consumption for space heating as an intrinsically relevant variable (see

Chapter 3, Info).

In general, no climate adjustment was carried out, and residential buildings were calibrated to measured consumption data. No calibration was carried out for non-residential buildings, since according to Statistics Austria (the central Austrian agency for statistical data in the energy sector) this data is based on residual values. The calculations in Chapter 3 are based on data from Statistics Austria, the building energy performance certificate data stored in the relevant databases in the provinces and on market surveys and statistics.

2. Evidence-based estimate based on the national building stock

A calculation tool was developed for this purpose. A description of this tool and screenshots of the Excel calculation tables may be found below.

Documentation on the Excel calculation template for potential savings in heating and hot water in buildings

The calculation program is divided into two spreadsheets, one relating to residential buildings (**RB**) and one to non-residential buildings (**NRB**). The methodology is largely identical, so that the following explanations apply equally to both parts, unless otherwise stated.
The **fields highlighted in yellow** in the tool may be changed by the user.

a. <u>Calculation of gross floor area by building age class and energy source</u>
   In the first block, the gross floor areas can be entered for different building age classes, building types and heating systems / energy sources.
   Residential buildings were subdivided according to the following distinguishing characteristics:
   - 6 building age classes (before 1919, 1919–60, 1961–80, 1981–90, 1991–2000, 2001–13)
   - 3 building types (detached and semi-detached houses, apartment buildings with 3 to 10 housing units and those with more than 10 housing units)
   - 7 heating systems (wood/wood chips/pellets, coal, fuel oil, natural gas, electricity, district heating, heat pump).

   The data on useful floor space was obtained from Statistics Austria, Building and Housing Census 2001 and updated with data from the micro-census 2011/12. To calculate the gross floor area, the useful floor space was multiplied by a factor of 1.25.

   The non-residential buildings were subdivided into the following categories:
   - 3 building age classes (before 1980, 1981–90, 1991 onwards)
   - 5 building types (office, hotel, trade, school/cultural and other)
   - 7 heating systems (see residential buildings).

   The data on useful floor space was derived from a special evaluation by

Statistics Austria and (in connection with heating) from the Building and Housing Census 2001. The same assumptions were made In the model for the calculation of the gross floor area as for residential buildings, i.e. the useful floor space was multiplied by a factor of 1.25.

In principle, any classification of the building stock can be selected (theoretically, the calculation template allows the building stock to be divided into 2 different groups of buildings with 3 further subdivisions, with a maximum of 6, 3 and 7 configurations respectively (see above)).

b. Calculation of useful energy demand

This area consists of three blocks with the following functions:

- HD (heating demand) in kWh/m²GFAa for the stock in the base year (2013): Average for the building groups (divided into building age class and building type, i.e. the heating demands are independent of the heating system in each case). The heating demand values for residential buildings correspond to average values that were determined from the ZEUS energy performance certificate database (see also AEA building typology brochure TABULA/EPISCOPE); the heating demand values for non-residential buildings were derived from the klima:aktiv ecofacility benchmark database and from the ZEUS energy performance certificate database.
- The heating demand (HD in kWh/m²GFAa) for thermally renovated buildings after 2013 was calculated in accordance with OIB Guideline 6 and the selected building typologies.
- Renovation rate: Percentage of the not as yet thermally renovated gross floor area in the year in question which changes from the existing heating demand values to the renovated heating demand values. In 2013, all gross floor area is considered for calculation purposes to be non-thermally renovated – this is taken into account by a corresponding downward adjustment of the heating demand for the building stock.

c. Conversion to final energy consumption

With the variables described above it is possible to determine the useful energy demand for space heating. To determine the final energy consumption for space heating (as an intrinsically relevant variable), the heating systems must be broken down.

The first step is to establish **annual utilisation rates** for existing and new **heating systems**. In this respect, the building is defined as a system boundary for the final energy. The useful energy is the energy corresponding to the heating demand, i.e. the heat that can actually be used. The annual utilisation rates shown were based on Recknagel/Sprenger, EU BOILeff project (AEA) etc., and the distribution losses were applied in accordance with ÖNORM H5050.

The next stage is to depict the **replacement of heating systems**:

- Firstly, the 'heating system disassembly rate' is used to define the percentage of heating systems (subdivided by all the distinctive characteristics of the buildings) that are dismantled in a year (end of

life).

- The second step is to use 'new heating system installation share' to define, for all buildings or housing units as a whole in which heating systems were dismantled, the **proportion of new heating systems**.

  In this way, changes in energy sources can be depicted easily and clearly.

Next, the **hot water demand** (HWD in kWh/m²$_{GFA}$a) can be specified. In non-residential buildings, a distinction is possible between building types. The entered values correspond to ÖNORM B 8110-5 (p. 8); the value for other non-residential buildings is an estimate.

The **annual demolition rate**, for which different values can be entered by building age class and building type, is then specified. The values for residential buildings were derived from ÖROK (Austrian Conference on Spatial Planning); somewhat higher values were applied for non-residential buildings.

In the case of residential buildings, the proportions covered by **solar thermal energy** can also be entered, separately for the different building age classes, building types and heating systems – and separately for space heating and hot water. (In non-residential buildings, solar thermal systems currently play only a minor role.) The values have been confirmed as a whole by Austria Solar, but only the breakdown by building type has been verified, and not the breakdown by heating system or building age class.
Annual growth rates can be entered on the right-hand side in each case. The value of 5 % is taken from the market statistics of Austria Solar (new installations compared to total stock in 2012).

d. Climate adjustment and consideration of climate change

The **climate adjustment** is carried out at the bottom of the sheet. It is entered here for both residential and non-residential buildings on the 'Residential building' sheet. The climate adjustment consists of two parts:

- First, the heating degree days (**HDD**s) are entered for the calibration year

  (used for the calibration below), including the average HDDs since a specific year (currently 2000). The data for the HDDs is derived from Statistics Austria and reflects the national average.
- The **annual decrease** in HDDs can also be entered beneath this. The value of 0.36 % per annum is derived from a study by BOKU (University of Natural Resources and Life Sciences, Vienna).

e. Calibration to actual consumption data

Since models generally give an excessively high consumption, it makes sense to **calibrate** to measured consumption data. This is only performed here for residential buildings, since data is available from the analysis of useful energy by Statistics Austria (which despite its name depicts the finalenergy consumption). Since according to Statistics Austria the data for non-residential buildings is based on residual values, no calibration was performed for this calculation.

The results – broken down by building age class (for residential buildings) or by building type (for non-residential buildings) – are displayed in bold and are also shown in the graph on the left-hand side.

Screenshots of Excel calculation tables – residential buildings

CALCULATION OF GROSS FLOOR AREA BY BUILDING AGE CLASS AND ENERGY SOURCE

Total floor area housing units m² 2013						
Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	17500000	13750000	18875000	1187500	8125000	11875000
Coal, coke, briquettes	187500	375000	562500	312500	93750	
Heating oil, LPG	5000000	1000000	26250000	12375000	11875000	1875000
Electricity	1125000	1750000	3000000	2125000	1000000	500000
Natural gas	4750000	9125000	13125000	7500000	8125000	4375000
Heat pump			125000	625000	6250000	7500000
District heating etc.	875000	1375000	2625000	1375000	1750000	2000000
3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	1750000	1875000	1625000	875000	1250000	1500000
Coal, coke, briquettes	75000	112500	37500	12500	6250	
Heating oil, LPG	2000000	1875000	3625000	1250000	1375000	1000000
Electricity	1125000	1625000	1250000	1250000	625000	250000
Natural gas	6875000	5000000	3375000	1875000	4375000	1875000
Heat pump						
District heating etc.	1500000	2750000	4500000	2562500	4250000	8750000
more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	562500	437500	625000	162500	162500	250000
Coal, coke, briquettes	87500	50000	37500	2500	1250	
Heating oil, LPG	1125000	687500	4375000	625000	437500	125000
Electricity	1375000	1187500	2000000	625000	250000	62500
Natural gas	10625000	4750000	7125000	2187500	2750000	1500000
Heat pump						
District heating etc.	2500000	5125000	15875000	5500000	6625000	11250000

CALCULATION OF USEFUL ENERGY DEMAND FOR SPACE HEATING

HD in kWh/m²a (as of 2013)						
	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Detached/semi-detached house	190	230	150	100	90	70
3–10 housing units	150	160	150	120	100	70
more than 10 housing units	120	100	90	80	70	50

HD in kWh/m²a renovated						
	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Detached/semi-detached house	92.198693	86.052113	86.052113	92.198693	92.198693	86.052113
3–10 housing units	73.758954	73.758954	67.612375	67.612375	67.612375	86.052113
more than 10 housing units	61.465795	61.465795	61.465795	61.465795	61.465795	

Thermal renovation rate/a [%]						
	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Detached/semi-detached house	0.50%	0.50%	0.50%	0.50%	0.00%	0.00%
3–10 housing units	0.50%	1.00%	1.00%	1.00%	0.50%	0.00%
more than 10 housing units	0.50%	1.00%	1.00%	1.00%	0.50%	0.00%

Thermal renovation rate 2020 [%]						
	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Detached/semi-detached house	3.50%	3.50%	3.50%	3.50%	0.00%	0.00%
3–10 housing units	3.50%	7.00%	7.00%	7.00%	3.50%	0.00%
more than 10 housing units	3.50%	7.00%	7.00%	7.00%	3.50%	0.00%

CONVERSION TO FINAL ENERGY CONSUMPTION

Utilisation rate of heating system 2013 [%]						
Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	52.00%	52.00%	52.00%	60.00%	66.00%	72.00%
Coal, coke, briquettes	52.00%	52.00%	52.00%	55.00%	60.00%	65.00%
Heating oil, LPG	66.00%	66.00%	66.00%	70.00%	75.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	72.00%	72.00%	72.00%	75.00%	79.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	220.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%
3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	52.00%	52.00%	52.00%	60.00%	66.00%	72.00%
Coal, coke, briquettes	52.00%	52.00%	52.00%	55.00%	60.00%	65.00%
Heating oil, LPG	66.00%	66.00%	66.00%	70.00%	75.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	72.00%	72.00%	72.00%	75.00%	79.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	250.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%
more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	52.00%	52.00%	52.00%	60.00%	66.00%	72.00%
Coal, coke, briquettes	52.00%	52.00%	52.00%	55.00%	60.00%	65.00%
Heating oil, LPG	66.00%	66.00%	66.00%	70.00%	75.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	72.00%	72.00%	72.00%	75.00%	79.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	250.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%

Utilisation rate of heating system renovated 2013 [%]			Source: Recknagel/Sprenger, BOILeff, Diss.Schriefl (TU			
Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	72.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	65.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	220.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%
3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	72.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	65.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	220.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%
more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	72.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	65.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	80.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	97.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	86.00%
Heat pump	220.00%	220.00%	220.00%	220.00%	280.00%	300.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	95.00%

Heating system disassembly rate/a [%]						
Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	0.30%	0.20%	0.20%	0.20%	0.15%	0.05%
Coal, coke, briquettes	0.30%	0.20%	0.20%	0.20%	0.15%	0.05%
Heating oil, LPG	0.30%	0.20%	0.20%	0.20%	0.15%	0.05%
Electricity	0.30%	0.20%	0.20%	0.20%	0.20%	0.00%
Natural gas	0.30%	0.20%	0.20%	0.20%	0.15%	0.05%
Heat pump	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%
District heating etc.	0.05%	0.05%	0.00%	0.05%	0.00%	0.00%
3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	0.30%	0.30%	0.15%	0.15%	0.15%	0.05%
Coal, coke, briquettes	0.30%	0.30%	0.15%	0.15%	0.15%	0.05%
Heating oil, LPG	0.30%	0.30%	0.15%	0.15%	0.15%	0.05%
Electricity	0.30%	0.30%	0.25%	0.30%	0.30%	0.00%
Natural gas	0.30%	0.30%	0.15%	0.15%	0.15%	0.05%
Heat pump	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%
District heating etc.	0.05%	0.05%	0.00%	0.05%	0.00%	0.00%
more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	0.30%	0.25%	0.15%	0.15%	0.25%	0.10%
Coal, coke, briquettes	0.30%	0.25%	0.15%	0.15%	0.25%	0.10%
Heating oil, LPG	0.30%	0.25%	0.15%	0.15%	0.40%	0.15%
Electricity	0.30%	0.25%	0.25%	0.25%	0.30%	0.15%
Natural gas	0.30%	0.25%	0.15%	0.15%	0.40%	0.15%
Heat pump	0.00%	0.00%	0.00%	0.05%	0.00%	0.00%
District heating etc.	0.10%	0.10%	0.00%	0.05%	0.00%	0.00%

New heating system installation share [%]						
Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
Coal, coke, briquettes						
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity						
Natural gas	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
Heat pump	10.00%	10.00%	10.00%	10.05%	10.00%	10.00%
District heating etc.	15.00%	15.00%	15.00%	15.00%	15.00%	15.00%
3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Coal, coke, briquettes						
Heating oil, LPG	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%
Electricity						
Natural gas	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
Heat pump						
District heating etc.	48.00%	48.00%	48.00%	48.00%	48.00%	48.00%
more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–2013
Wood, wood chips, pellets, wood	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
Coal, coke, briquettes						
Heating oil, LPG	7.00%	7.00%	7.00%	7.00%	7.00%	7.00%
Electricity						
Natural gas	30.00%	30.00%	30.00%	30.00%	30.00%	30.00%
Heat pump						
District heating etc.	53.00%	53.00%	53.00%	53.00%	53.00%	53.00%

HOT WATER

Useful energy demand in kWh/m²

12.8

REMOVAL OF BUILDINGS NO LONGER IN EXISTENCE

Effective demolition rate/a in % of existing stock

	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Detached/semi-detached house						
3–10 housing units						
more than 10 housing units						

Demolition rate/a in % of existing stock

	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Detached/semi-detached house	0.60%	0.70%	0.70%	0.30%	0.05%	0.00%
3–10 housing units	0.60%	0.70%	0.70%	0.30%	0.05%	0.00%
more than 10 housing units	0.60%	0.70%	0.70%	0.30%	0.05%	0.00%

Solar energy share for space

Detached/semi-detached house	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	7.00%	7.00%	7.00%	7.00%	10.00%	15.00%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	1.00%	1.00%	1.00%	2.00%	4.00%	8.00%
Electricity	1.00%	1.00%	1.00%	1.00%	2.00%	6.00%
Natural gas	2.00%	2.00%	2.00%	2.50%	4.00%	8.00%
Heat pump	2.50%	2.50%	2.50%	3.00%	4.00%	10.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%

3–10 housing units	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	2.00%	2.00%	2.00%	2.00%	2.00%	4.00%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Electricity	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Natural gas	1.00%	1.00%	1.00%	1.00%	1.00%	3.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	10.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%

more than 10 housing units	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	2.00%	2.00%	2.00%	2.00%	2.00%	4.00%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	1.00%	1.00%	1.00%	1.00%	1.00%	2.00%
Electricity	0.50%	0.50%	0.50%	0.50%	0.50%	0.50%
Natural gas	1.00%	1.00%	1.00%	1.00%	1.00%	2.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	10.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%

Increase per year (compared to total stock from previous year)

Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

Solar energy share for hot water

Detached/semi-detached house	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	15.00%	15.00%	20.00%	20.00%	20.00%	30.00%
Coal, coke, briquettes						
Heating oil, LPG	7.00%	7.00%	7.00%	7.00%	7.00%	10.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	10.00%
Natural gas	10.00%	10.00%	10.00%	10.00%	10.00%	15.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	15.00%	30.00%
District heating etc.					3.00%	3.00%

3–10 housing units	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	10.00%
Coal, coke, briquettes						
Heating oil, LPG	2.00%	2.00%	2.00%	2.00%	2.00%	5.00%
Electricity	1.00%	1.00%	1.00%	1.00%	1.00%	5.00%
Natural gas	4.00%	4.00%	4.00%	4.00%	4.00%	8.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	10.00%	20.00%
District heating etc.					3.00%	3.00%

more than 10 housing units	before	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	10.00%
Coal, coke, briquettes						
Heating oil, LPG	2.00%	2.00%	2.00%	2.00%	2.00%	5.00%
Electricity	1.00%	1.00%	1.00%	1.00%	1.00%	5.00%
Natural gas	4.00%	4.00%	4.00%	4.00%	4.00%	8.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	10.00%	20.00%
District heating etc.					3.00%	3.00%

Increase per year (compared to previous year)

Detached/semi-detached house	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

3–10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

more than 10 housing units	before 1919	1919–60	1961–80	1981–90	1991–2000	2001–13
Wood, wood chips, pellets, wood	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Coal, coke, briquettes	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heating oil, LPG	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Electricity	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Natural gas	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Heat pump	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
District heating etc.	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%

CLIMATE ADJUSTMENT AND CONSIDERATION OF CLIMATE CHANGE

HDDs calibration year	3257.5
HDDs average since 2000	3256.8
HDDs decrease per year	0.00%

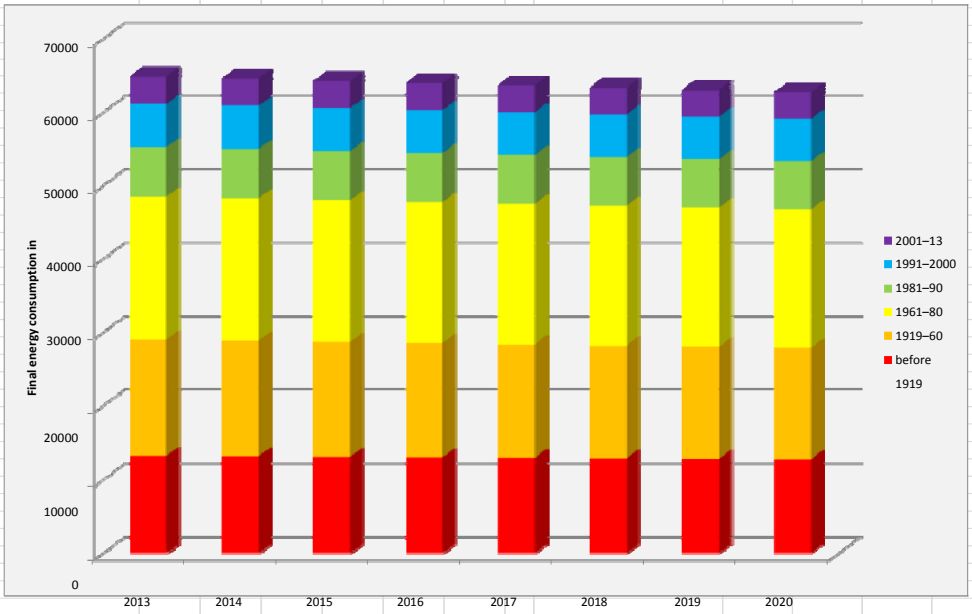
CALIBRATION TO ACTUAL CONSUMPTION DATA

		STAT AT	in model	
2012: AUE:	Space heating	56 08	68 94	0.81346055
	HW	5	6631	1.3262538

in GWh/a	before	1919–60	1961–80	1981–90	1991–2000	2001–13
2013	13 283	15 728	19 498	6749	5905	3717
2014	13 218	15 643	19 411	6726	5888	3701
2015	13 153	15 553	19 323	6703	5870	3683
2016	13 083	15 464	19 234	6680	5852	3665
2017	13 015	15 374	19 143	6656	5833	3645
2018	12 945	15 283	19 052	6631	5813	3625
2019	12 873	15 190	18 960	6606	5792	3604
2020	12 801	15 097	18 866	6579	5771	3581

total	Savings in GWh/a absolute - in %			in TJ
64 880				
64 584	296	2 072	0.46%	
64 283	301	1 805	0.47%	
63 977	306	1 530	0.48%	
63 666	312	1 246	0.49%	
63 348	317	952	0.50%	
63 025	323	647	0.51%	
62 695	330	330	0.52%	
		8 582		30 897

Savings 2020 to 2013 **2 185 GWh/a**

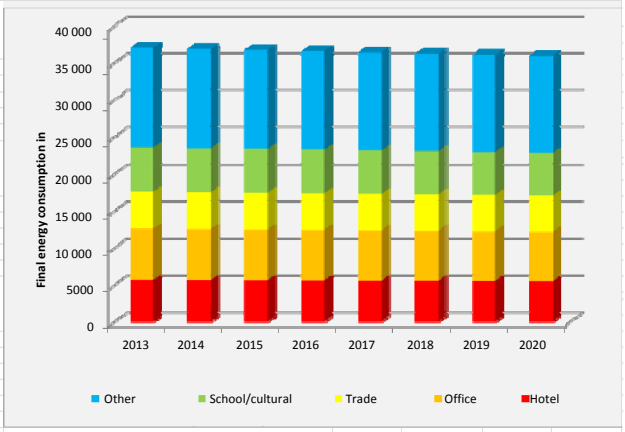


Number of housing units						
Detached/semi-detached house	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	164586	140737	167904	98341	68203	101057
Coal, coke, briquettes	1967	4194	5395	2660	822	0
Heating oil, LPG	43943	96692	229475	99047	90832	13733
Electricity	11580	19295	28148	17977	8893	4687
Natural gas	42484	91565	118499	60975	63575	32993
Heat pump	0	0	1068	4780	44727	50430
District heating etc.	7458	13882	23612	11319	14961	17784
3–10 housing units	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	24912	29508	21976	10484	15403	19024
Coal, coke, briquettes	1125	1866	537	154	93	0
Heating oil, LPG	27447	27820	47116	15507	17805	13543
Electricity	16632	27315	17939	15997	8201	3366
Natural gas	82115	76763	45290	23202	57442	26218
Heat pump	0	0	0	0	0	0
District heating etc.	20063	45477	58839	32026	56236	123008
more than 10 housing units	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	9640	7946	9936	2034	2171	3581
Coal, coke, briquettes	1542	923	622	36	19	0
Heating oil, LPG	20933	12165	64654	8508	6324	1926
Electricity	25597	22379	30540	8600	3716	1010
Natural gas	150429	82784	104329	28806	39348	23497
Heat pump	0	0	0	0	0	0
District heating etc.	38505	96654	226546	72669	91898	164244
Number of buildings						
Detached/semi-detached house	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	140672	120288	143507	84052	58293	86374
Coal, coke, briquettes	1681	3584	4611	2274	702	0
Heating oil, LPG	37558	82643	196132	84656	77634	11738
Electricity	9898	16491	24058	15365	7601	4006
Natural gas	36311	78261	101281	52116	54337	28199
Heat pump	0	0	913	4085	38228	43103
District heating etc.	6374	11865	20182	9674	12787	15200
3–10 housing units	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	4480	5307	3953	1886	2770	3422
Coal, coke, briquettes	202	336	96	28	17	0
Heating oil, LPG	4936	5004	8474	2789	3202	2436
Electricity	2991	4913	3226	2877	1475	605
Natural gas	14769	13806	8146	4173	10331	4715
Heat pump	0	0	0	0	0	0
District heating etc.	3609	8179	10582	5760	10114	22124
more than 10 housing units	*before 1919*	*1919–60*	*1961–80*	*1981–90*	*1991–2000*	*2001–13*
Wood, wood chips, pellets, briquettes	520	429	536	110	117	193
Coal, coke, briquettes	83	50	34	2	1	0
Heating oil, LPG	1129	656	3487	459	341	104
Electricity	1381	1207	1647	464	200	54
Natural gas	8114	4465	5627	1554	2122	1267
Heat pump	0	0	0	0	0	0
District heating etc.	2077	5213	12219	3920	4957	8859

Screenshots of Excel calculation tables - Non-residential buildings

CALCULATION OF GROSS FLOOR AREA BY BUILDING AGE CLASS AND ENERGY SOURCE

Total floor area m² 2013						
up to 1980	*Hotel*	*Office*	*Trade*	*School/cultural*	*other*	.
Wood, wood chips, pellets, wood	2346552	1482329	803489	1603725	6766168	
Coal, coke, briquettes	183324	65881	102262	21383	634328	
Heating oil, LPG	13932655	10046898	8911425	8040009	16915419	
Electricity	1026617	2196043	876534	1834662	5825670	
Natural gas	3500763	10824297	5817261	9151925	15900494	
Heat pump	167925	294270	131480	295085	788259	
District heating etc.	831560	4845570	2012375	6006485	3816119	
1981–1990	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	541155	378536	263165	338365	2266527	
Coal, coke, briquettes	42278	16824	33494	4512	212487	
Heating oil, LPG	3213108	2565635	2918743	1696336	5666317	
Electricity	236755	560795	287090	387090	1951480	
Natural gas	807336	2764156	1905317	1930936	5326338	
Heat pump	38726	75146	43063	62259	264050	
District heating etc.	191772	1237393	659110	1267290	1278321	
1991–2013	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	265859	386968	330338	302941	1911877	
Coal, coke, briquettes	20770	17199	42043	4039	179238	
Heating oil, LPG	1578539	2622784	3663750	1518742	4779692	
Electricity	116313	573286	360369	346564	1646126	
Natural gas	396629	2825727	2391648	1728781	4492910	
Heat pump	19026	76820	54055	55741	222734	
District heating etc.	94214	1264956	827347	1134614	1078298	



CALCULATION OF USEFUL ENERGY DEMAND FOR SPACE HEATING

HD in kWh/m²a (as of 2013)						
	Hotel	Office	Trade	School/cultural	other	.
up to 1980	130	130	130	130	130	
1981–1990	120	90	100	100	100	
1991–2013	95	75	80	85	85	

HD in kWh/m²a renovated						
	Hotel	Office	Trade	School/cultural	other	.
up to 1980	50	40	50	40	60	
1981–1990	50	40	50	40	60	
1991–2013	50	40	50	40	60	

Thermal renovation rate/a [%]						
	Hotel	Office	Trade	School/cultural	other	.
up to 1980	0.50%	0.50%	0.50%	0.50%	0.50%	0.00%
1981–1990	0.50%	0.50%	0.50%	0.50%	0.50%	0.00%
1991–2013	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%

REMOVAL OF BUILDINGS NO LONGER IN EXISTENCE

Demolition rate/a in % of existing stock						
	Hotel	Office	Trade	School/cultural	other	.
up to 1980						
1981–1990						
1991–2013						

HOT WATER

Useful energy demand in kWh/m²a	
Hotel	12.8
Office	4.7
Trade	5.5
School/cultural	4.7
other	8

CONVERSION TO FINAL ENERGY CONSUMPTION

Utilisation rate of heating system 2013						
up to 1980	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	60.00%	60.00%	60.00%	60.00%	60.00%	
Coal, coke, briquettes	55.00%	55.00%	55.00%	55.00%	55.00%	
Heating oil, LPG	70.00%	70.00%	70.00%	70.00%	70.00%	
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	
Natural gas	75.00%	75.00%	75.00%	75.00%	75.00%	
Heat pump	250.00%	250.00%	250.00%	250.00%	250.00%	
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	
1981–1990	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	60.00%	60.00%	60.00%	60.00%	60.00%	
Coal, coke, briquettes	55.00%	55.00%	55.00%	55.00%	55.00%	
Heating oil, LPG	70.00%	70.00%	70.00%	70.00%	70.00%	
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	
Natural gas	75.00%	75.00%	75.00%	75.00%	75.00%	
Heat pump	250.00%	250.00%	250.00%	250.00%	250.00%	
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	
1991–2013	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	72.00%	72.00%	72.00%	72.00%	72.00%	
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	
Heat pump	300.00%	300.00%	300.00%	300.00%	300.00%	
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	

Utilisation rate of heating system renovated [%]						
up to 1980	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	0.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	0.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	0.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	0.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	0.00%
Heat pump	300.00%	300.00%	300.00%	300.00%	300.00%	0.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	0.00%
1981–1990	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	0.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	0.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	0.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	0.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	0.00%
Heat pump	300.00%	300.00%	300.00%	300.00%	300.00%	0.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	0.00%
1991–2013	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	72.00%	72.00%	72.00%	72.00%	72.00%	0.00%
Coal, coke, briquettes	65.00%	65.00%	65.00%	65.00%	65.00%	0.00%
Heating oil, LPG	80.00%	80.00%	80.00%	80.00%	80.00%	0.00%
Electricity	97.00%	97.00%	97.00%	97.00%	97.00%	0.00%
Natural gas	86.00%	86.00%	86.00%	86.00%	86.00%	0.00%
Heat pump	300.00%	300.00%	300.00%	300.00%	300.00%	0.00%
District heating etc.	95.00%	95.00%	95.00%	95.00%	95.00%	0.00%

Heating system disassembly rate/a [%]						
up to 1980	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Electricity	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Natural gas	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Heat pump	2.00%	2.00%	2.00%	2.00%	2.00%	1.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%
1981–1990	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Electricity	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Natural gas	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Heat pump	2.00%	2.00%	2.00%	2.00%	2.00%	1.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%
1991–2013	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood briquette	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Coal, coke, briquettes	2.50%	2.50%	2.50%	2.50%	2.50%	1.25%
Heating oil, LPG	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Electricity	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Natural gas	3.00%	3.00%	3.00%	3.00%	3.00%	1.50%
Heat pump	2.00%	2.00%	2.00%	2.00%	2.00%	1.00%
District heating etc.	1.00%	1.00%	1.00%	1.00%	1.00%	0.50%

New heating system installation share [%]						
up to 1980	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Coal, coke, briquettes						
Heating oil, LPG	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Electricity						
Natural gas	39.00%	39.00%	39.00%	39.00%	39.00%	39.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
District heating etc.	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
1981–1990	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Coal, coke, briquettes						
Heating oil, LPG	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Electricity						
Natural gas	39.00%	39.00%	39.00%	39.00%	39.00%	39.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
District heating etc.	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%
1991–2013	Hotel	Office	Trade	School/cultural	other	.
Wood, wood chips, pellets, wood	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Coal, coke, briquettes						
Heating oil, LPG	8.00%	8.00%	8.00%	8.00%	8.00%	8.00%
Electricity						
Natural gas	39.00%	39.00%	39.00%	39.00%	39.00%	39.00%
Heat pump	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
District heating etc.	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%

Year / in GWh/a	Hotel	Office	Trade	School/cultur	other	.	total	Savings, absolute [GWh/a per annum	by 2020	in TJ	in %
2013	5678	6908	5056	5986	13 46		37 096				
2014	5650	6873	5033	5956	13 41		36 922	175	1,223		0.47%
2015	5624	6839	5011	5925	13 35		36 753	169	1,014		0.46%
2016	5599	6805	4990	5896	13 29		36 588	164	822		0.45%
2017	5574	6772	4969	5867	13 24		36 428	161	642		0.44%
2018	5551	6740	4949	5839	13 19		36 271	157	471		0.43%
2019	5528	6709	4929	5811	13 14		36 117	154	307		0.42%
2020	5506	6678	4910	5784	13 08		35 966	151	151		0.42%
									4 631	16 671	

Savings 2020 to 2013 1 130 GWh/a

<

NUMBER OF BUILDINGS

total	Hotel	Office	Trade	School	other
Wood, wood chips, pellets, wood	3873	1572	1413	1151	11 67
Coal, coke, briquettes	303	70	180	15	1094
Heating oil, LPG	22 994	10 656	15 67	5770	29 18
Electricity	1694	2329	1542	1317	10 05
Natural gas	5778	11 48	10 23	6568	27 43
Heat pump	277	312	231	212	1360
District heating etc.	1372	5139	3539	4311	6584
Total	**36 29**	**31 56**	**32 81**	**19 34**	**87 37**

up to 1980	Hotel	Office	Trade	School	other
Wood, wood chips, pellets, wood	2766	978	871	747	7220
Coal, coke, briquettes	216	43	111	10	677
Heating oil, LPG	16 42	6628	9661	3744	18 05
Electricity	1210	1449	950	854	6217
Natural gas	4126	7141	6307	4262	16 96
Heat pump	198	194	143	137	841
District heating etc.	980	3197	2182	2797	4072
Total up to 1980	25 918	19 631	20 224	12 55	54 047

1981–90	Hotel	Office	Trade	School	other
Wood, wood chips, pellets, wood	559	215	193	152	
Coal, coke, briquettes	44	10	25	2	159
Heating oil, LPG	3317	1456	2143	764	4236
Electricity	244	318	211	174	1459
Natural gas	833	1568	1399	869	3982
Heat pump	40	43	32	28	197
District heating etc.	198	702	484	570	956
Total 1981–90	5235	4311	4485	2560	12 68

from 1991	Hotel	Office	Trade	School	other
Wood, wood chips, pellets, wood	548	380	349	252	2758
Coal, coke, briquettes	43	17	44	3	259
Heating oil, LPG	3255	2572	3870	1262	6896
Electricity	240	562	381	288	2375
Natural gas	818	2771	2526	1437	6482
Heat pump	39	75	57	46	321
District heating etc.	194	1241	874	943	1556
Total from 1991	5138	7618	8101	4232	20 64

3. Residential building subsidies in the provinces

Burgenland

Residential building subsidies

In accordance with the Burgenland Residential Building Subsidies Act 2005, as amended, funding is available, and moreover equity replacement loans and residential subsidies are granted, for the construction and renovation of residential properties, the creation of housing, the purchasing of non-subsidised homes and dwellings, the setting up of alternative energy systems and measures to improve the thermal quality of the building envelope of a subsidised property.

The amount of subsidy is closely related to the energy efficiency. Thus, for example, in the case of a new construction loan, the level of funding may rise to a maximum of € 25 000, according to the ecopoints achieved and depending on the percentage by which the energy indicator is below the required minimum value (36 kWh/m²a with an S/V ratio > 0.8). Similarly, there are correspondingly graduated ecopoints for renovation measures and minimum energy standards that must be met.

In the case of the initial installation of heating and hot water supply systems in a new build, the use of innovative climate-relevant systems is a prerequisite for the granting of a subsidy. Renovation measures relating to the heat supply or heating systems will generally only be subsidised if innovative climate-relevant systems are used and if these systems or additional renovation measures lead to a reduction in the energy indicator compared to the initial value.

The use of environmentally friendly building materials is an additional requirement for receiving a subsidy.

The funding principles are published on the federal state's website www.bgld.gv.at/buergerservice/wohnbaufoerderung .

A non-repayable grant may be awarded in the context of the residential building subsidy for the installation or expansion of alternative energy systems and equipment for saving energy and elementary resources, and for systems for recovering thermal energy. The current guidelines can be viewed at www.eabgld.at under Service/Downloads.

Furthermore, the federal state has instructed the Burgenland Energy Agency to offer construction and
subsidy advice free of charge (www.eabgld.at).

The thermal and energy standards for the granting of subsidies for new residential construction and the renovation of houses and apartments will in future continue to be raised or developed further.

Carinthia

Residential building subsidies

The residential building subsidies of the federal state of Carinthia are used to promote new construction and renovations of residential buildings. The amount of

subsidy is closely related to the energy efficiency achieved. This includes both the quality of the building envelope and the type of energy supply. For example, for the new construction of a passive house rather than a house built to the minimum standard, the subsidy may be as much as € 275 per m². Similarly, there are correspondingly graduated incentives for renovations. The guidelines are publicly available on the federal state's website at http://www.ktn.gv.at/27987_DE.

Subsidies for renewable energy sources in residential buildings

Investment grants are provided for installations of an energy supply based on renewable energy sources. These are subject to strict quality criteria. The guidelines are publicly available on the website (http://www.energiewirtschaft.ktn.gv.at/143396_DE).

Lower Austria

Residential building subsidies

In 2002, a system of residential building subsidies was created in Lower Austria, taking account of minimum standards for heating demand, the use of heating and hot water generation systems based on renewable energy sources and environmentally friendly building materials. The better the energy quality, the higher the subsidy.

Since 2010, the use of innovative climate-relevant heating systems has been a prerequisite for receiving a subsidy. The support consists of the provision of loans by the federal state or interest subsidies for bank loans. Funding is provided for both new construction and for (total thermal) renovation. Each year, subsidies are provided for the construction of approximately 7 000 homes and apartments and for 15 000 renovation projects.

The funding principles in Lower Austria have been standardised in the Lower Austrian Residential Subsidy Guidelines 2011 and published on the website of the federal state of Lower Austria at http://www.noe.gv.at/Foerderungen/Foerderungen.html.

Public sector buildings in Lower Austria:

In January 2008, the Lower Austrian state parliament adopted guidelines for energy measures in federal state properties. Consequently, in accordance with the mandatory 'Energy Efficiency Requirement Specifications', which regulate planning requirements with regard to saving operating costs and reducing CO_2 emissions, for the new construction of public sector buildings in Lower Austria the target value for heating demand is to be no more than 10 kWh/m^2 per year and the maximum value no more than 30 kWh/m^2 per year. In the case of the structural renovation of existing buildings, the target value is 30 kWh/m^2 and the maximum value 50 kWh/m^2 per year. To minimise electricity consumption, energy-saving measures are to be specified in terms of demand-based lighting control systems and high-efficiency electrical appliances and equipment for heating, ventilation and lighting. Fossil fuels must be replaced by sustainable energy sources.

Special federal state financing:
In particular, infrastructure construction projects by Lower Austrian local authorities or their agencies are eligible for this special funding. The support consists of the granting of interest subsidies on loans or lease financing agreements. The prerequisite for receiving funding is compliance with specific standards for the heating demand in new buildings and in renovations; furthermore, the heating system must be based on renewable energy sources, and energy-efficient appliances and equipment must be used for heating, ventilation and lighting.

Subsidies for consultancy activities:
The federal state of Lower Austria organises and finances advisory programmes, including the following:
Lower Austria Energy Advice was set up to provide advice to private households. The project includes a hotline and a pool of consultants currently consisting of 80 advisors. Every citizen of Lower Austria may request free energy advice. The advice primarily concerns measures for increasing energy efficiency (building insulation) and the use of efficient heating systems.
The EcoManagement consultancy initiative was set up to provide advice to the commercial sector. Enterprises receive comprehensive subsidised advice, focusing on increasing the energy efficiency of buildings and of building services engineering.
A comprehensive range of services was set up for local authorities as part of the 'Municipal Energy Package'. Local authorities can take advantage of free consultations for their own buildings. The promotion of energy concepts and energy guidelines has transformed local authorities into information hubs for energy issues. Since last month, Lower Austria now also contains 'e5 local authorities'.
This programme is intended for highly committed municipalities and aims to benchmark local authorities in terms of energy.

Upper Austria

The federal state of Upper Austria provides the following subsidies, among others, to support the implementation of Directive 2010/31/EU:

- Subsidies for the construction of energy-efficient buildings (Upper Austrian Regulation on Home Ownership, Upper Austrian Regulation on Subsidies for New Construction),
- Subsidies for the energy-efficient renovation of existing buildings,
- (Upper Austrian Regulation on the Renovation of Residential Buildings, State Environmental Subsidies for the Thermal Renovation of Buildings),
- Energy requirements for the new construction and renovation of schools, kindergartens, after-school centres and official buildings of local authorities in accordance with needs-based allocation of funds,
- Subsidies for energy-efficient technical building systems (Upper Austrian Energy Saving Regulations, State Environmental Subsidies, Biomass

Funding Guidelines),
- Comprehensive, product-independent energy advice on the construction and renovation of buildings for private individuals, enterprises and public bodies.

A detailed presentation of these subsidies is available at http://www.land-oberoesterreich.gv.at/cps/rde/xchg/ooe/hs.xsl/187_DEU_HTML.htm. The energy advice and other consultancy activities are carried out by the Upper Austrian Energy Agency:
http://www.energiesparverband.at/

Salzburg

Residential building subsidies:

As part of the residential building subsidies provided by the federal state of Salzburg, a system of incentives was set up as early as 1993 for energy and environmental measures which go beyond the relevant minimum requirements. The amount of subsidy is closely related to the energy efficiency achieved. This includes both the quality of the building envelope and the type of energy supply.
In the case of residential building subsidies, these measures were constantly adjusted for the purpose of reducing greenhouse gas emissions, and minimum energy requirements were defined for new residential construction and for subsidies for residential building renovations.
In addition, financial incentives continue to be offered for additional measures, e.g. energy indicators lower than the minimum requirements, the construction of houses to the passive house standard, the use of particularly environmentally friendly building materials, increased efficiency in heating systems, the installation of heat recovery systems and solar energy systems in new residential construction. For example, for the new construction of a passive house rather than a house built to the minimum standard, the subsidy (preferential loan) may be as much as € 615 per m^2.
Since, in contrast to residential construction, the renovation of residential buildings leads to 'actual' savings, a special financial incentive in the form of interest-free loans is currently being offered for deep energy renovations of residential buildings. In particular, subsidies are provided for innovative climate-relevant systems for the supply of heating and hot water, so that the use of fossil fuels is gradually being reduced.
The specified minimum requirements in accordance with the agreement pursuant to Article 15a of the Austrian Federal Constitution were implemented in the residential building subsidies in March 2010. This provided for a gradual implementation and adjustment by 1 January 2012 at the latest.
The implementing regulation is available on the federal state's website:
http://www.salzburg.gv.at/wfvo_2010_mit_db-2.pdf

Subsidies for renewable energy sources in residential buildings

Investment grants are awarded for the installation of an energy supply based on renewable energy sources. These are subject to strict quality criteria.
The relevant guidelines are available at:

http://portal.foerdermanager.net/information-und-beratung/downloads/

Central Energy Performance Certificate Database (ZEUS):
In Salzburg it is mandatory for all energy performance certificates to be sent by the issuer to the federal state's energy performance certificate database 'ZEUS' (Building Control Act Article 17a(4)). Here they are checked for compliance with the energy-related building regulations and the legal provisions governing subsidies.
The database can be accessed publicly via the website https://www.energieausweise.net
The subsidies are released on the basis of the data in the energy performance certificate, which is collected in a central energy performance certificate database (ZEUS) and of the data in the confirmation of the residential building subsidy.

Consultancy services for energy-efficient construction and renovation
The 'Salzburg Energy Advice' centre provides relevant consultancy services for building owners, tenants, local authorities, developers and professionals. See: http://www.salzburg.gv.at/energieberatung

The federal state's own buildings
In accordance with a decision by the state government of Salzburg, the 'Energy efficiency specifications for Salzburg state buildings' must be used on a mandatory basis for all state-owned buildings.

Energy Active management platform
The Energy Active management platform is used for networking between all the actors involved in the processing of an energy subsidy or in an energy project. The result is an energy project that is coordinated between the contracting authority and the professionals. In the submission process, the planning declaration submitted by the planner is automatically checked for compliance with funding regulations and other legal minimum requirements. The quality of execution is assured by random inspections.

Styria

Residential building subsidies
In Styria, residential building subsidy guidelines have been in force since 1 April 2009; these guidelines are in accordance with the agreement pursuant to Article 15a of the Austrian Federal Constitution. Among other things, the new subsidy variant 'Deep energy renovation' was introduced. New thermal insulation standards were specified for 2010/2012 for multi-storey buildings: with effect from 1 January 2010, this may not exceed 45 kWh/m²,a at a minimum surface to volume ratio of 0.8 and 25 kWh/m²,a at a maximum surface to volume ratio of 0.2, and with effect from 1 January 2012 36 kWh/m²,a at a minimum S/V ratio of 0.8 and 20 kWh/m²,a at a maximum S/V ratio of 0.2. For improved thermal

insulation and ecological construction methods, in multi-storey construction, on account of the additional costs and bank financing, a non-repayable grant is necessary as a compensatory payment for the ecological construction method, in order to avoid triggering any further increases in living costs in Styria.
Several years ago, the mandatory use of solar energy for water heating was introduced, together with a ban on fossil fuels for heating (with exceptions for natural gas supply under certain conditions). The use of direct electric heating has been prohibited for over 20 years.
Deep energy renovation:

This refers to renovation work on the building envelope and/or the technical systems of a building within a specific timescale, insofar as it includes at least three of the following elements and the heating demand does not exceed 75 kWh/m²a at a minimum surface to volume ratio of 0.8 and 35 kWh/m²a at a maximum surface to volume ratio of 0.2:

- Window areas
- Roof insulation or top floor ceiling
- Facade surface
- Basement ceiling
- Energy-relevant building services systems

The subsidy takes the form of either a non-repayable 30 % interest subsidy on a bank loan with a term of 14 years or a one-off non-repayable contribution of 15 % of the approved total subsidised construction costs up to a maximum of € 30 000 per dwelling.

Deep renovation

The values (heating demand) for deep energy renovation (e.g. loft conversion) also apply to deep renovation.
The subsidy rates were set at € 970/m^2 and € 1 130/m^2 of approved total subsidised construction costs. Supplements for optimised thermal insulation of € 40 for new construction values 2010 and € 70 for passive houses have been introduced as a new incentive. A non-repayable 45 % interest subsidy is granted, term 15 years, or for social housing a federal state loan, term 25 years.
Comprehensive information is available on the website of the federal state of Styria:
http://www.wohnbau.steiermark.at

Federal state environmental fund

Resources from the federal state environmental fund are used to subsidise systems using renewable energy sources for non-commercial users, primarily low-output biomass furnaces, solar energy systems (thermal and photovoltaic), district heating from biomass etc., not only to make buildings more energy-efficient, but overall to give them an optimum supply of energy in line with the European Union's 20-20-20 targets. Detailed information can be found at http://www.technik.steiermark.at/cms/ziel/59689784/DE/.

Tyrol

Residential building subsidies

The residential building subsidies in Tyrol include comprehensive measures and instruments for pursuing the goals of Directive 2010/31/EU. As financial instruments, both loans and grants are provided in the context of residential building subsidies. There are, in principle, subsidies for both the construction of new buildings and for the renovation of existing buildings. The relevant subsidy eligibility criteria take account of the requirements with regard to energy efficiency. For example, in the construction of new buildings, the use of innovative climate-relevant heating systems is a prerequisite for receiving residential building subsidies. Furthermore, a heating demand calculation must be submitted for the property to be subsidised, in which a maximum permissible annual heating demand (HD) per m² of conditioned gross floor area is to be observed.

In the case of subsidies for the renovation of existing buildings,
mandatory eligibility criteria include compliance with corresponding U-values for the relevant parts of the building (walls, roof, windows etc.). For the renovation of the heating or heat supply system, the use of innovative climate-relevant systems is also a prerequisite for funding. The corresponding detailed subsidy types, eligibility criteria and the existing funding guidelines may be found on the website of the federal state of Tyrol – Department of Residential Building Subsidies:
www.tirol.gv.at/wohnbau

Range of advisory services for energy-efficient construction and renovation:

In 1992 the 'Energie Tirol' association was set up by the federal state of Tyrol as an independent advisory body for the promotion of environmentally friendly energy technologies and energy efficiency measures. Its consultancy services focus on energy-saving construction and building technology and environmentally friendly heating. Through its financial participation in 'Energie Tirol', the federal state of Tyrol is therefore supporting comprehensive advisory services for energy-efficient construction and renovation: http://www.energie-tirol.at

e5 federal state programme for energy-efficient local authorities

It should finally be noted that for several years Tyrol has contained a number of e5 local authorities (at present 13 local authorities in Tyrol). More information on this and other topics is available at http://www.energie-tirol.at

Vorarlberg

Residential building subsidies

The residential building subsidies in the federal state of Vorarlberg are used to support new construction and renovations of residential buildings. The amount of subsidy is closely related to the energy efficiency achieved. This includes both the

quality of the building envelope and the type of energy supply. For example, for the new construction of a passive house rather than a house built to the minimum standard, the subsidy (preferential loan) may be as much as € 300/m^2. Similarly, there are correspondingly graduated incentives for renovations. The guidelines are publicly available on the federal state's website at https://www.vorarlberg.at/vorarlberg/bauen_wohnen/wohnen/wohnbaufoerderung/weitereinformationen/foerderungsrichtlinien/saemtlicherichtliniendera.htm.

Subsidies for renewable energy sources in residential buildings

Investment grants are awarded for the installation of an energy supply based on renewable energy sources. These are subject to strict quality criteria. An overview of these may be found on the federal state's website http://www.vorarlberg.at

Support for ventilation systems with heat recovery

A separate investment subsidy was set up to promote the wide-scale introduction of ventilation systems with heat recovery. For quality assurance, this is linked to high technical standards. Information on this is also publicly available on the federal state's website http://www.vorarlberg.at/vorarlberg/wasser_energie/energie/energie/formulare/energieformulare.htm (additional documents in Word and PDF format)

Energy performance certificate platform

In Vorarlberg, it is mandatory for all energy performance certificates to be recorded in a comprehensive database. This allows the development of the construction process to be easily evaluated and random quality checks to be carried out. This database is linked to an extensive information and advisory section. It can be publicly accessed via the website https://www.eawz.at/

Database of building products

Details of approximately 1 800 quality assured building products and construction materials are recorded in an extensive database, together with their physical and environmental characteristics (e.g. greenhouse gas potential, energy input). The database can be used free of charge by all users and is designed to support energy-efficient building (www.baubook.at).

Consultancy services for energy-efficient construction and renovation:

For example, the federal state supports the provision of comprehensive advice on renovation projects. Likewise, the State Energy Agency (https://www.energieinstitut.at/) offers relevant consultancy services for building owners, tenants, developers and professionals. All this information is listed on the website of the federal state of Vorarlberg in the Energy section and is therefore easy to find:
http://www.vorarlberg.at/vorarlberg/wasser_energie/energie/energie/start.htm

Vienna

Residential building subsidies

The residential building subsidies should enable as many people as possible to create their own home and to equip it with state-of-the-art technology. Funding is provided for new construction projects and major expansion and conversion activities, but also for structural changes to allotment buildings. The subsidies are graduated according to income and family situation. Both tenants and owners of houses and apartments are eligible to receive financial support. In addition, there are special eco-subsidies for environmentally friendly construction and renovation measures.

Information on residential building subsidies and related topics such as heating, allotments, new construction and renovation can be found at: www.wien.gv.at/wohnen/wohnbaufoerderung/foerderungen/

Example: Thermal and energy renovation (THEWOSAN)

A variety of funding opportunities are available in the area of housing improvements and renovation. In the context of thermal and energy renovation (THEWOSAN), structural measures are subsidised for the thermal renovation of the entire building envelope, such as the insulation of all external components, the elimination of thermal bridges or the increasing of passive solar heat gains. In addition, measures relating to technical systems are supported, such as the conversion or installation of heating and hot water generation systems with primary energy-efficient and/or CO2 reduced or renewable energy sources.

The aim is to significantly reduce the building's heating demand and thus its CO_2 emissions as well as the consumption of fossil fuels.

Subsidies are provided in the form of a non-repayable contribution from € 25 to € 160 per m² of useful floor space, depending on the energy indicators achieved, and an additional € 60 per m² of useful floor space upon reaching the passive house standard. The maximum amount of the non-repayable contribution is limited, depending on the funding stage, to up to 30 % of the total eligible construction costs.

Consideration of renewable energy sources in residential building subsidies
The appropriate choice of energy source for future energy supplies is also one of the prerequisites for receiving funding. The main guidelines are the conservation of the environment and of natural resources and a rational and economical use of energy.

www.wien.gv.at/stadtentwicklung/energieplanung/foerderungen/wbf.html