



ENER/C1/2018-494 – Renewable Space Heating under the Revised Renewable Energy Directive

Description of the heat supply sectors of EU Member States
Space heating market summary 2017

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Summary

This document has been prepared as part of the project Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494. The country reports included in this document aim at describing today's energy use and supply of space and water heating in the individual EU member states. They include information on the energy consumption for supplying space and water heating, technology distribution, building structure, and the regulatory framework in place. Data in the country reports are shown for the year 2017 if not stated otherwise. More details on the content and data sources are explained at the beginning of each country report. This document includes the country reports for the 27 member states as well as an aggregated report for the European Union (EU-27). The uniform applied methodology for all member states enables the comparability of the country reports. However this might result in deviations from national statistics data.

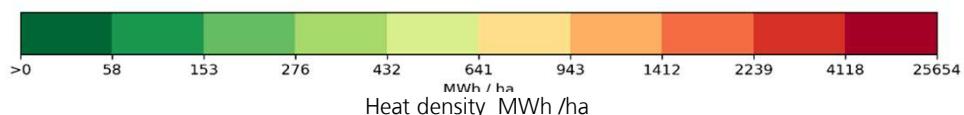
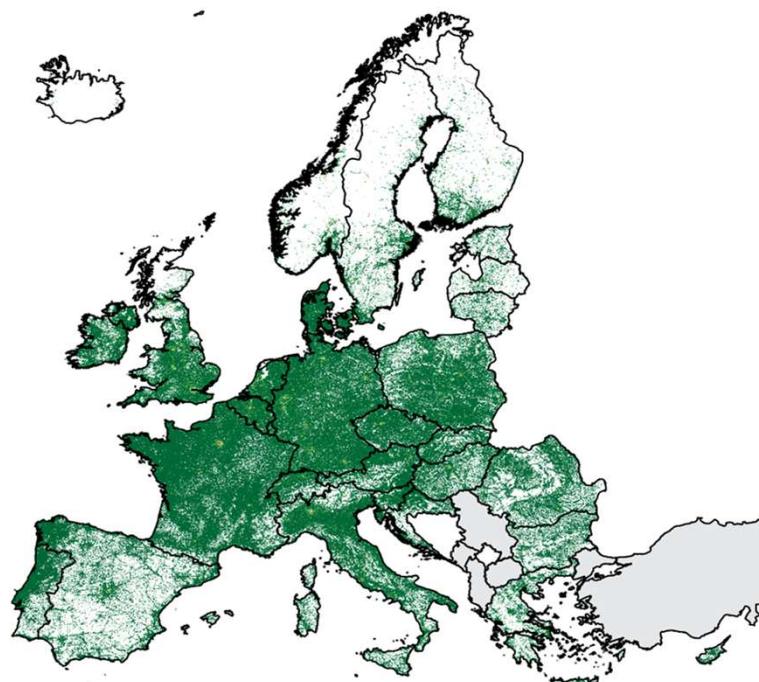
Country reports



Space heating market summary

2017

European Union (EU-27)



Source: <https://www.hotmaps.eu/map>

Introduction

This report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the European Union (EU-27). The report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present average heating degree days for EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.

2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the report:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Historical trends

Following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

RES-H shares in heating and cooling 2004-2017: They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].

Energy carrier shares in residential sector 2000-2017: The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.

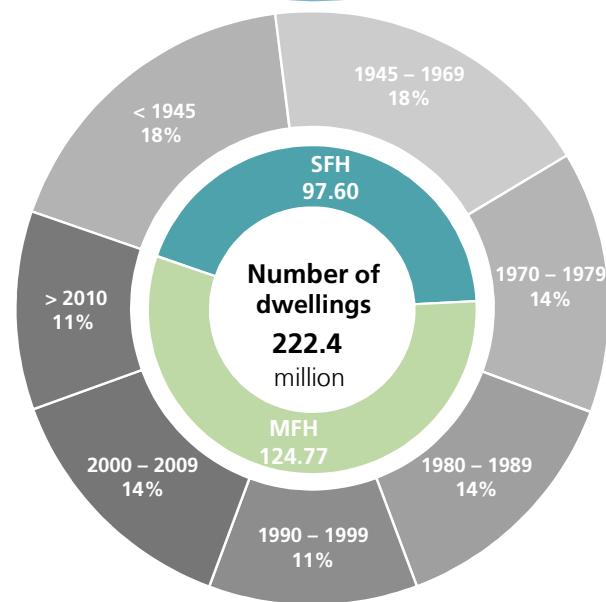
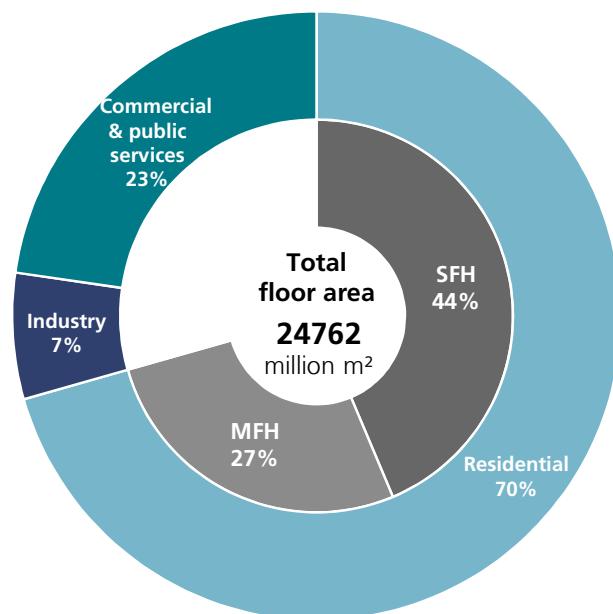
Energy carrier shares in gross heat production of district heating 2000-2017: As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

SFH: Single family house
MFH: Multi-family house

EU-27 2017

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Climate Data

Heating degree days

EU-27

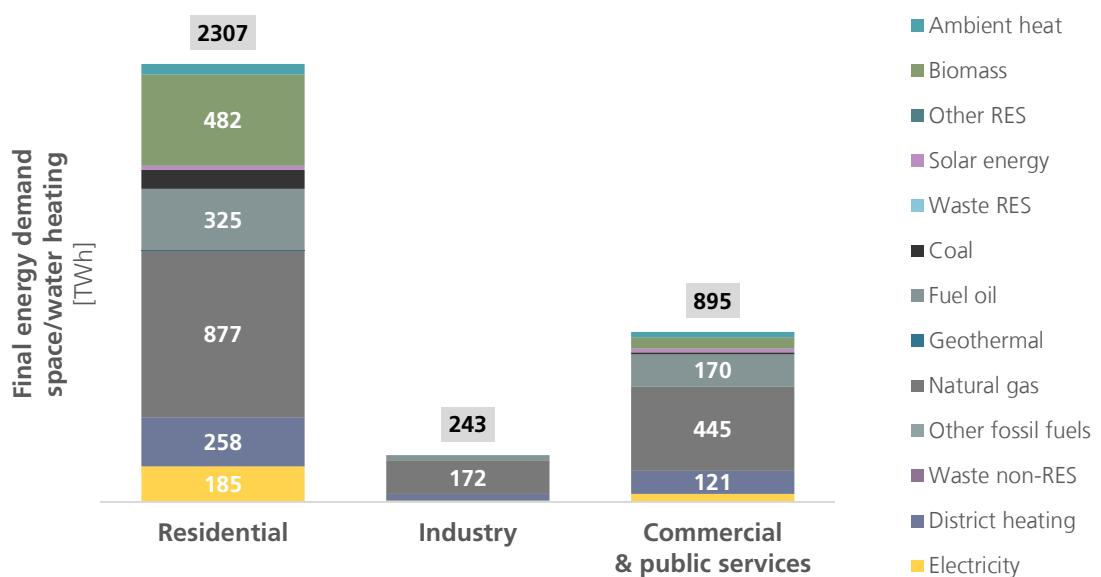
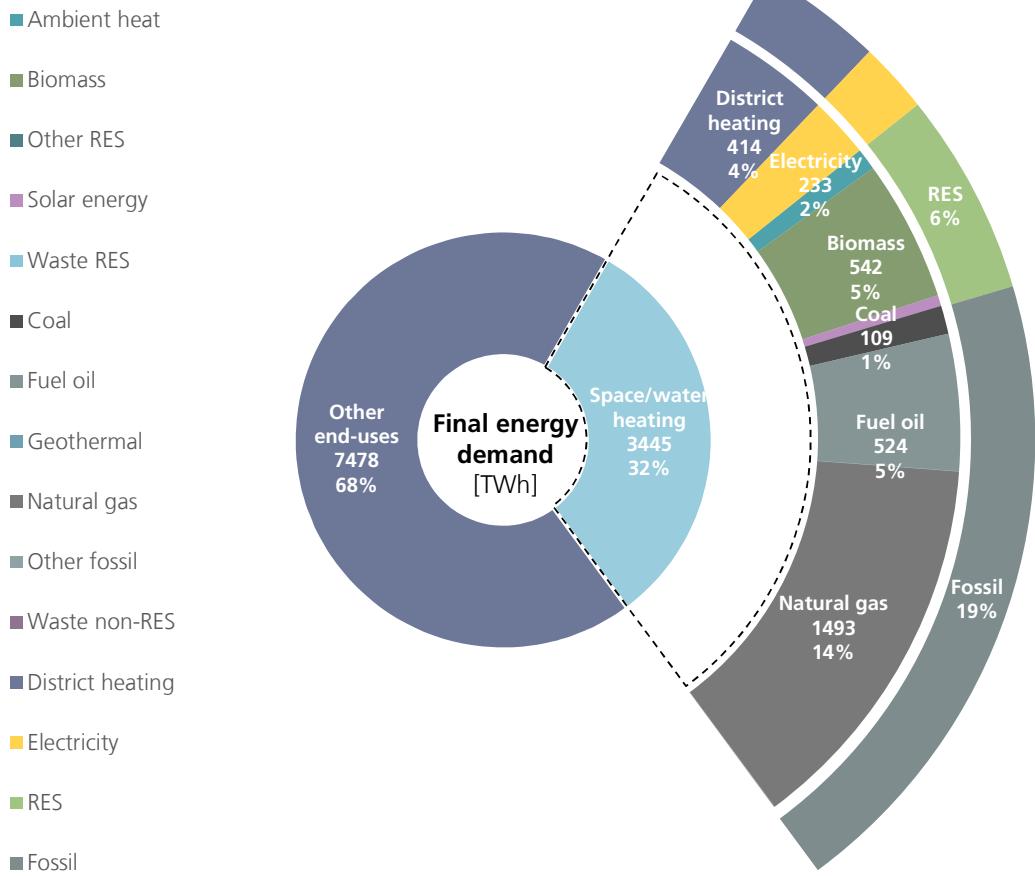
Average value 2000-2017

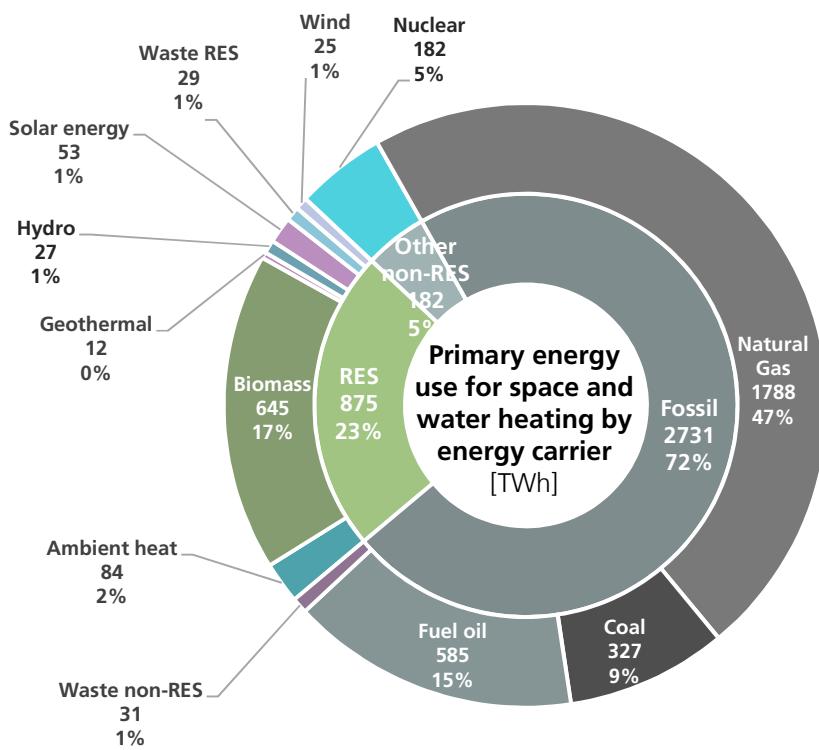
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Overview of energy demand

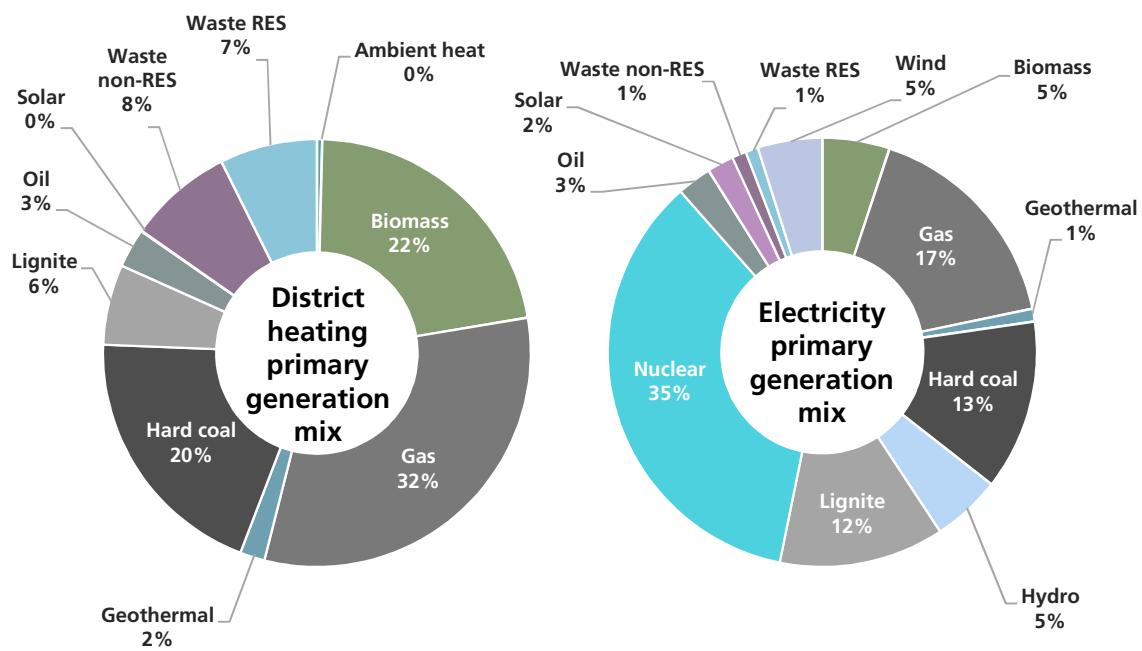
EU-27 2017

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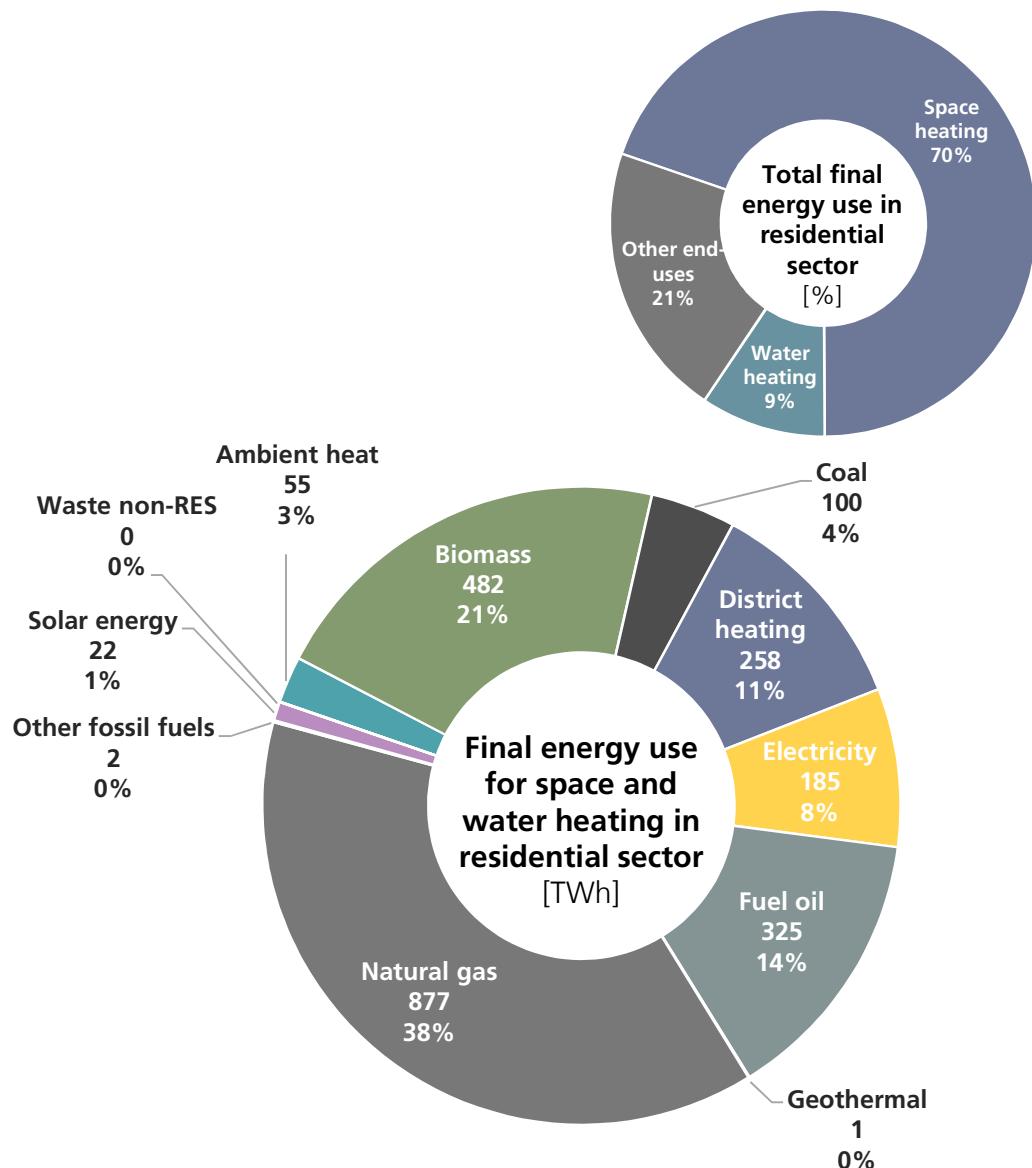
Generation mix



Space & water heating in residential sector

EU-27 2017

8



Specific energy demand

132

kWh/m²yr

Final energy demand

147

kWh/m²yr

Primary energy demand

154

kWh/m²yr

Single-family dwellings

170

kWh/m²yr

Single-family dwellings

96

kWh/m²yr

Multi-family dwellings

109

kWh/m²yr

Multi-family dwellings

Technology mix

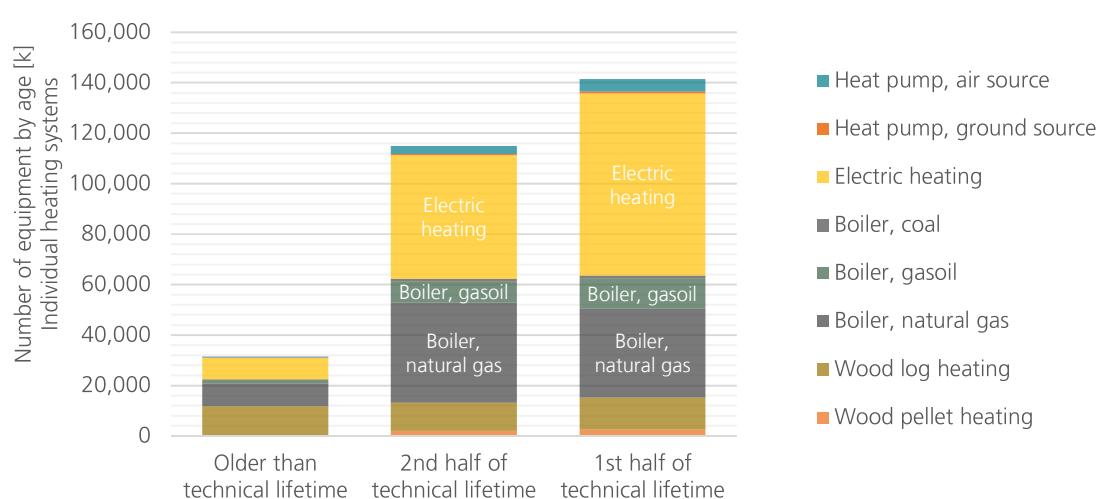
EU-27 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	8,444	4%	38%	58%	3.7	57.9
Heat pump ground source	1,339	4%	40%	56%	3.8	14.6
Solar thermal	50,493*	3%	27%	70%	3.6	35.3
Electric heating	129,762	7%	38%	56%	2.7	129.8
Boiler, coal	2,242	8%	41%	51%	0.8	44.7
Boiler, gasoil	21,945	6%	39%	55%	0.9	655.9
Boiler, natural gas	83,843	11%	47%	42%	1.0	2,211.4
Wood log heating	35,426	32%	32%	36%	0.7	435.8
Wood pellet heating	4,872	8%	41%	51%	0.8	159.3

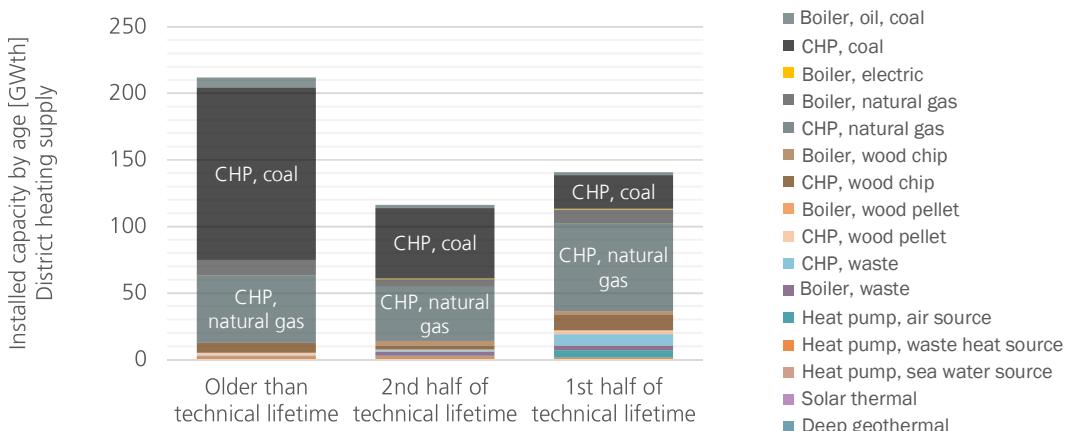
* unit 1000 m²

- no data



Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]	
District heating supply	Boiler, oil, coal	887	50%	27%	20%	0.9	12.0
	CHP, coal	882	73%	14%	6%	0.5	207.6
	Boiler, electric	77	0%	3%	93%	1.0	1.1
	Boiler, natural gas	2,313	33%	25%	39%	1.1	27.3
	CHP, natural gas	8,308	19%	47%	29%	0.4	158.0
	Boiler, wood chip	916	0%	52%	48%	1.1	6.5
	CHP, wood chip	484	19%	8%	56%	0.9	21.9
	Boiler, wood pellet	-	-	-	-	1.0	-
	CHP, wood pellet	127	28%	6%	50%	0.7	5.1
	CHP, waste	155	14%	15%	63%	0.8	10.2
	Boiler, waste	56	6%	24%	43%	1.1	7.0
	Heat pump air source	906	2%	15%	83%	3.5	6.2
	Heat pump waste heat source	741	33%	33%	34%	5.0	5.2
	Heat pump sea water source	214	4%	34%	51%	3.4	0.5
	Solar thermal	50	0%	44%	56%	0.5	0.1
	Deep geothermal	-	-	-	-	6.5	-

- no data

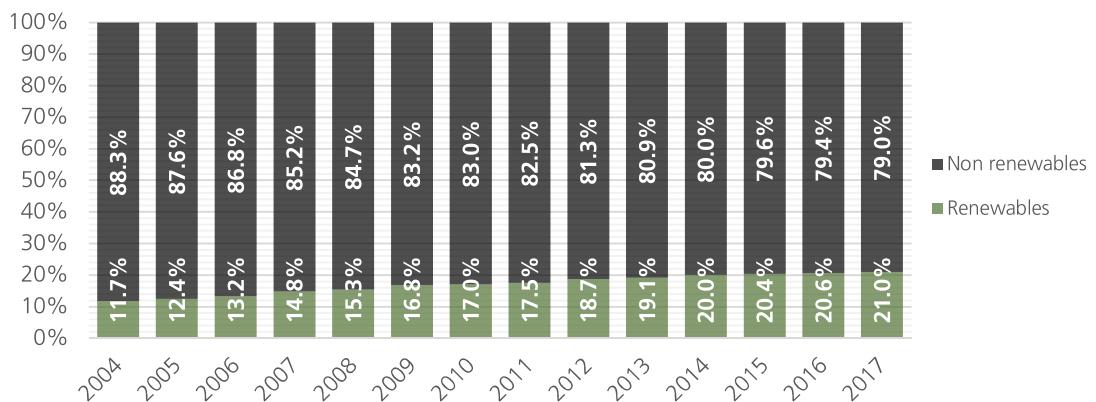


Historical trends

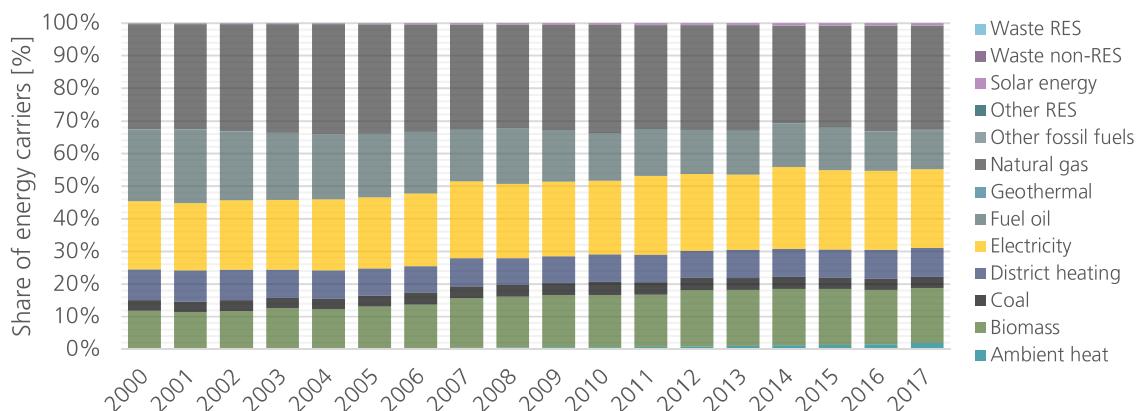
EU-27 2017

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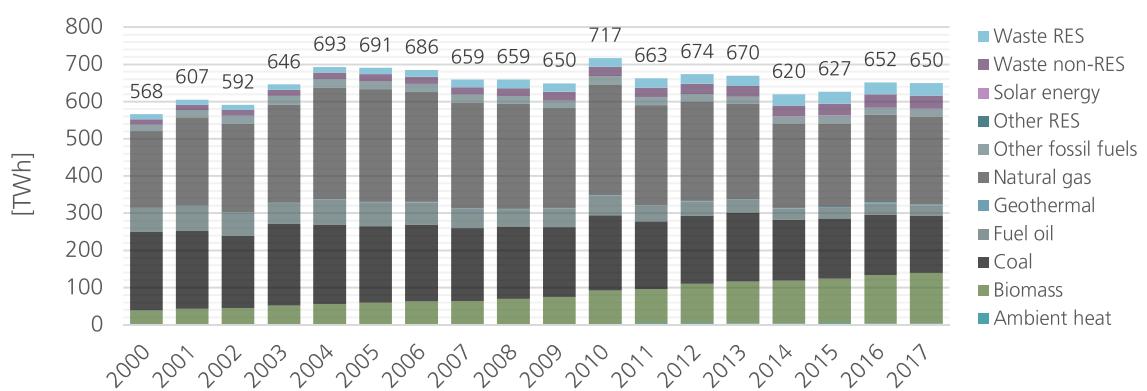
Share of RES in Heating & Cooling



Final energy consumption in residential sector



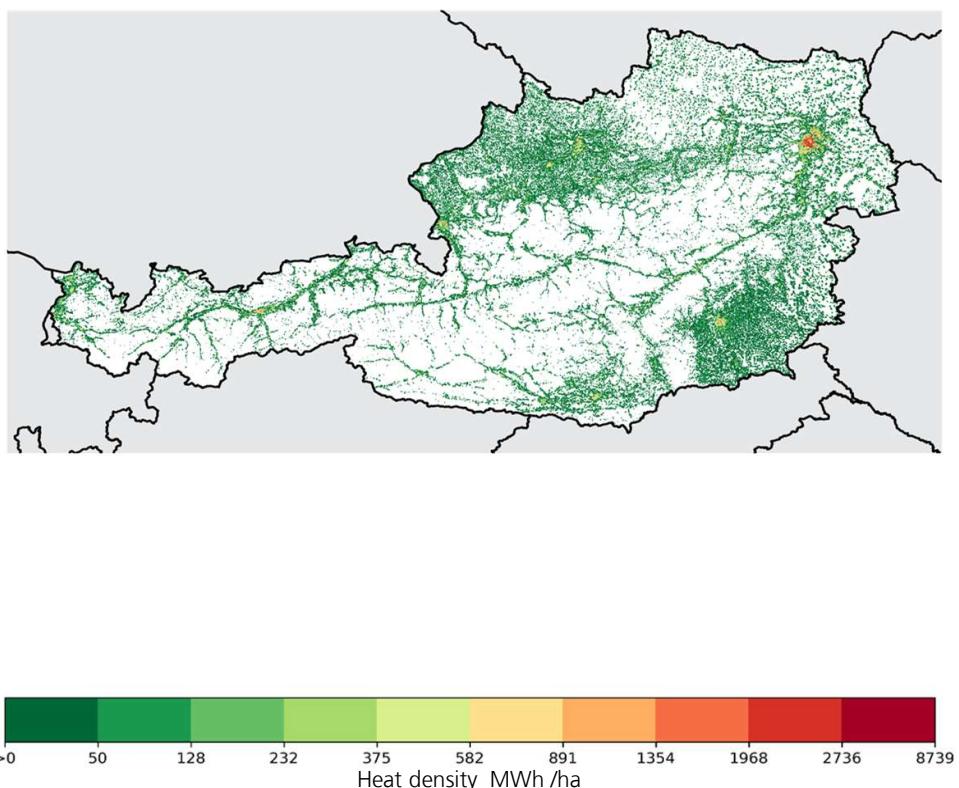
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Austria



Fraunhofer
ISI



Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

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Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

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Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

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The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

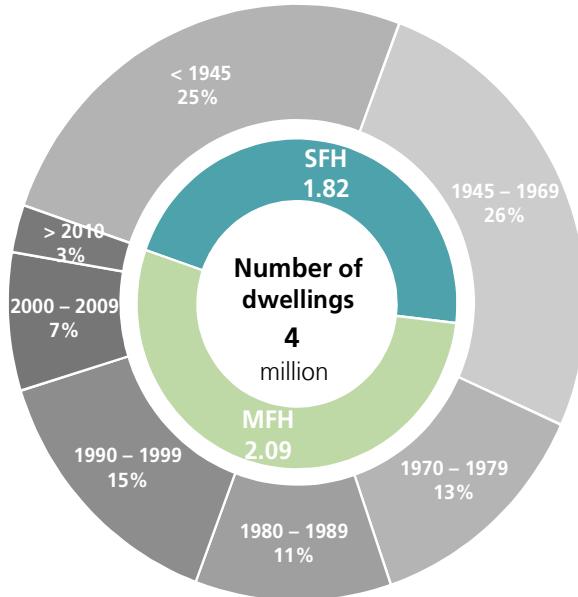
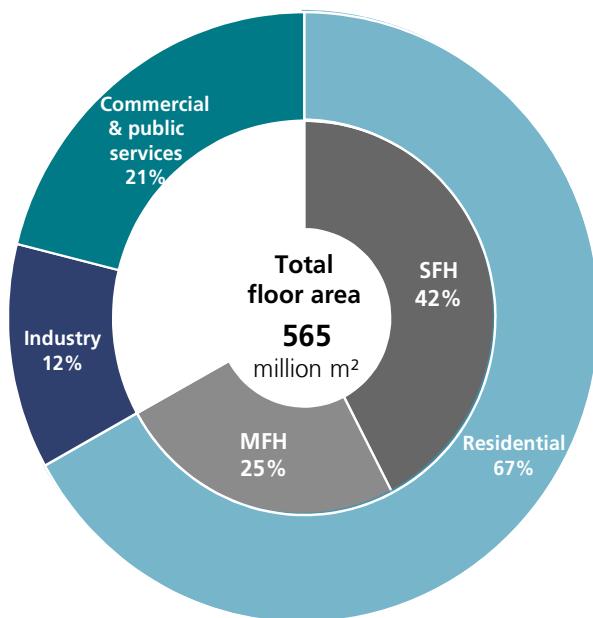
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- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

SFH: Single family house
MFH: Multi-family house

Austria 2017

5



Climate Data

Heating degree days

Austria

EU-27

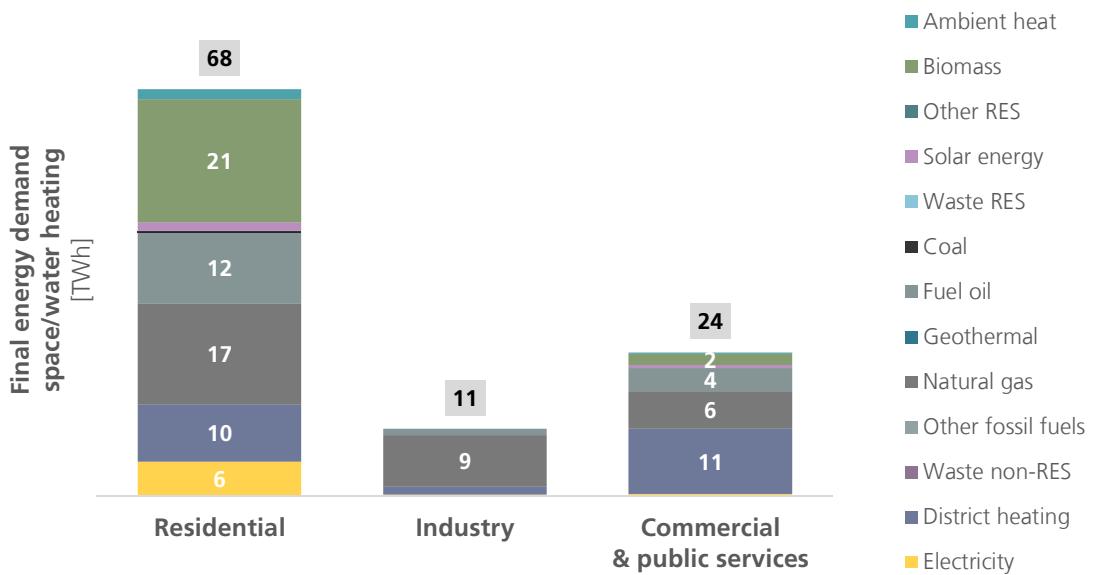
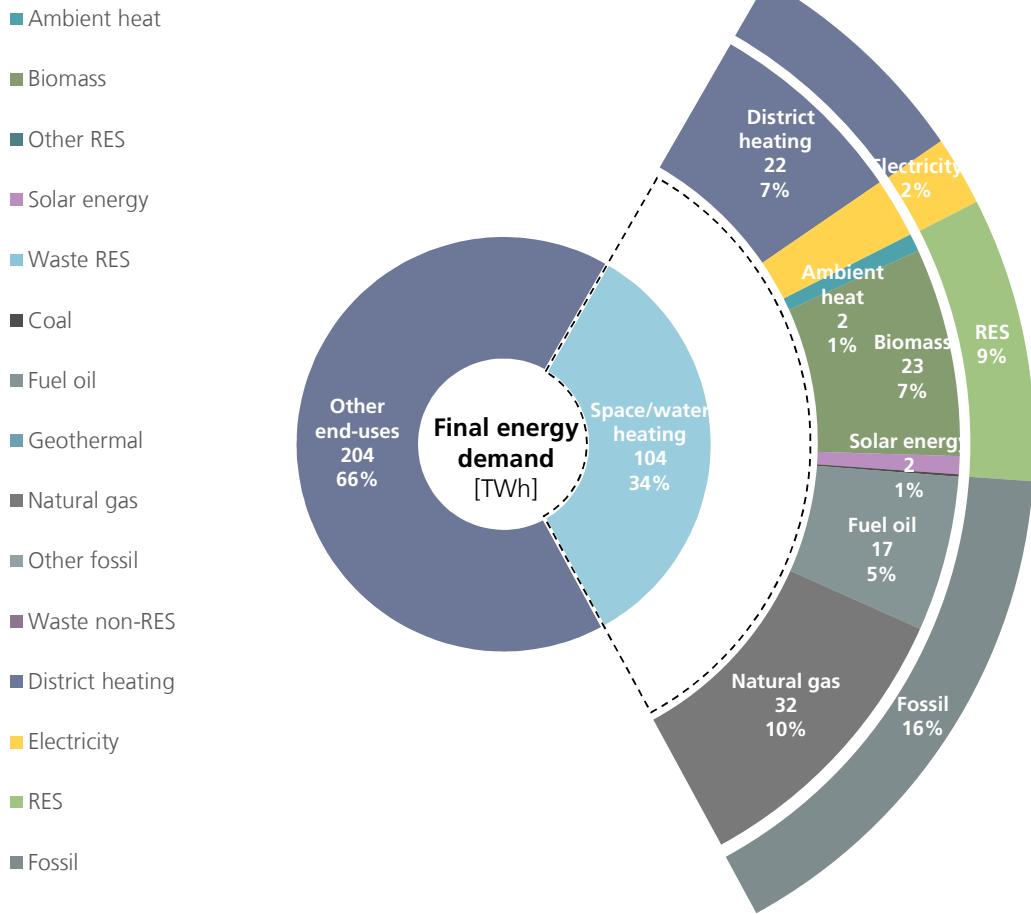
Average value 2000-2017

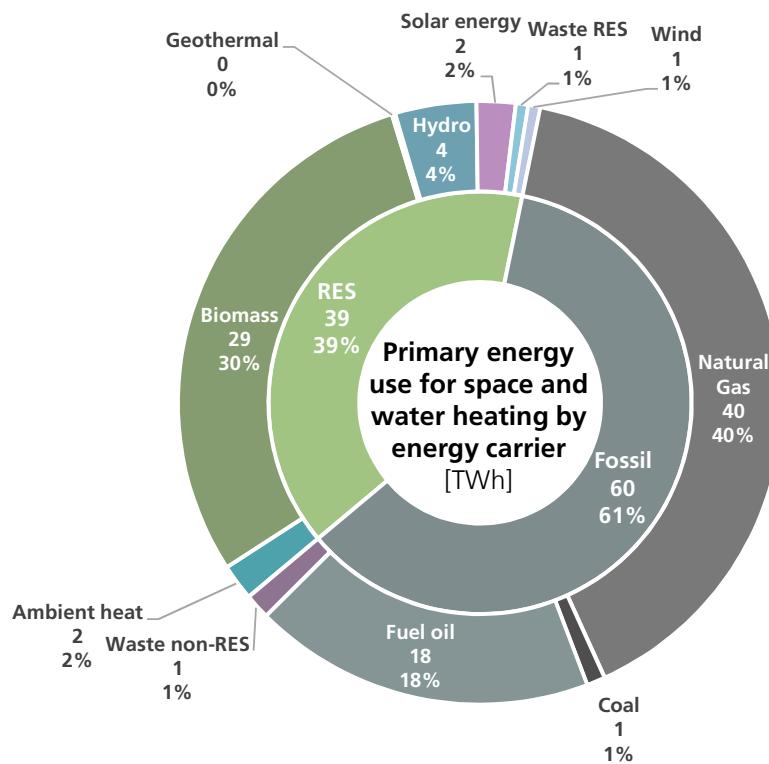
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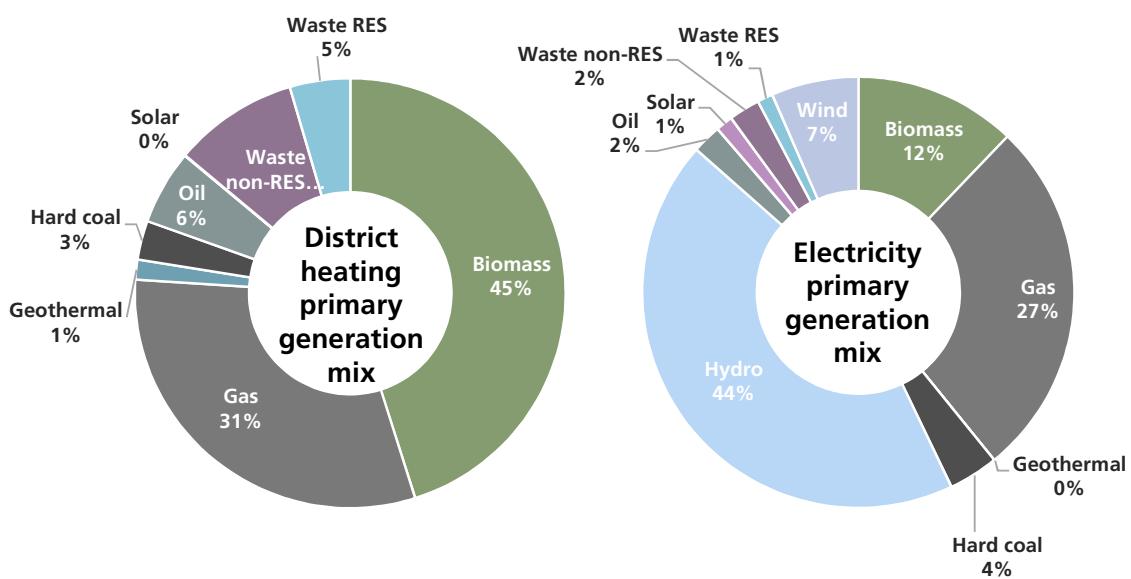
Overview of energy demand

Austria 2017
6





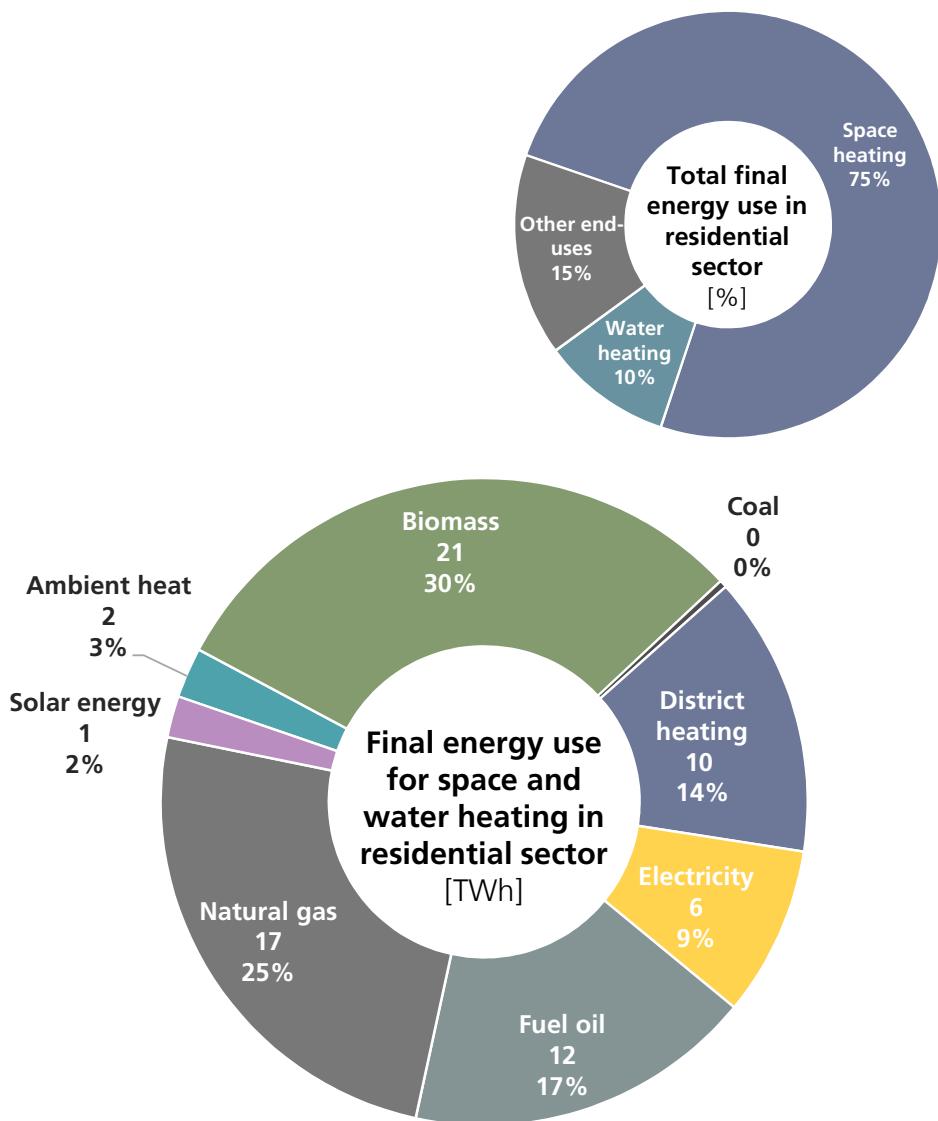
Generation mix



Space & water heating in residential sector

Austria 2017

8



Specific energy demand

181

kWh/m²yr

Final energy demand

180

kWh/m²yr

Primary energy demand

185

kWh/m²yr

Single-family dwellings

184

kWh/m²yr

Single-family dwellings

173

kWh/m²yr

Multi-family dwellings

173

kWh/m²yr

Multi-family dwellings

Technology mix

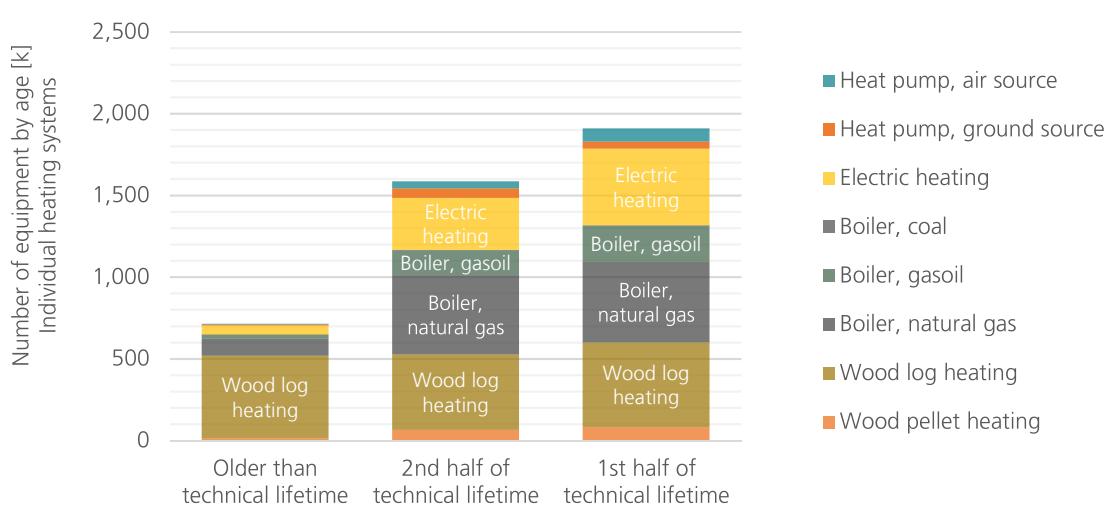
Austria 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	129	4%	34%	62%	3.3	1.2
Heat pump ground source	108	6%	53%	41%	3.5	1.3
Solar thermal	5,068*	3%	27%	70%	0.5	3.5
Electric heating	842	7%	38%	56%	1.0	0.8
Boiler, coal	4	8%	41%	51%	0.8	0.1
Boiler, gasoil	400	6%	38%	55%	0.9	18.0
Boiler, natural gas	1,082	10%	45%	45%	1.0	32.4
Wood log heating	1,486	34%	31%	35%	0.7	19.0
Wood pellet heating	159	8%	41%	51%	0.8	4.0

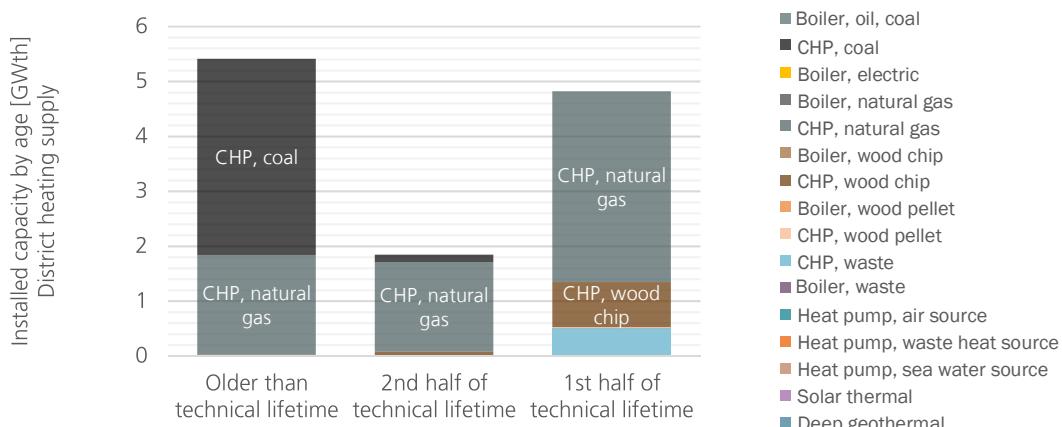
* unit 1000 m²

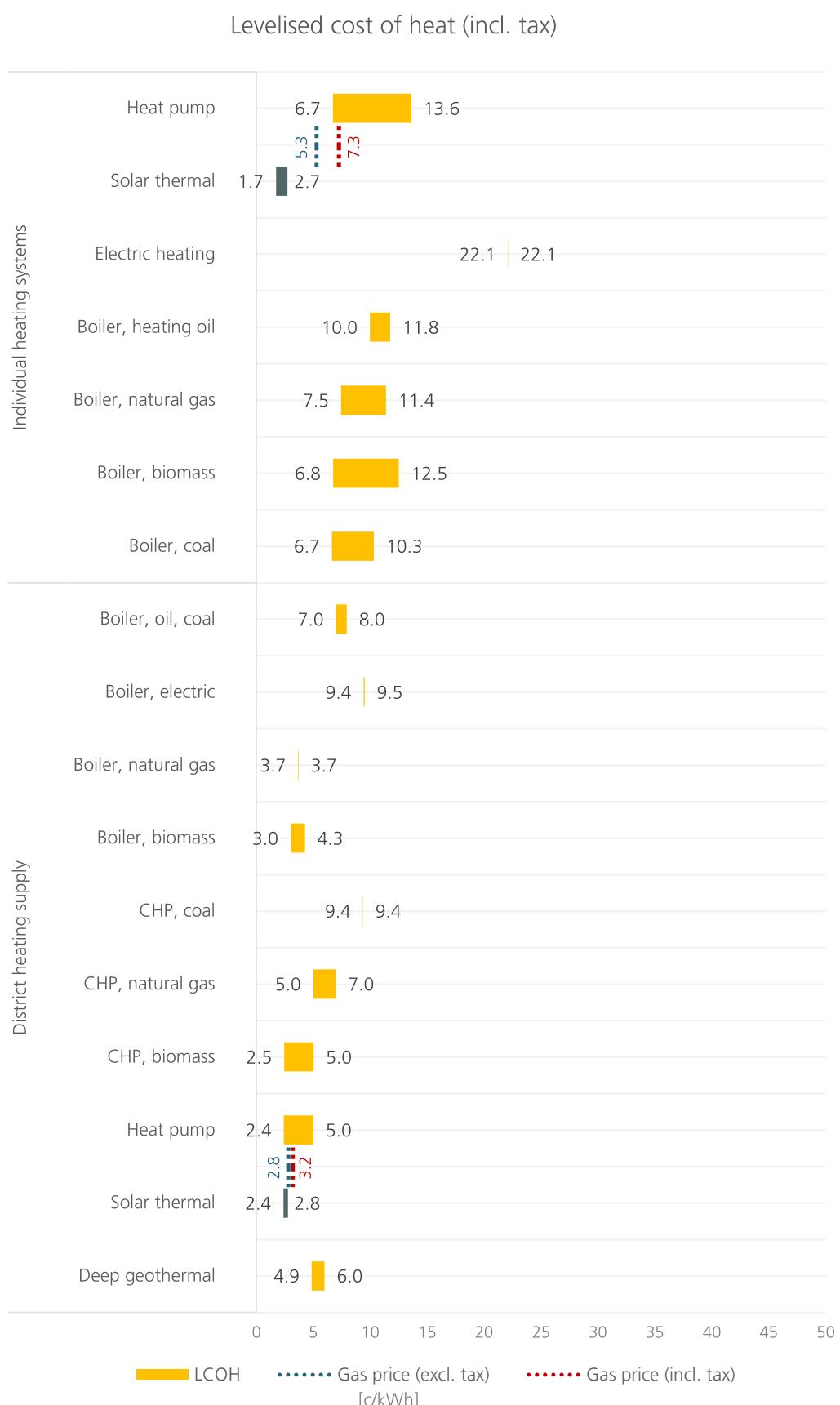
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	8	75%	25%	0%	0.5	3.7
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	197	23%	46%	31%	0.4	6.9
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	77	8%	5%	87%	0.9	0.9
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	2	0%	50%	50%	0.7	0.0
CHP, waste	4	0%	0%	100%	0.8	0.5
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	2	0%	0%	100%	5.0	0.0
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	18	0%	33%	67%	0.4	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Austria 2017

12

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Yellow
Financial support specifically addressing public buildings	Red
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO₂ pricing	
CO ₂ pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Yellow
RES-H obligation for existing buildings	Yellow
Trigger point: Major renovation	Yellow
Trigger point: Exchange of heating system	Yellow
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Green
New installations in existing buildings	Yellow
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Green
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

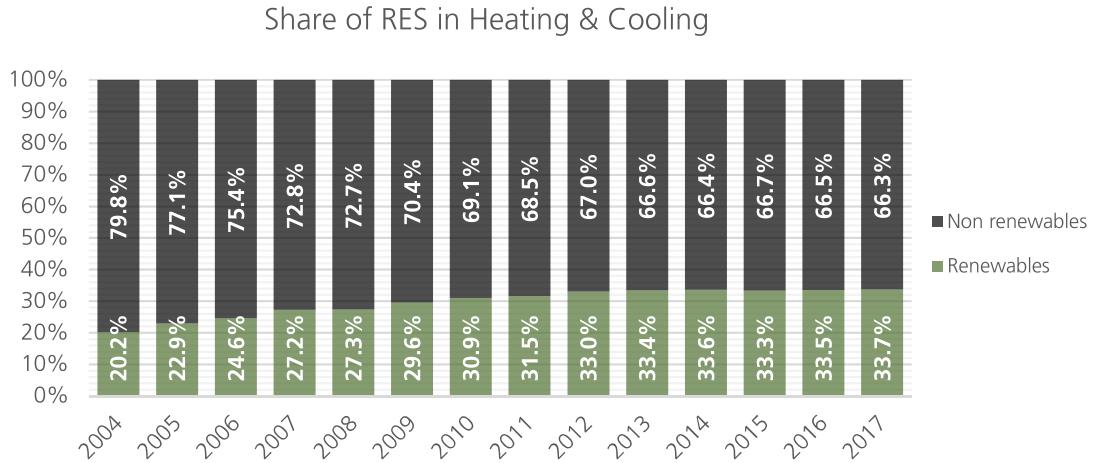
Measures in development

Measures in place

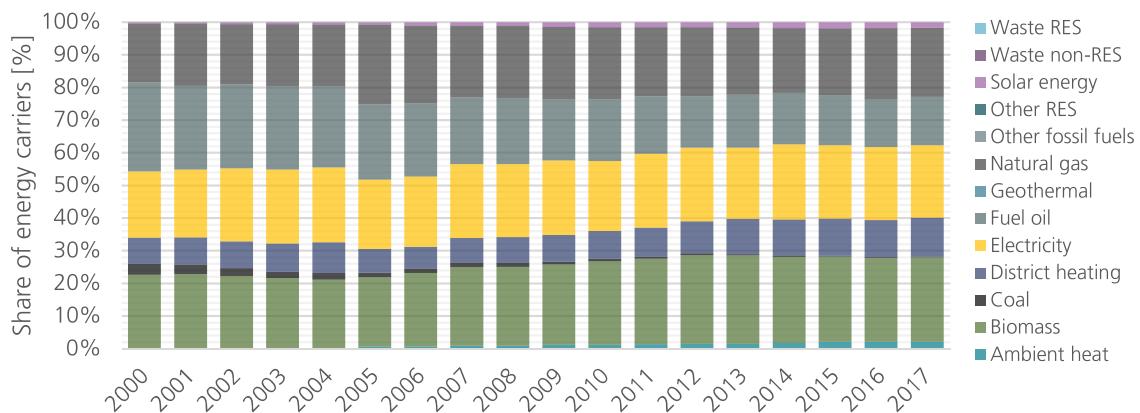
Historical trends

Austria 2017

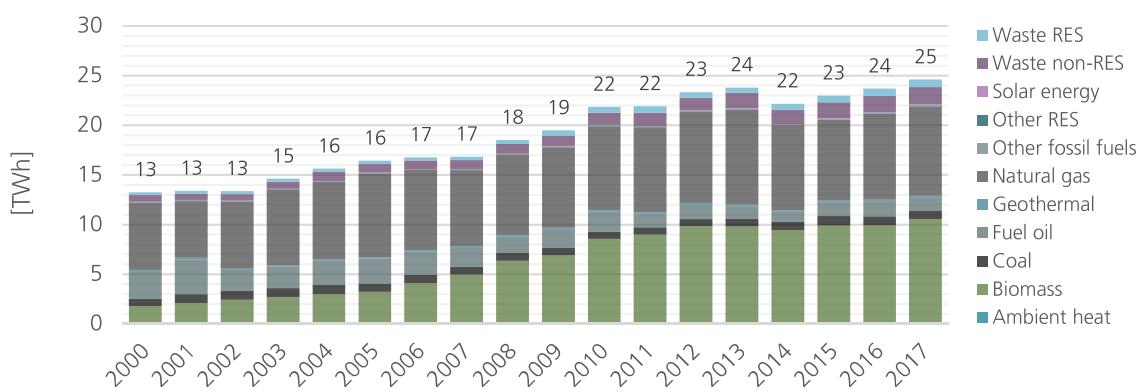
13



Final energy consumption in residential sector



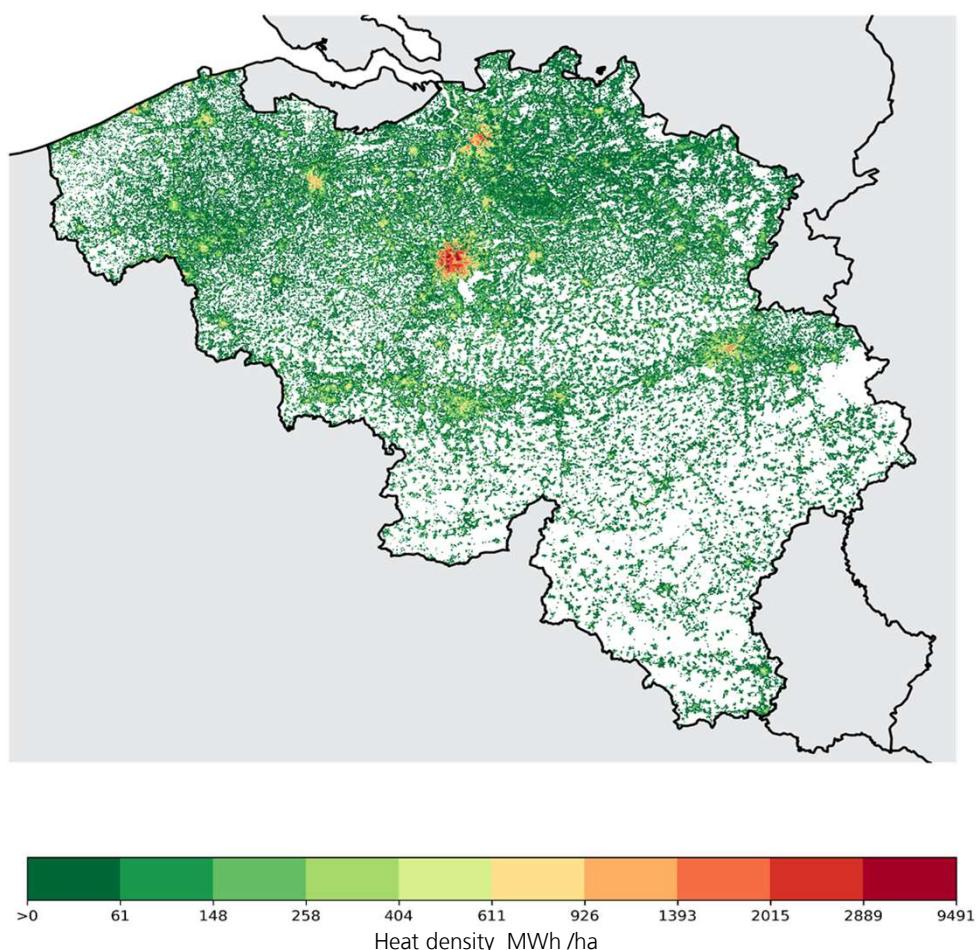
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Belgium



Fraunhofer
ISI

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

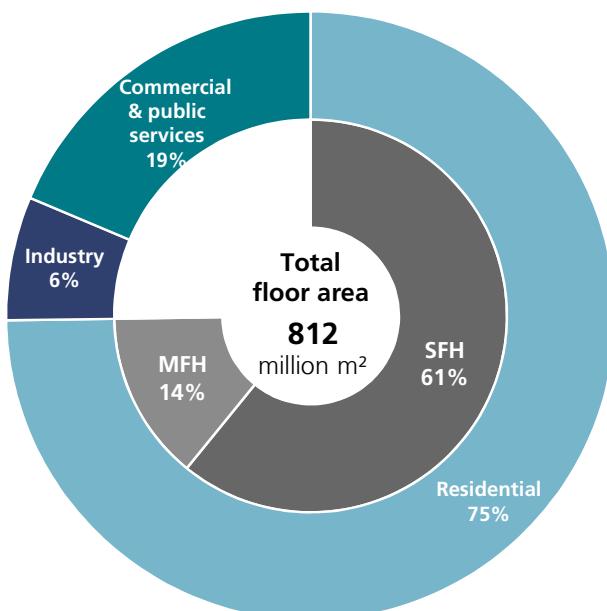
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

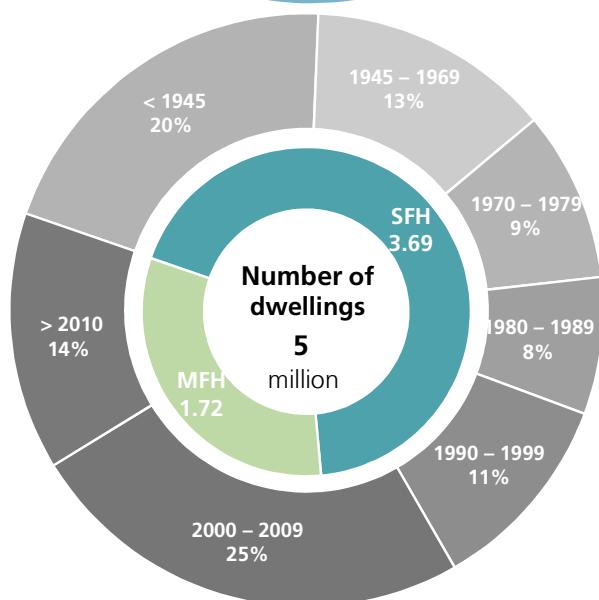
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Belgium 2017

5



Climate Data

Heating degree days

Belgium

EU-27

Average value 2000-2017

2663

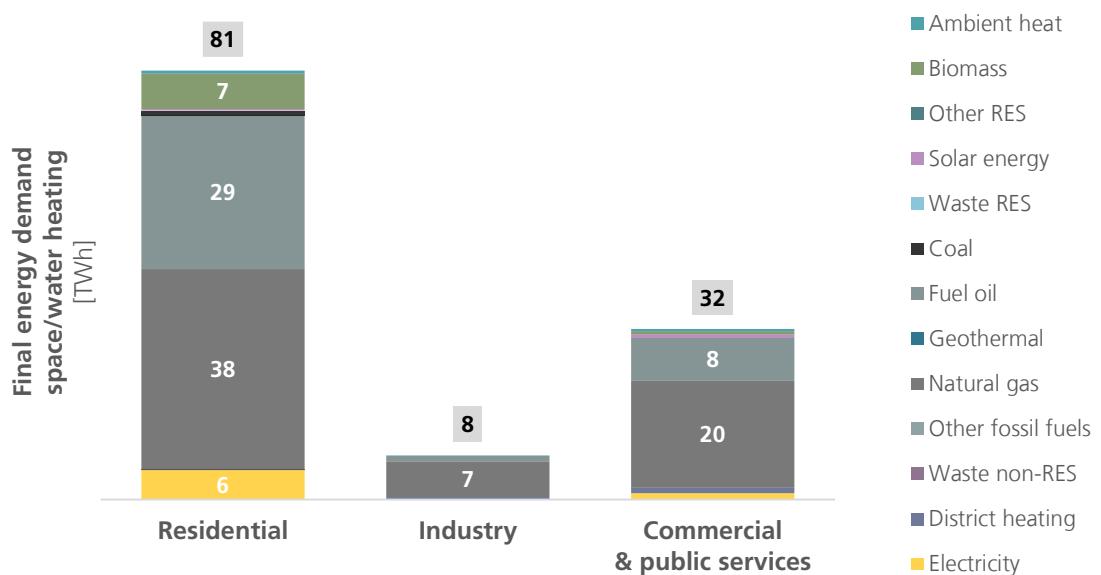
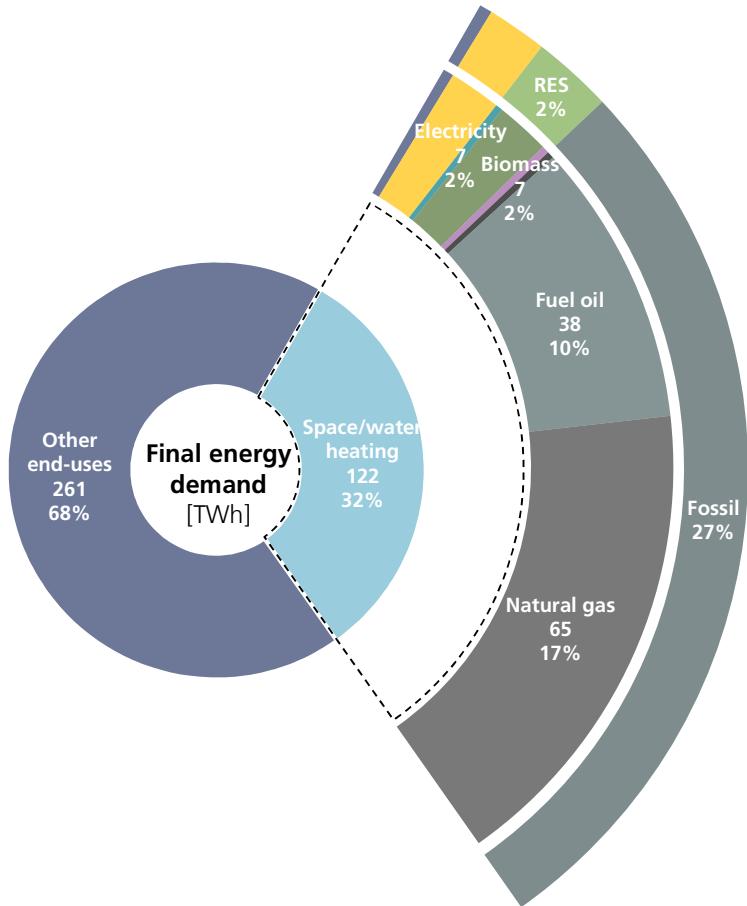
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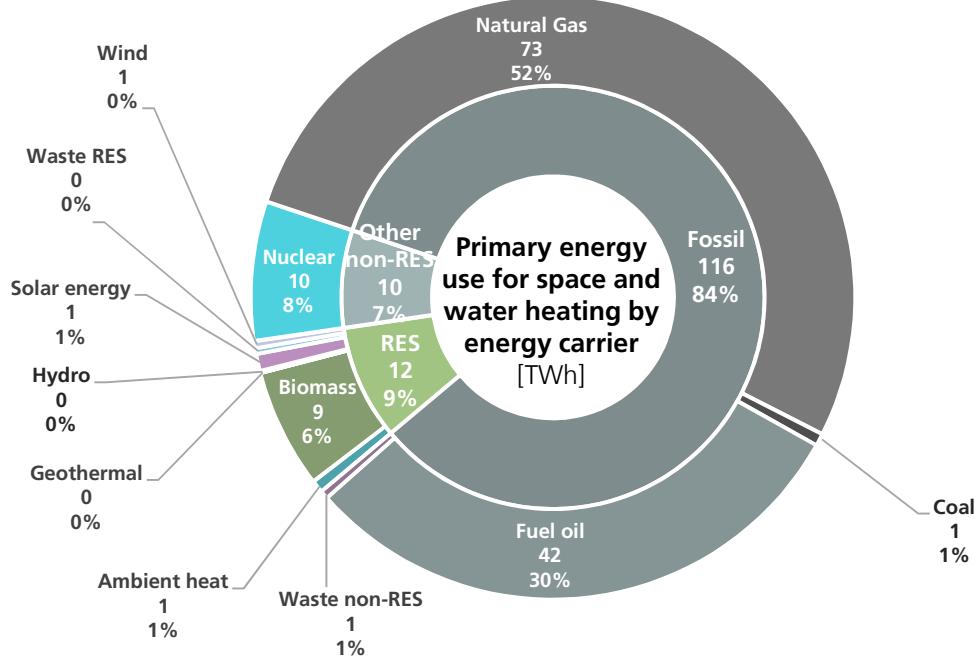
Overview of energy demand

Belgium 2017

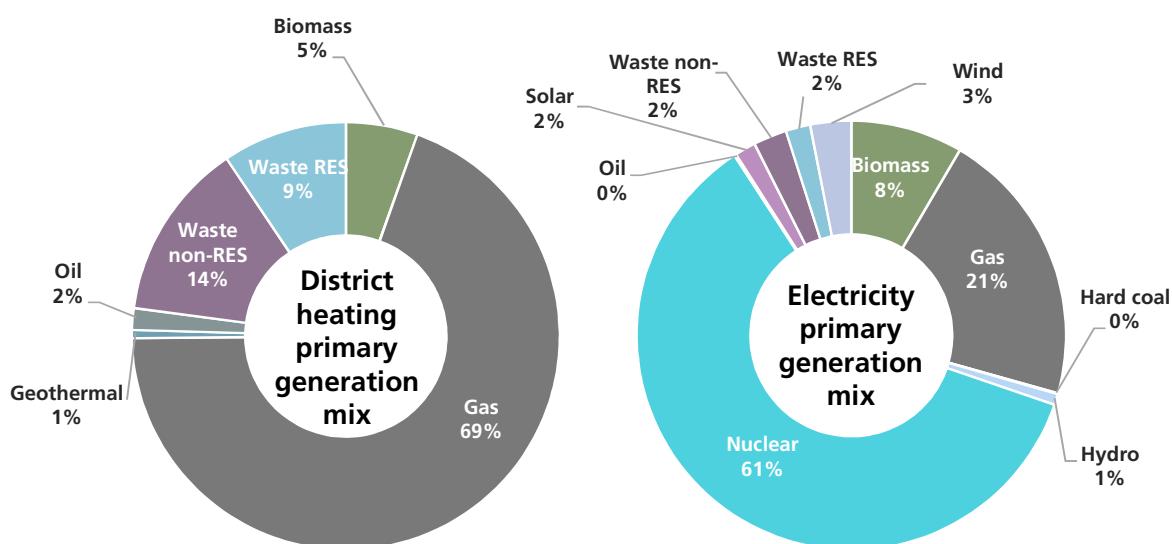
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- Ambient heat
- Biomass
- Other RES
- Solar energy
- Waste RES
- Coal
- Fuel oil
- Geothermal
- Natural gas
- Other fossil
- Waste non-RES
- District heating
- Electricity
- RES
- Fossil





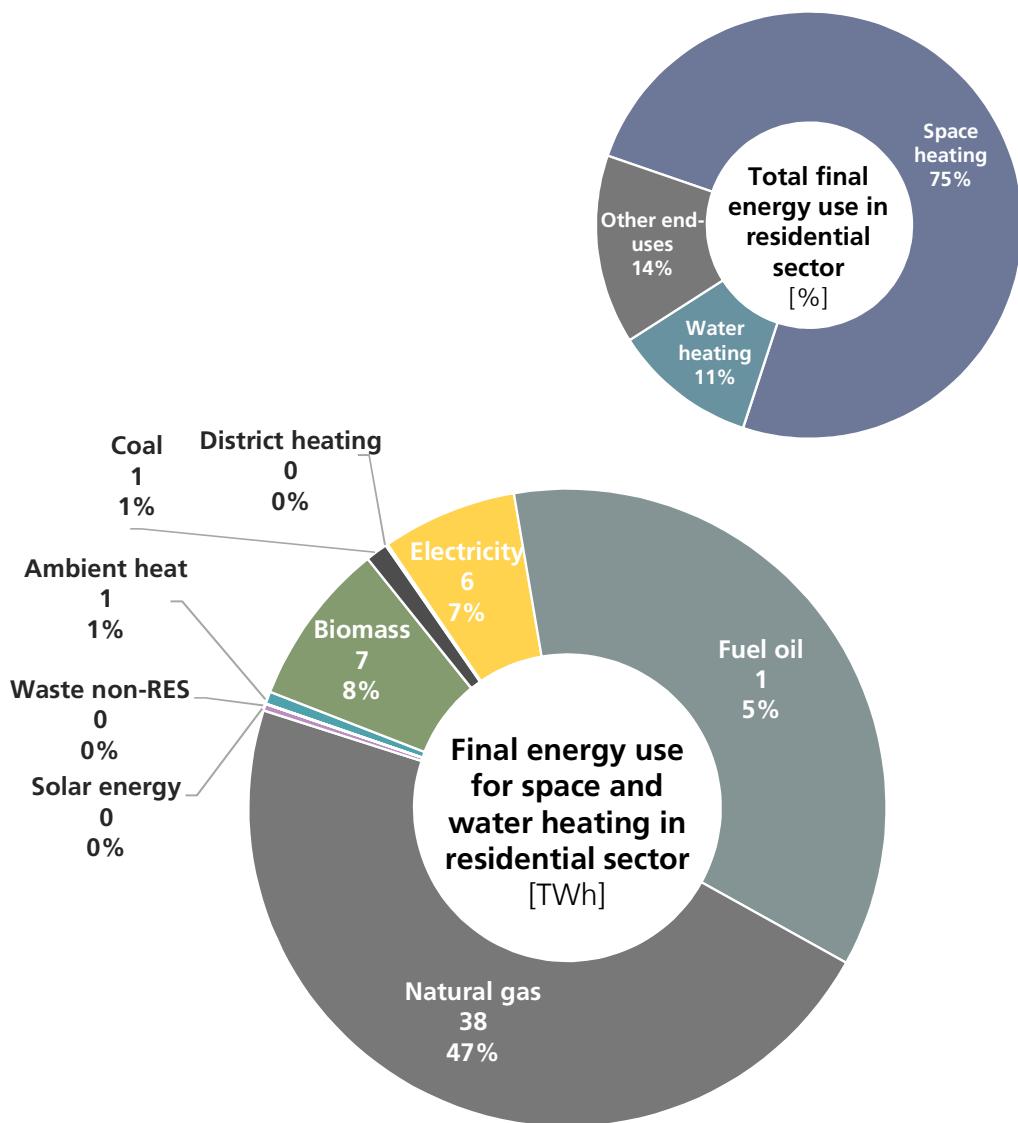
Generation mix



Space & water heating in residential sector

Belgium 2017

8



Specific energy demand

134

kWh/m²yr

Final energy demand

155

kWh/m²yr

Primary energy demand

151

kWh/m²yr

Single-family dwellings

173

kWh/m²yr

Single-family dwellings

61

kWh/m²yr

Multi-family dwellings

76

kWh/m²yr

Multi-family dwellings

Technology mix

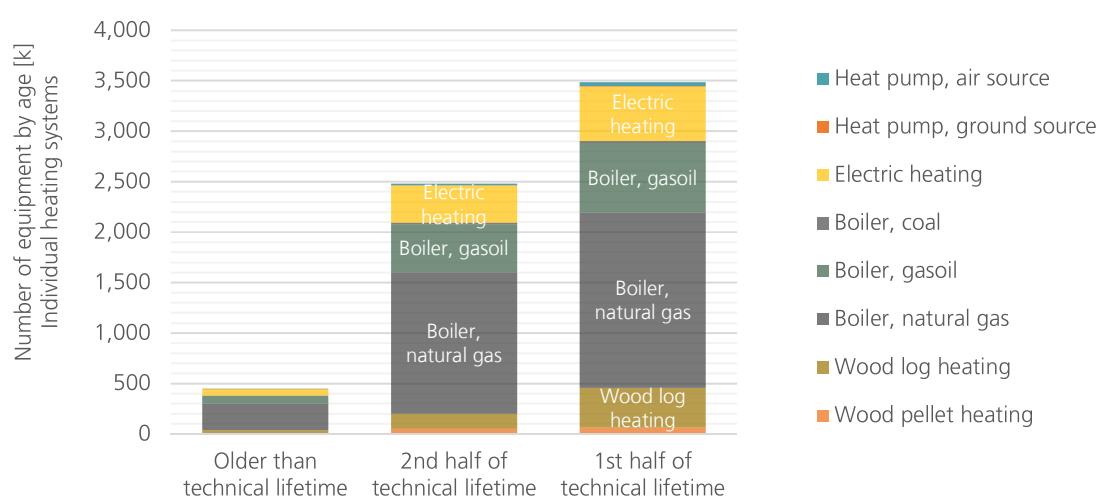
Belgium 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	55	4%	32%	64%	3.8	0.4
Heat pump ground source	13	4%	32%	65%	3.7	0.1
Solar thermal	770*	3%	27%	70%	0.5	0.5
Electric heating	969	7%	38%	56%	1.0	1.0
Boiler, coal	36	8%	41%	51%	0.8	0.5
Boiler, gasoil	1,240	6%	38%	55%	0.9	29.3
Boiler, natural gas	3,407	8%	41%	51%	1.0	111.9
Wood log heating	572	5%	26%	69%	0.7	6.8
Wood pellet heating	123	8%	41%	51%	0.8	1.6

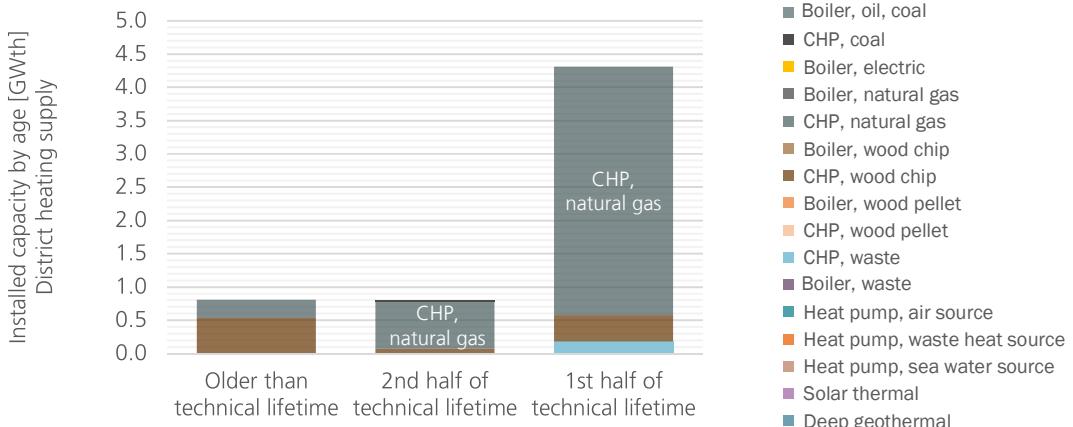
* unit 1000 m²

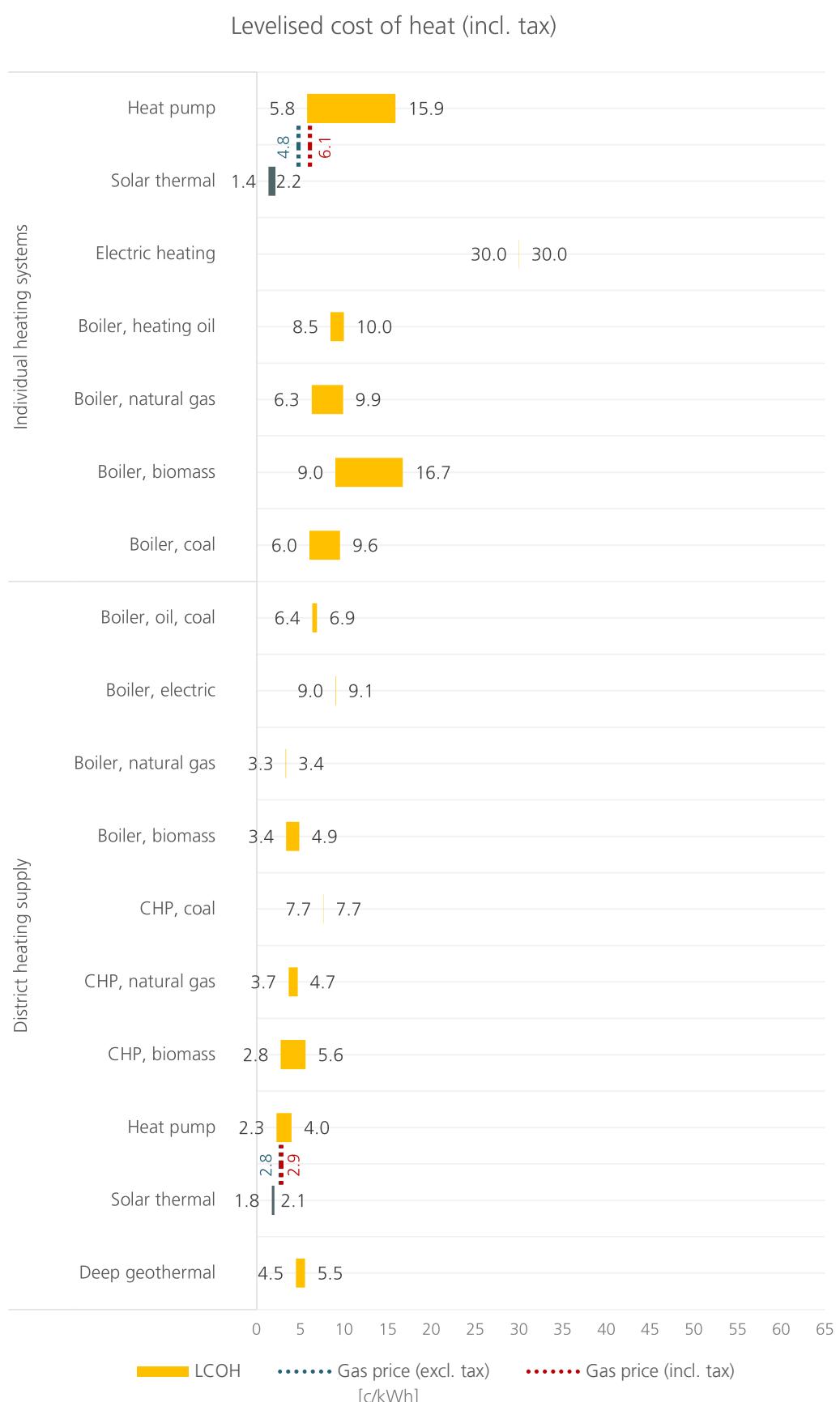
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	1	0%	100%	0%	0.5	0.0
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	317	14%	40%	46%	0.4	4.7
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	12	8%	8%	83%	0.9	1.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	6	0%	0%	100%	0.8	0.2
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	3.4	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	3.3	-
Solar thermal	-	-	-	-	0.5	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Yellow
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO2 pricing	
CO2 pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
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Trigger point: Major renovation	Yellow
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RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
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Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
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Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Yellow
New installations in existing buildings	Yellow
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Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

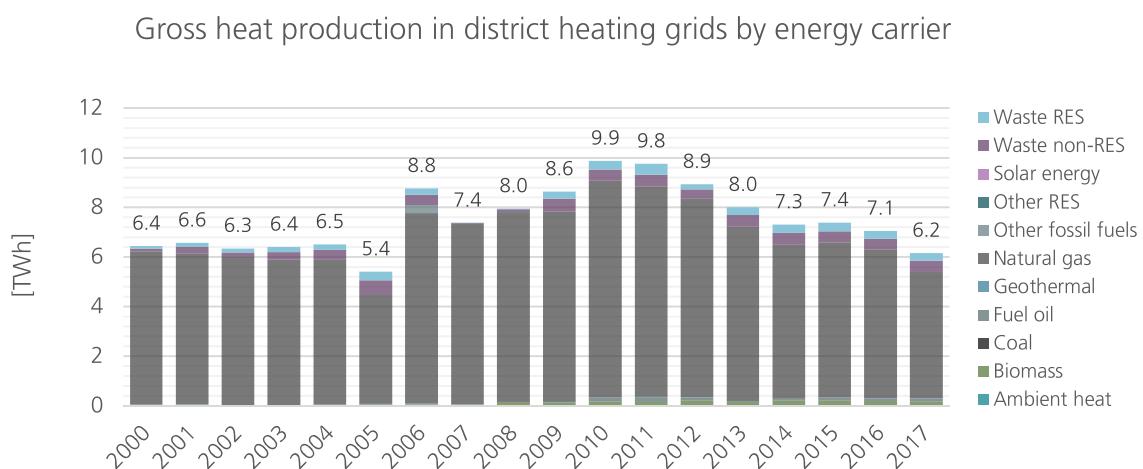
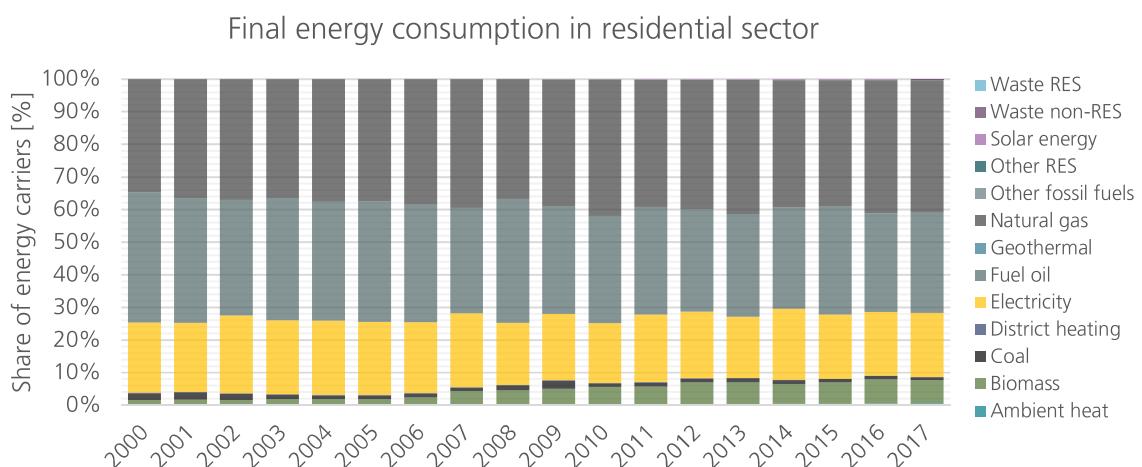
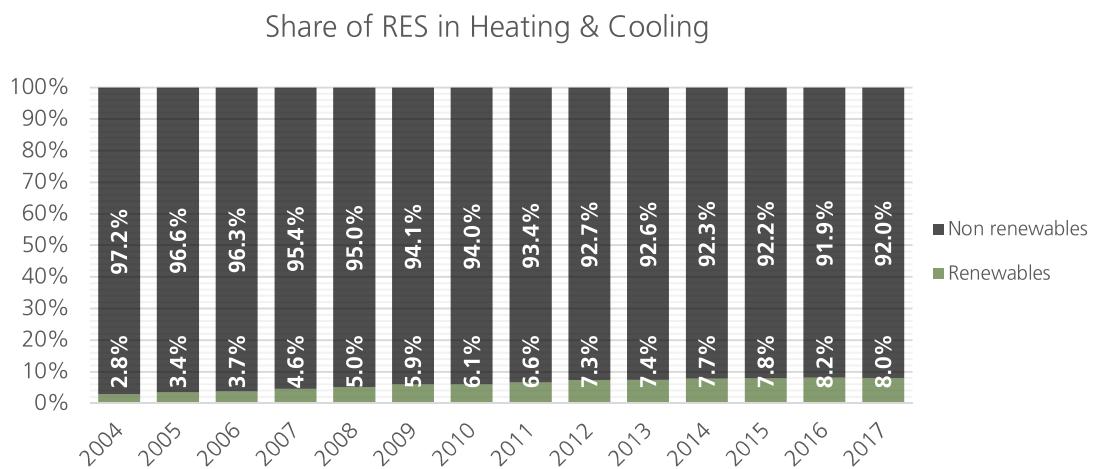
No measure

Measures in development

Measures in place

Historical trends

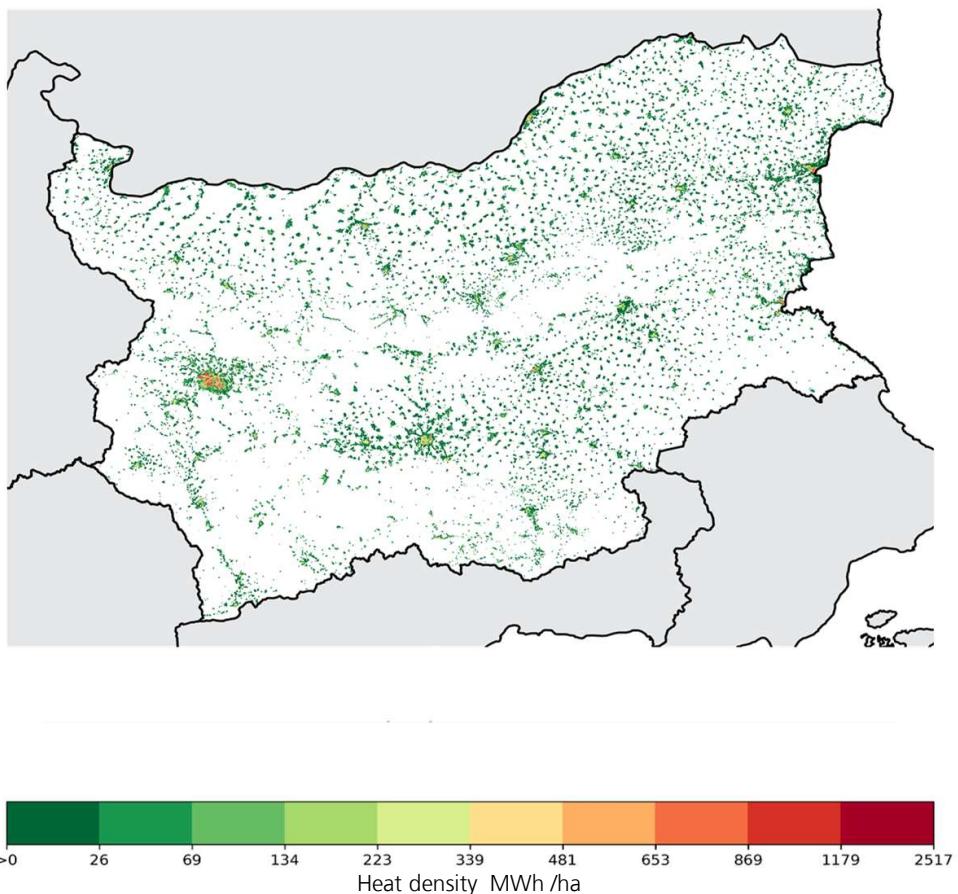
Belgium 2017
13



Space heating market summary

2017

Bulgaria



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

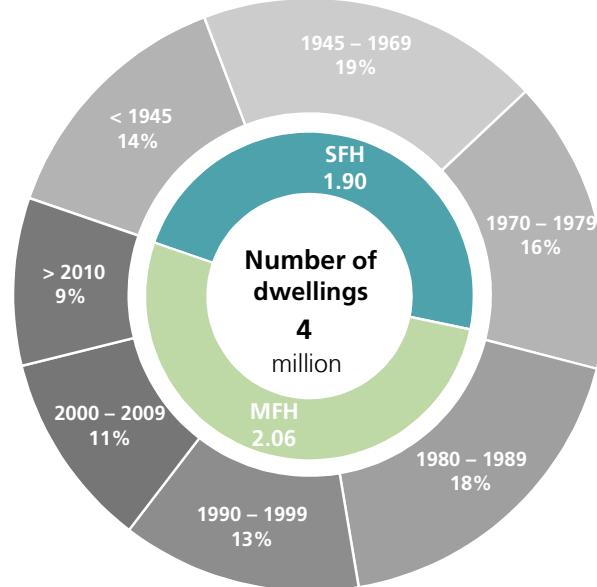
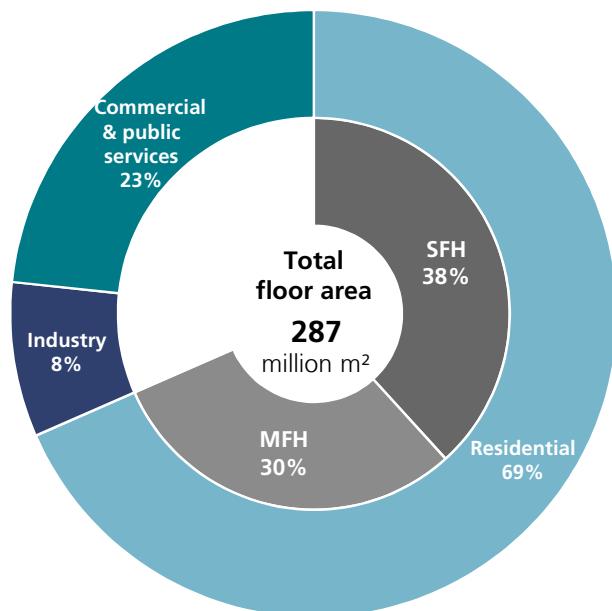
- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

Bulgaria 2017

5

SFH: Single family house
MFH: Multi-family house



Climate Data

Heating degree days

Bulgaria

EU-27

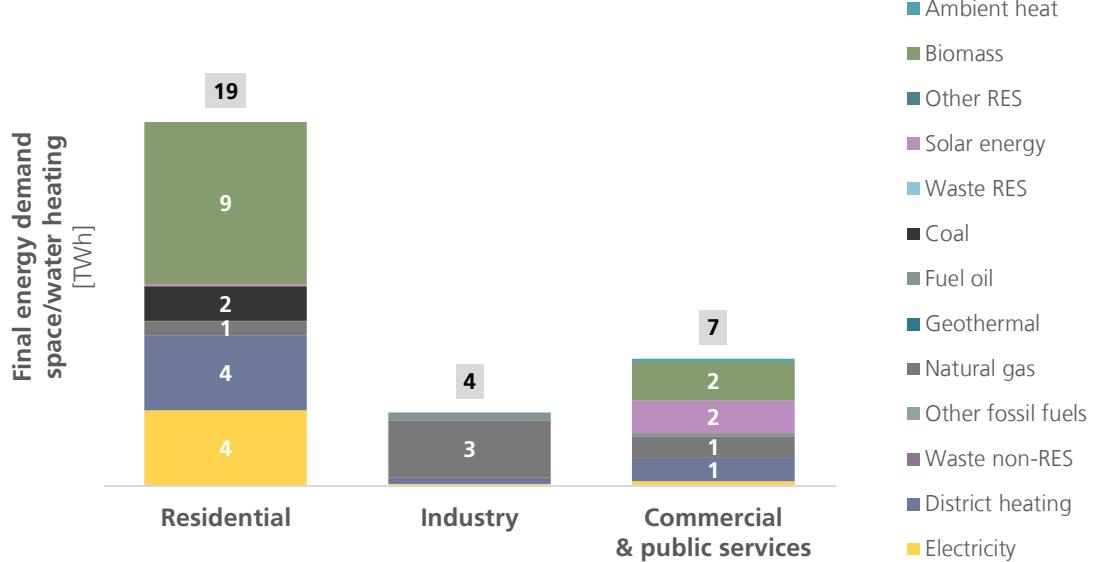
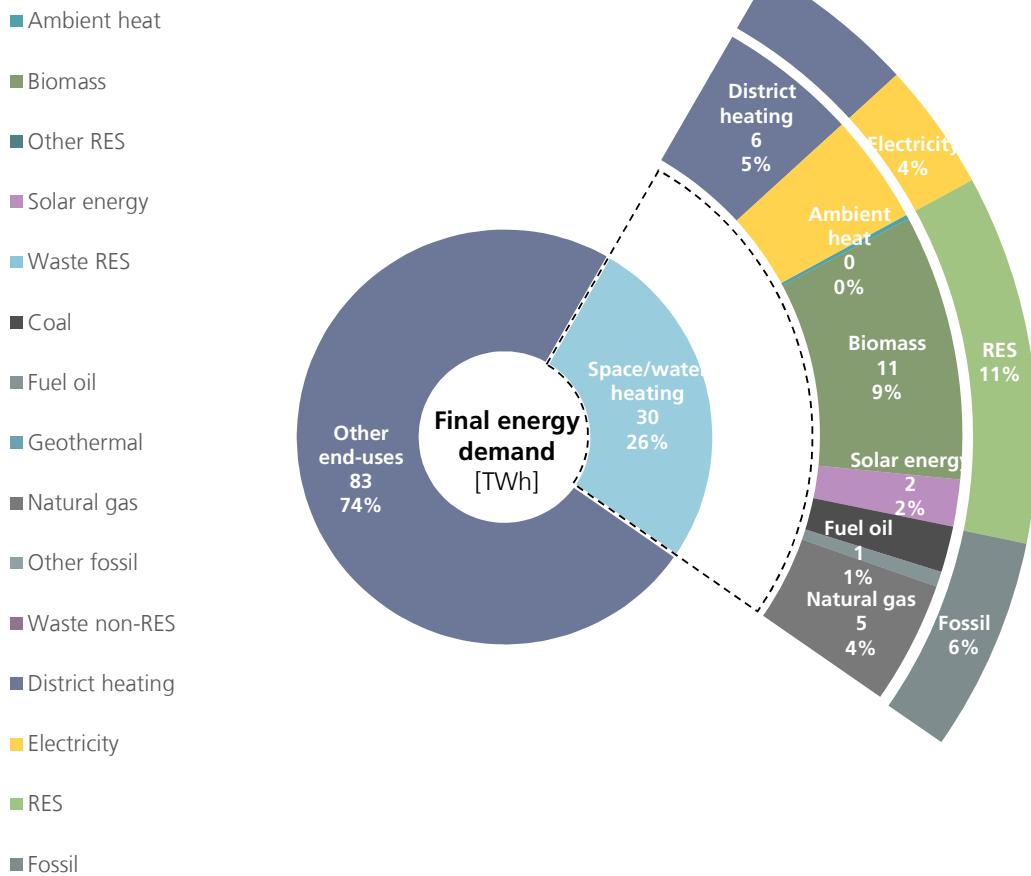
Average value 2000-2017

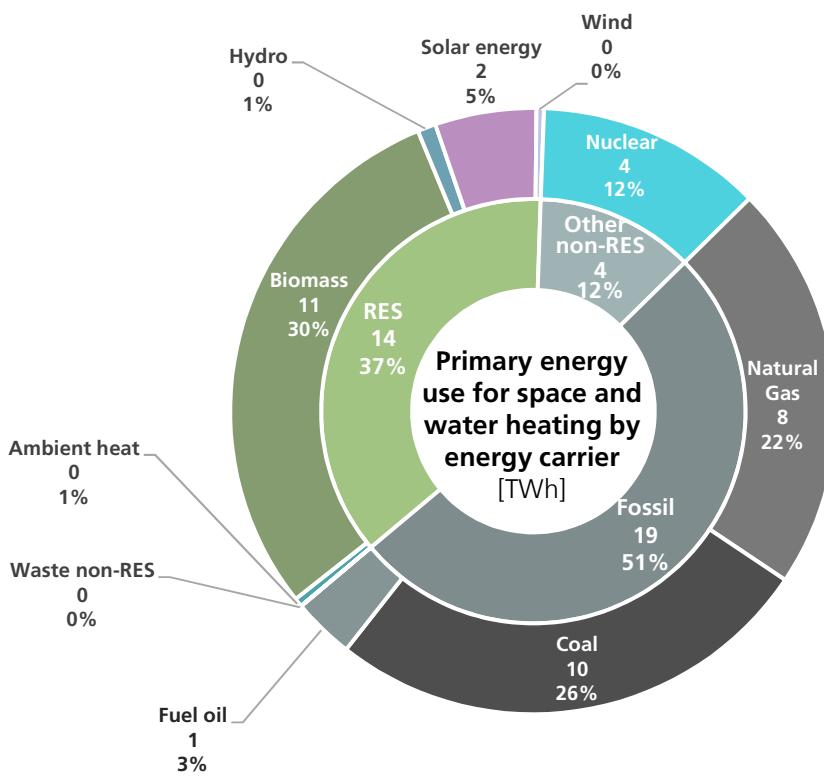
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3098

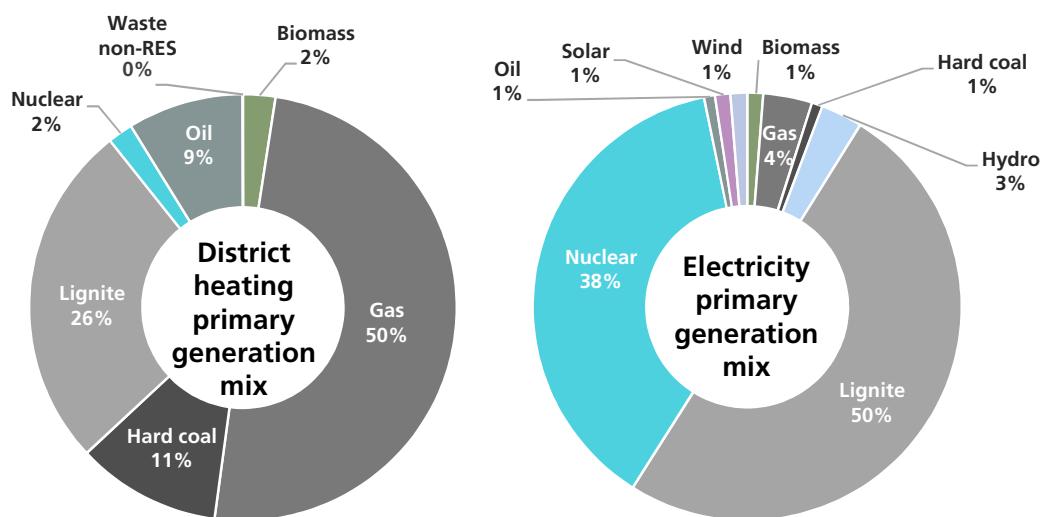
Overview of energy demand

Bulgaria 2017
6





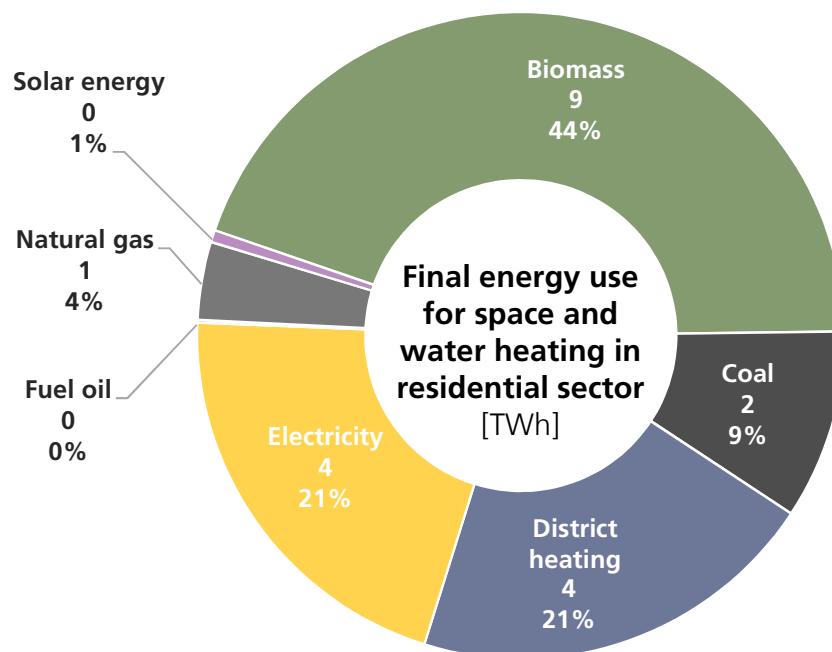
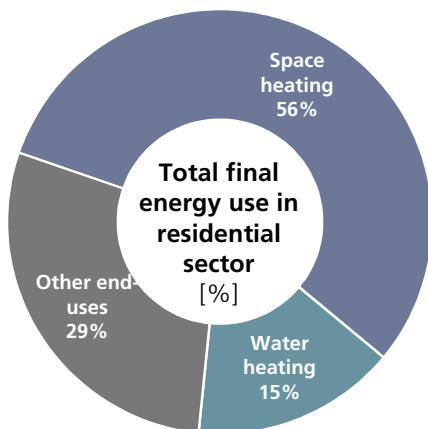
Generation mix



Space & water heating in residential sector

Bulgaria 2017

8



Specific energy demand

98

kWh/m²yr

Final energy demand

131

kWh/m²yr

Primary energy demand

121

kWh/m²yr

Single-family dwellings

153

kWh/m²yr

Single-family dwellings

69

kWh/m²yr

Multi-family dwellings

102

kWh/m²yr

Multi-family dwellings

Technology mix

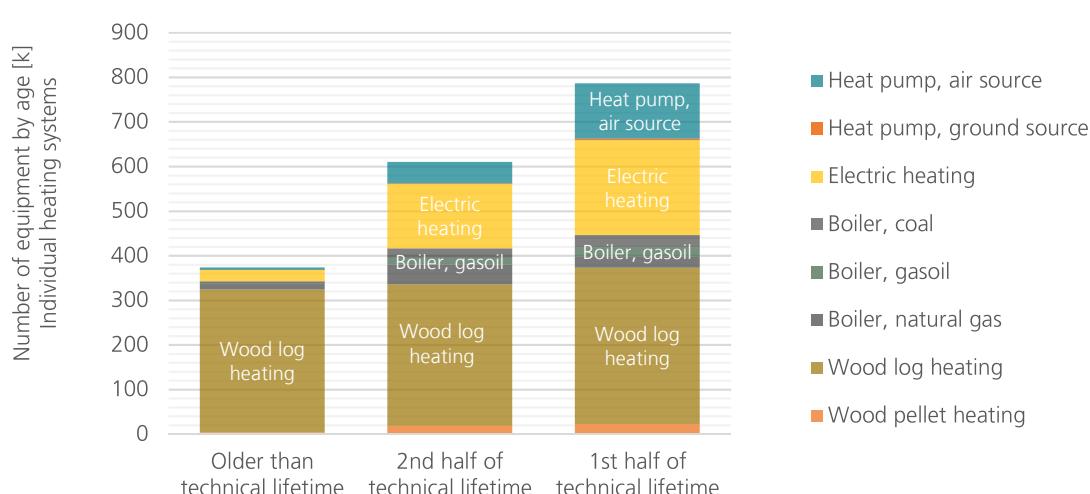
Bulgaria 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Individual heating systems	Heat pump air source	177	3%	27%	70%	3.3
	Heat pump ground source	5	3%	27%	70%	3.5
	Solar thermal	398*	3%	27%	70%	0.5
	Electric heating	383	7%	38%	56%	1.0
	Boiler, coal	53	8%	41%	51%	0.8
	Boiler, gasoil	39	6%	38%	55%	0.9
	Boiler, natural gas	80	15%	55%	30%	1.0
	Wood log heating	988	32%	32%	35%	0.7
	Wood pellet heating	45	8%	41%	51%	0.8

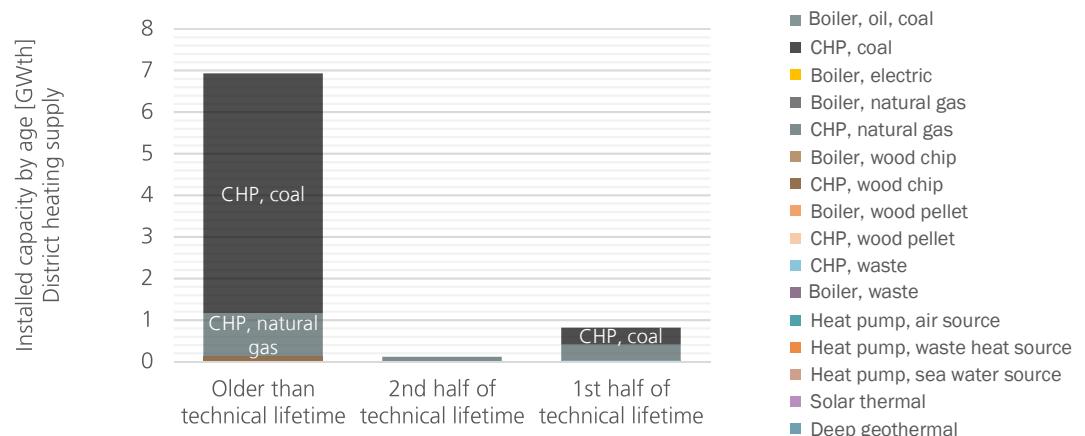
* unit 1000 m²

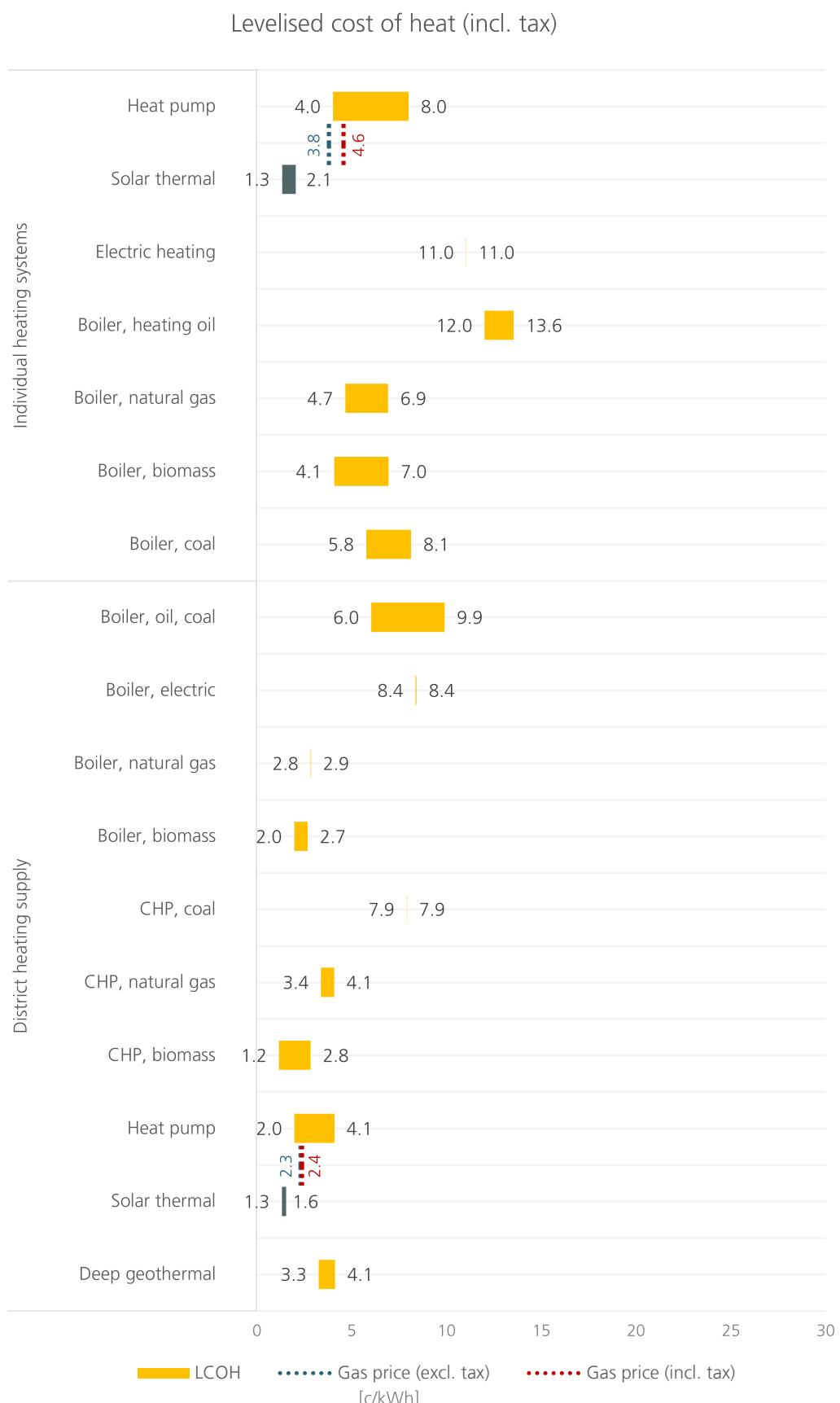
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	25	76%	0%	24%	0.5	6.2
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	57	44%	4%	53%	0.4	1.5
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	2	100%	0%	0%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	1	0%	0%	100%	0.8	0.0
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Bulgaria 2017

12

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO₂ pricing	
CO ₂ pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Green
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Red
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Red
New installations in existing buildings	Red
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

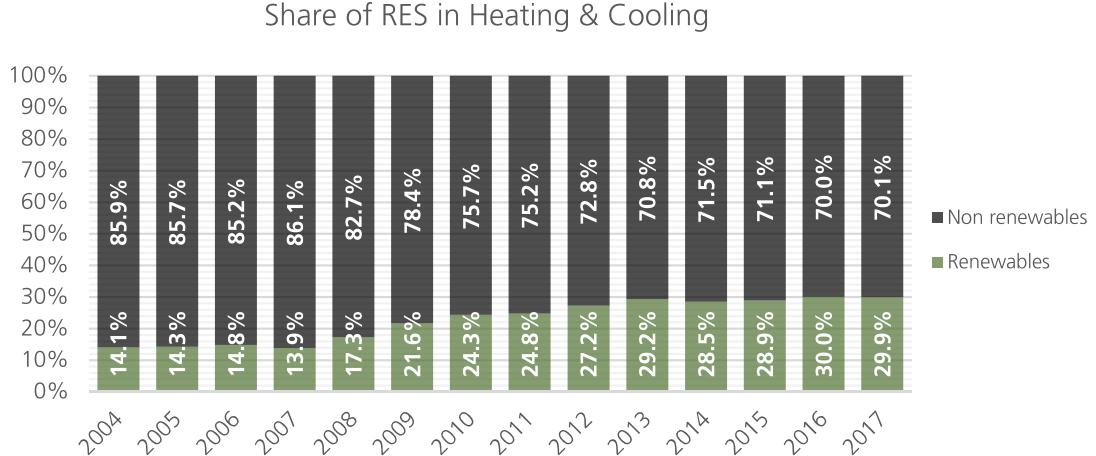
Measures in development

Measures in place

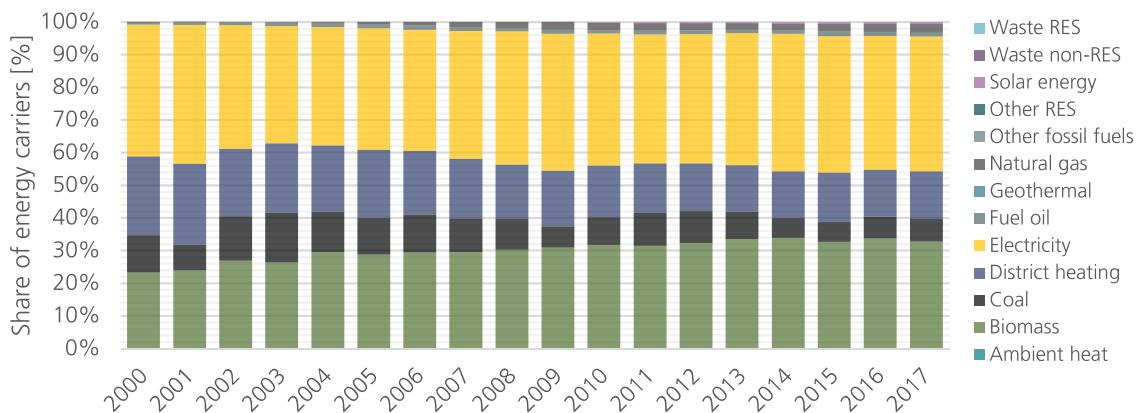
Historical trends

Bulgaria 2017

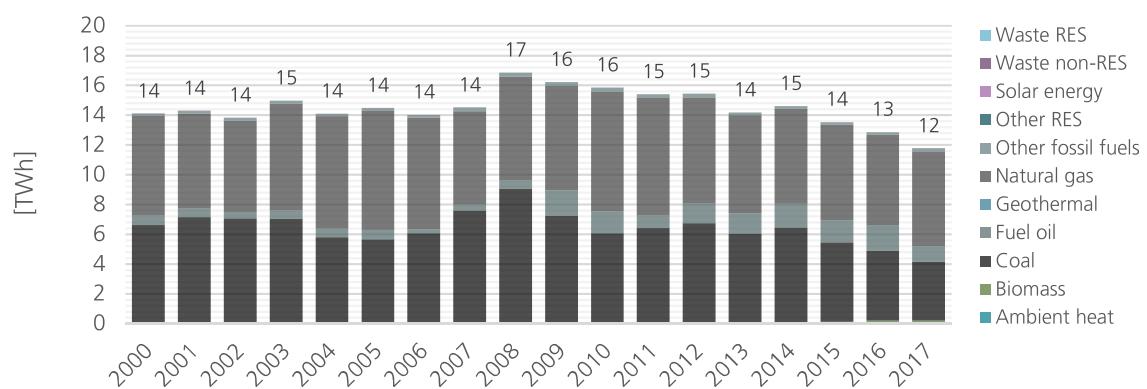
13



Final energy consumption in residential sector



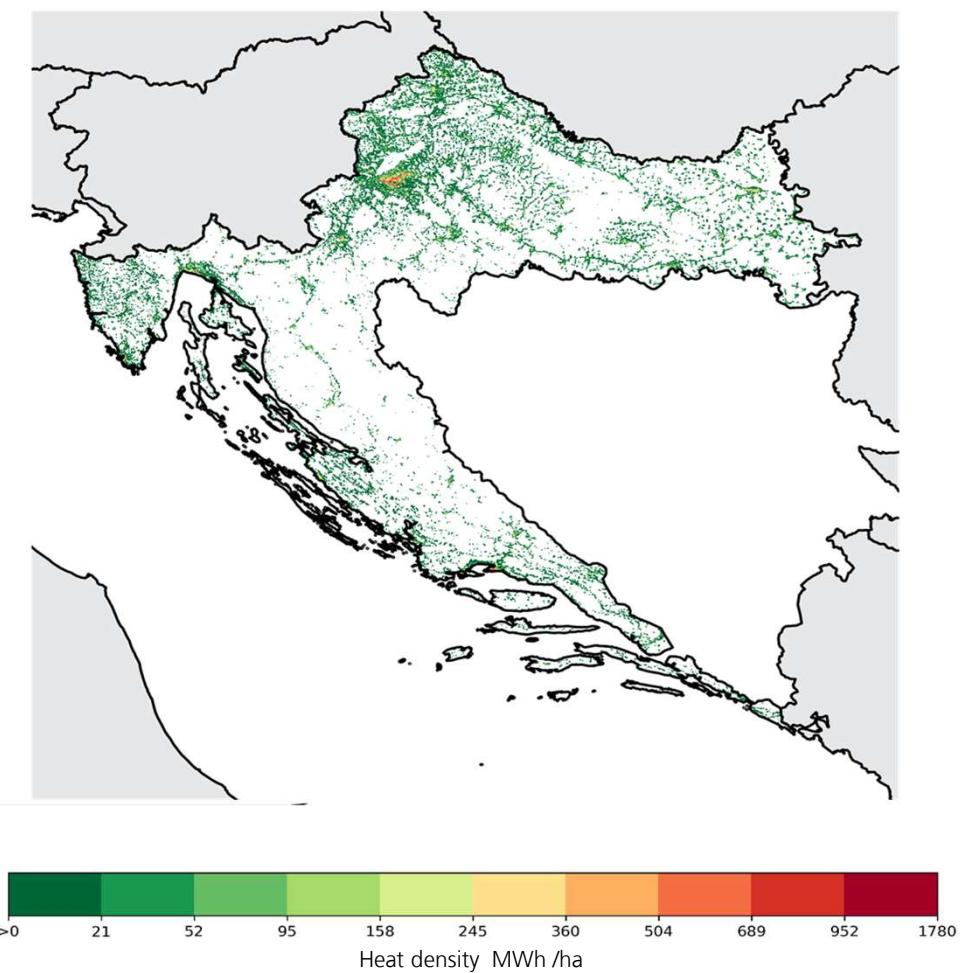
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Croatia



Fraunhofer
ISI

Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

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Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

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The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

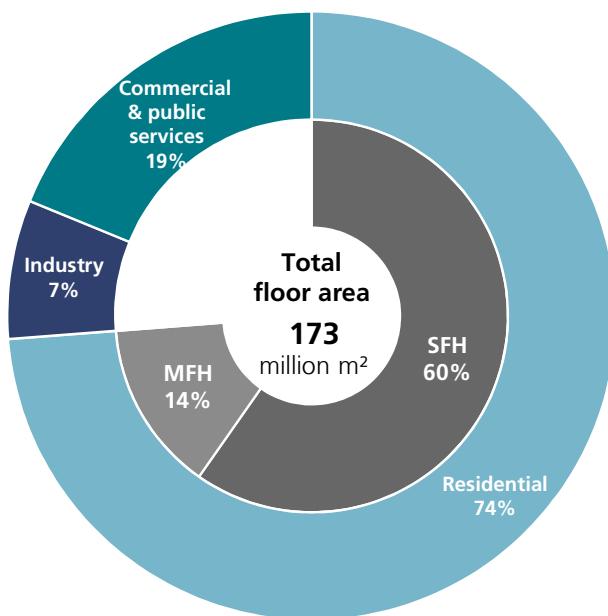
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
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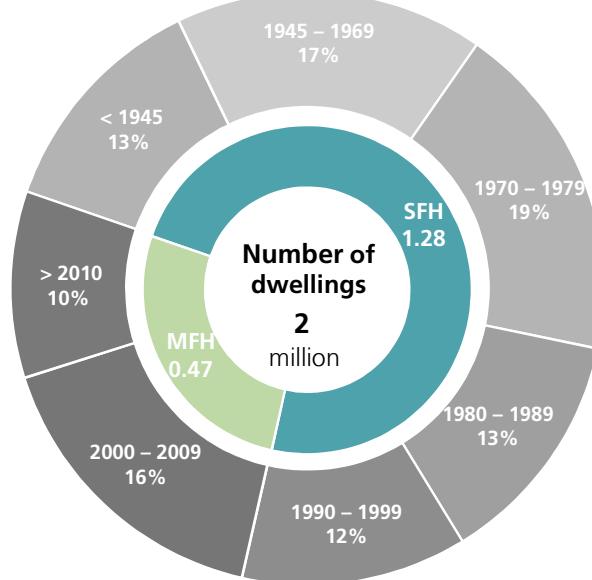
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Croatia 2017

5



Climate Data

Heating degree days

Croatia

EU-27

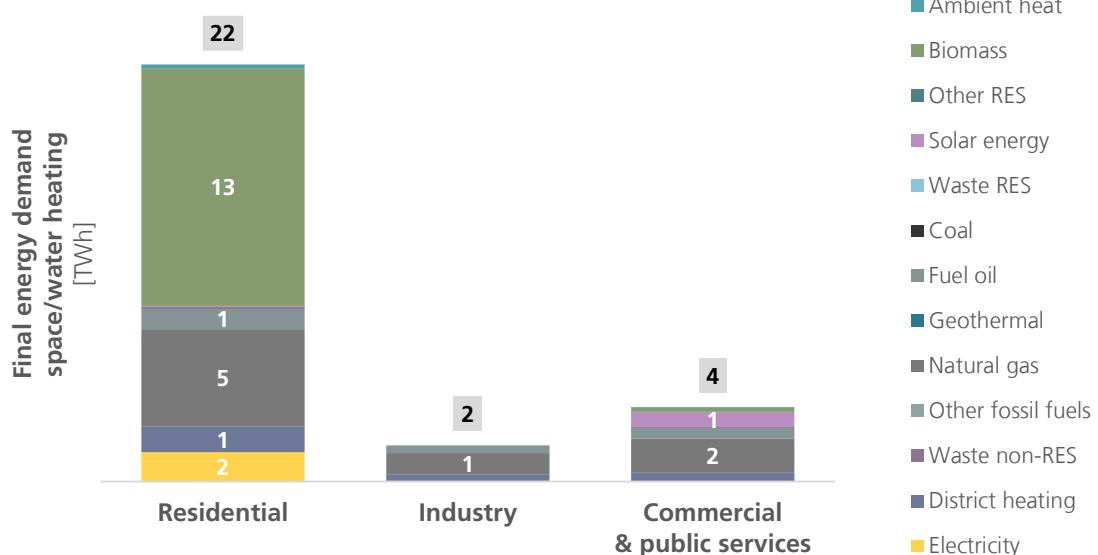
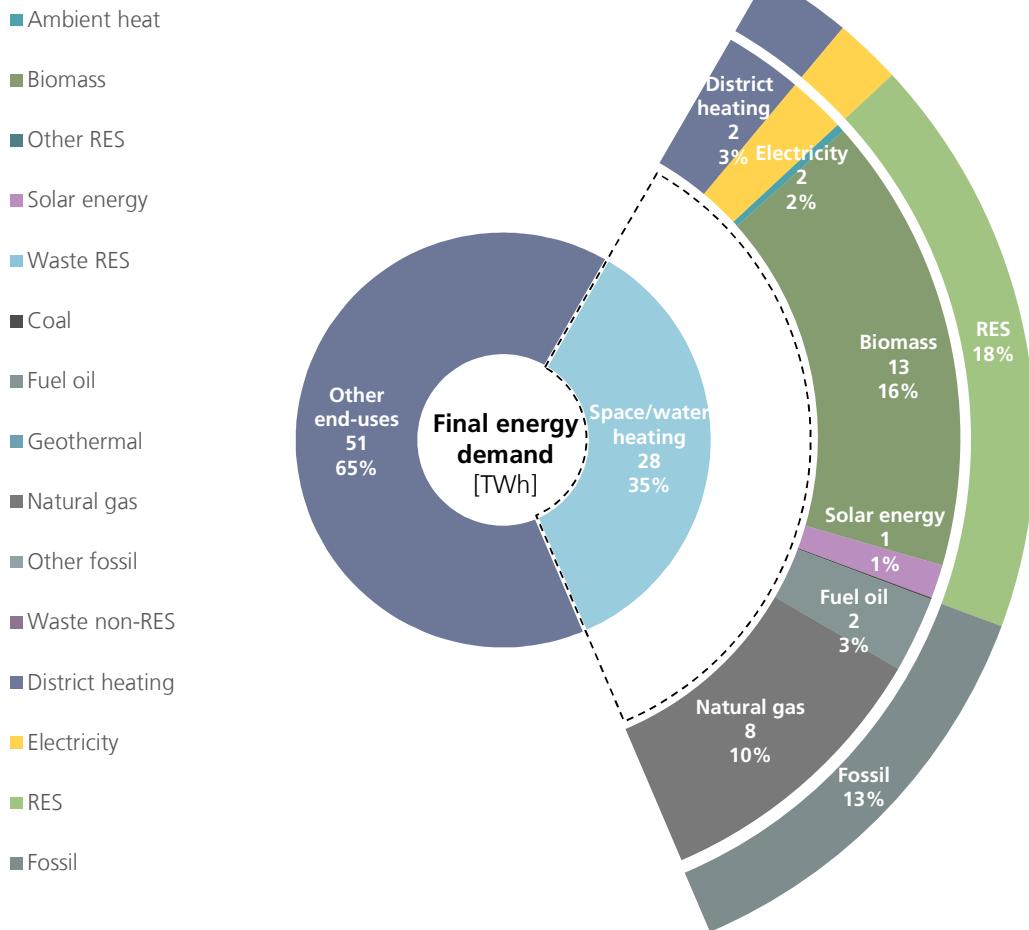
Average value 2000-2017

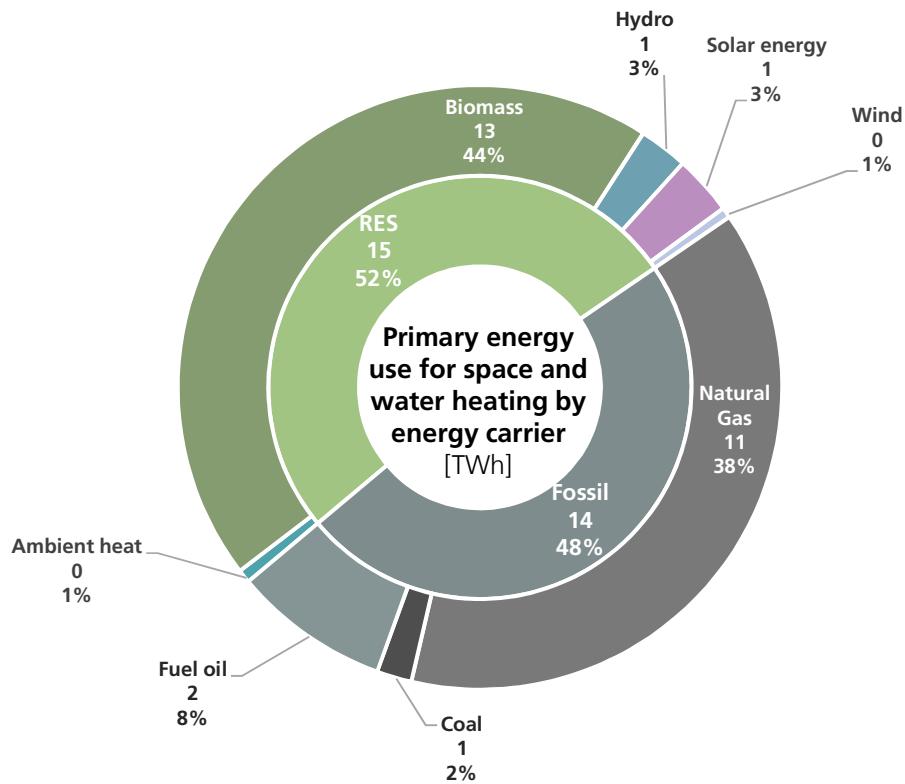
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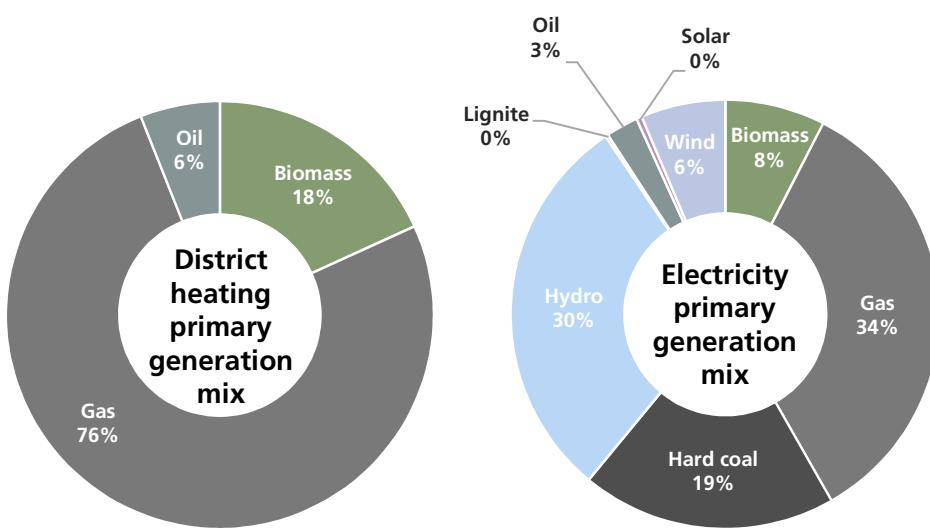
Overview of energy demand

Croatia 2017
6





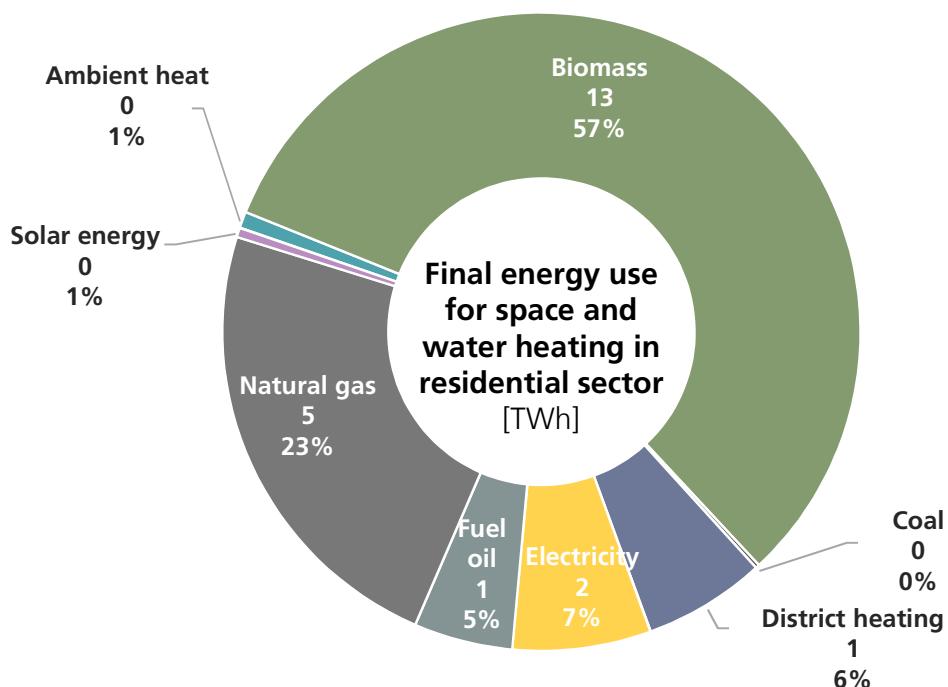
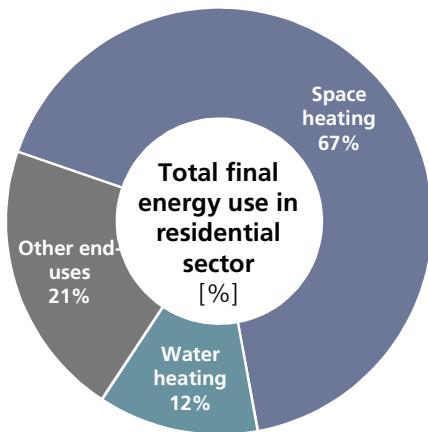
Generation mix



Space & water heating in residential sector

Croatia 2017

8



Specific energy demand

172

kWh/m²yr

Final energy demand

184

kWh/m²yr

Primary energy demand

178

kWh/m²yr

Single-family dwellings

148

kWh/m²yr

Multi-family dwellings

189

kWh/m²yr

Single-family dwellings

160

kWh/m²yr

Multi-family dwellings

Technology mix

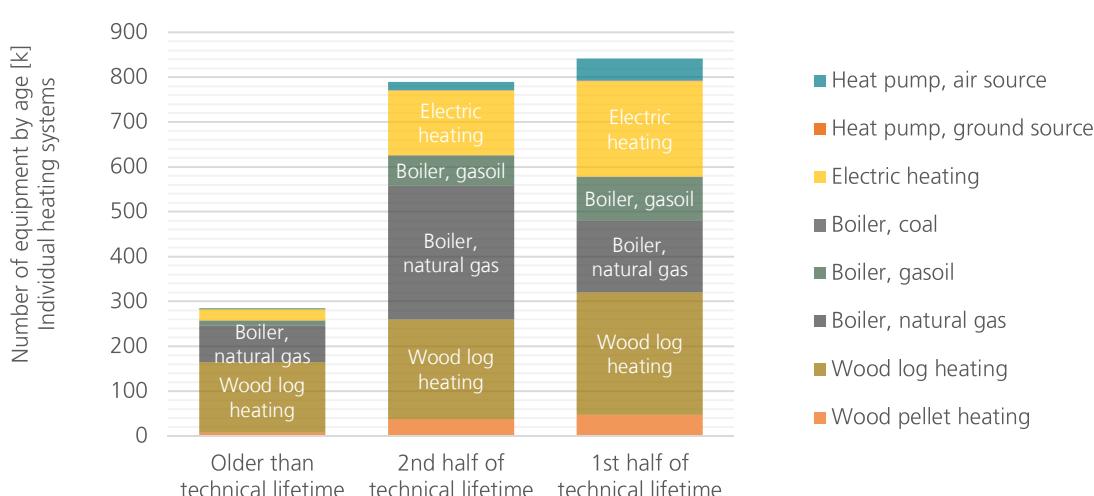
Croatia 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	70	3%	27%	70%	3.3	0.4
Heat pump ground source	2	3%	27%	70%	3.5	0.0
Solar thermal	249*	3%	27%	70%	0.5	0.2
Electric heating	383	7%	38%	56%	1.0	0.4
Boiler, coal	1	8%	41%	51%	0.8	0.0
Boiler, gasoil	176	6%	38%	55%	0.9	4.9
Boiler, natural gas	539	15%	55%	30%	1.0	10.9
Wood log heating	652	24%	34%	42%	0.7	10.6
Wood pellet heating	92	8%	41%	51%	0.8	3.8

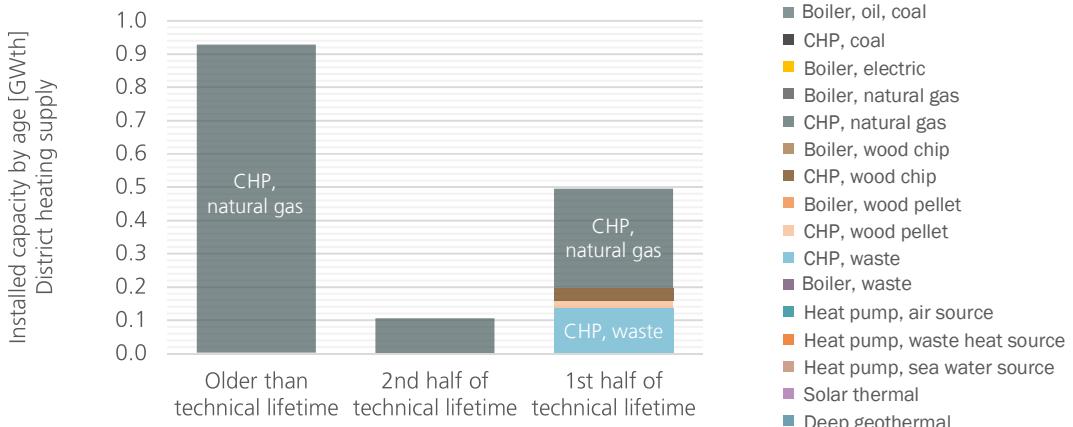
* unit 1000 m²

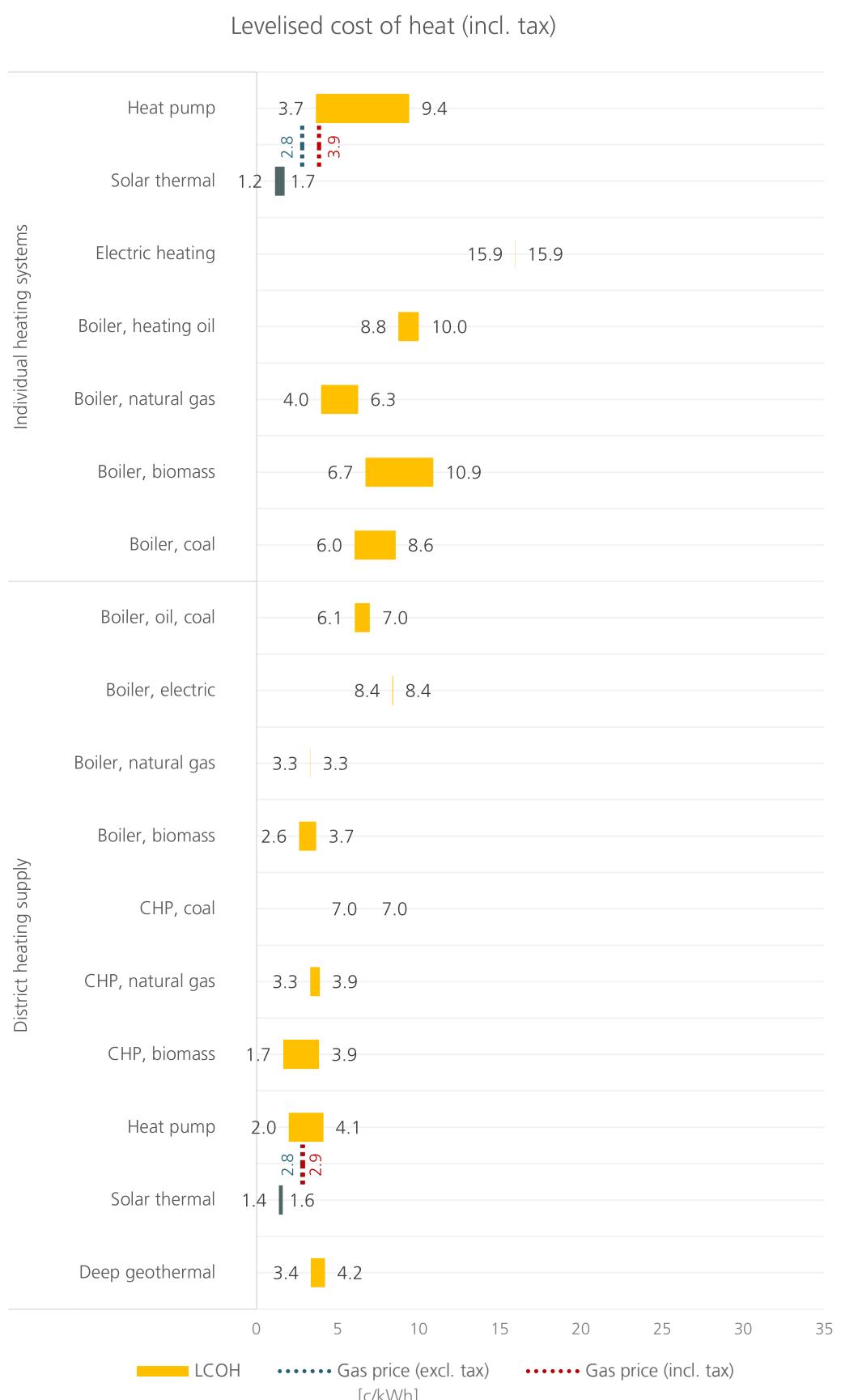
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	28	64%	11%	25%	0.4	1.3
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	2	0%	0%	100%	0.9	0.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	2	50%	0%	50%	0.7	0.0
CHP, waste	2	0%	0%	100%	0.8	0.1
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	
Financial support specifically addressing public buildings	
Scrapping schemes for heating equipment based on fossil fuels	
Financial support for energy efficiency investments	
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Heat incentives for central heating systems	
Heat incentives for decentral heating systems	
Energy- and CO₂ pricing	
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RES-H obligations	
RES-H obligation for new buildings	
RES-H obligation for existing buildings	
Trigger point: Major renovation	
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RES-quota for district heating	
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Energy efficiency requirements for new buildings	
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Trigger point: Efficiency class below certain level	
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	
New installations in existing buildings	
Use of fossil fuel heating technologies	
Phase-out for certain building segments (e.g. public buildings)	
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

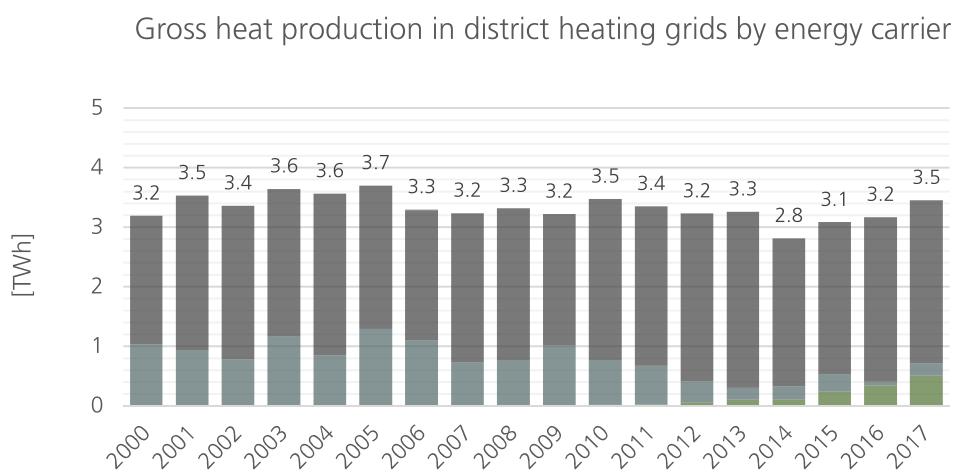
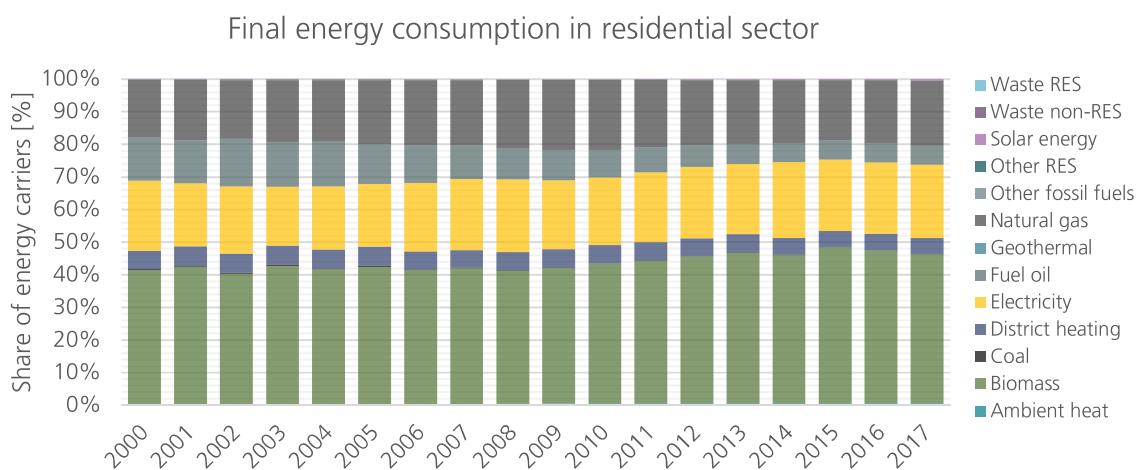
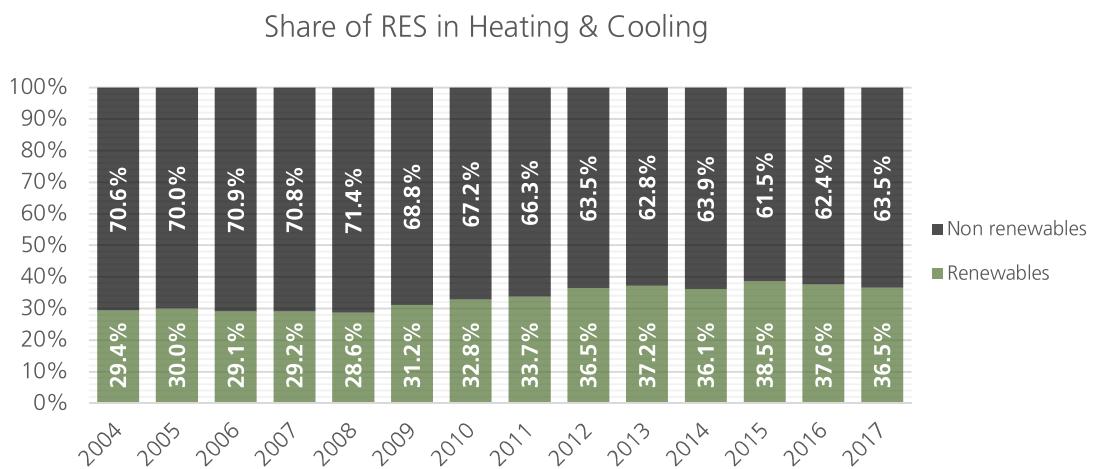
 No measure

 Measures in development

 Measures in place

Historical trends

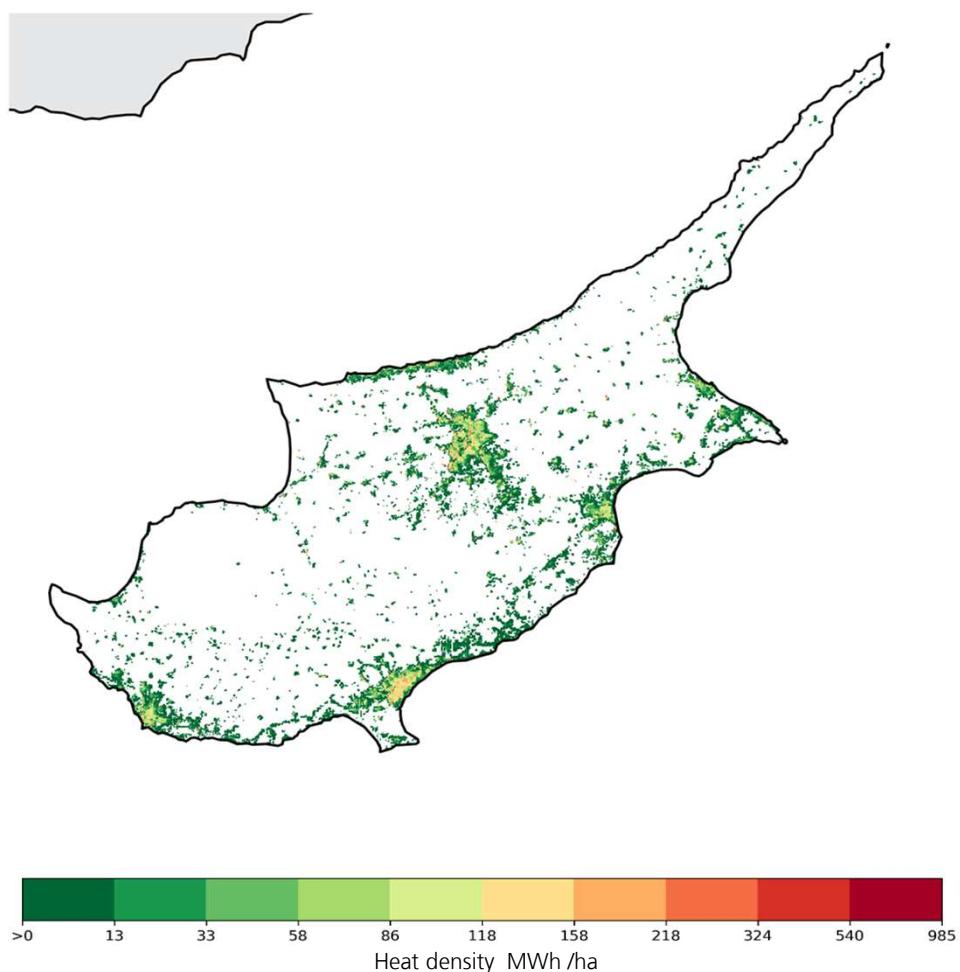
Croatia 2017
13



Space heating market summary

2017

Cyprus



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

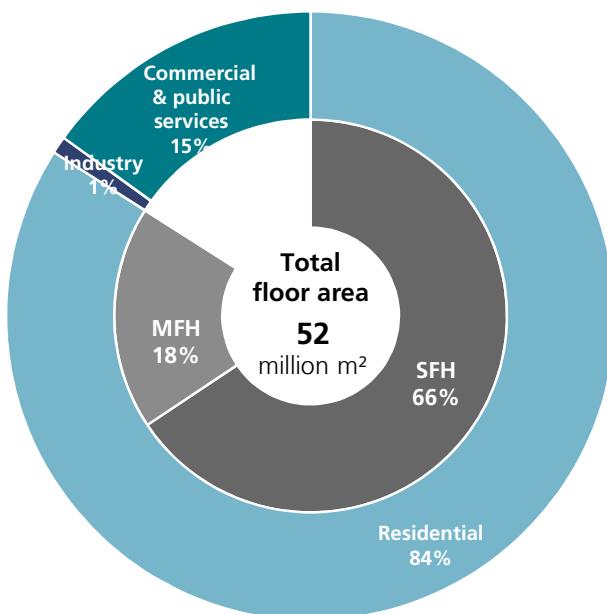
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.

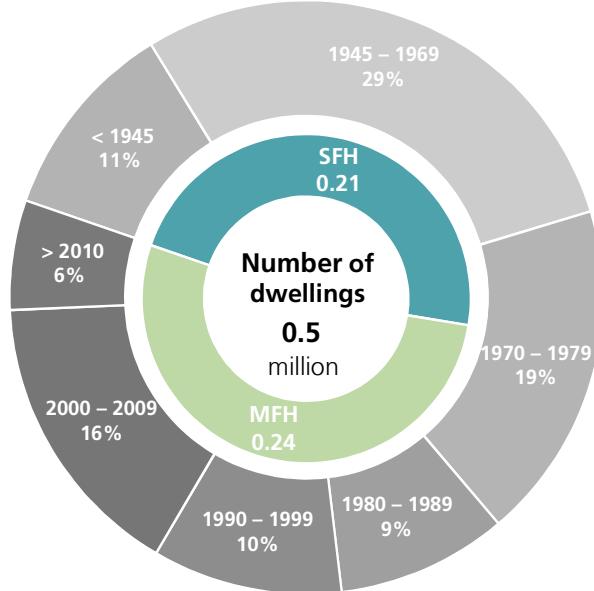
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Cyprus 2017

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Climate Data

Heating degree days

Cyprus

EU-27

Average value 2000-2017

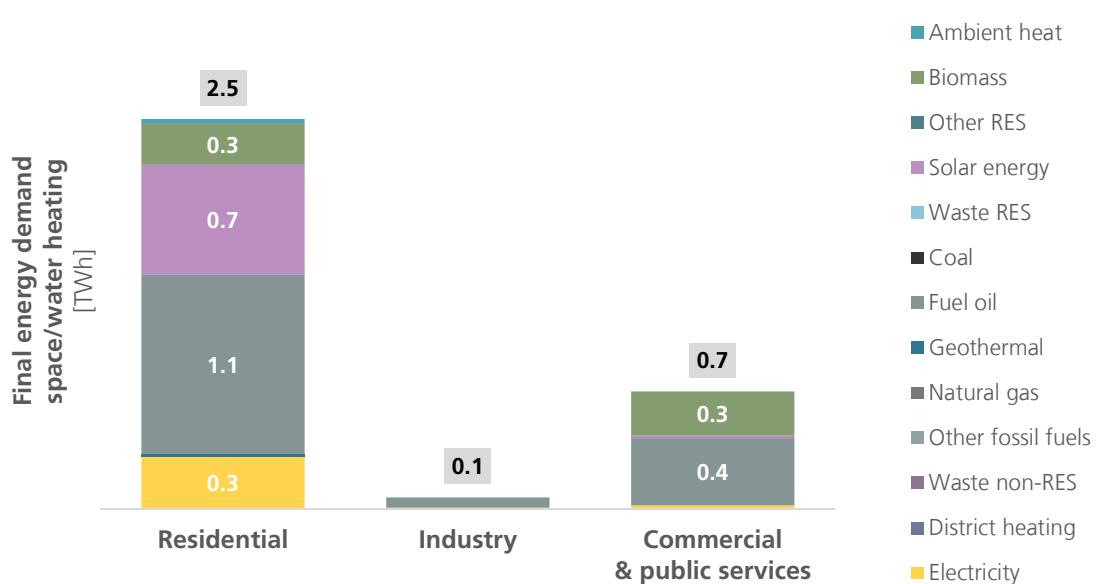
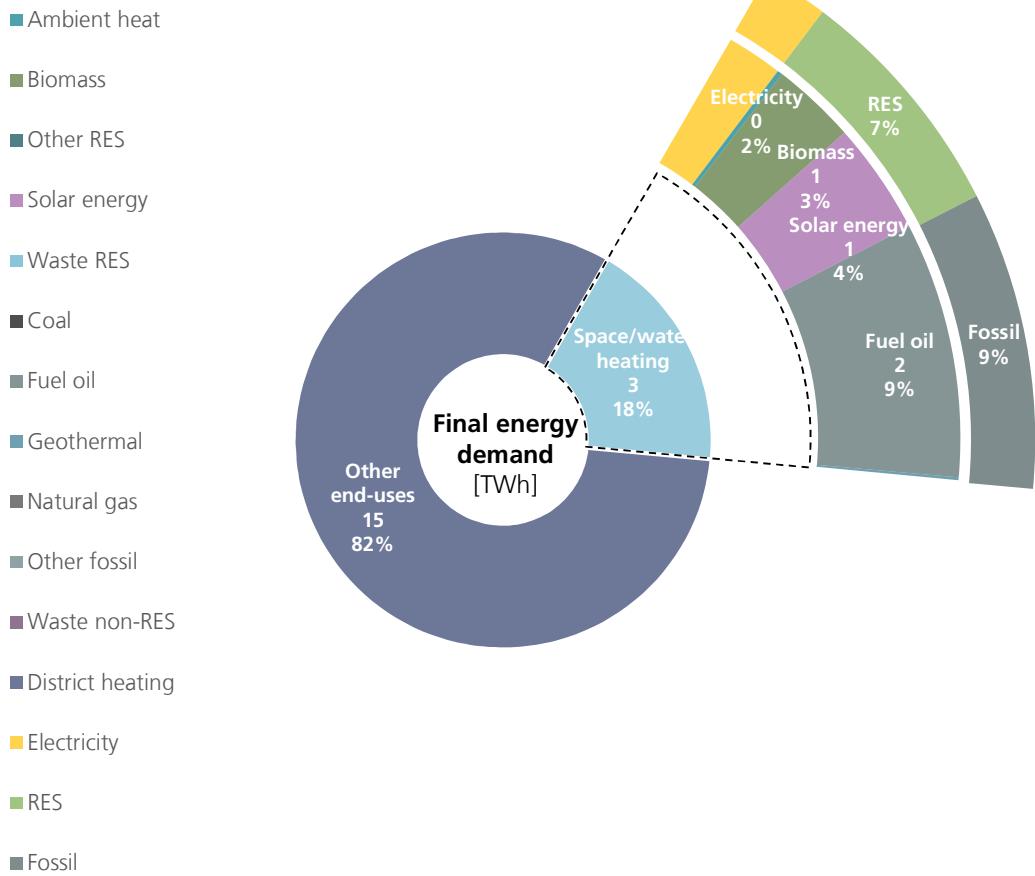
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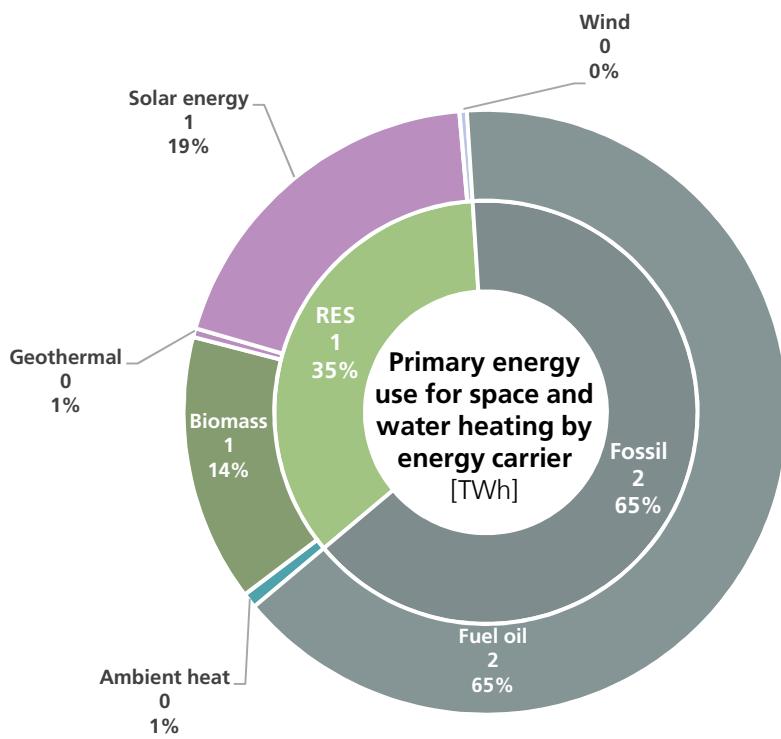
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Overview of energy demand

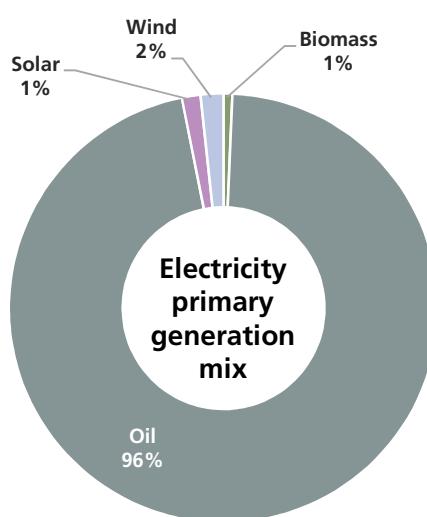
Cyprus 2017

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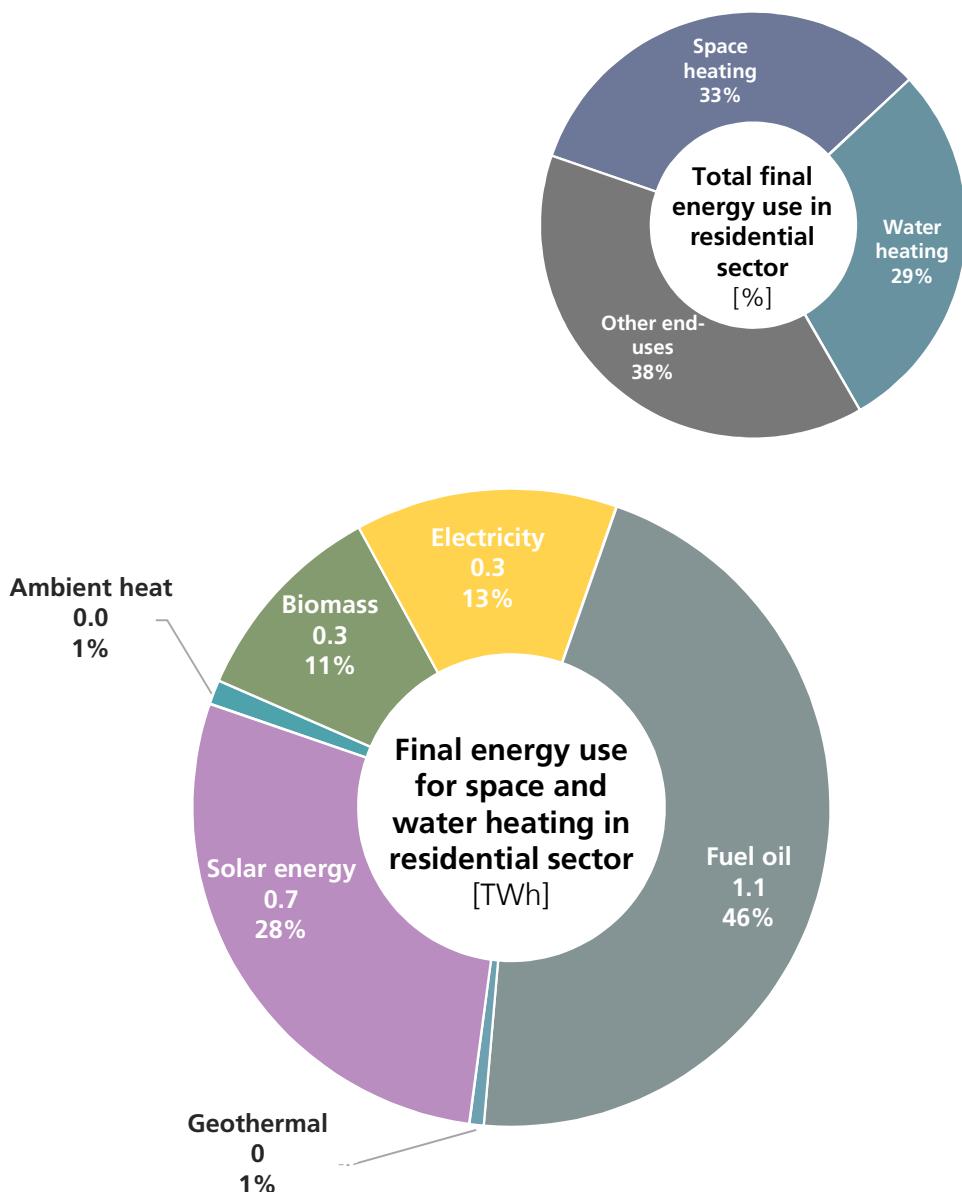
Generation mix



Space & water heating in residential sector

Cyprus 2017

8



Specific energy demand

56

kWh/m²yr

Final energy demand

67

kWh/m²yr

Primary energy demand

57

kWh/m²yr

Single-family dwellings

68

kWh/m²yr

Single-family dwellings

55

kWh/m²yr

Multi-family dwellings

65

kWh/m²yr

Multi-family dwellings

Technology mix

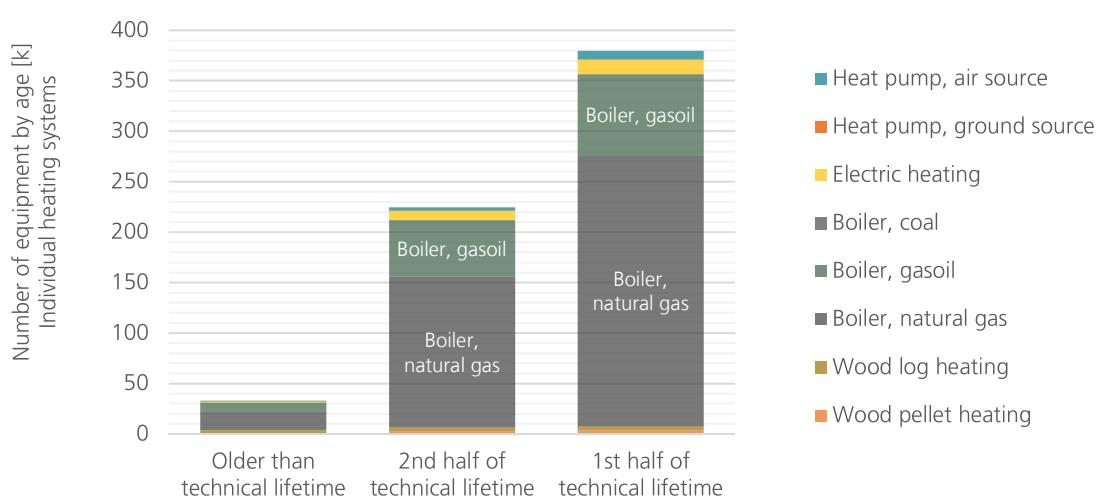
Cyprus 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	12	3%	27%	70%	4.6	0.1
Heat pump ground source	1	3%	27%	70%	4.2	0.0
Solar thermal	1,070*	3%	27%	70%	0.4	0.7
Electric heating	26	7%	38%	56%	1.0	0.0
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	145	6%	38%	55%	0.9	3.9
Boiler, natural gas	436	4%	34%	62%	1.0	4.5
Wood log heating	10	32%	32%	35%	0.7	0.0
Wood pellet heating	7	8%	41%	51%	0.8	0.2

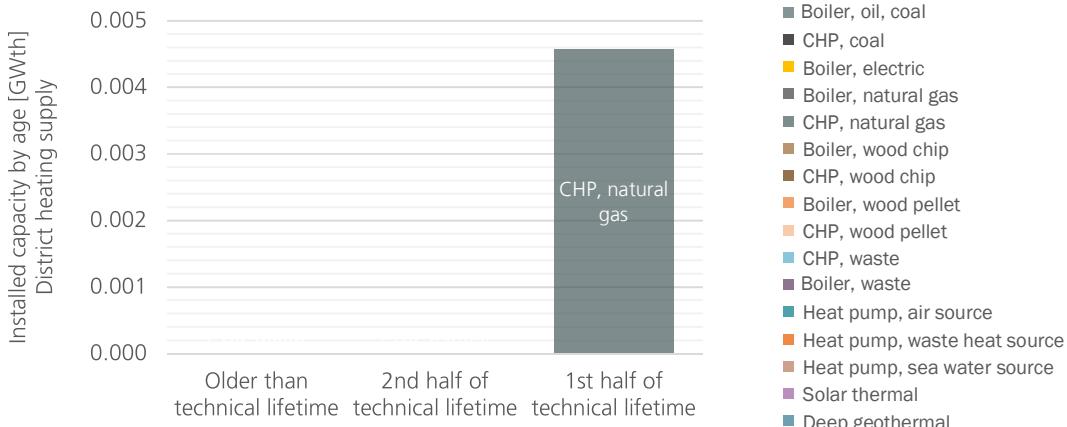
* unit 1000 m²

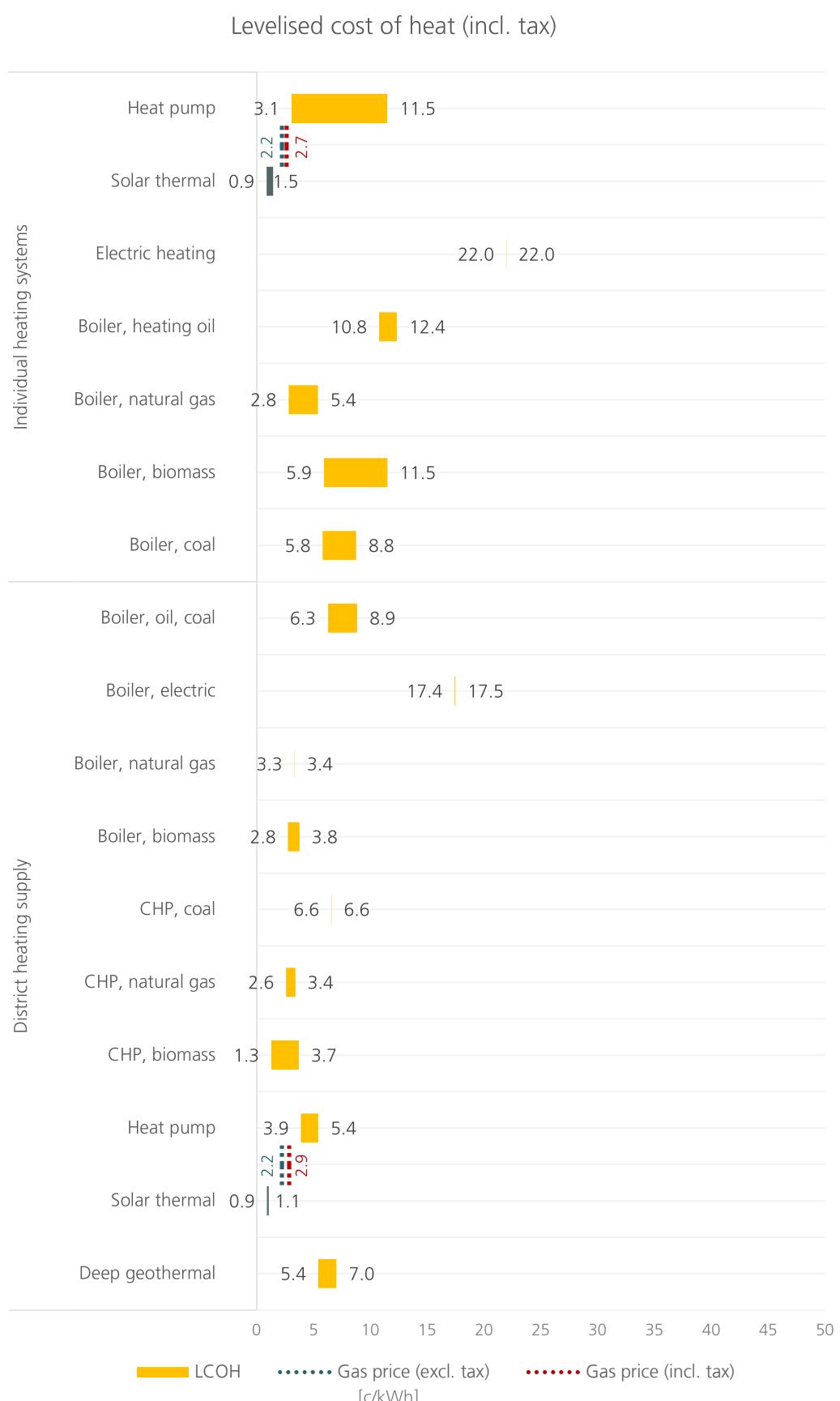
- no data



Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	13	0%	0%	100%	0.4	0.0
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	-	-	-	-	0.9	-
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	4.3	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	4.2	-
Solar thermal	-	-	-	-	0.5	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	No measure
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO₂ pricing	
CO ₂ pricing	No measure
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	No measure
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	No measure
Priority access for RES and/or waste heat in district heating	No measure
Energy efficiency requirements for new buildings	Measures in place
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Use of fossil fuel heating technologies	No measure
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Energy efficiency obligations (including buildings)	No measure
Zoning regulations for DH and/or Gas	No measure
Information and planning	
National Database for EPC	Measures in place
National requirements for urban heat planning	No measure

No measure

Measures in development

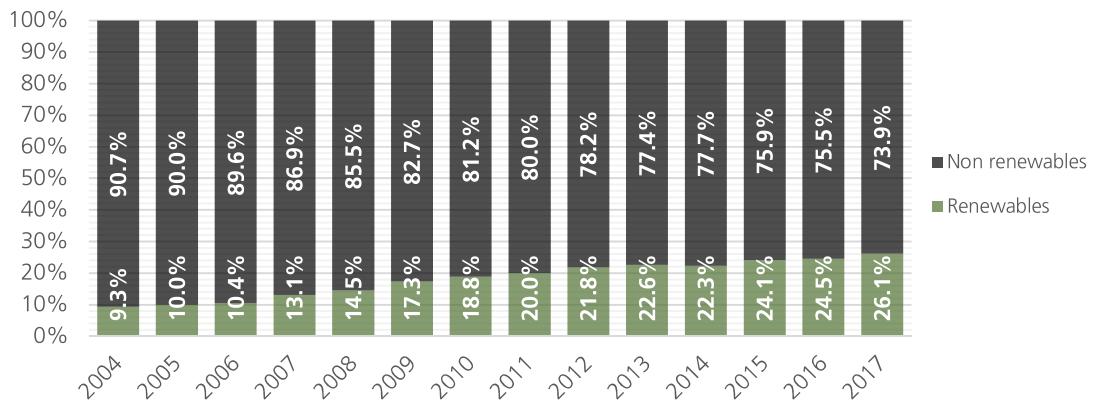
Measures in place

Historical trends

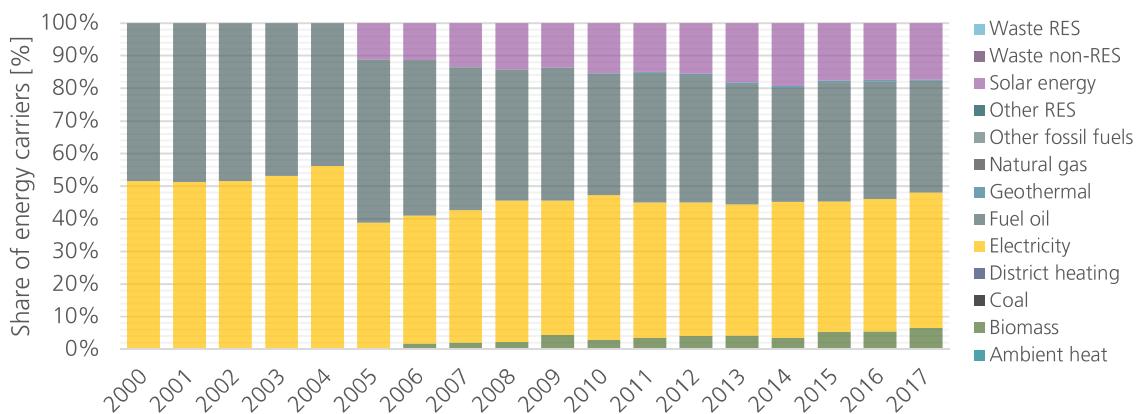
Cyprus 2017

13

Share of RES in Heating & Cooling



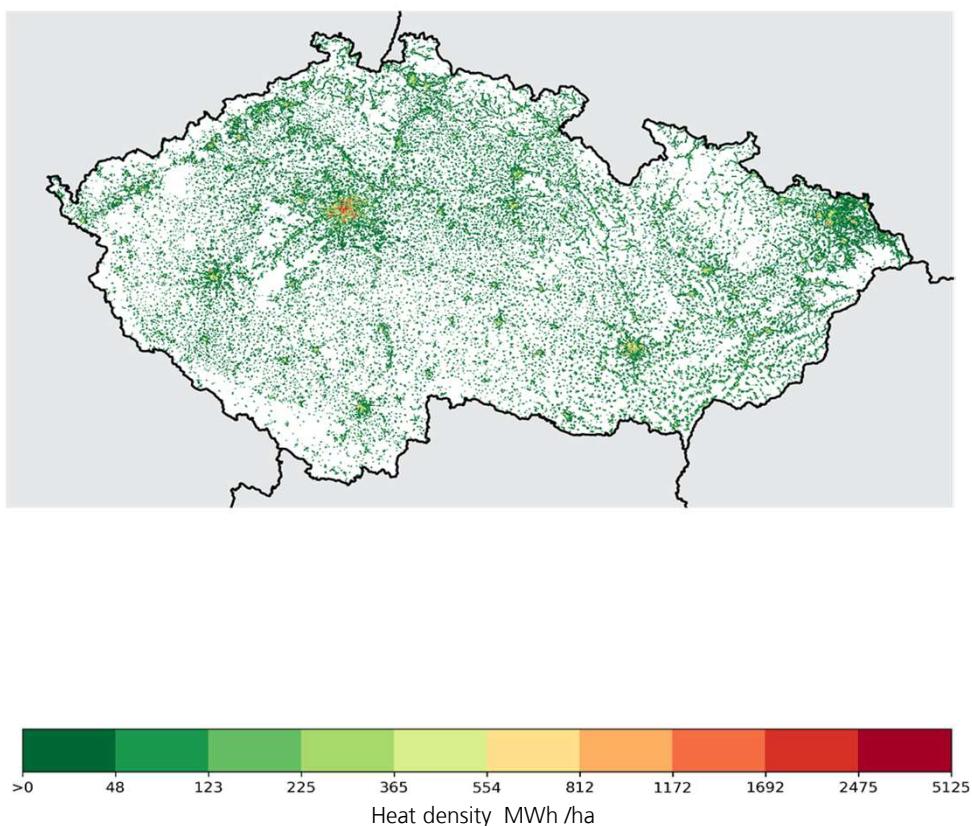
Final energy consumption in residential sector



Space heating market summary

2017

Czech Republic



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
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energy people

Introduction

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1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

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Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

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Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
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Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
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Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

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Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

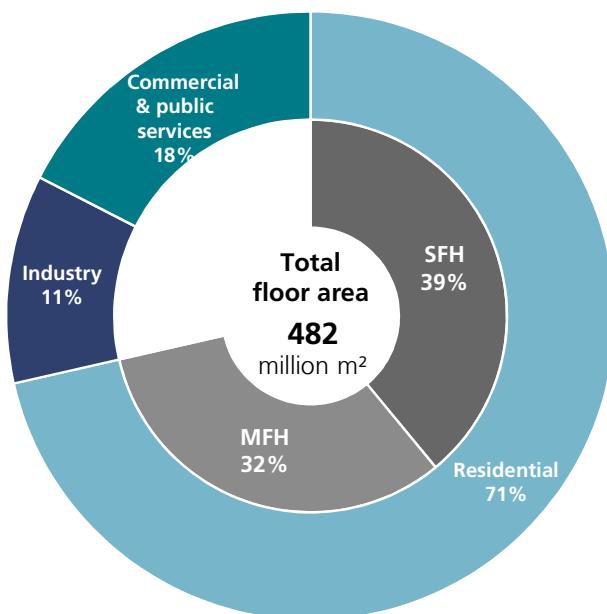
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

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- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

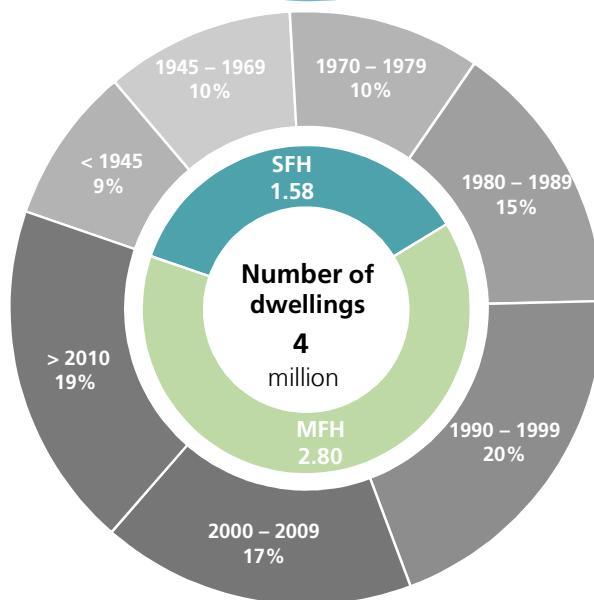
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Czech Republic

5



Climate Data

Heating degree days

Czech Republic

EU-27

Average value 2000-2017

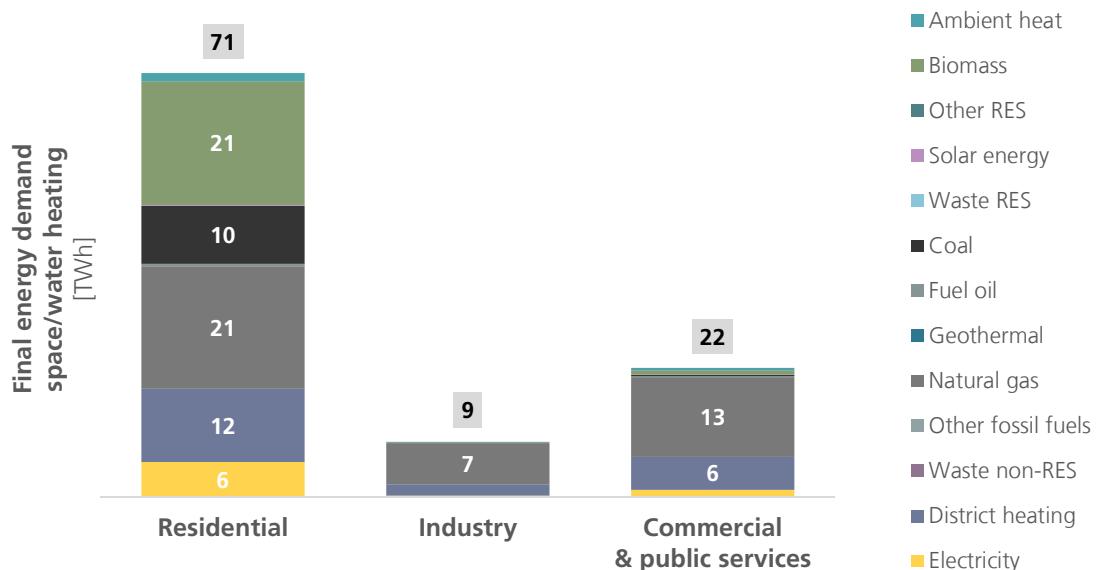
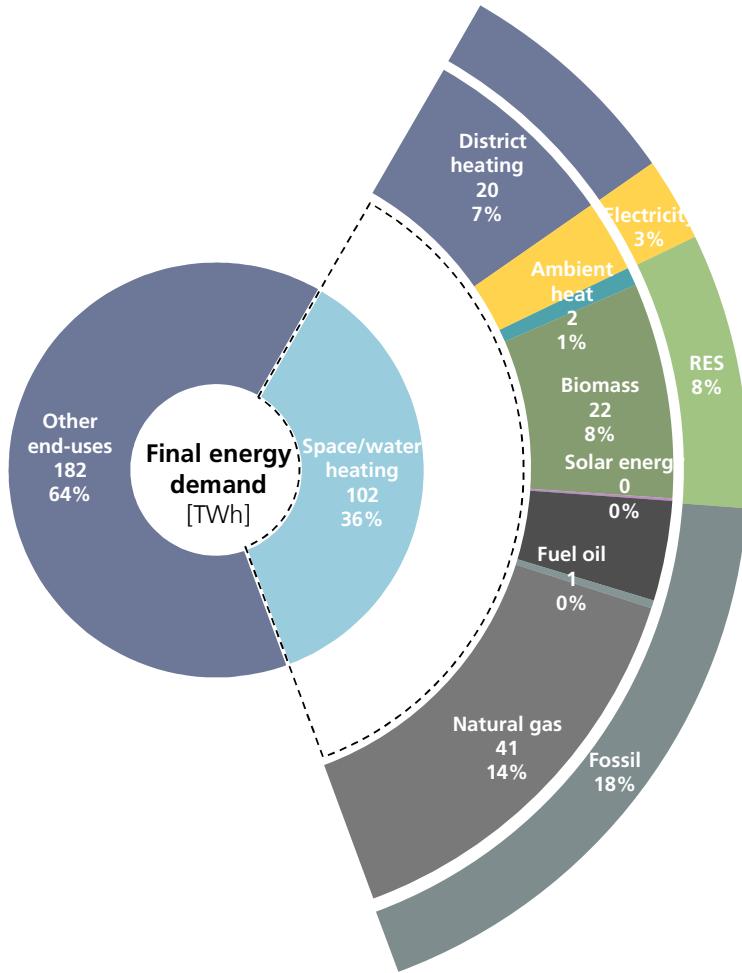
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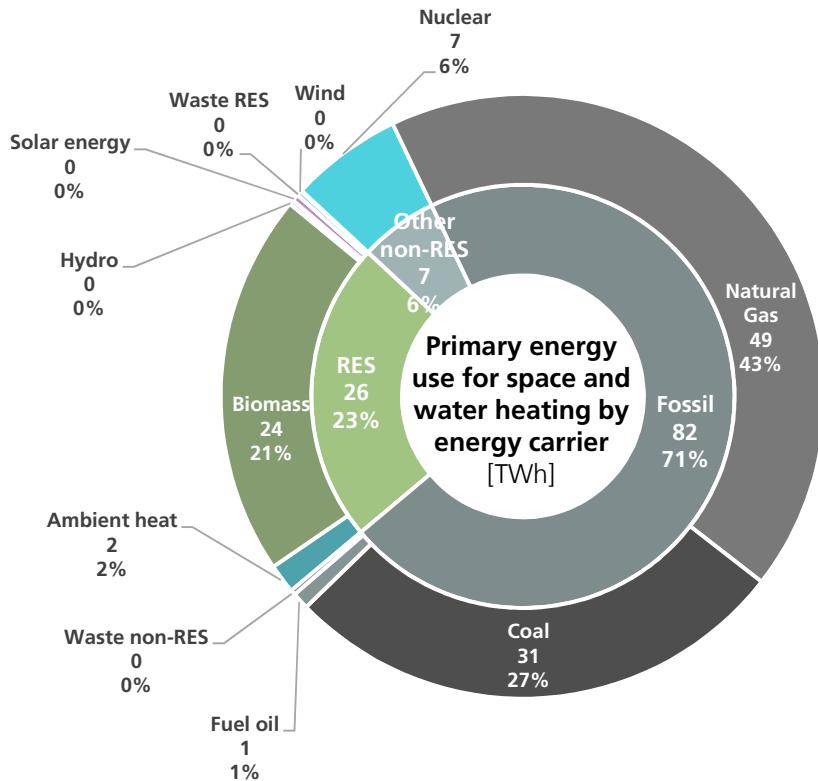
3098

Overview of energy demand

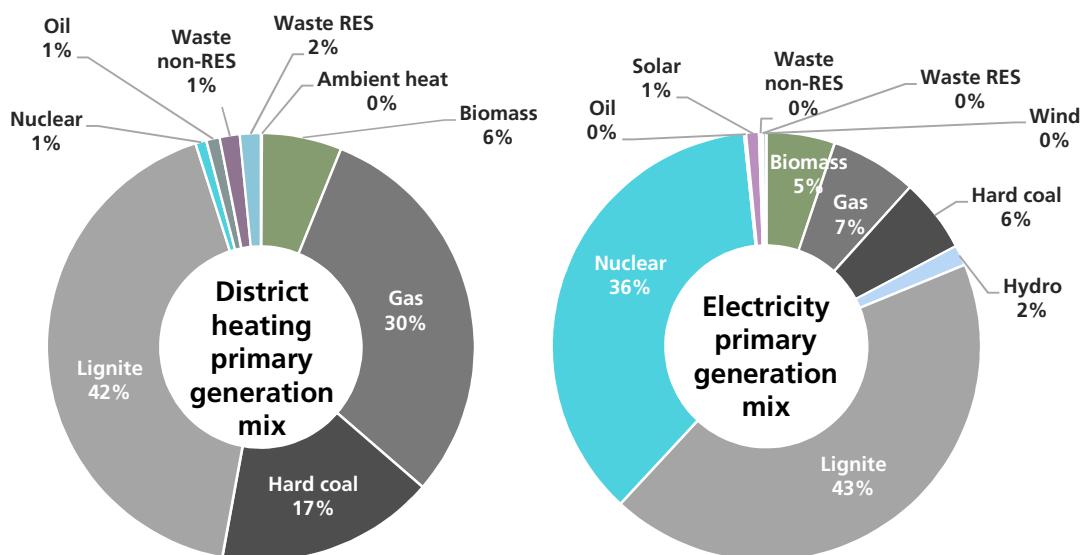
Czech Republic
6

- Ambient heat
- Biomass
- Other RES
- Solar energy
- Waste RES
- Coal
- Fuel oil
- Geothermal
- Natural gas
- Other fossil
- Waste non-RES
- District heating
- Electricity
- RES
- Fossil





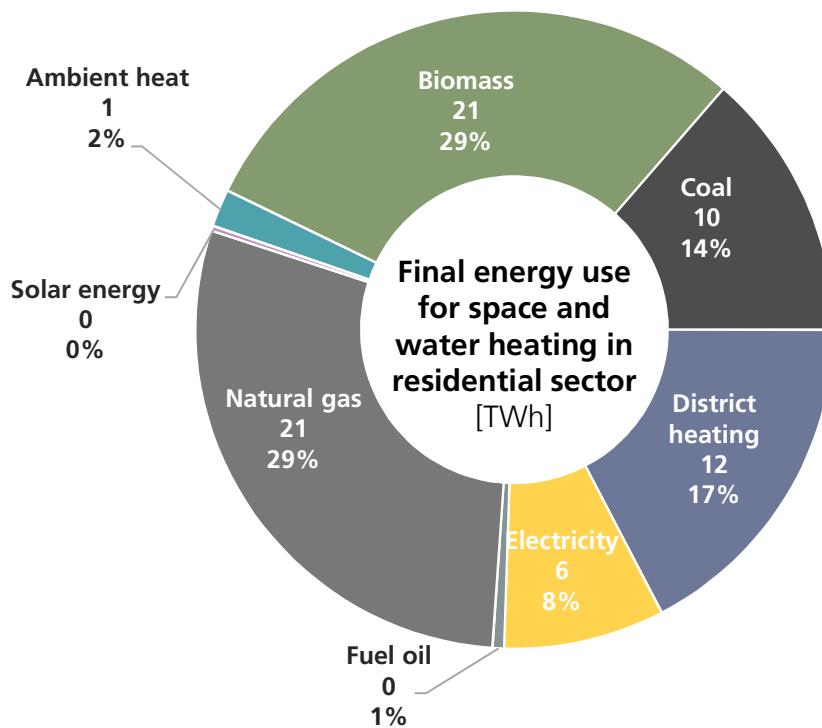
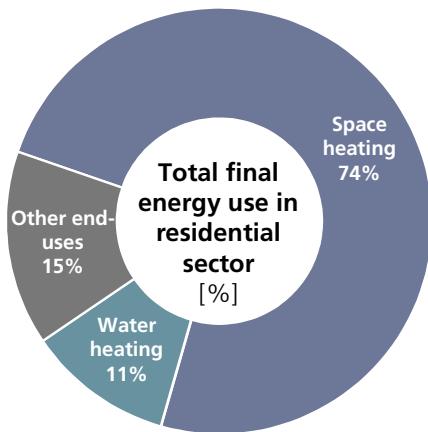
Generation mix



Space & water heating in residential sector

Czech Republic

8



Specific energy demand

207 kWh/m²yr
Final energy demand

237 kWh/m²yr
Primary energy demand

292 kWh/m²yr
Single-family dwellings

327 kWh/m²yr
Single-family dwellings

106 kWh/m²yr
Multi-family dwellings

129 kWh/m²yr
Multi-family dwellings

Technology mix

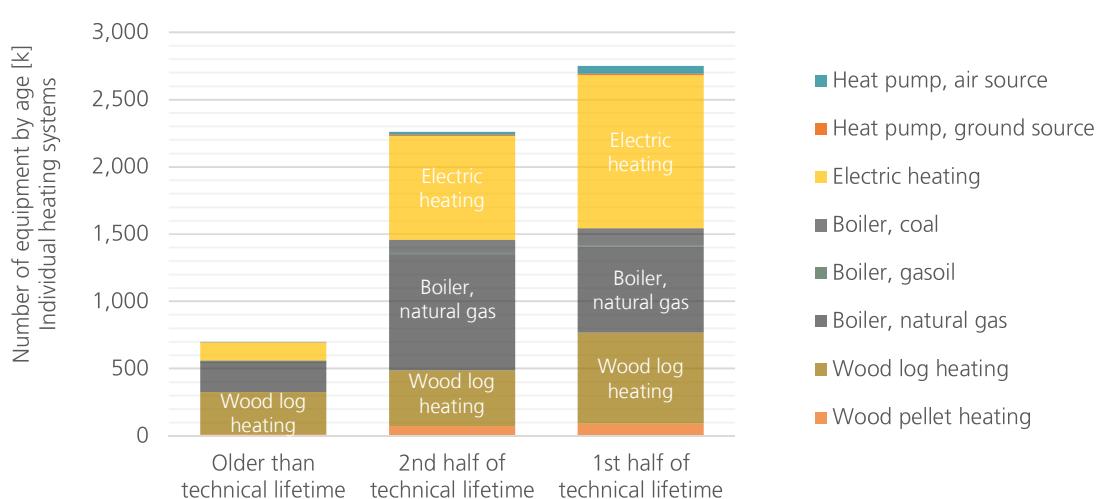
Czech Republic

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	79	3%	25%	72%	3.3	0.7
Heat pump ground source	23	5%	41%	54%	3.5	0.2
Solar thermal	617*	3%	27%	70%	0.5	0.4
Electric heating	2,040	7%	38%	56%	1.0	2.0
Boiler, coal	246	8%	41%	51%	0.8	4.2
Boiler, gasoil	20	6%	38%	55%	0.9	0.4
Boiler, natural gas	1,718	12%	50%	37%	1.0	48.3
Wood log heating	1,405	22%	30%	48%	0.7	17.2
Wood pellet heating	178	8%	41%	51%	0.8	5.6

* unit 1000 m²

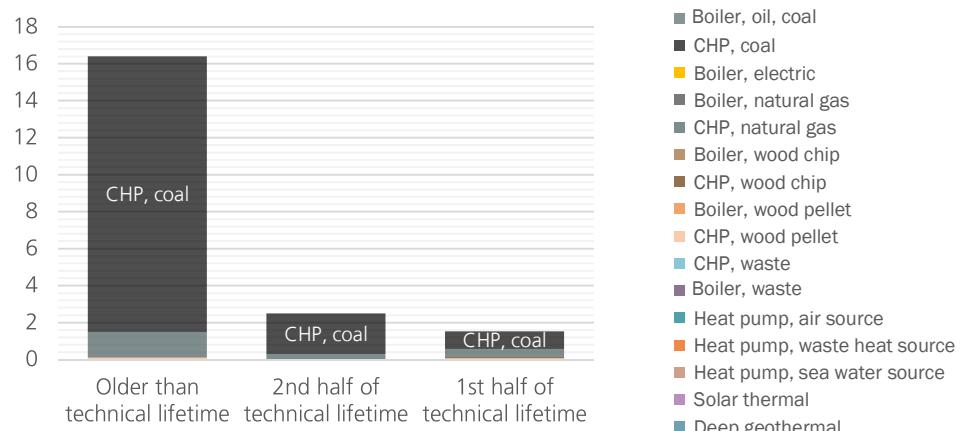
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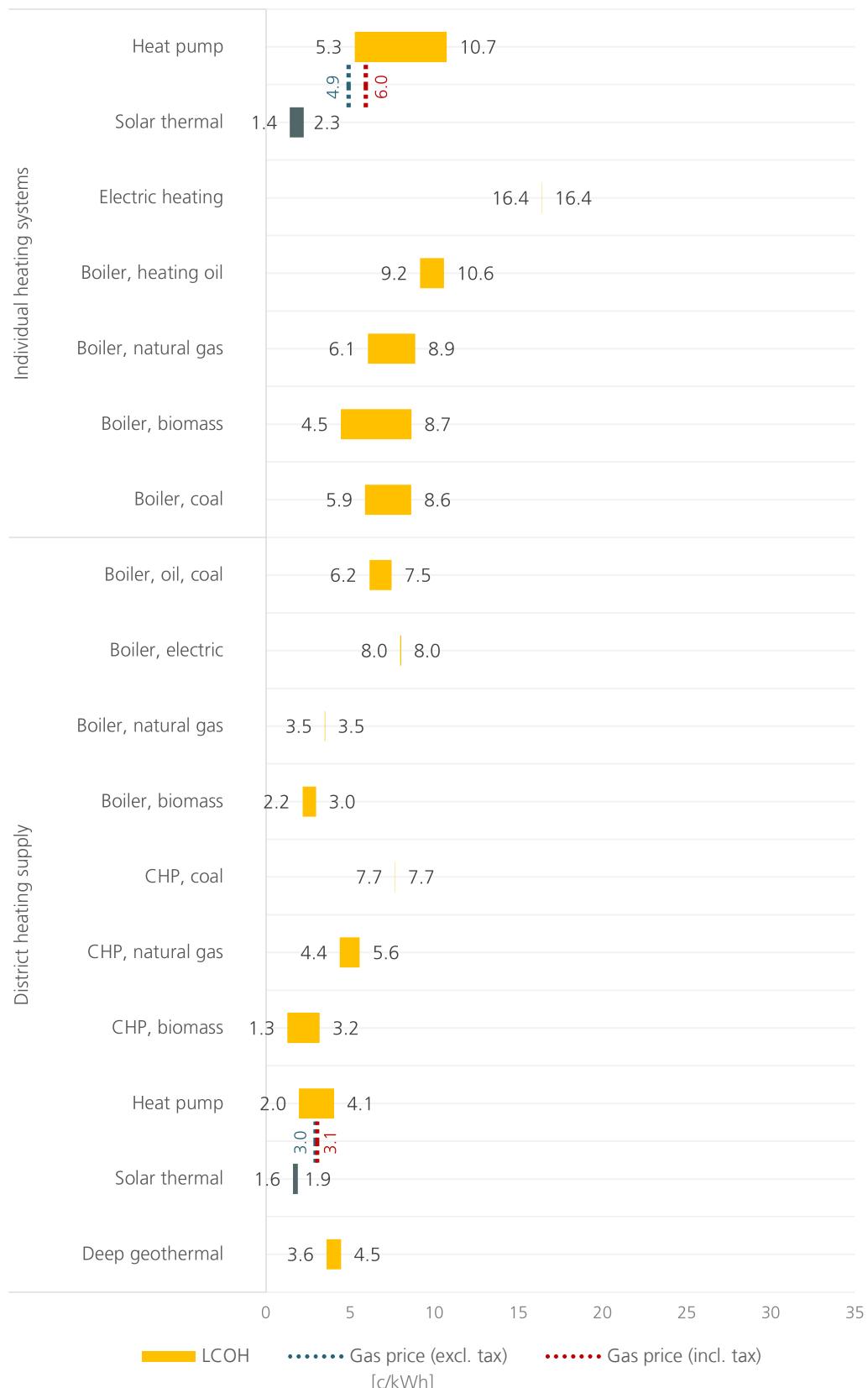
Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	112	71%	21%	8%	0.5	18.1
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	199	67%	17%	17%	0.4	2.1
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	11	27%	9%	64%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	5	40%	0%	60%	0.7	0.2
CHP, waste	4	0%	25%	75%	0.8	0.0
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply



Levelised cost of heat (incl. tax)



Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	No measure
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	Measures in place
Trigger point: Exchange of heating system	Measures in place
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	No measure
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

█ No measure

█ Measures in development

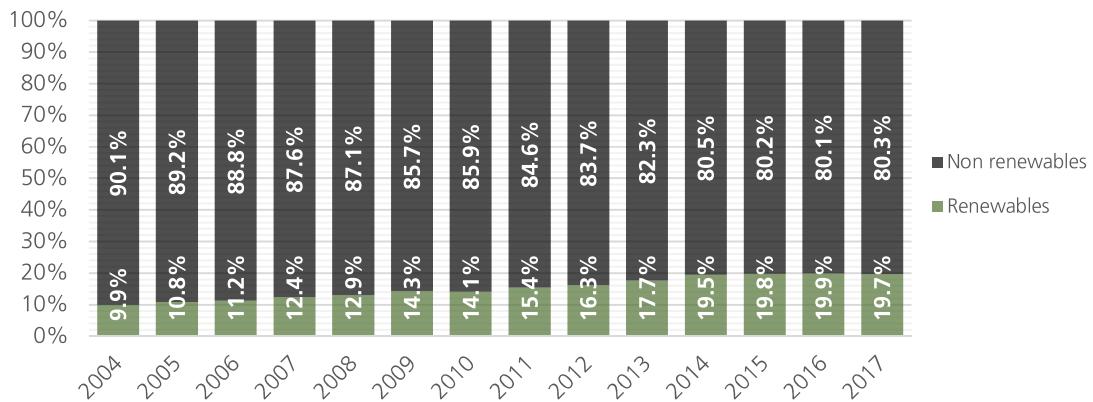
█ Measures in place

Historical trends

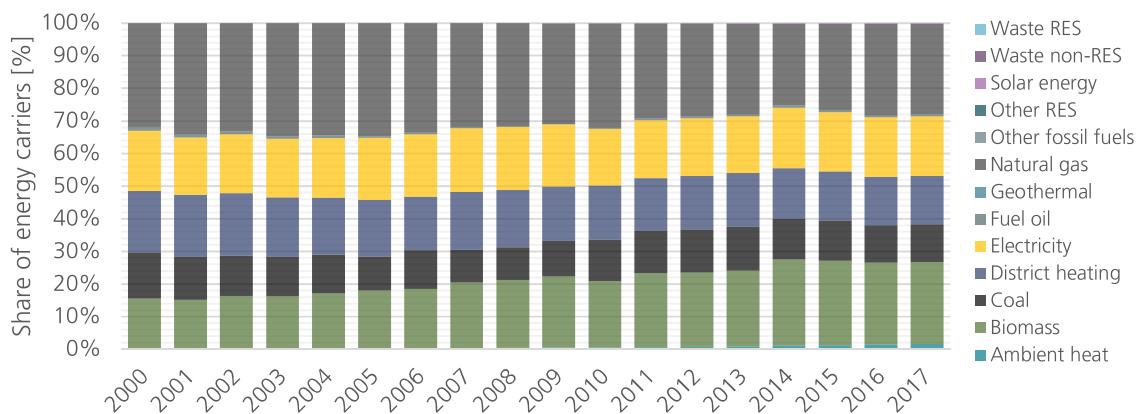
Czech Republic

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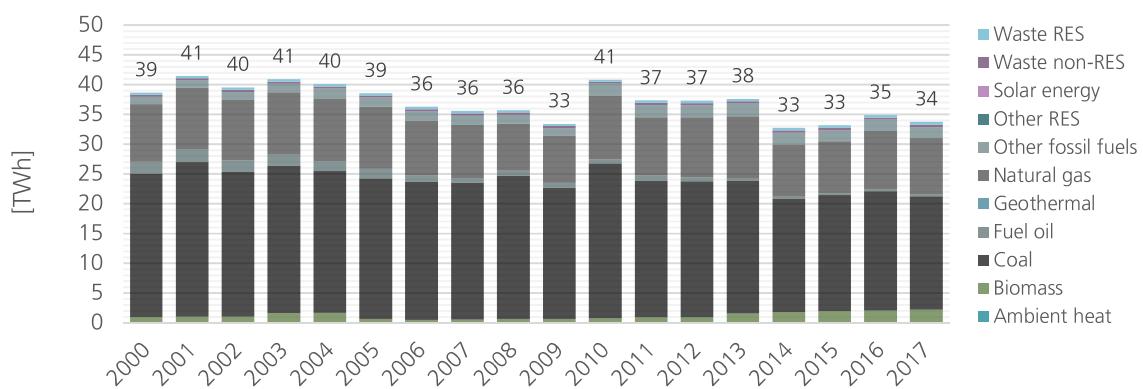
Share of RES in Heating & Cooling



Final energy consumption in residential sector



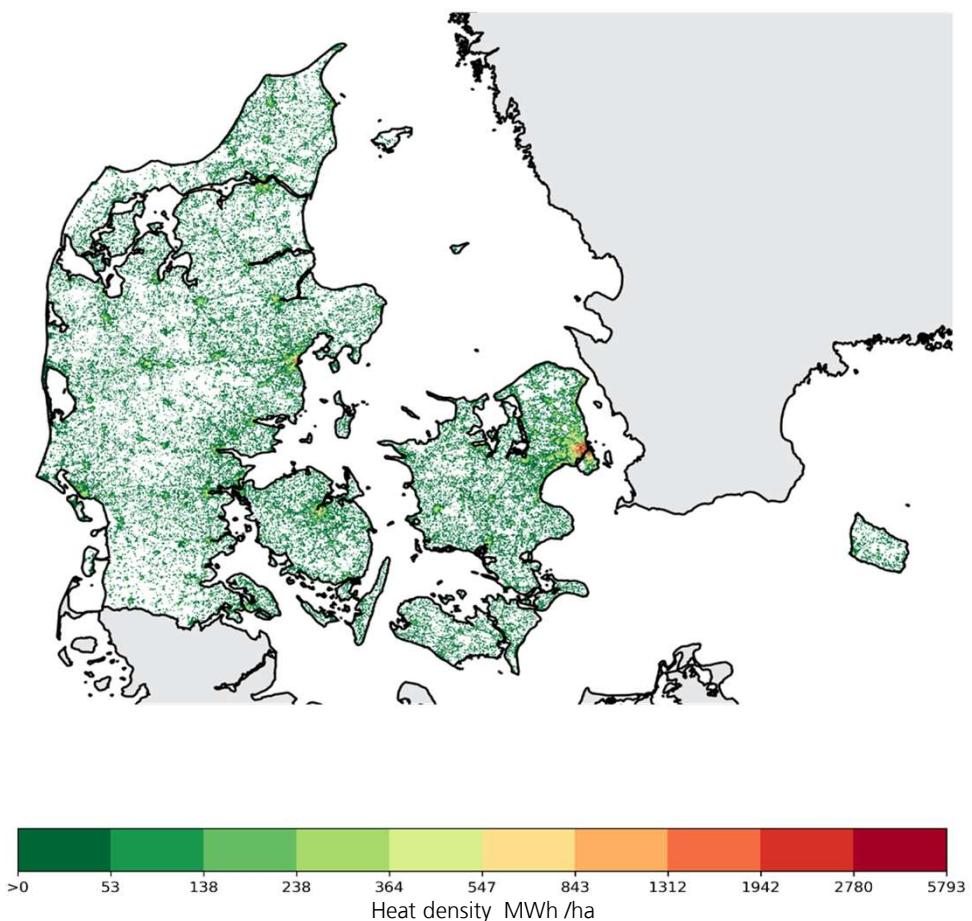
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Denmark



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

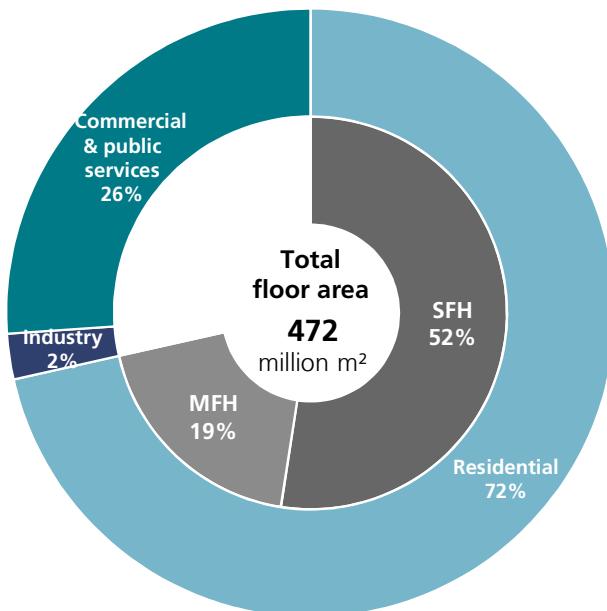
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

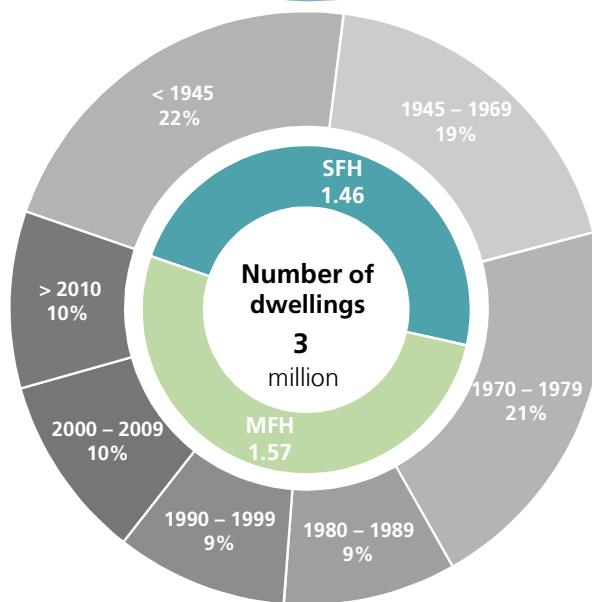
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Denmark 2017

5



Climate Data

Heating degree days

Denmark

EU-27

Average value 2000-2017

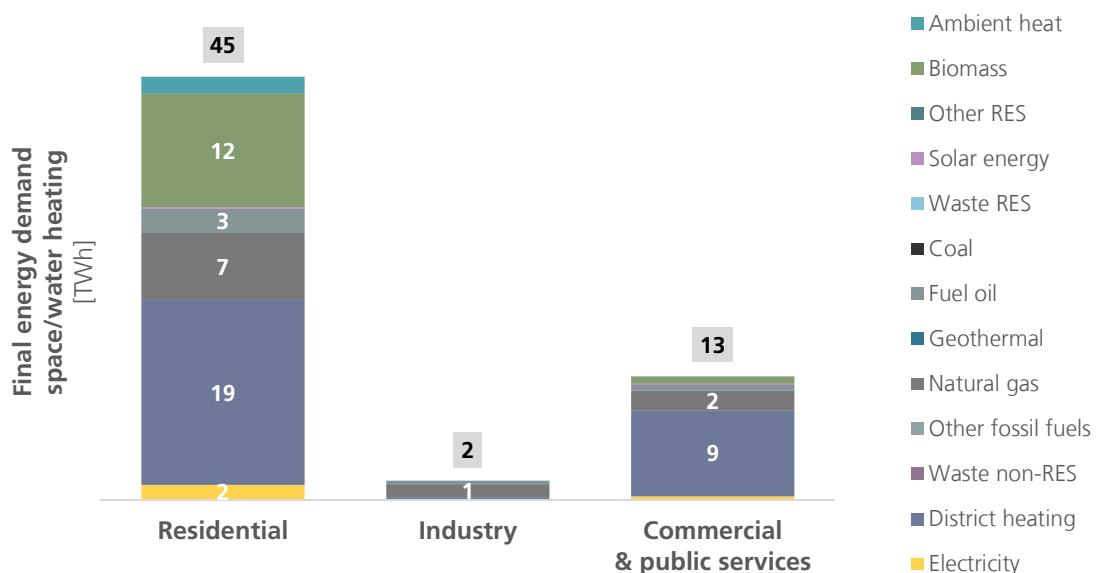
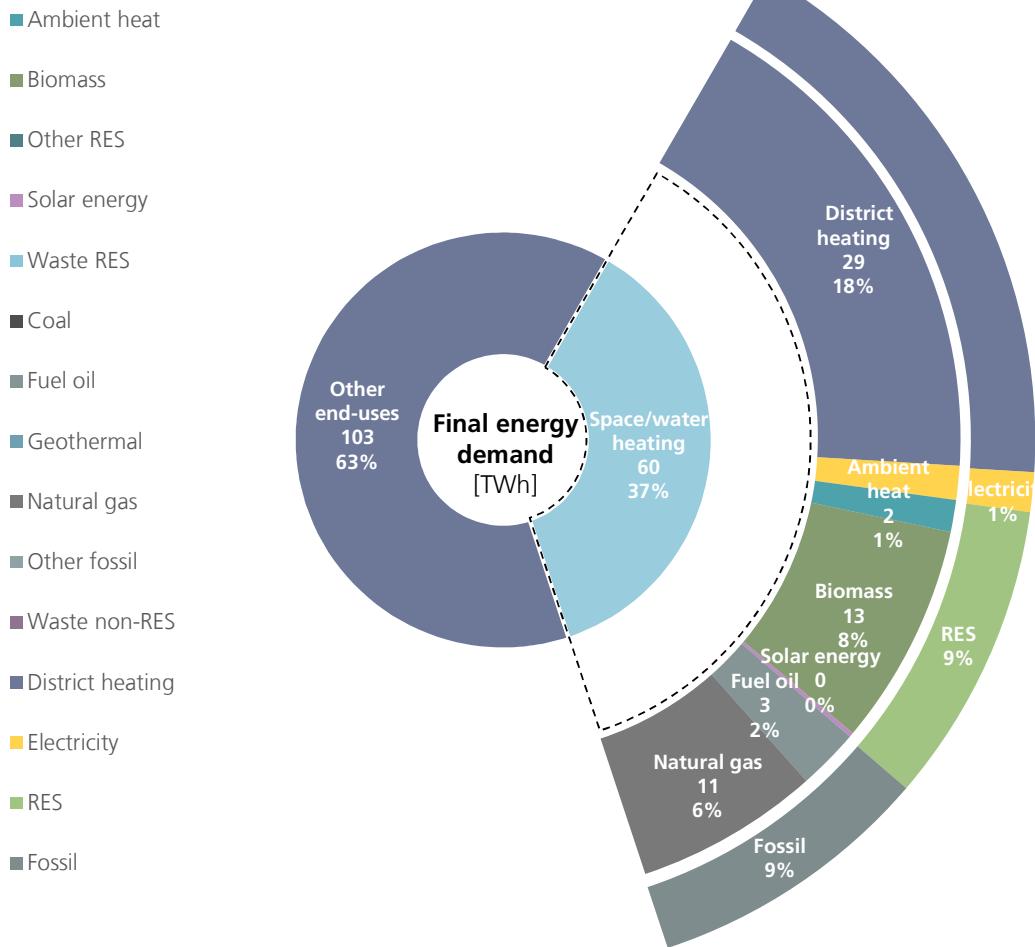
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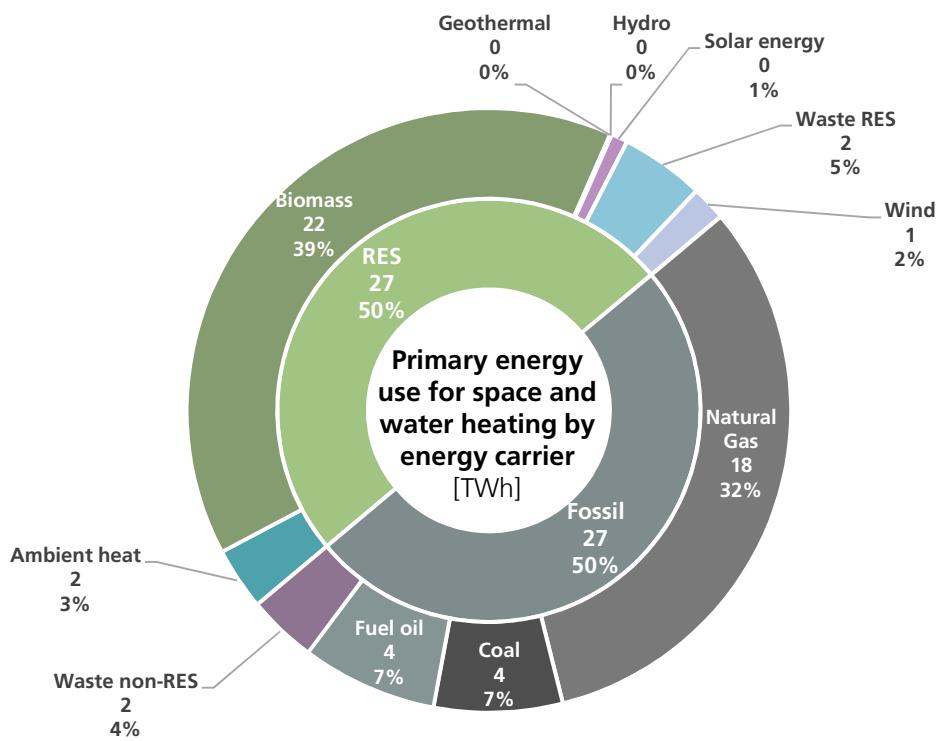
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Overview of energy demand

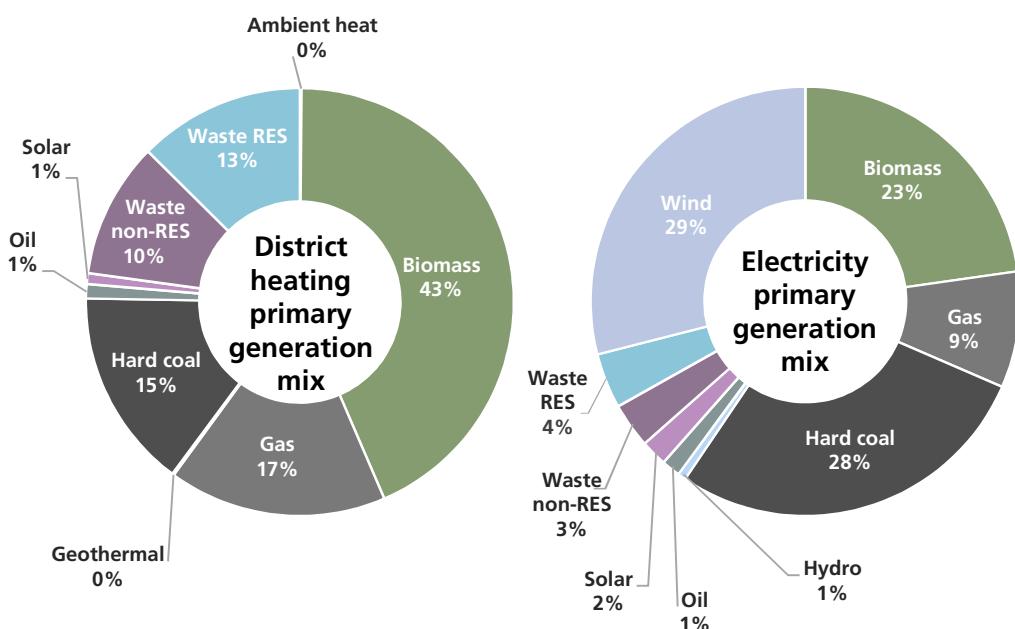
Denmark 2017

6





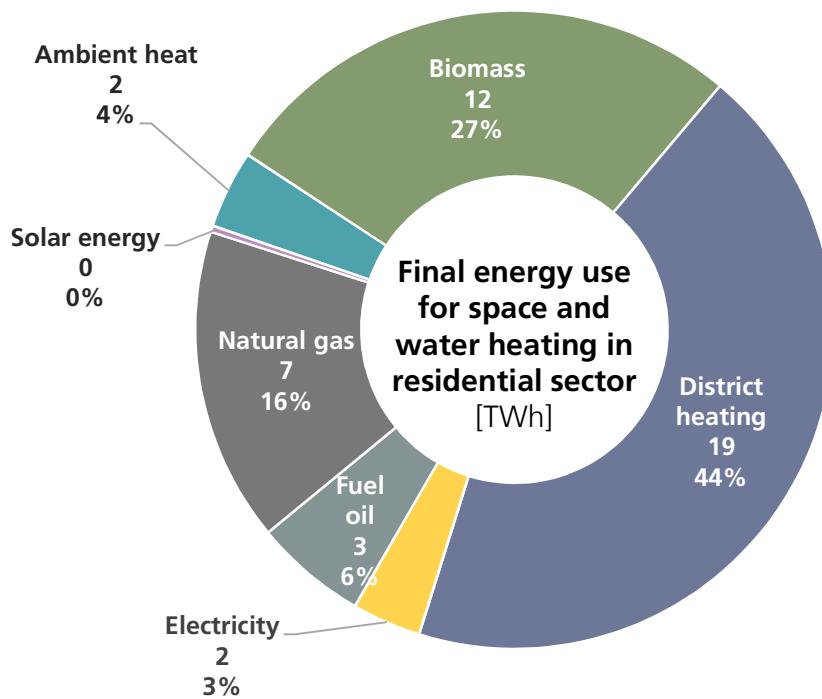
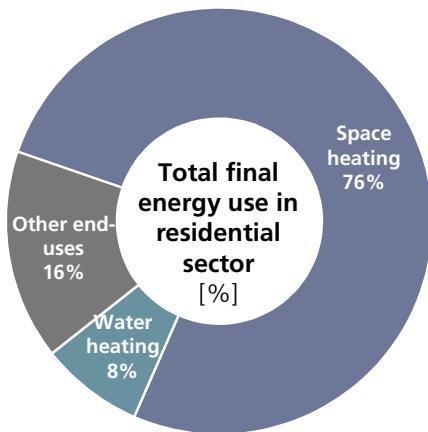
Generation mix



Space & water heating in residential sector

Denmark 2017

8



Specific energy demand

132

kWh/m²yr

Final energy demand

123

kWh/m²yr

Primary energy demand

149

kWh/m²yr

Single-family dwellings

86

kWh/m²yr

Multi-family dwellings

139

kWh/m²yr

Single-family dwellings

80

kWh/m²yr

Multi-family dwellings

Technology mix

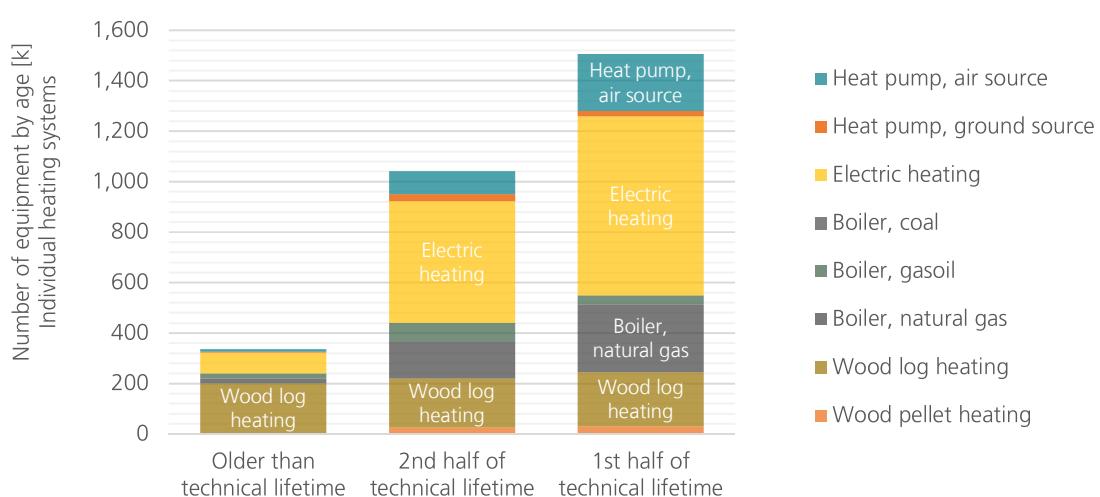
Denmark 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	329	3%	28%	69%	3.8	2.0
Heat pump ground source	53	6%	53%	41%	3.7	0.5
Solar thermal	227*	3%	27%	70%	0.5	0.2
Electric heating	1,275	7%	38%	56%	1.0	1.3
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	128	16%	57%	27%	0.9	1.9
Boiler, natural gas	436	4%	34%	62%	1.0	4.5
Wood log heating	604	32%	32%	35%	0.7	7.1
Wood pellet heating	61	8%	41%	51%	0.8	0.7

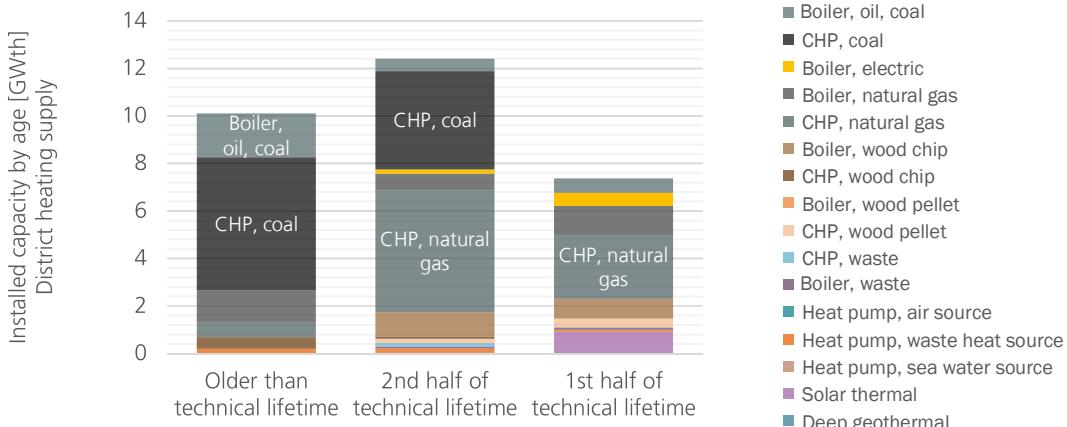
* unit 1000 m²

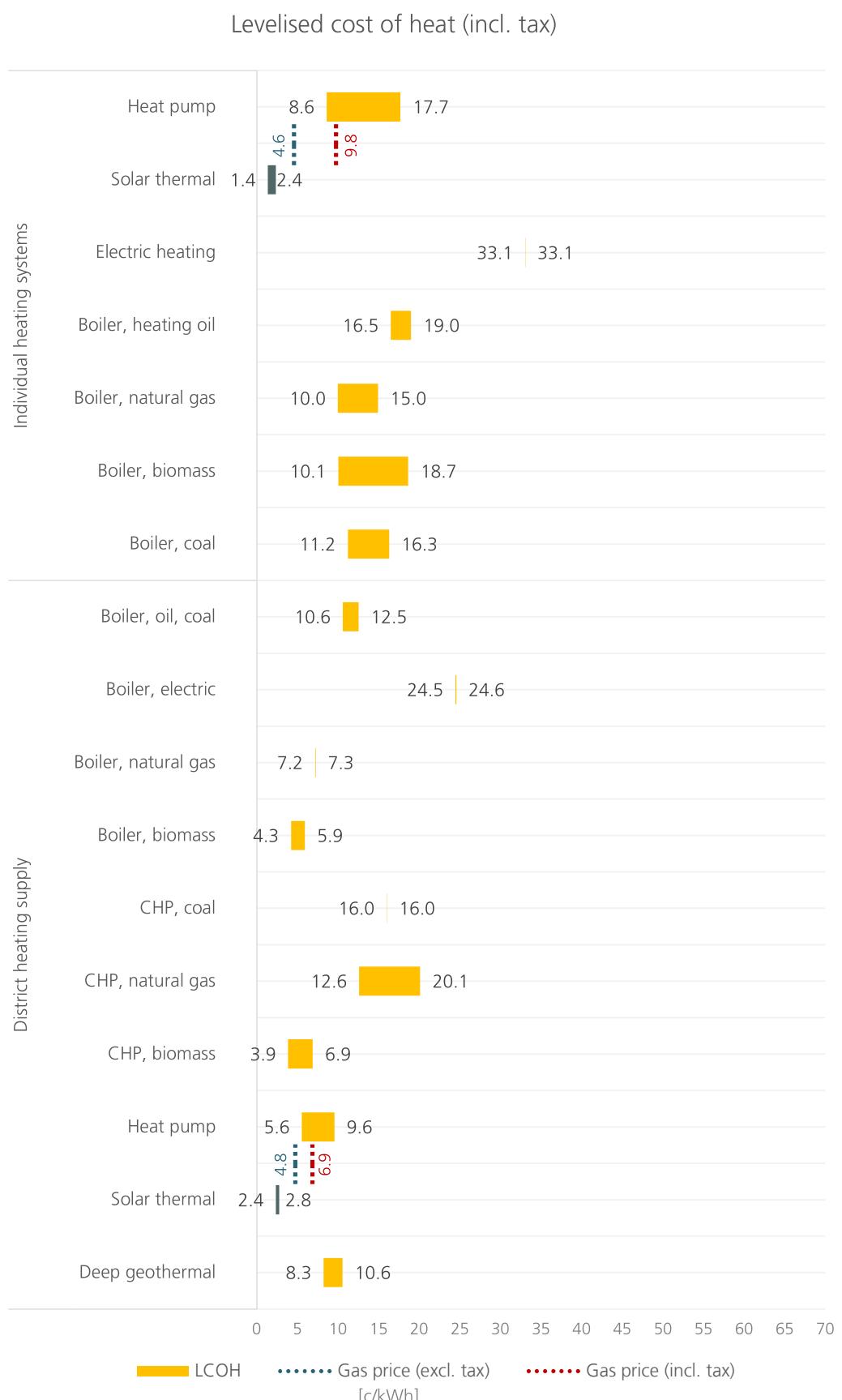
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
District heating supply	Boiler, oil, coal	227	48%	29%	24%	0.9
	CHP, coal	9	56%	44%	0%	0.5
	Boiler, electric	49	0%	3%	97%	1.0
	Boiler, natural gas	295	33%	26%	40%	1.1
	CHP, natural gas	720	4%	80%	15%	0.4
	Boiler, wood chip	338	0%	53%	47%	1.1
	CHP, wood chip	8	50%	50%	0%	0.9
	Boiler, wood pellet	-	-	-	-	1.0
	CHP, wood pellet	8	0%	50%	50%	0.7
	CHP, waste	7	0%	86%	14%	0.8
	Boiler, waste	5	6%	33%	61%	1.1
	Heat pump air source	12	17%	0%	83%	3.4
	Heat pump waste heat source	29	33%	33%	33%	5.0
	Heat pump sea water source	-	-	-	-	3.3
	Solar thermal	109	3%	4%	94%	0.5
	Deep geothermal	-	-	-	-	6.5

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Green
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Red
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Green
Heat incentives for decentral heating systems	Green
Energy- and CO₂ pricing	
CO ₂ pricing	Green
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Yellow
RES-H obligation for existing buildings	Yellow
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Yellow
New installations in existing buildings	Yellow
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

 No measure

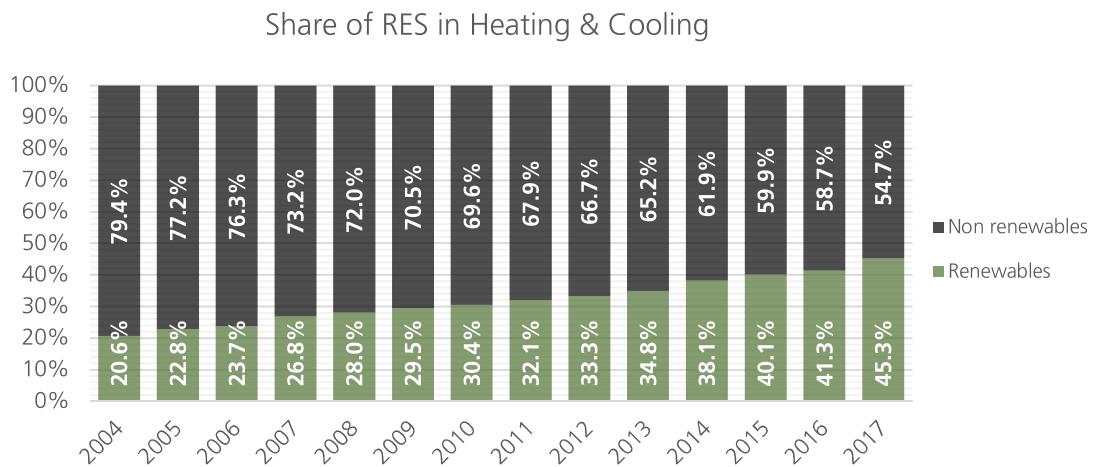
 Measures in development

 Measures in place

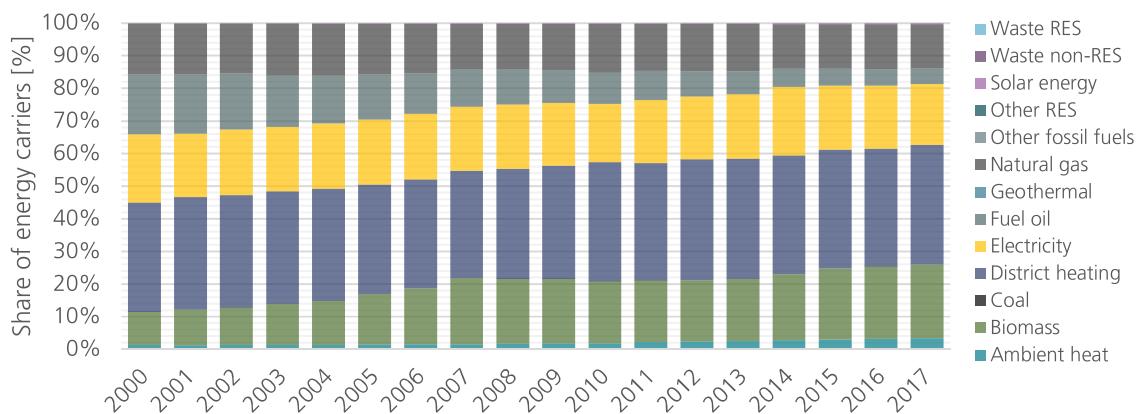
Historical trends

Denmark 2017

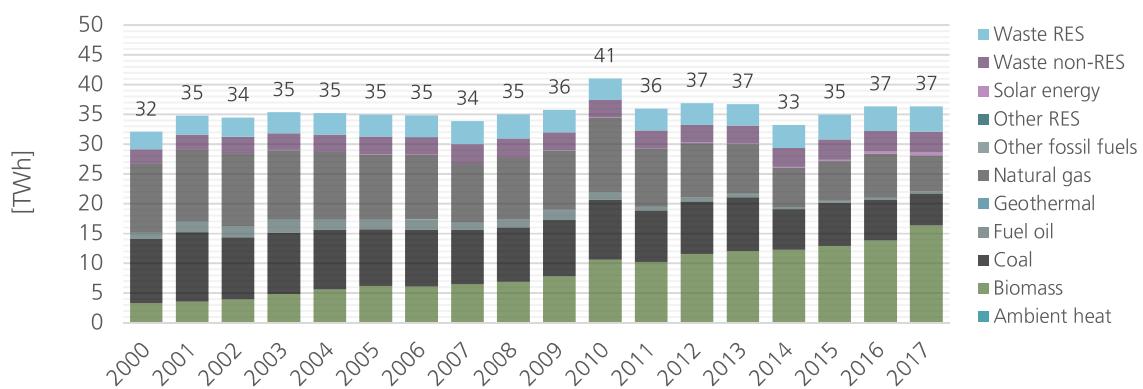
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Final energy consumption in residential sector



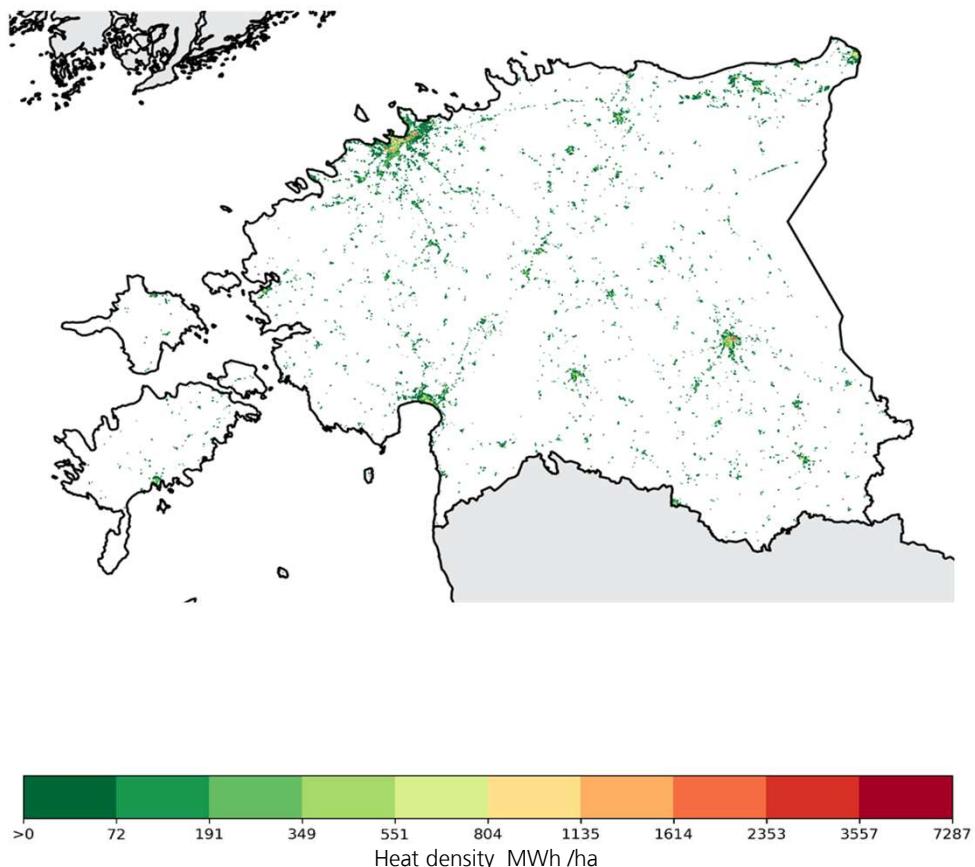
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Estonia



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

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Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

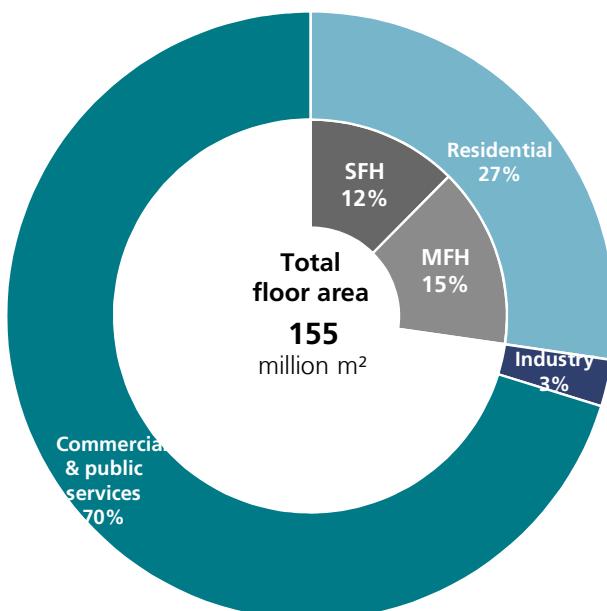
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

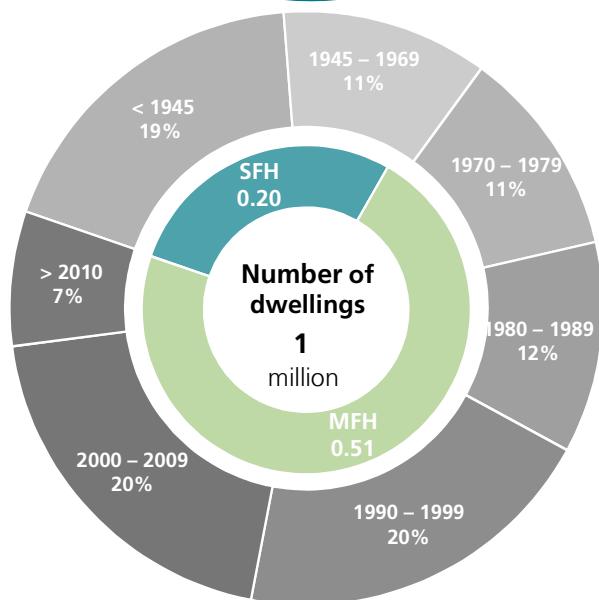
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Estonia 2017

5



Climate Data

Heating degree days

Estonia

EU-27

Average value 2000-2017

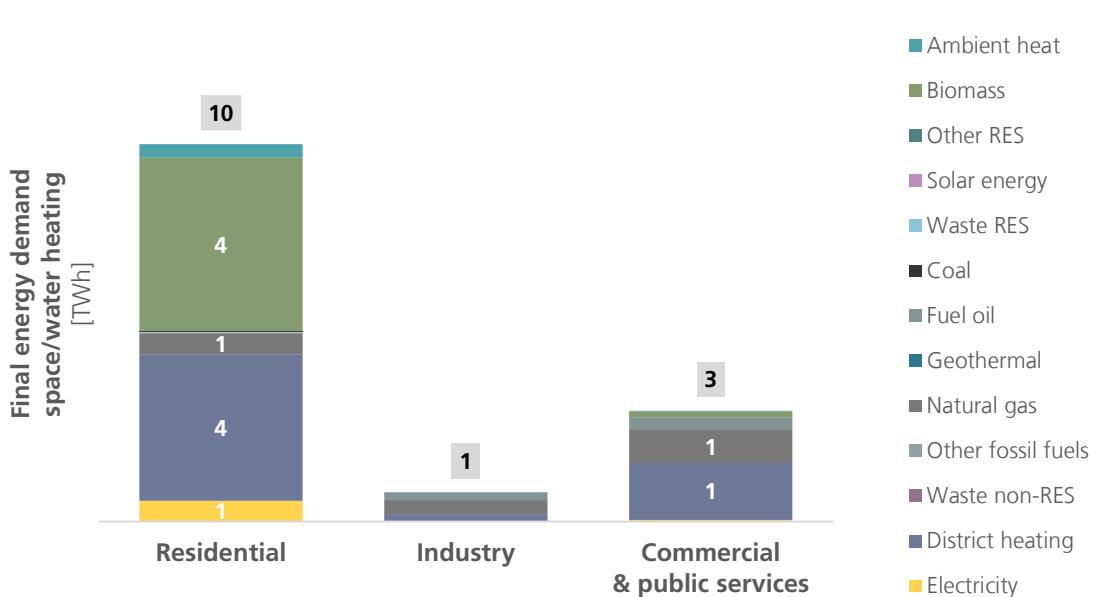
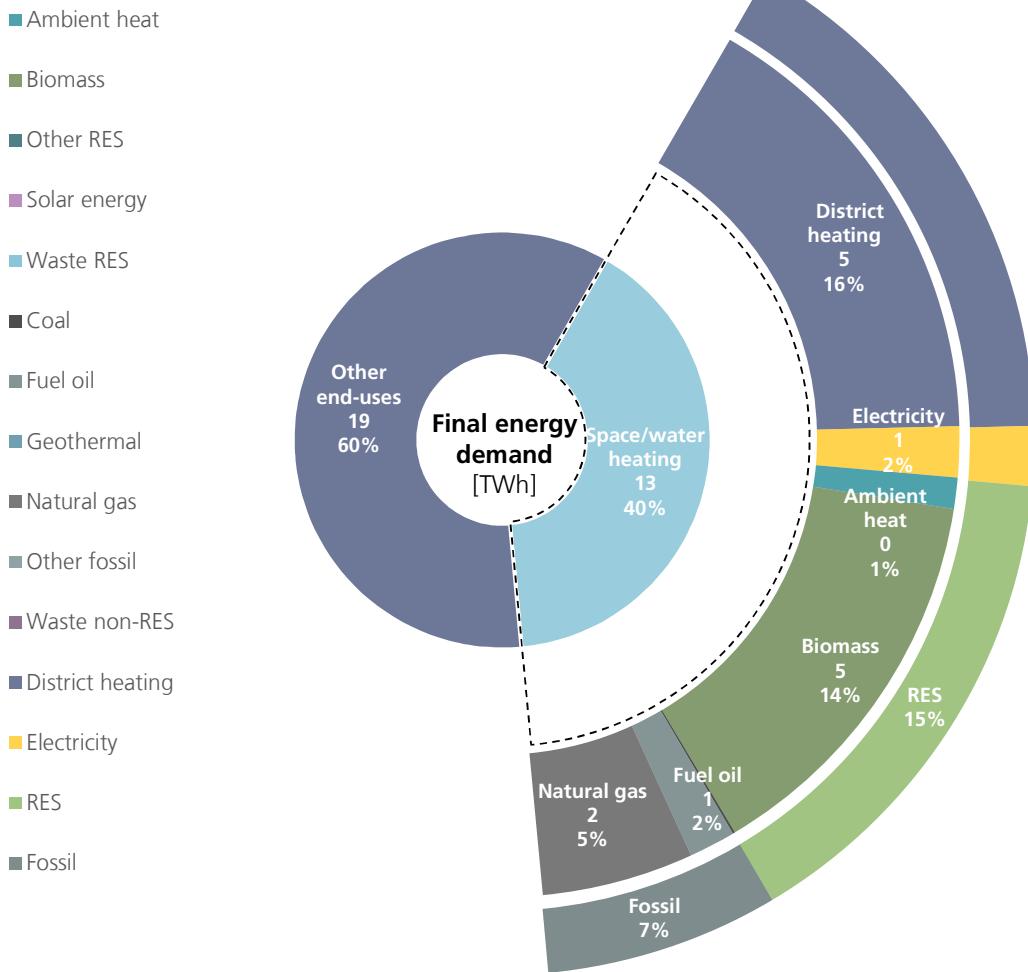
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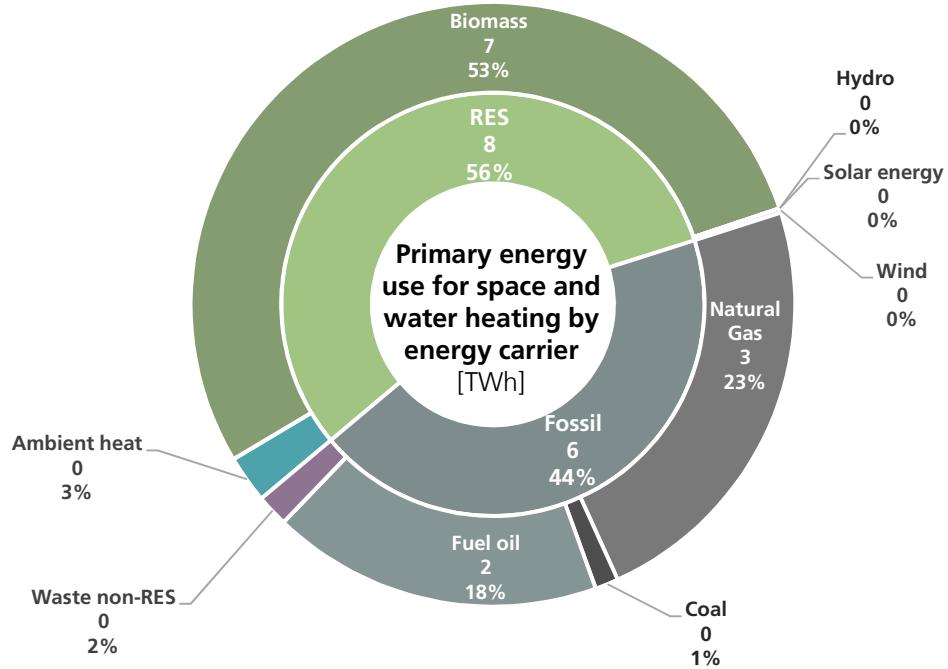
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Overview of energy demand

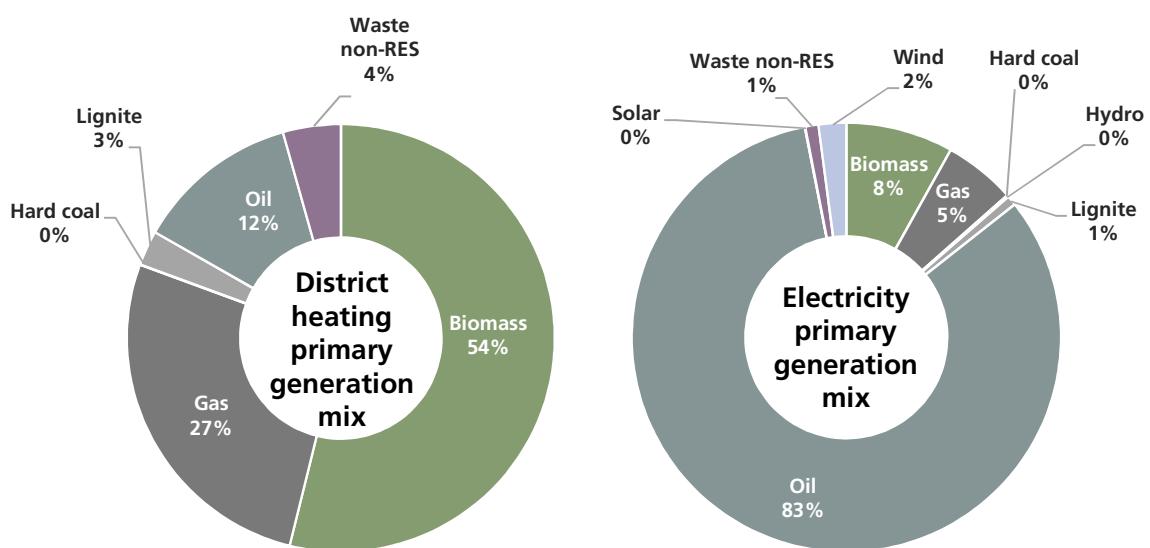
Estonia 2017

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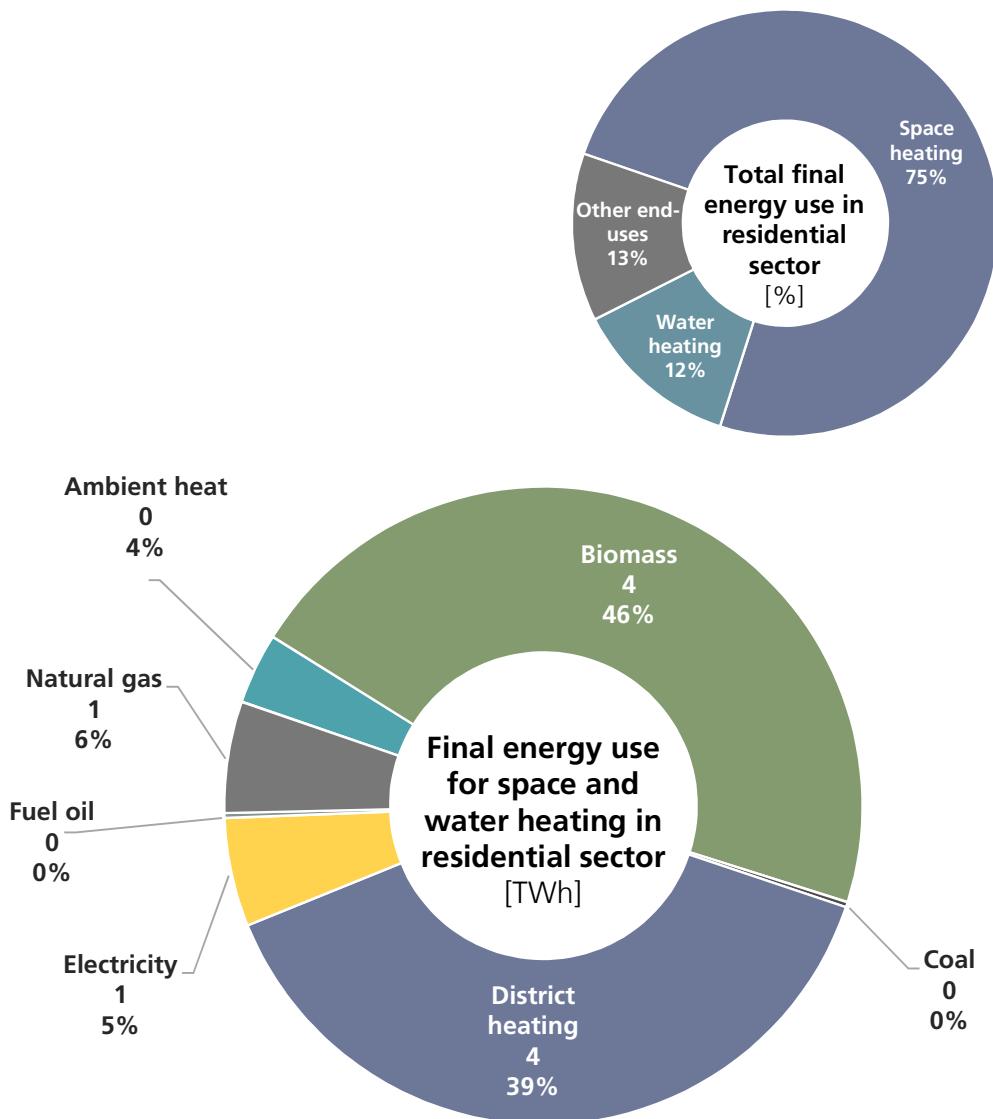
Generation mix



Space & water heating in residential sector

Estonia 2017

8



Specific energy demand

225

kWh/m²yr

Final energy demand

242

kWh/m²yr

Primary energy demand

279

kWh/m²yr

Single-family dwellings

300

kWh/m²yr

Single-family dwellings

180

kWh/m²yr

Multi-family dwellings

193

kWh/m²yr

Multi-family dwellings

Technology mix

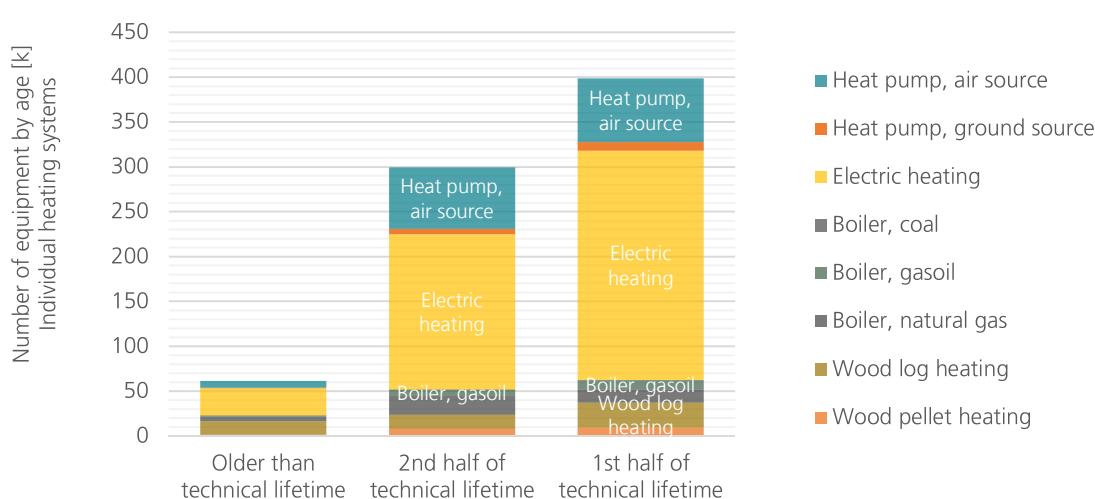
Estonia 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	147	5%	46%	48%	3.3	0.8
Heat pump ground source	16	4%	36%	60%	3.5	0.2
Solar thermal	16*	3%	27%	70%	0.5	0.0
Electric heating	459	7%	38%	56%	1.0	0.5
Boiler, coal	0	8%	41%	51%	0.8	0.0
Boiler, gasoil	18	6%	38%	55%	0.9	0.9
Boiler, natural gas	41	13%	51%	36%	1.0	2.0
Wood log heating	59	25%	27%	47%	0.7	0.6
Wood pellet heating	18	8%	41%	51%	0.8	1.8

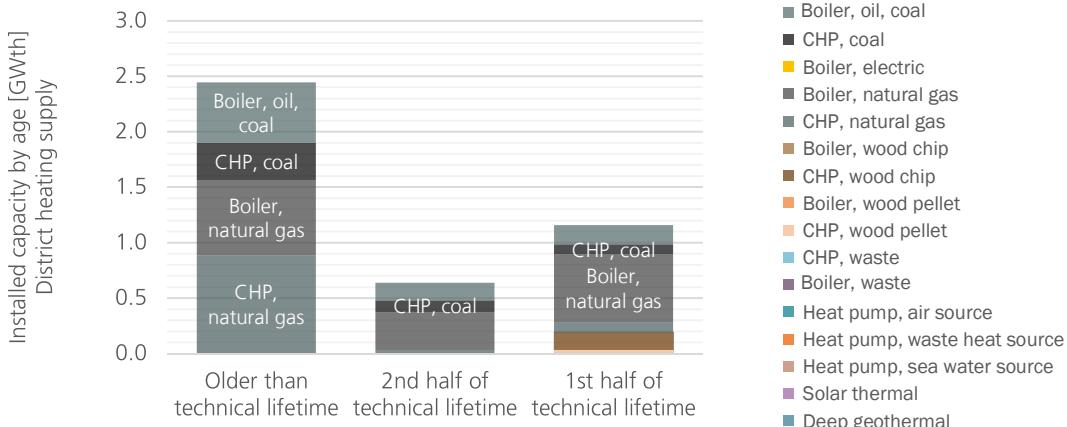
* unit 1000 m²

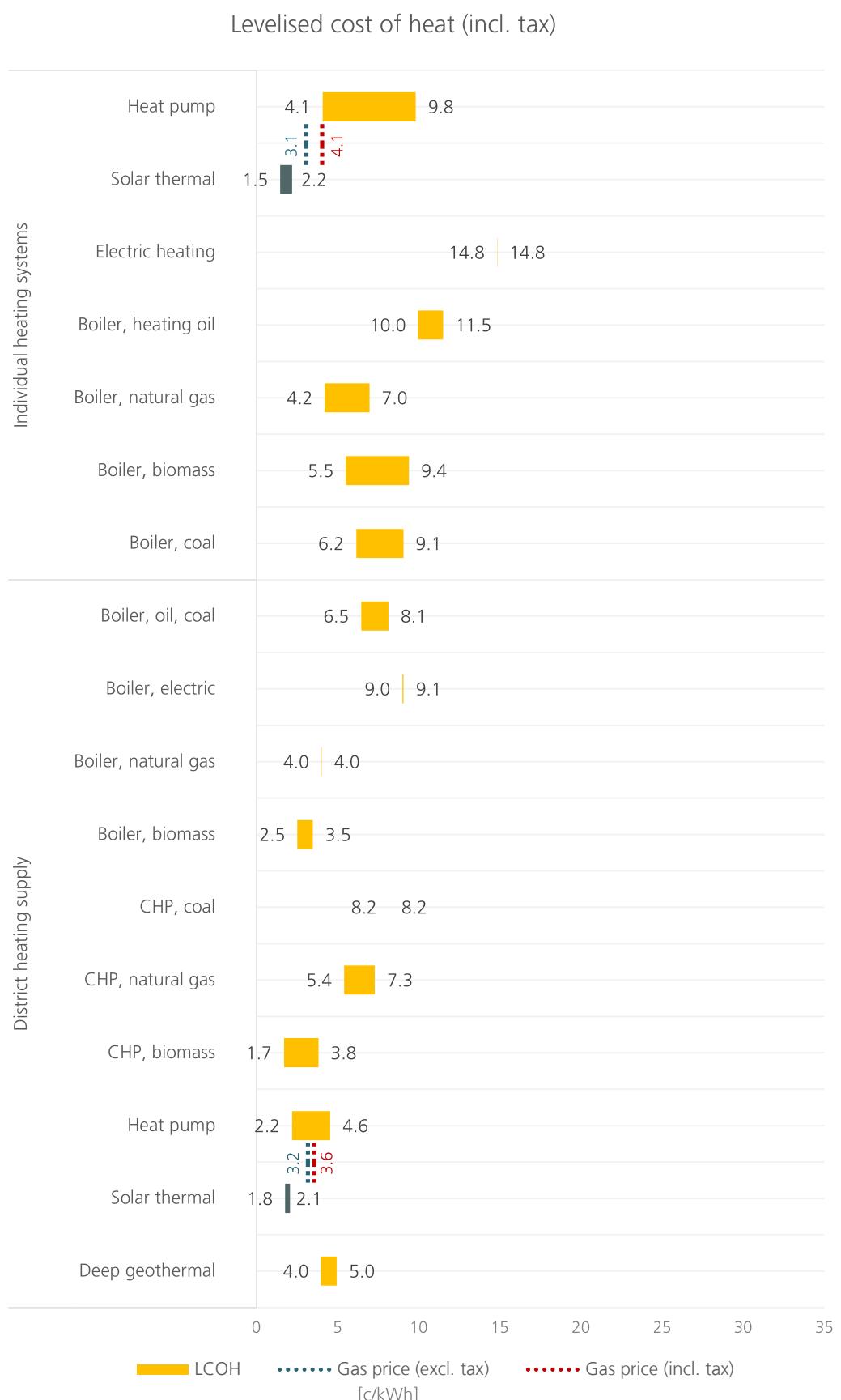
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
District heating supply	Boiler, oil, coal	67	48%	29%	23%	0.9
	CHP, coal	9	52%	21%	27%	0.5
	Boiler, electric	-	-	-	-	1.0
	Boiler, natural gas	146	33%	26%	40%	1.1
	CHP, natural gas	21	71%	14%	14%	0.4
	Boiler, wood chip	1	0%	52%	48%	1.1
	CHP, wood chip	3	0%	0%	100%	0.9
	Boiler, wood pellet	-	-	-	-	1.0
	CHP, wood pellet	2	0%	0%	100%	0.7
	CHP, waste	-	-	-	-	0.8
	Boiler, waste	-	-	-	-	1.1
	Heat pump air source	-	-	-	-	2.7
	Heat pump waste heat source	-	-	-	-	5.0
	Heat pump sea water source	-	-	-	-	2.6
	Solar thermal	-	-	-	-	0.4
	Deep geothermal	-	-	-	-	6.5

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Scrapping schemes for heating equipment based on fossil fuels	Measures in place
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Measures in place
Heat incentives for decentral heating systems	Measures in place
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	Measures in place
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	Measures in place
Trigger point: Exchange of heating system	Measures in place
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	Measures in place
Trigger point: Efficiency class below certain level	Measures in place
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Measures in place
New installations in existing buildings	Measures in place
Use of fossil fuel heating technologies	Measures in place
Phase-out for certain building segments (e.g. public buildings)	Measures in place
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

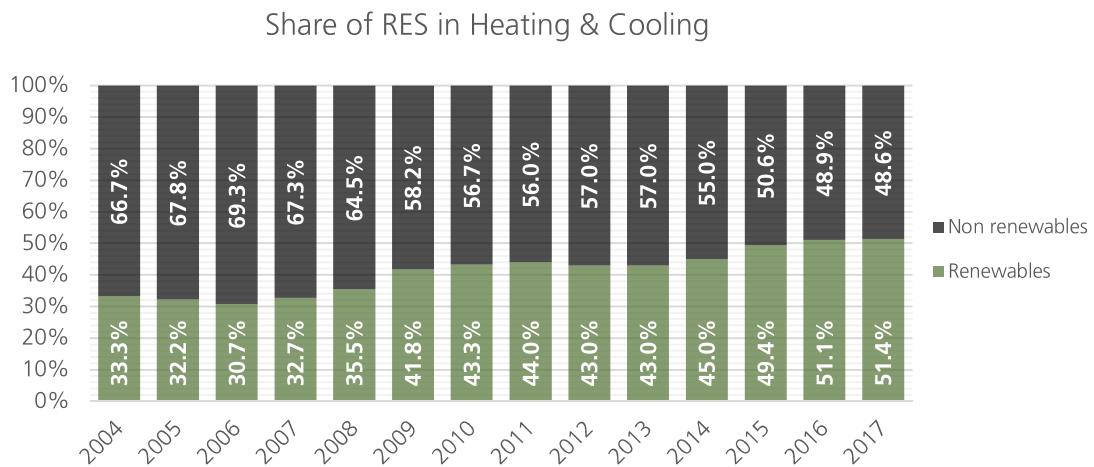
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Measures in development

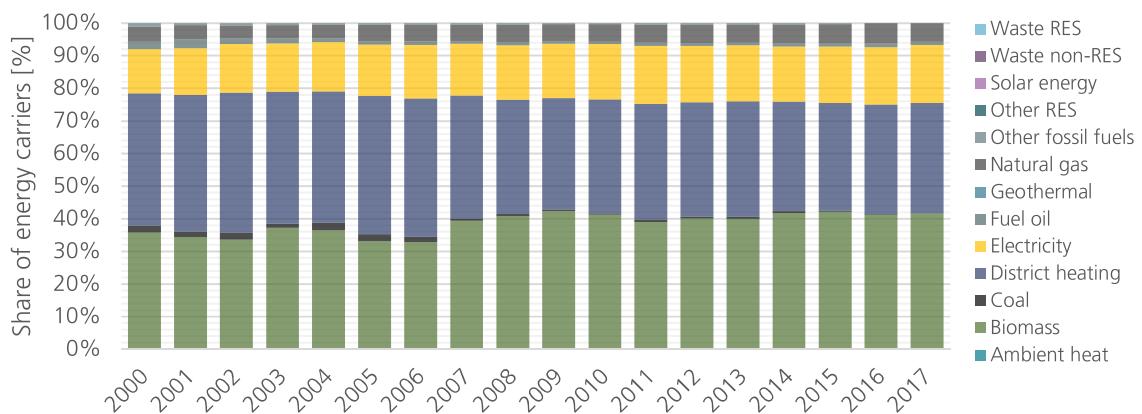
Measures in place

Historical trends

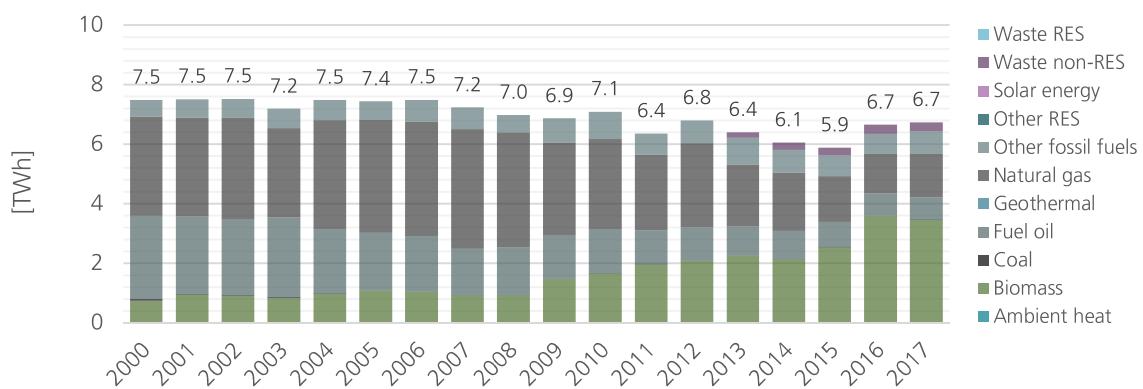
Estonia 2017



Final energy consumption in residential sector



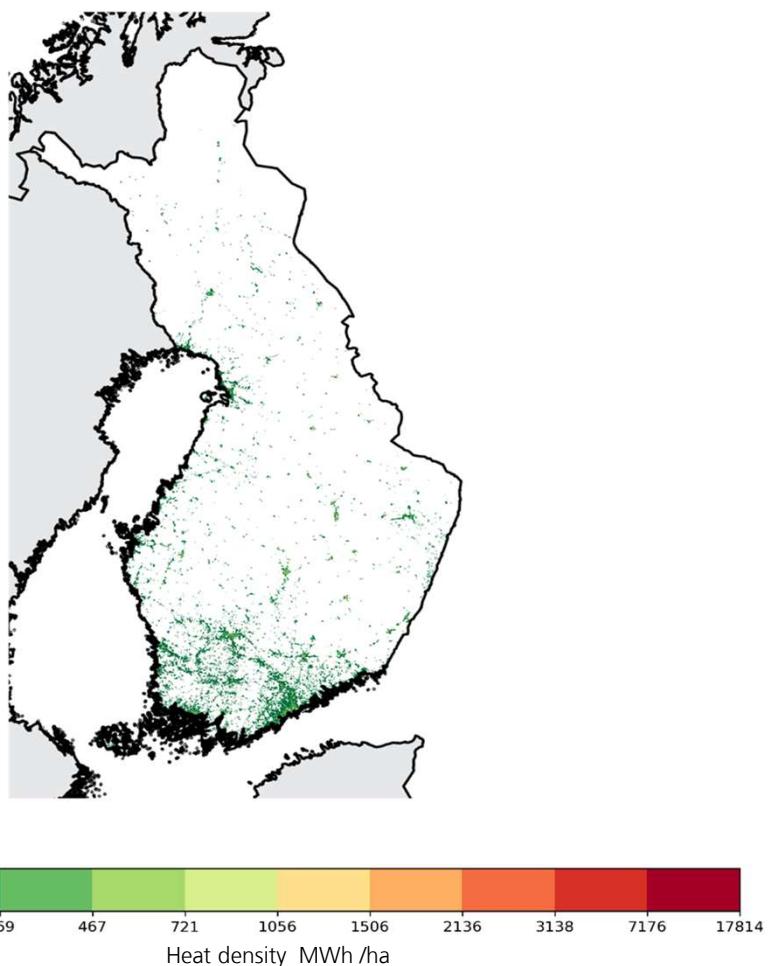
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Finland



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI



Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

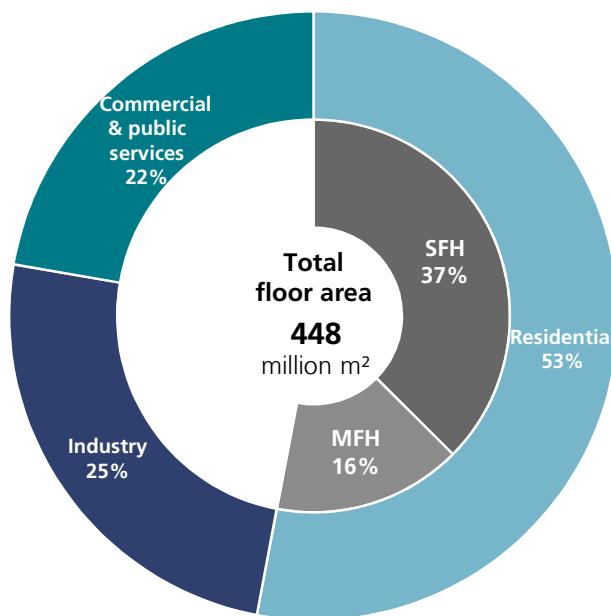
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- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

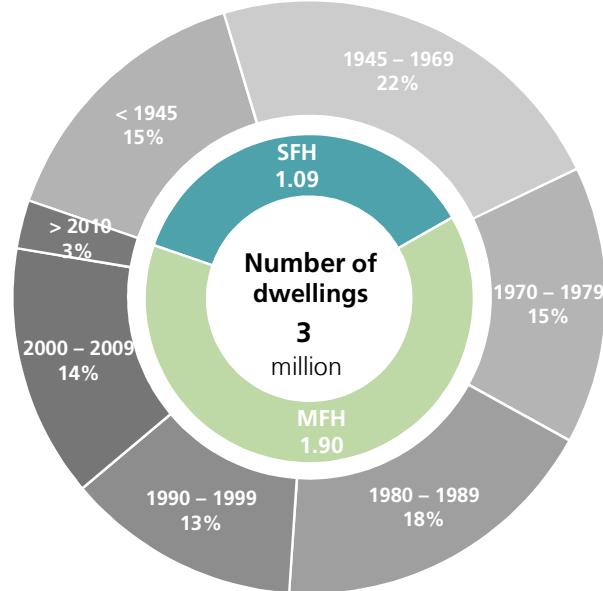
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Finland 2017

5



Climate Data

Heating degree days

Finland

EU-27

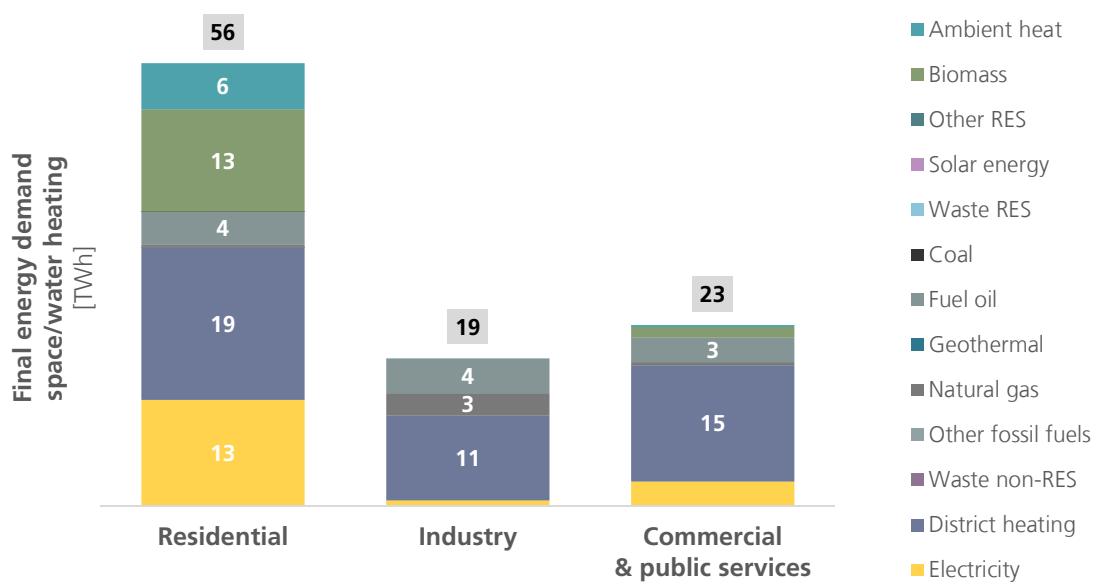
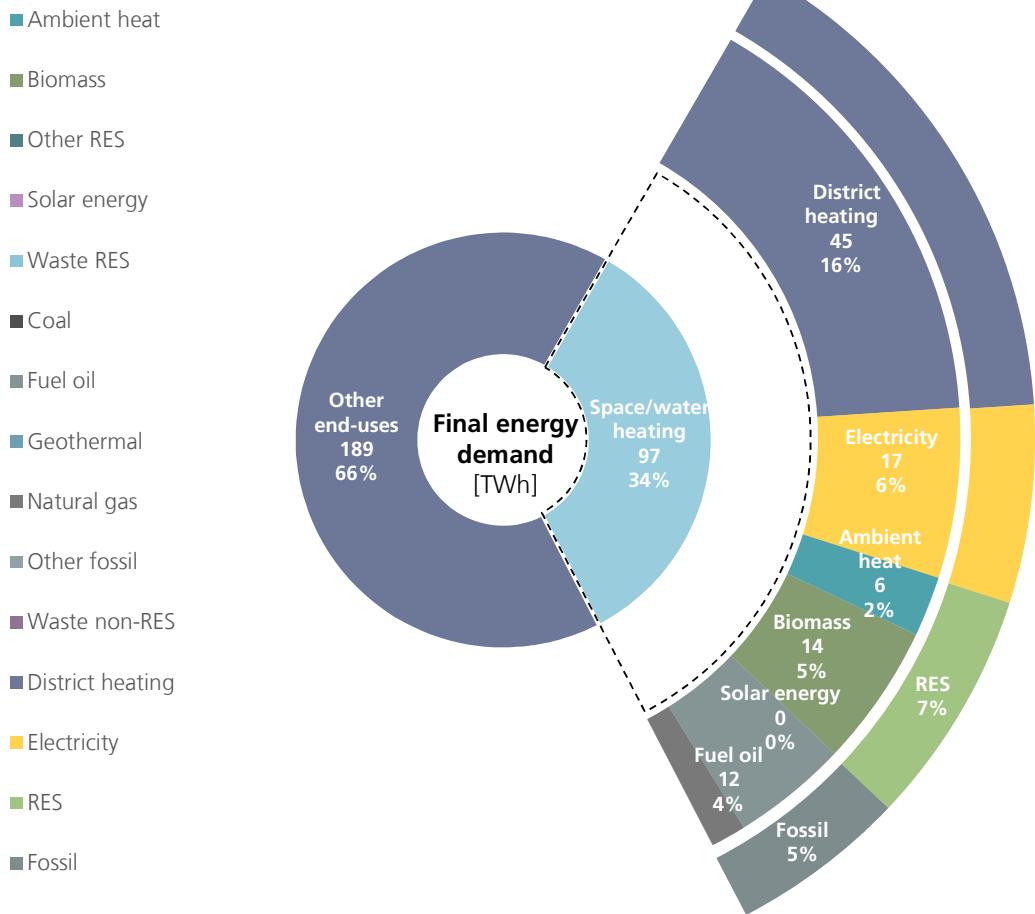
Average value 2000-2017

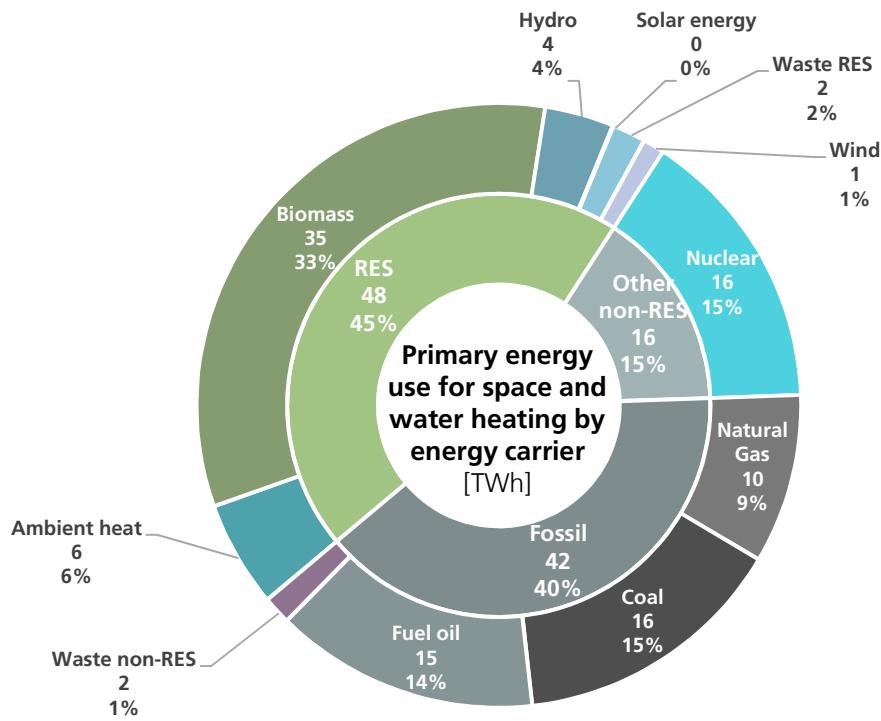
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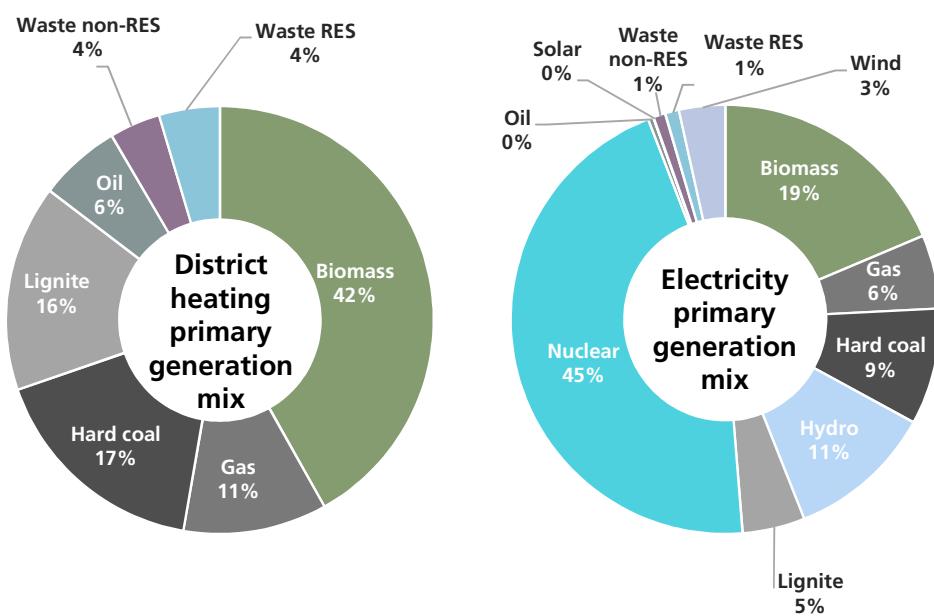
Overview of energy demand

Finland 2017
6





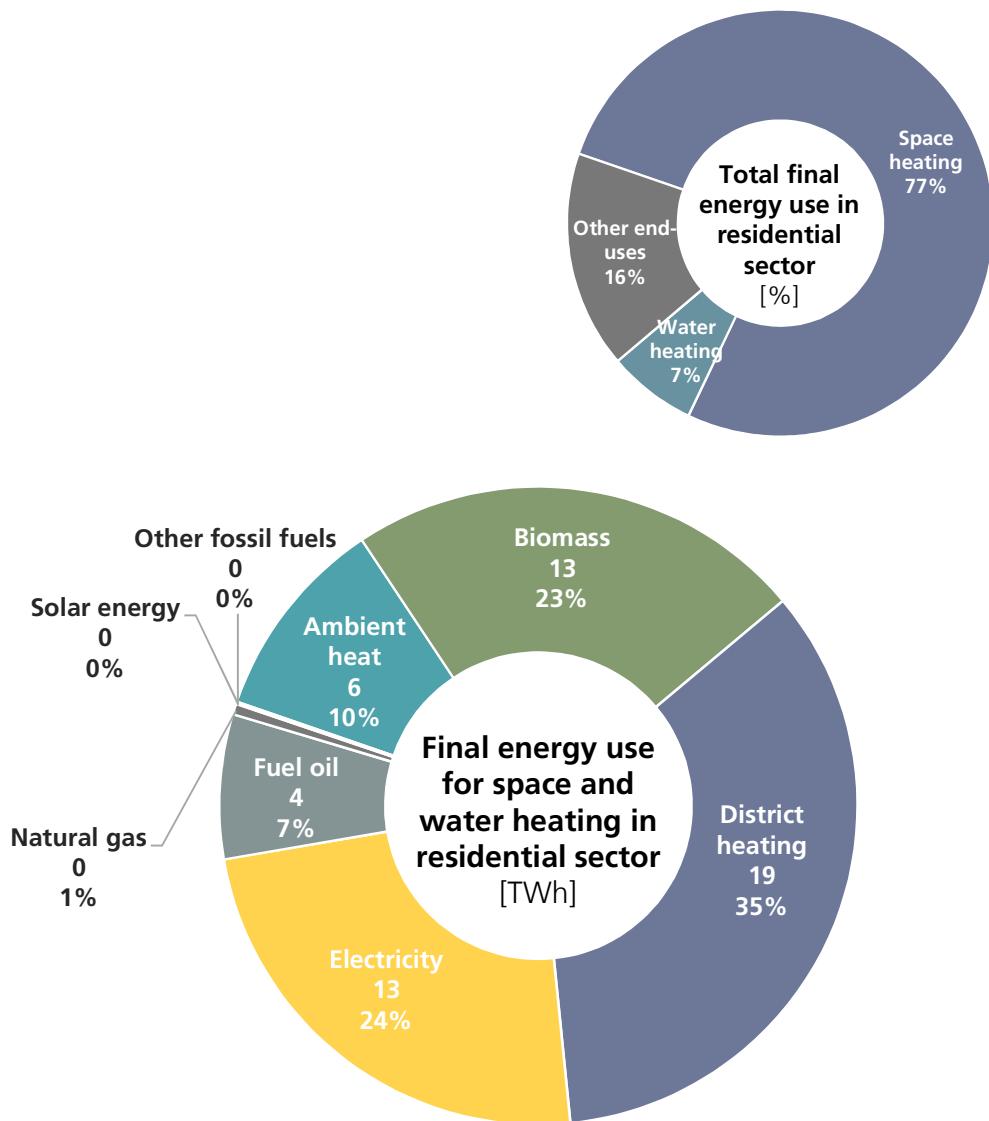
Generation mix



Space & water heating in residential sector

Finland 2017

8



Specific energy demand

236

kWh/m²yr

Final energy demand

279

kWh/m²yr

Primary energy demand

270

kWh/m²yr

Single-family dwellings

318

kWh/m²yr

Single-family dwellings

154

kWh/m²yr

Multi-family dwellings

186

kWh/m²yr

Multi-family dwellings

Technology mix

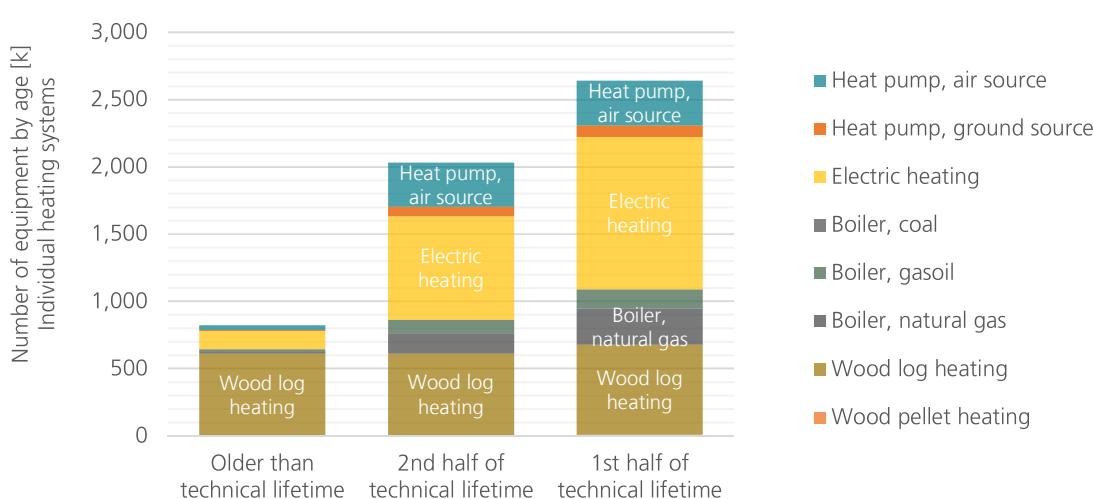
Finland 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	696	5%	47%	48%	3.3	4.2
Heat pump ground source	163	5%	44%	51%	3.5	1.5
Solar thermal	62*	3%	27%	70%	0.5	0.0
Electric heating	2,040	7%	38%	56%	1.0	2.0
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	259	6%	38%	55%	0.9	7.0
Boiler, natural gas	436	4%	34%	62%	1.0	4.5
Wood log heating	1,883	32%	32%	35%	0.7	22.5
Wood pellet heating	19	8%	41%	51%	0.8	0.5

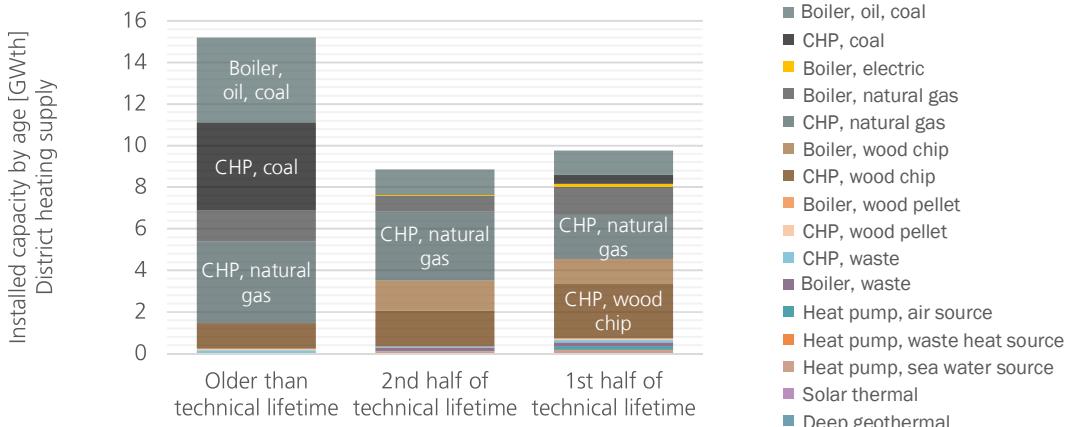
* unit 1000 m²

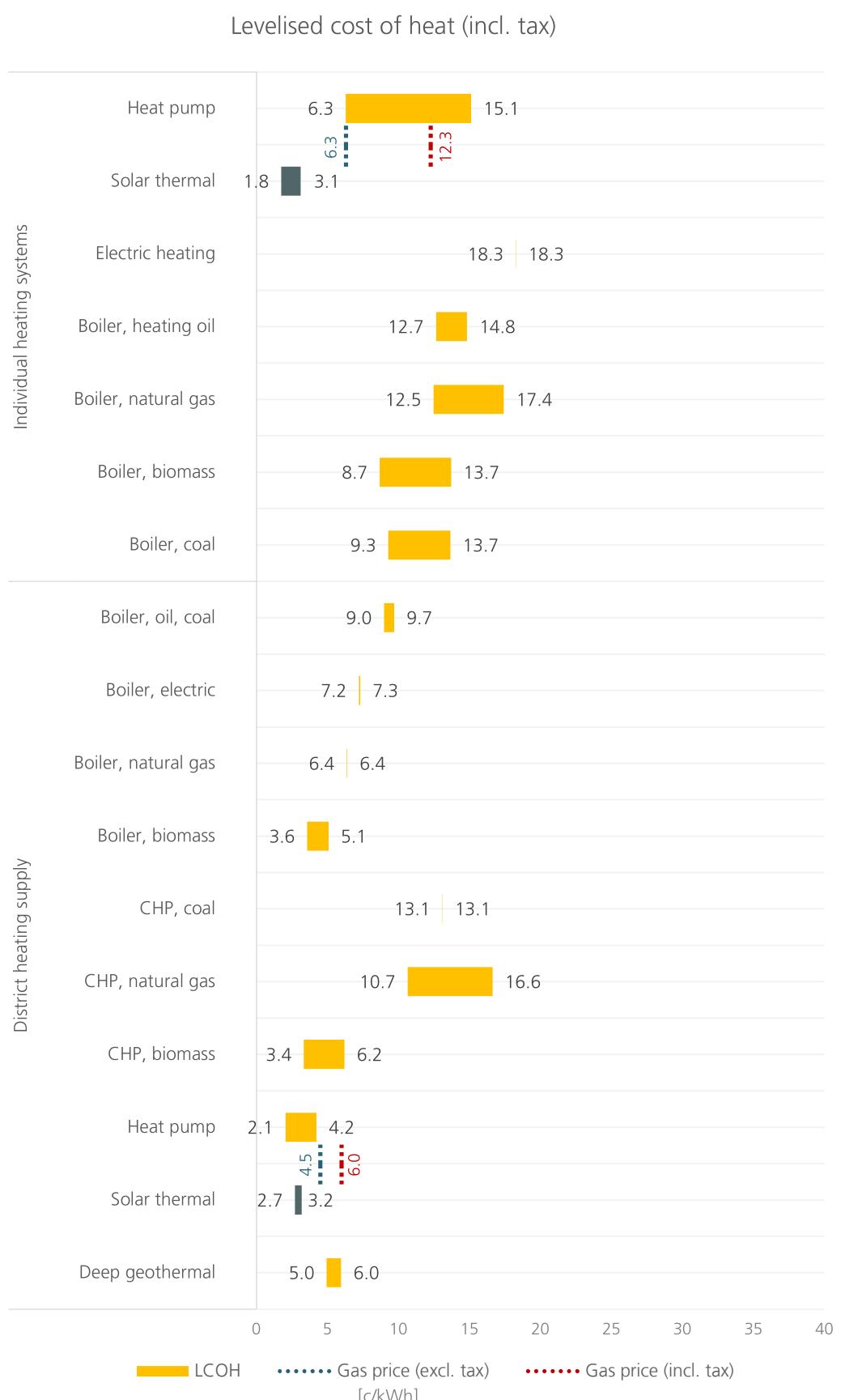
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
District heating supply	Boiler, oil, coal	488	50%	28%	21%	0.9
	CHP, coal	16	94%	0%	6%	0.5
	Boiler, electric	13	0%	3%	97%	1.0
	Boiler, natural gas	321	33%	26%	40%	1.1
	CHP, natural gas	120	48%	35%	18%	0.4
	Boiler, wood chip	475	0%	53%	47%	1.1
	CHP, wood chip	52	33%	33%	35%	0.9
	Boiler, wood pellet	-	-	-	-	1.0
	CHP, wood pellet	3	33%	0%	67%	0.7
	CHP, waste	9	67%	11%	22%	0.8
	Boiler, waste	12	6%	33%	61%	1.1
	Heat pump air source	30	2%	15%	83%	2.7
	Heat pump waste heat source	6	33%	33%	33%	5.0
	Heat pump sea water source	15	0%	7%	90%	2.6
	Solar thermal	1	0%	100%	0%	0.4
	Deep geothermal	-	-	-	-	6.5

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	No measure
Financial support for RES-H infrastructure investments	No measure
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Measures in place
Heat incentives for decentral heating systems	No measure
Energy- and CO₂ pricing	
CO ₂ pricing	Measures in place
Tax exemptions for electricity for heat pumps	Measures in place
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	Measures in place
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	Measures in place
National requirements for urban heat planning	No measure

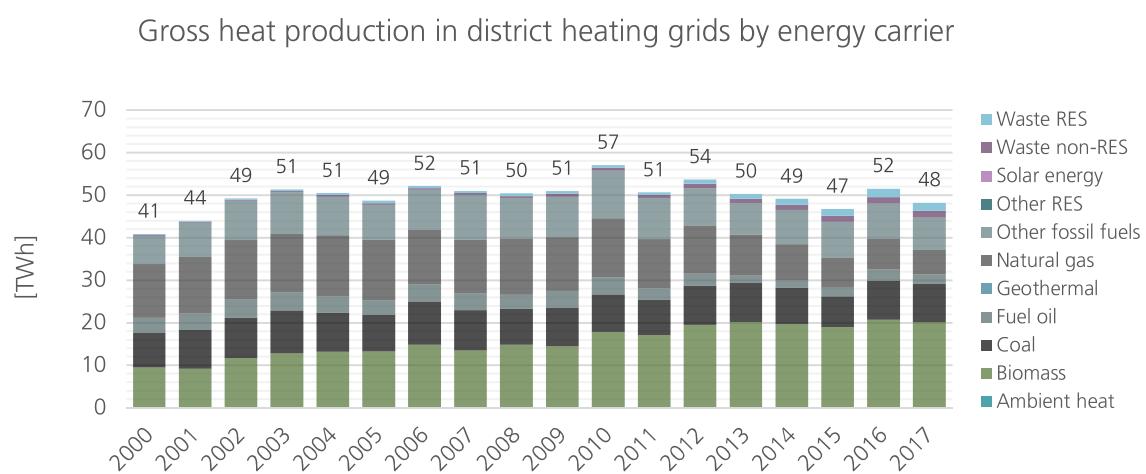
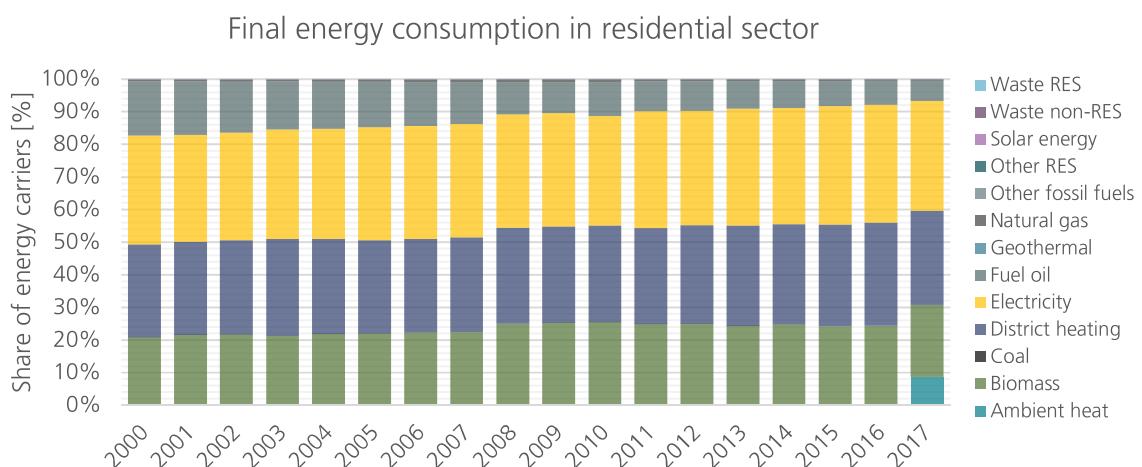
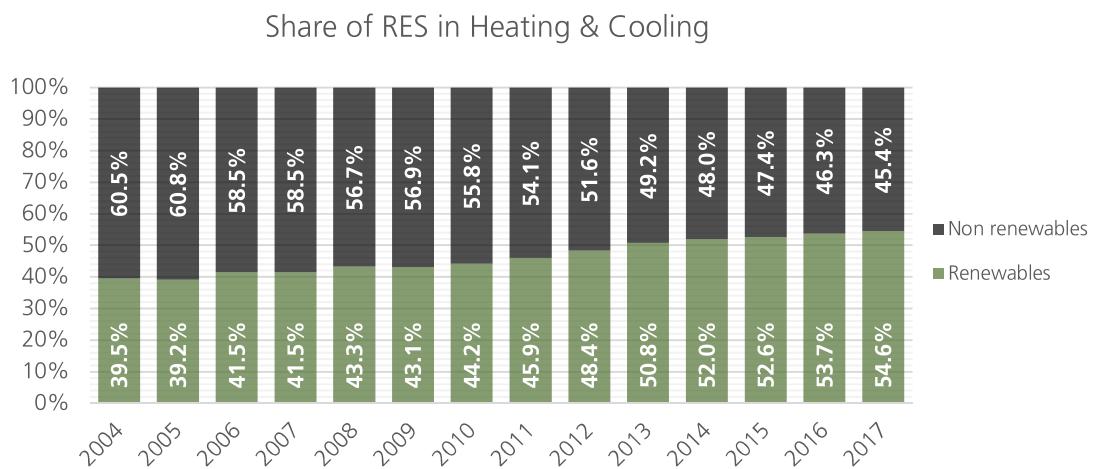
 No measure

 Measures in development

 Measures in place

Historical trends

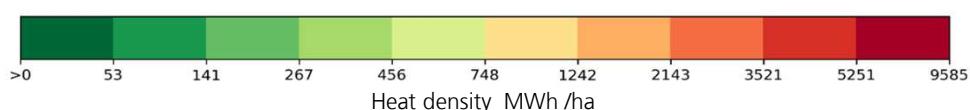
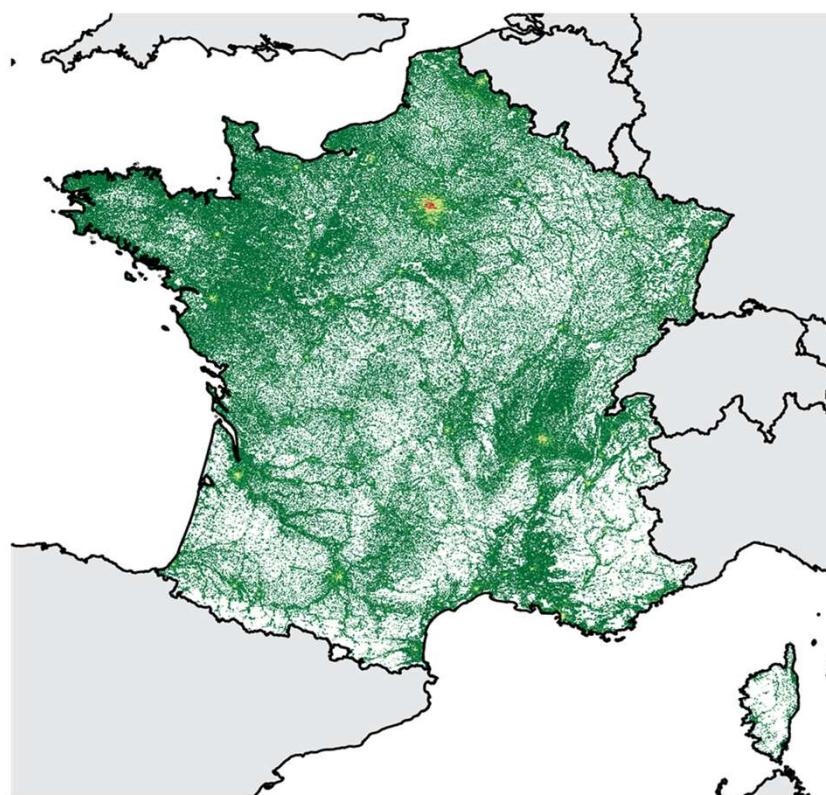
Finland 2017
13



Space heating market summary

2017

France



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

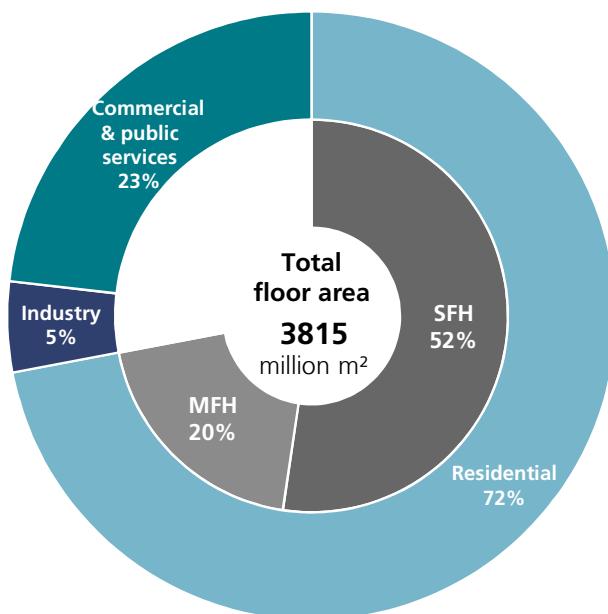
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

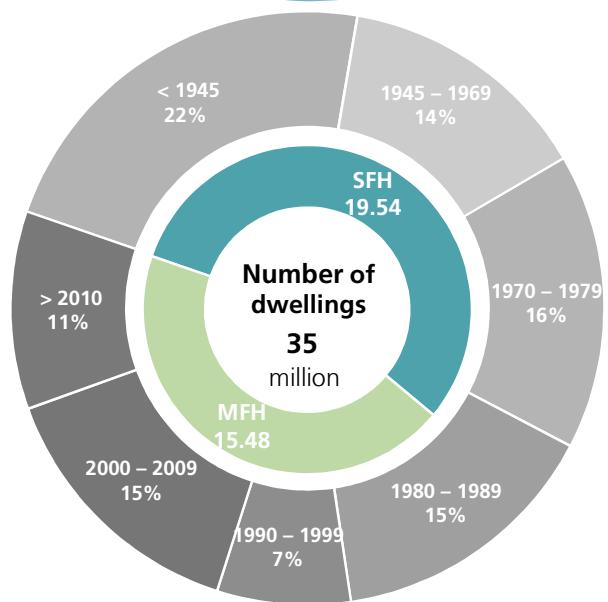
Building Stock Data

SFH: Single family house
MFH: Multi-family house



France 2017

5



Climate Data

Heating degree days

France

EU-27

Average value 2000-2017

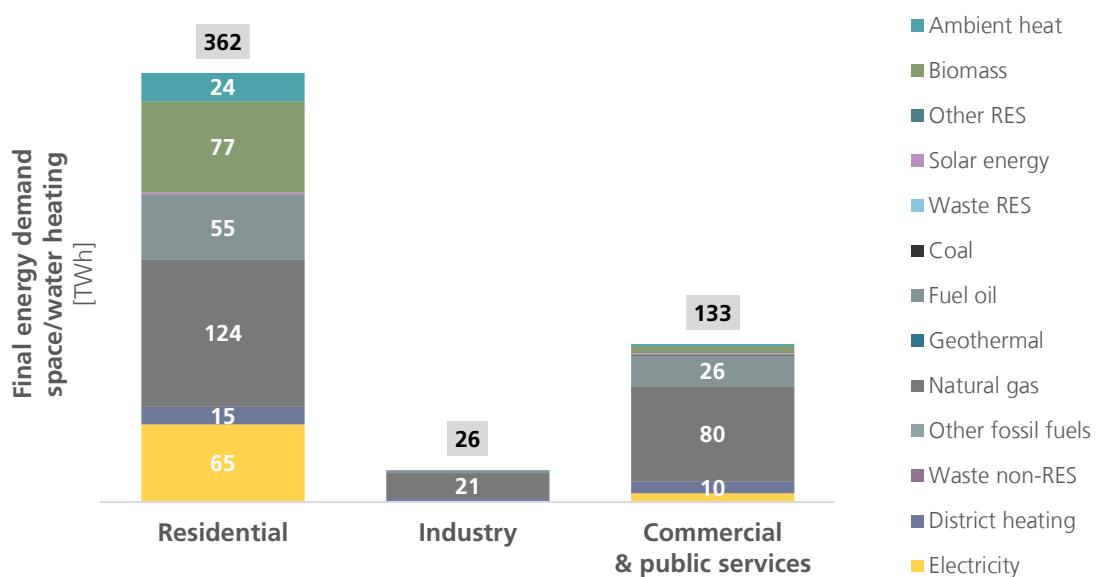
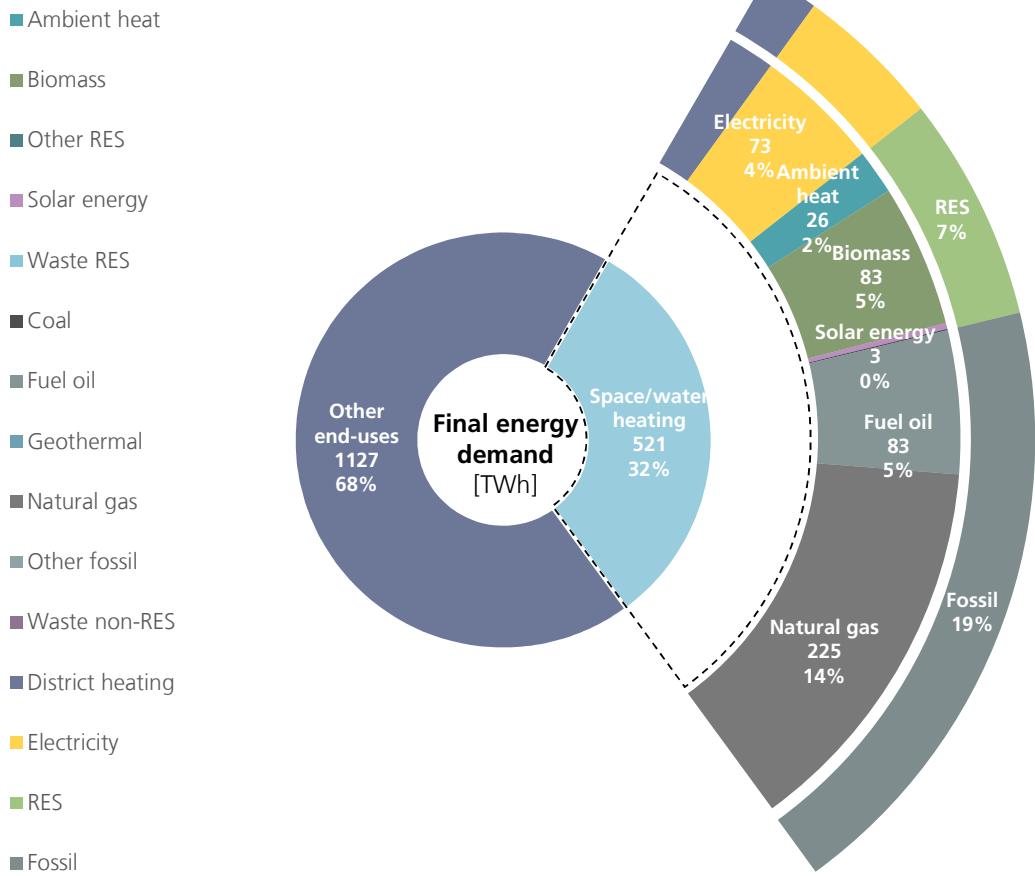
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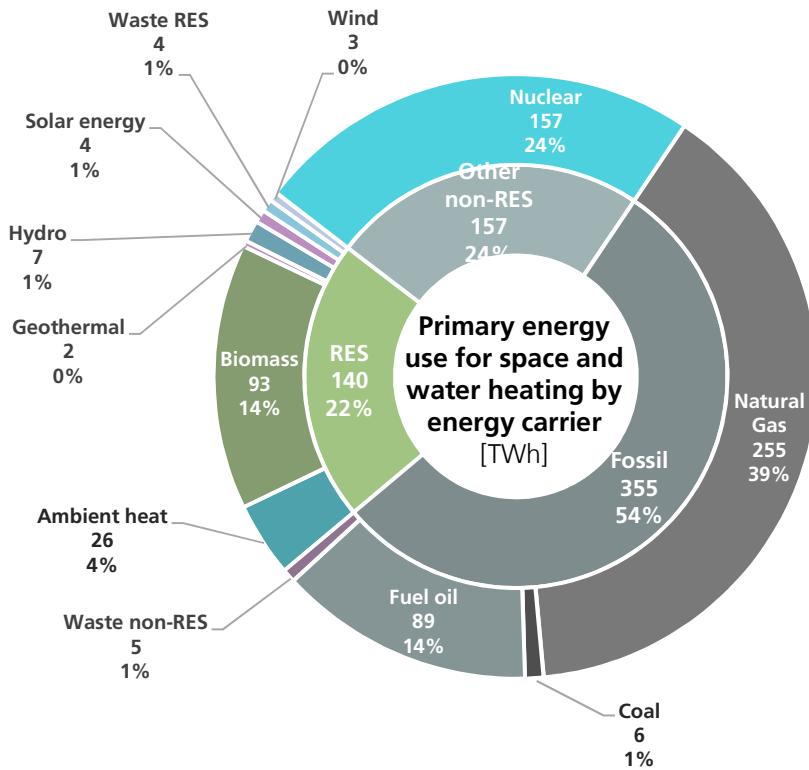
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Overview of energy demand

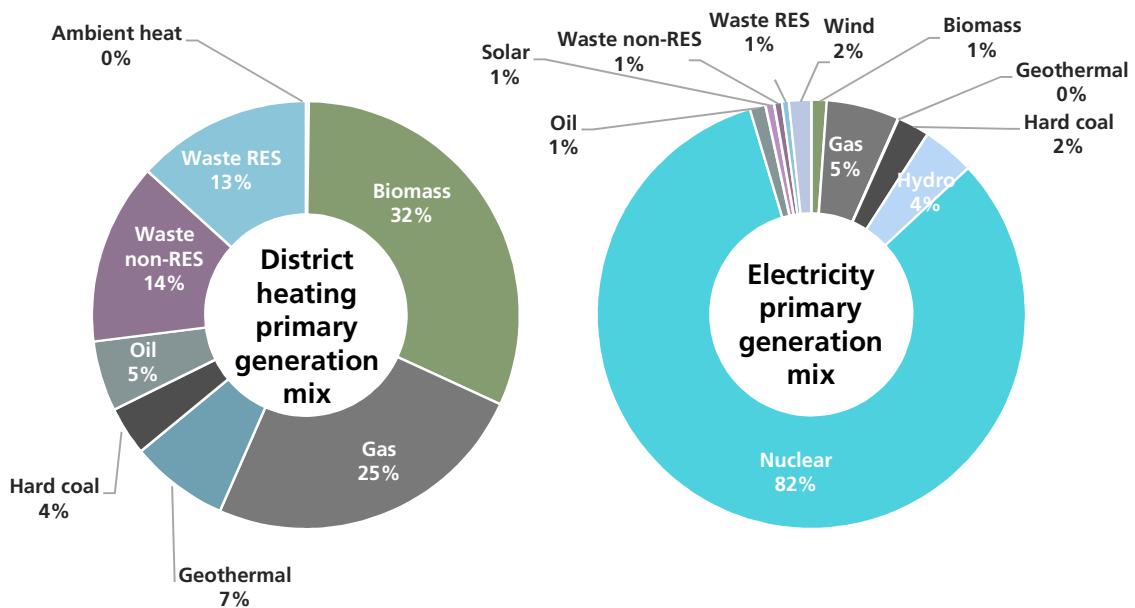
France 2017

6





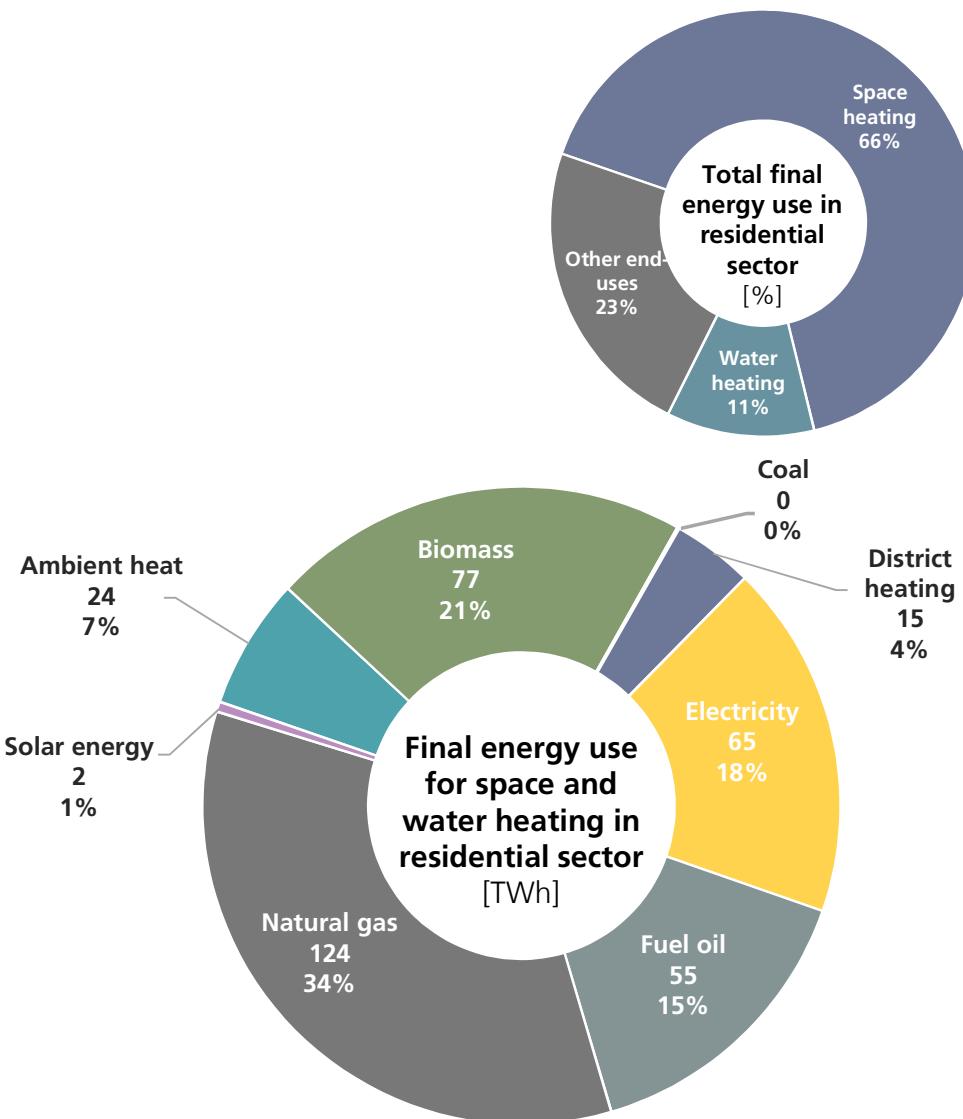
Generation mix



Space & water heating in residential sector

France 2017

8



Specific energy demand

132

kWh/m²yr

Final energy demand

173

kWh/m²yr

Primary energy demand

162

kWh/m²yr

Single-family dwellings

210

kWh/m²yr

Single-family dwellings

50

kWh/m²yr

Multi-family dwellings

75

kWh/m²yr

Multi-family dwellings

Technology mix

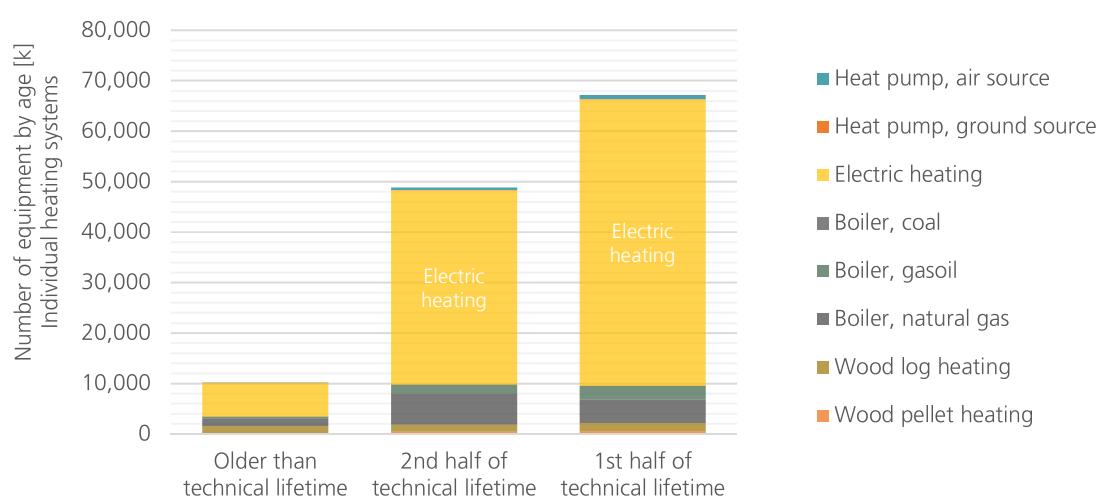
France 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	1,470	4%	37%	59%	3.9	12.1
Heat pump ground source	53	5%	45%	50%	3.8	0.7
Solar thermal	3,214*	3%	27%	70%	0.5	2.2
Electric heating		7%	38%	56%	1.0	102.0
Boiler, coal	19	8%	41%	51%	0.8	0.3
Boiler, gasoil	4,767	6%	38%	55%	0.9	122.1
Boiler, natural gas	12,293	12%	49%	39%	1.0	342.7
Wood log heating	4,528	34%	31%	35%	0.7	54.2
Wood pellet heating	1,071	8%	41%	51%	0.8	37.3

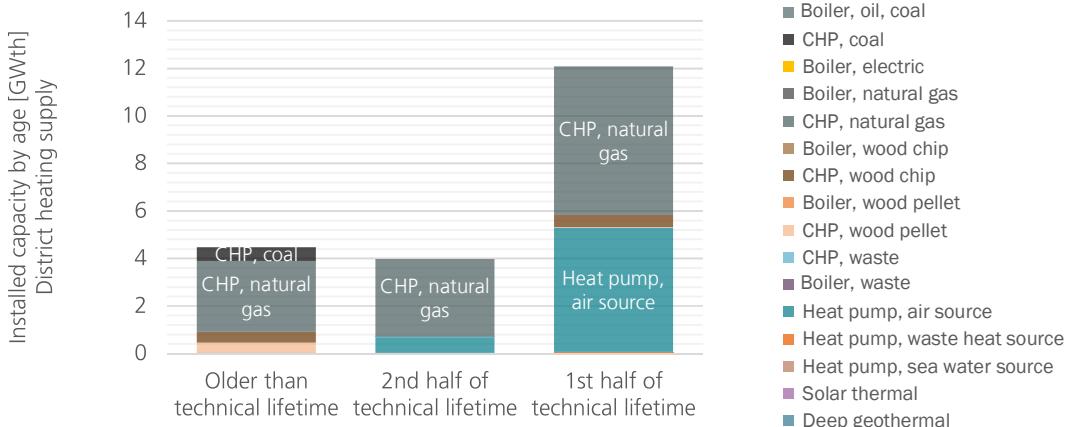
* unit 1000 m²

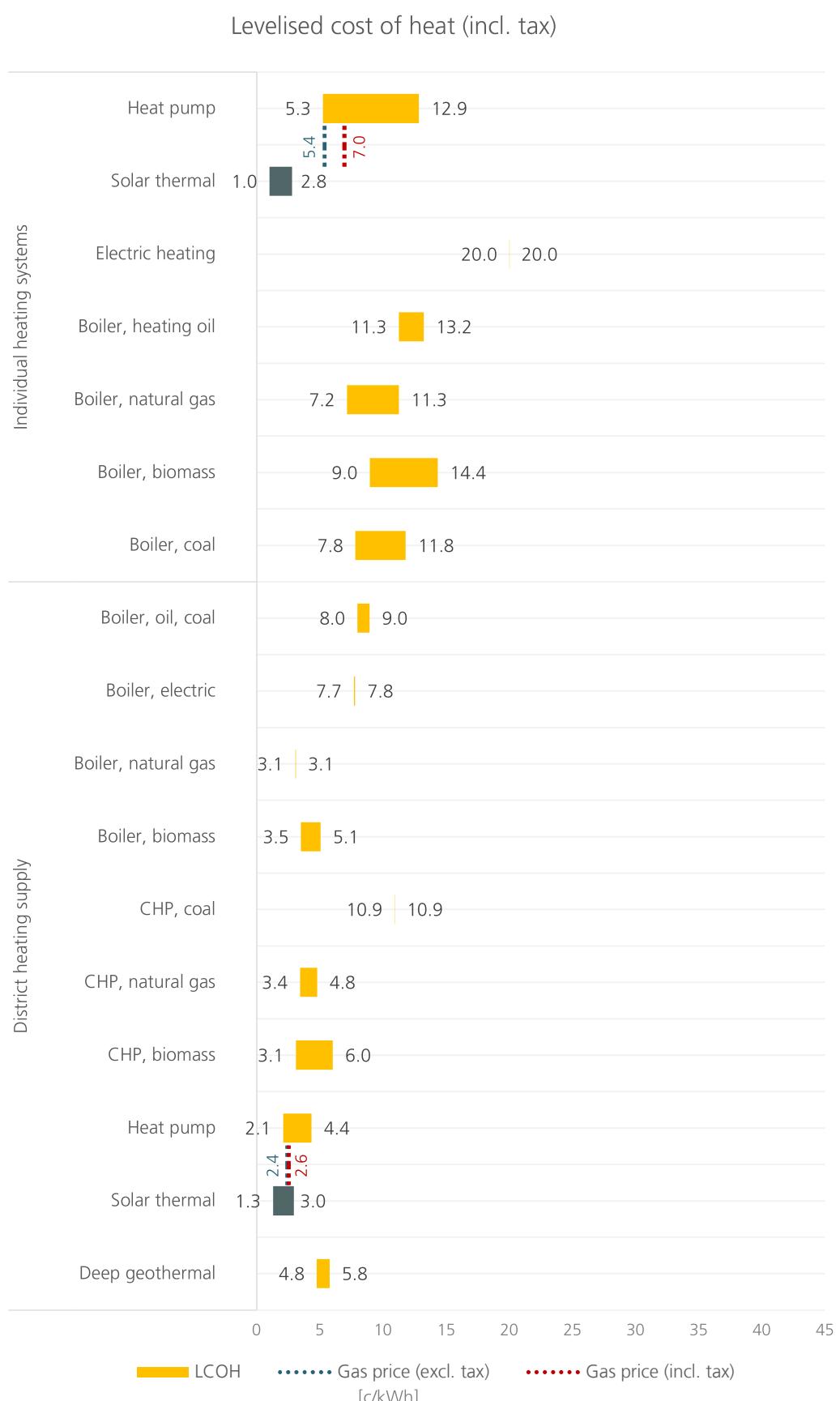
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	39	95%	5%	0%	0.5	0.6
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	741	19%	63%	18%	0.4	12.4
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	21	48%	0%	52%	0.9	1.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	10	80%	0%	20%	0.7	0.5
CHP, waste	1	0%	100%	0%	0.8	0.0
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	835	2%	15%	83%	3.5	5.9
Heat pump waste heat source	1	0%	0%	100%	5.0	0.0
Heat pump sea water source	50	4%	36%	13%	3.4	0.2
Solar thermal	6	0%	17%	83%	0.5	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in development
Scrapping schemes for heating equipment based on fossil fuels	Measures in place
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
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CO ₂ pricing	Measures in place
Tax exemptions for electricity for heat pumps	Measures in place
Regulatory measures	
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Trigger point: Major renovation	No measure
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Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	Measures in development
Trigger point: Efficiency class below certain level	Measures in place
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Measures in development
New installations in existing buildings	Measures in development
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Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

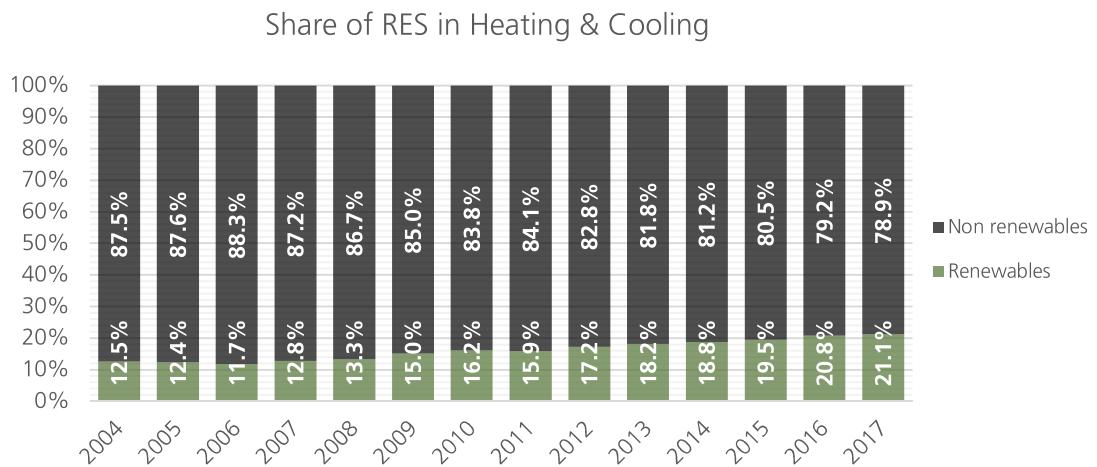
Measures in development

Measures in place

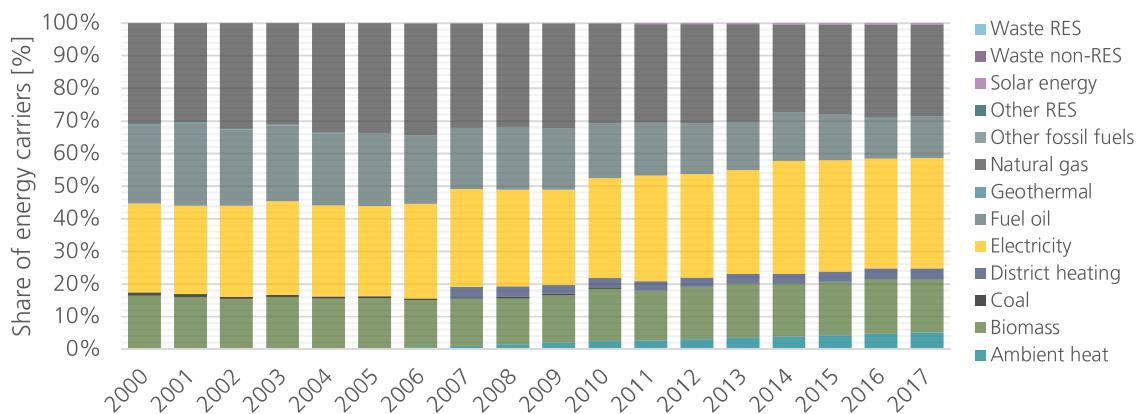
Historical trends

France 2017

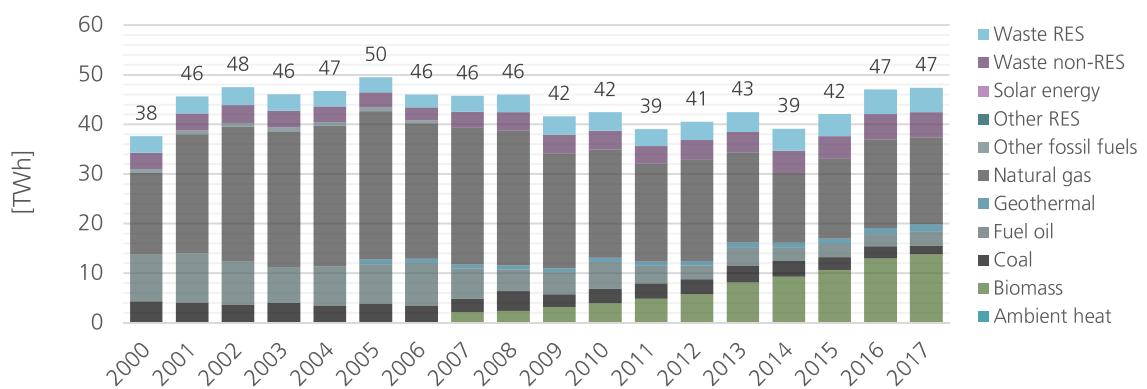
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Final energy consumption in residential sector



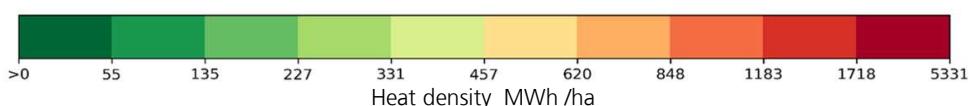
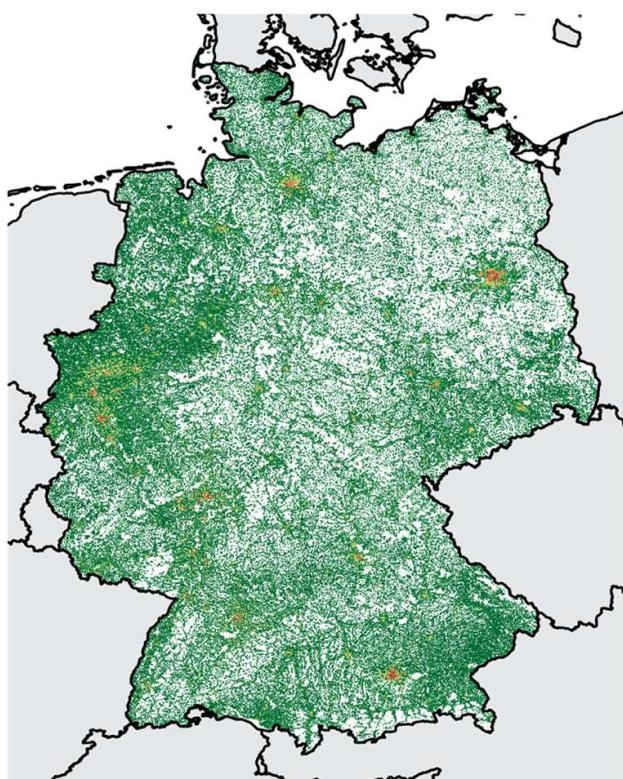
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Germany



Source: <https://www.hotmaps.eu/map>

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

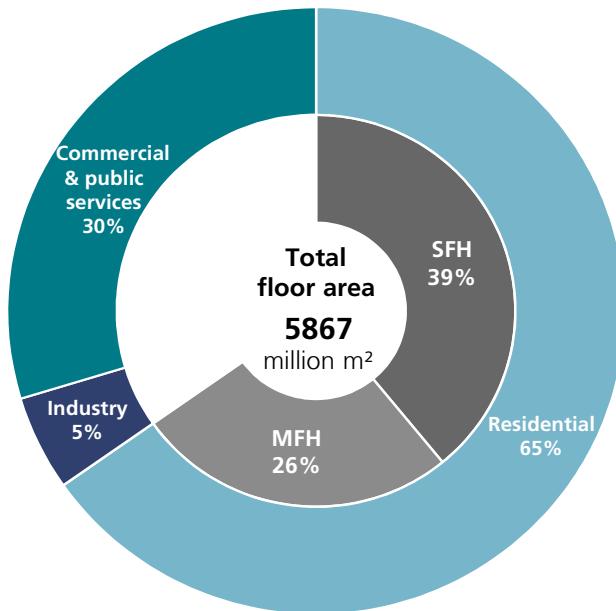
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

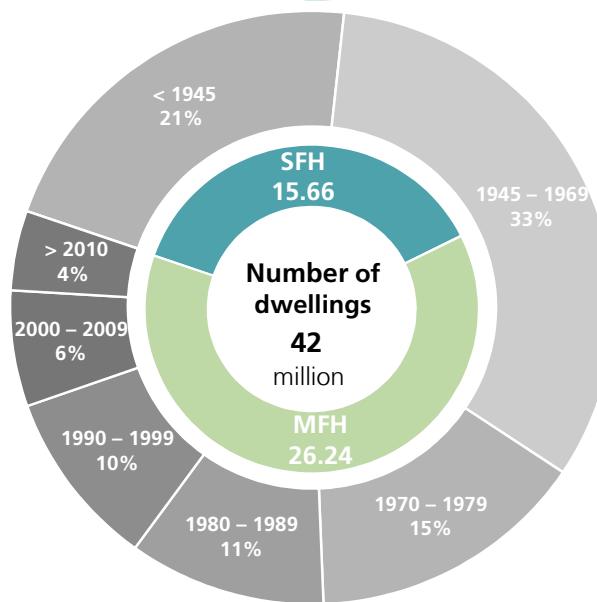
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Germany 2017

5



Climate Data

Heating degree days

Germany

EU-27

Average value 2000-2017

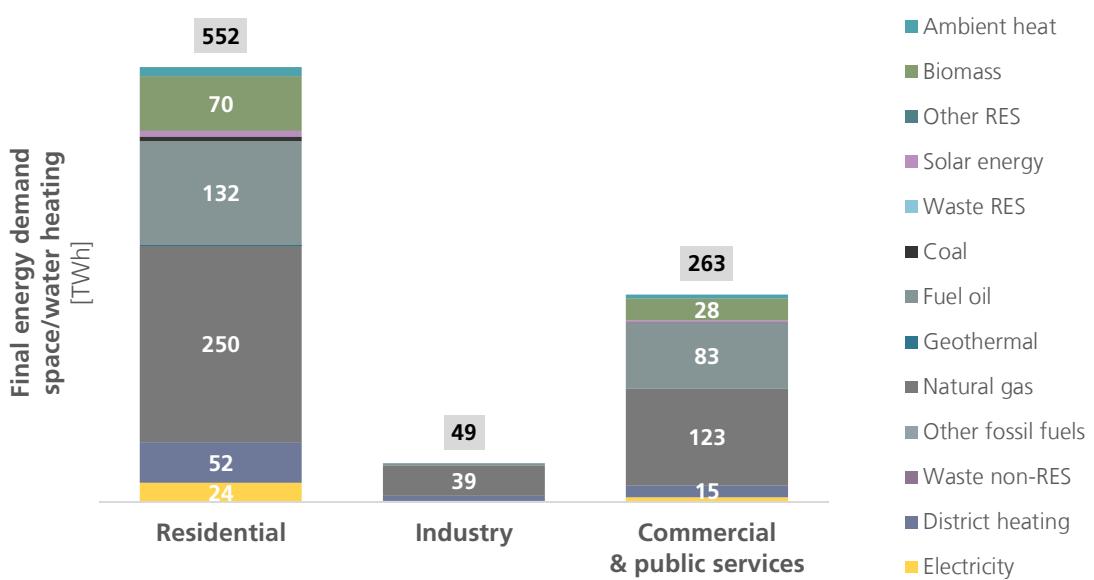
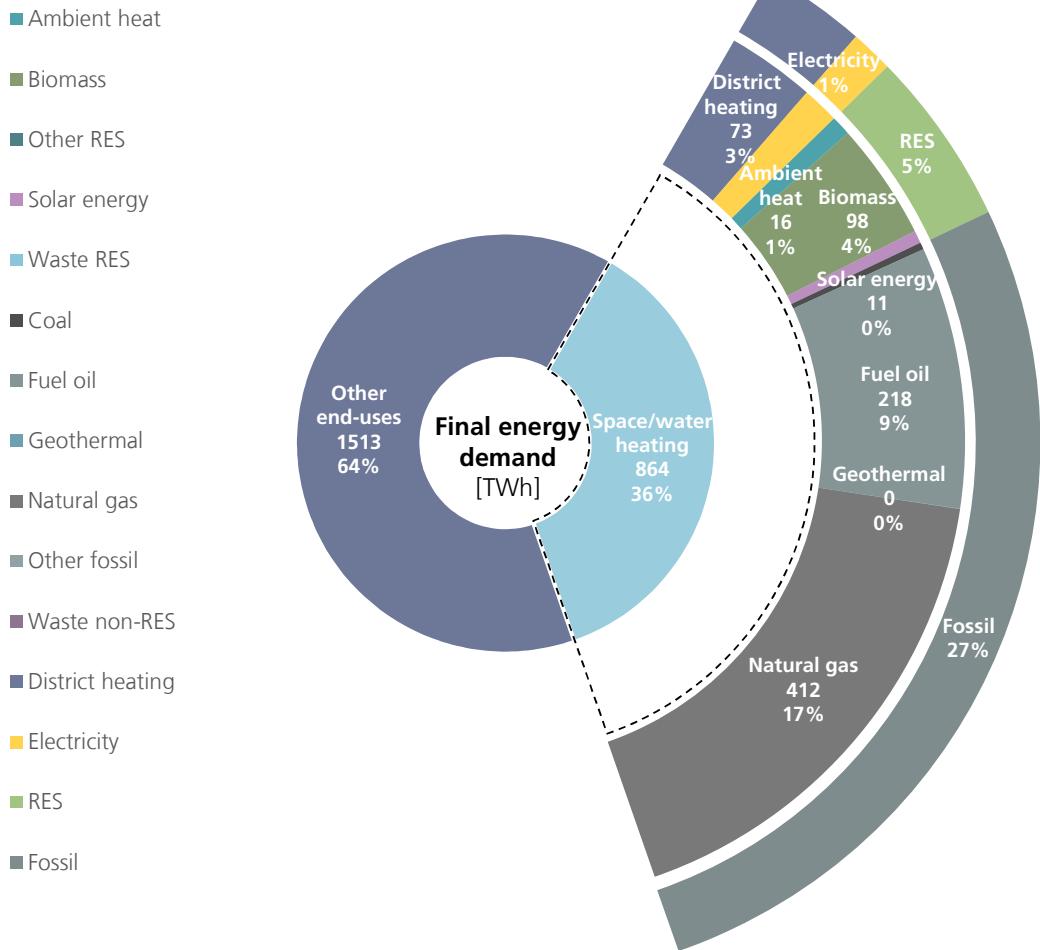
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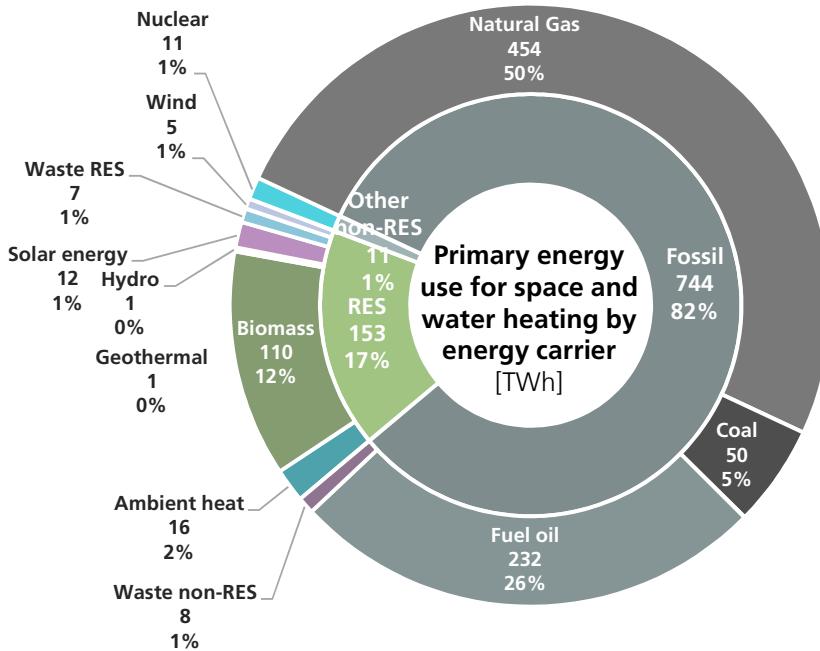
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Overview of energy demand

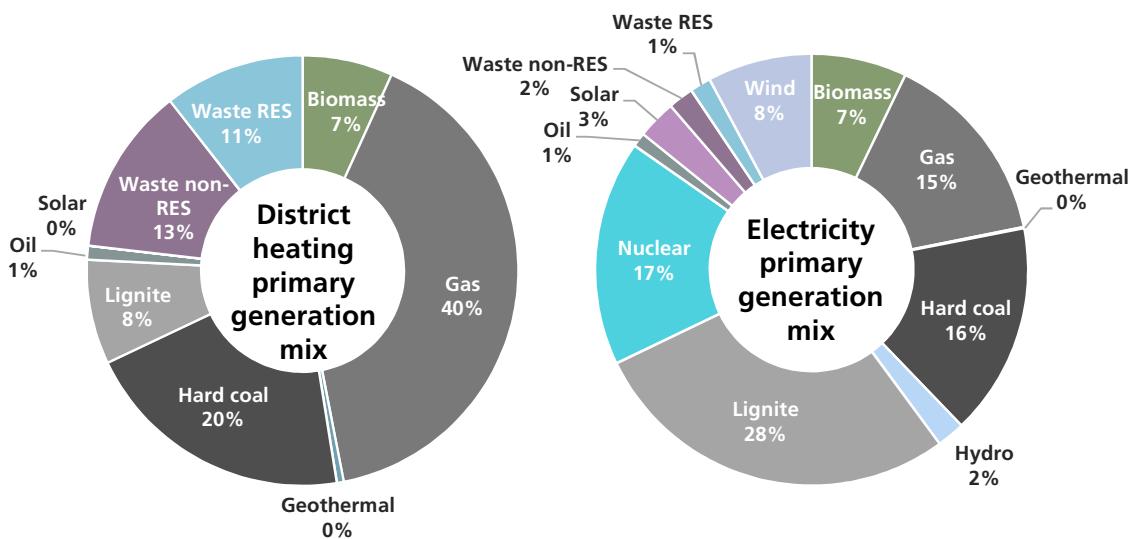
Germany 2017

6





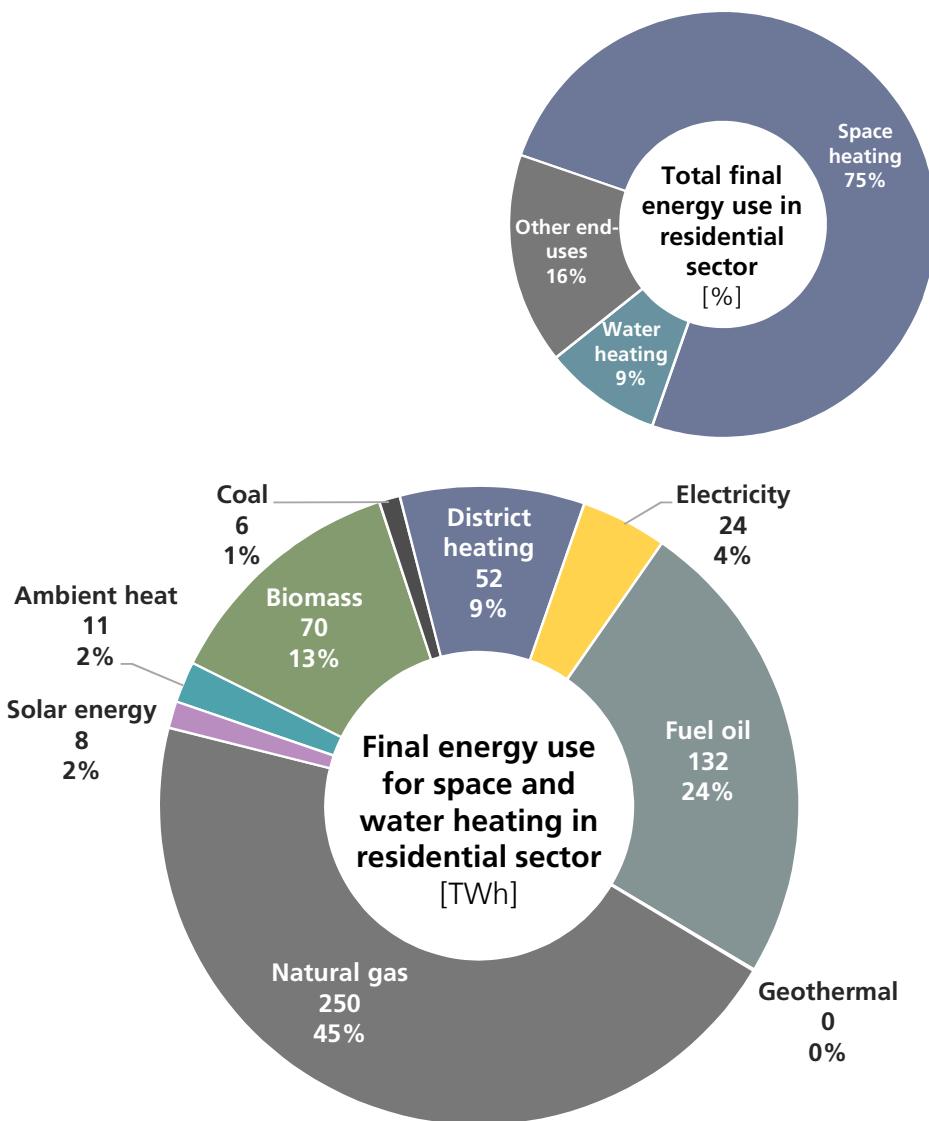
Generation mix



Space & water heating in residential sector

Germany 2017

8



Specific energy demand

144 kWh/m²yr
Final energy demand

152 kWh/m²yr
Primary energy demand

157 kWh/m²yr
Single-family dwellings

165 kWh/m²yr
Single-family dwellings

125 kWh/m²yr
Multi-family dwellings

133 kWh/m²yr
Multi-family dwellings

Technology mix

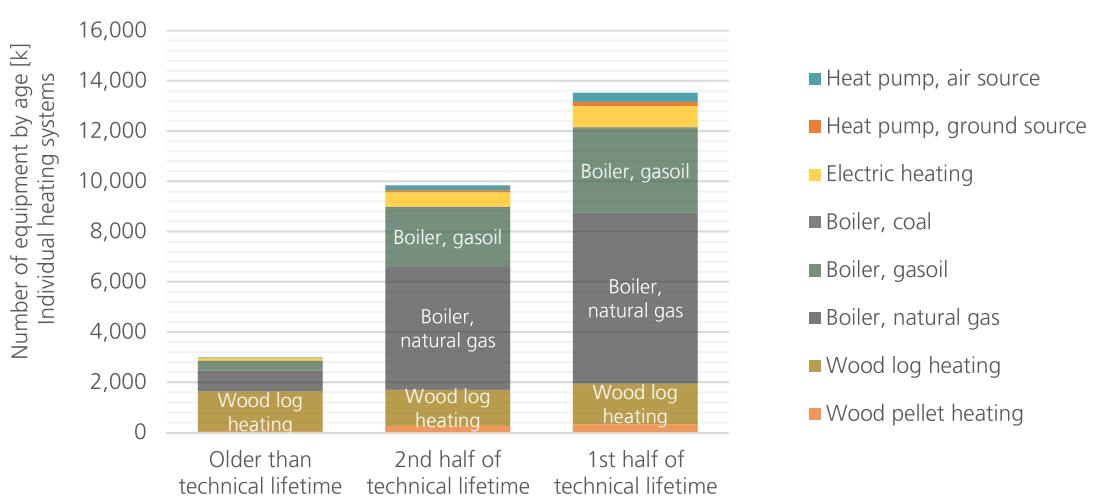
Germany 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	555	4%	33%	63%	3.5	5.2
Heat pump ground source	273	4%	35%	61%	3.6	3.4
Solar thermal	19,221*	3%	27%	70%	0.5	13.5
Electric heating	1,530	7%	38%	56%	1.0	1.5
Boiler, coal	110	8%	41%	51%	0.8	2.9
Boiler, gasoil	6,029	6%	38%	55%	0.9	229.9
Boiler, natural gas	12,560	7%	39%	54%	1.0	368.7
Wood log heating	4,646	34%	31%	35%	0.7	55.6
Wood pellet heating	626	8%	41%	51%	0.8	19.5

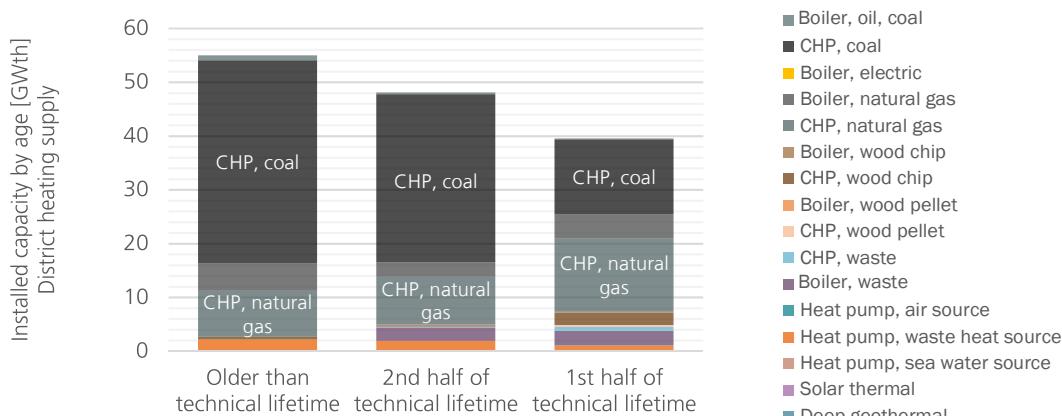
* unit 1000 m²

- no data

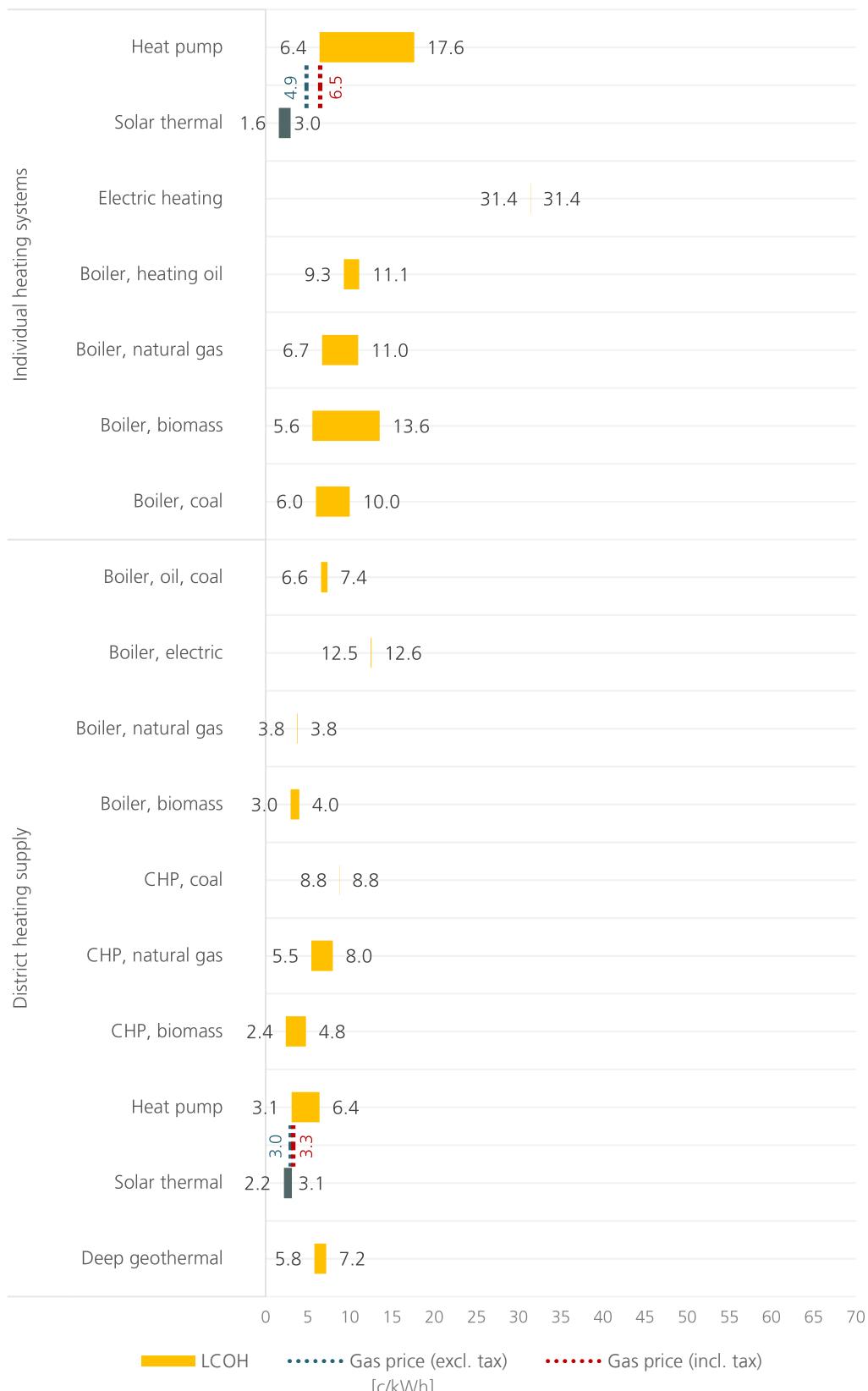


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	99	60%	27%	14%	0.9	1.4
CHP, coal	138	54%	35%	12%	0.5	82.9
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	1,095	33%	26%	40%	1.1	12.2
CHP, natural gas	1,695	20%	46%	35%	0.4	31.2
Boiler, wood chip	51	0%	52%	48%	1.1	0.3
CHP, wood chip	144	7%	8%	85%	0.9	2.9
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	13	8%	8%	85%	0.7	0.4
CHP, waste	26	4%	23%	73%	0.8	0.9
Boiler, waste	-	-	-	-	1.1	5.2
Heat pump air source	10	2%	15%	83%	3.1	0.1
Heat pump waste heat source	728	33%	33%	33%	5.0	5.1
Heat pump sea water source	13	4%	36%	60%	3.0	0.0
Solar thermal	18	0%	50%	50%	0.5	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data



Levelised cost of heat (incl. tax)



Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Scrapping schemes for heating equipment based on fossil fuels	Green
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO2 pricing	
CO2 pricing	Green
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Red
Trigger point: Major renovation	Red
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Yellow
New installations in existing buildings	Yellow
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

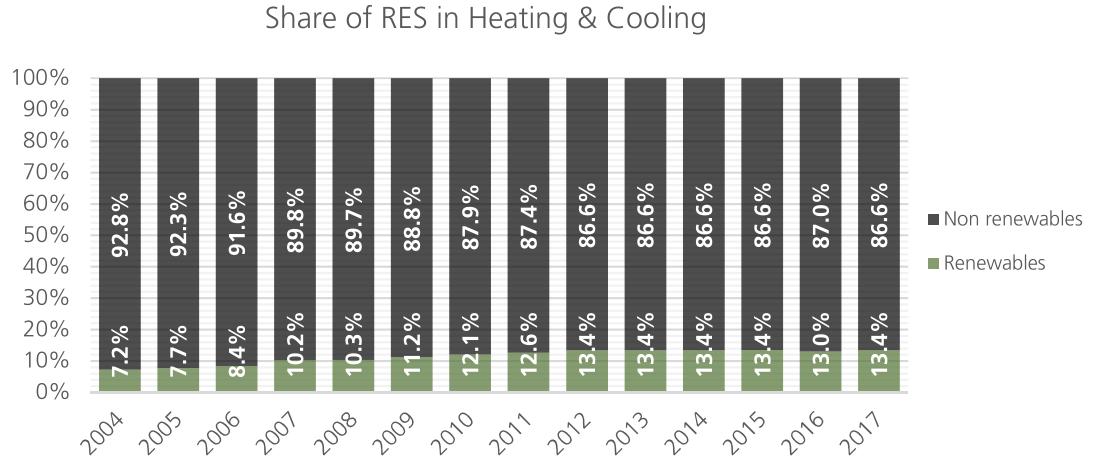
Measures in development

Measures in place

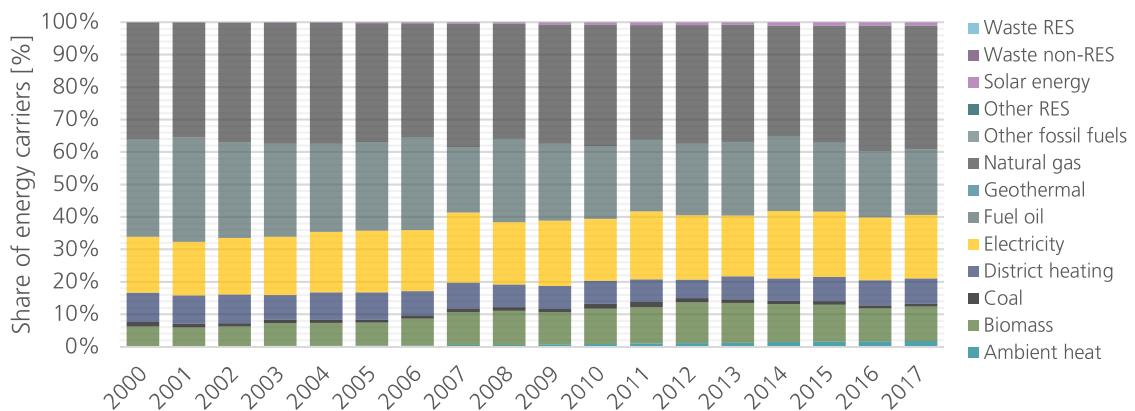
Historical trends

Germany 2017

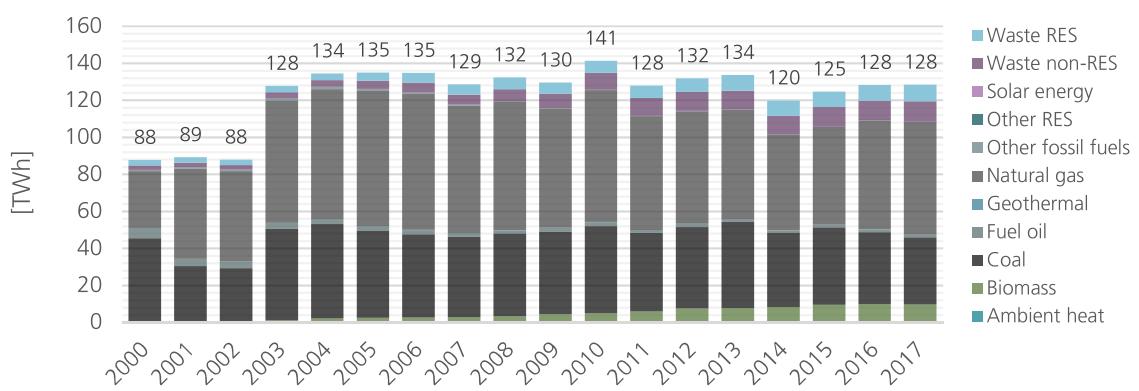
13



Final energy consumption in residential sector



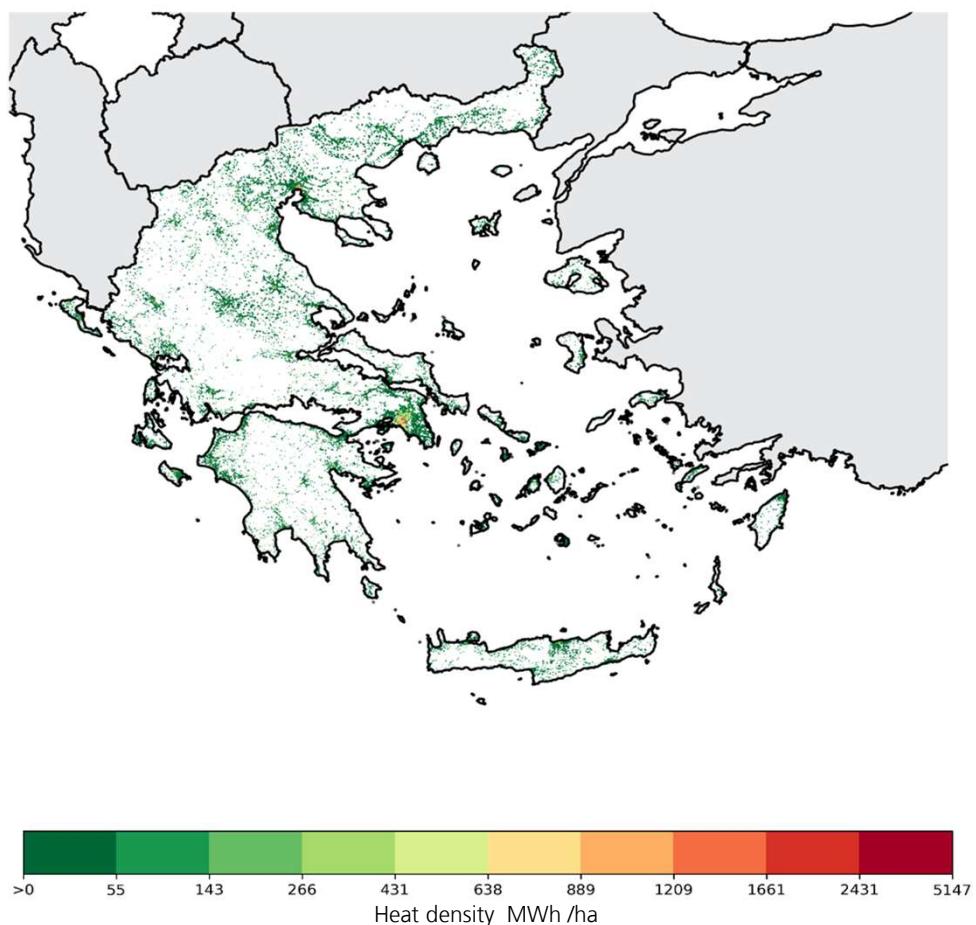
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Greece



Source: <https://www.hotmaps.eu/map>

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

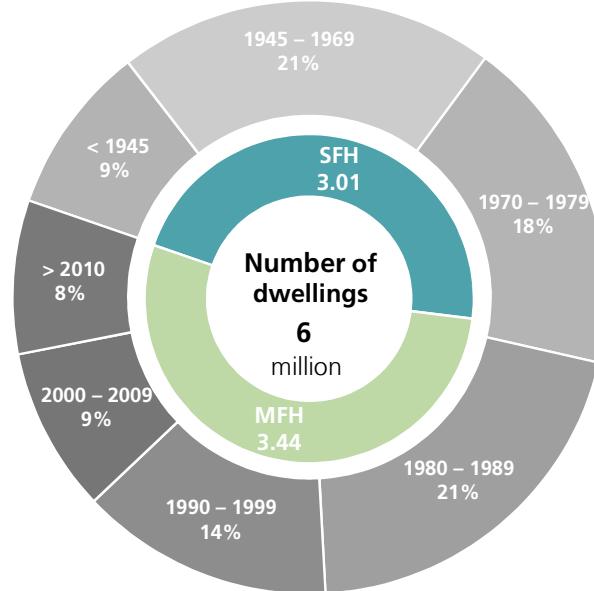
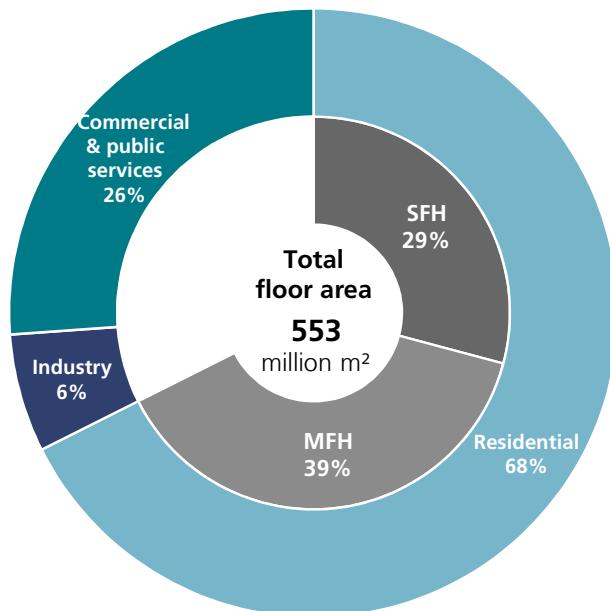
- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
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- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

SFH: Single family house
MFH: Multi-family house

Greece 2017

5



Climate Data

Heating degree days

Greece

EU-27

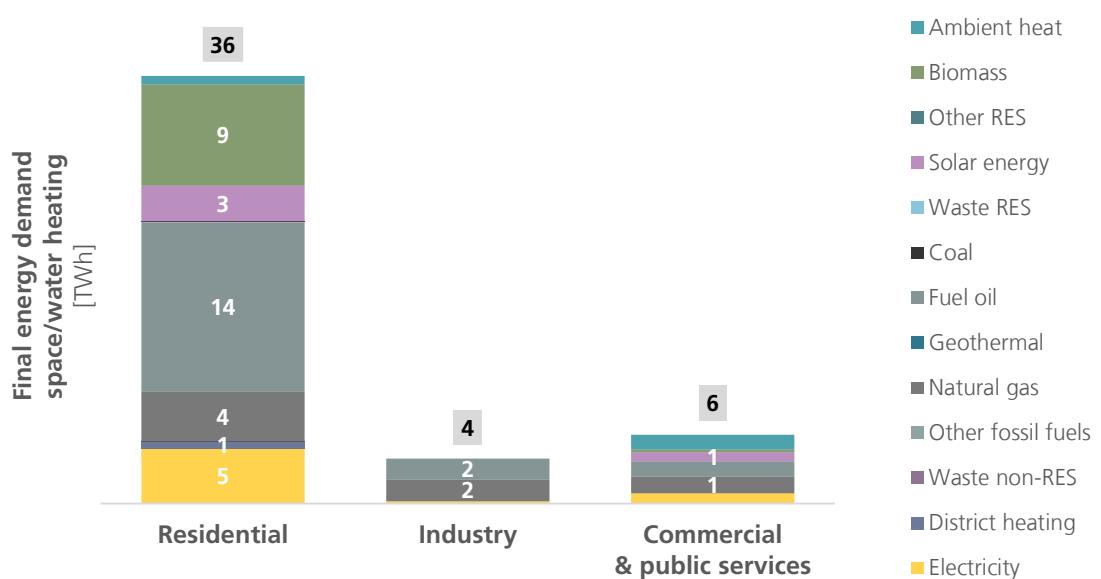
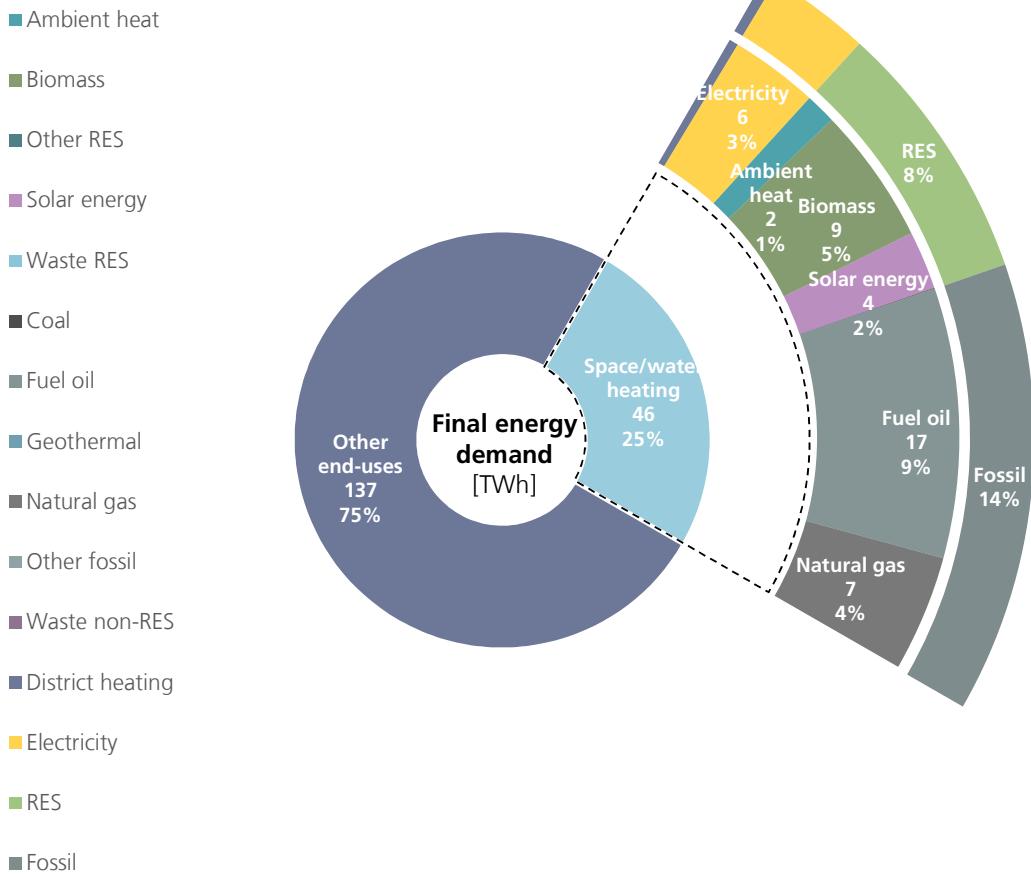
Average value 2000-2017

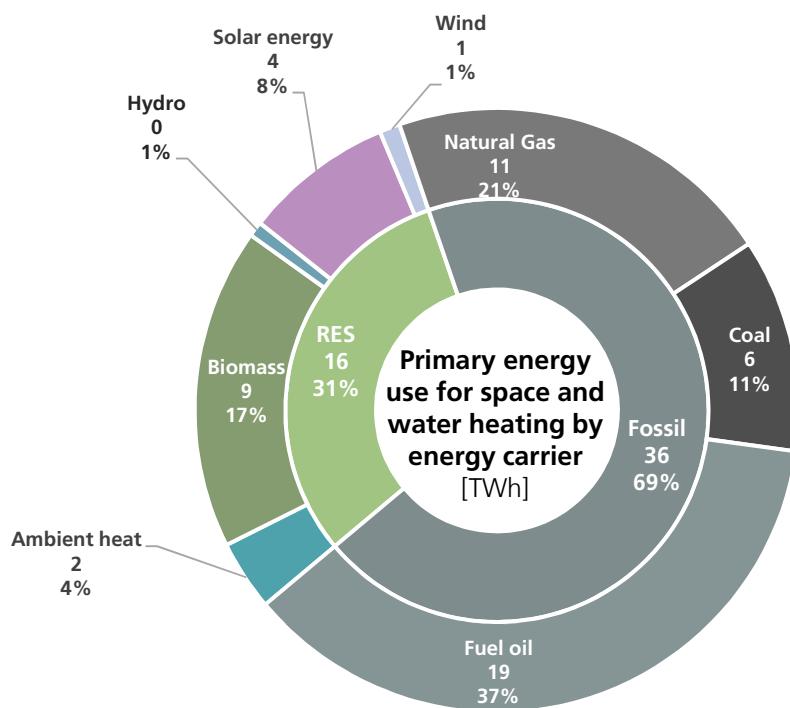
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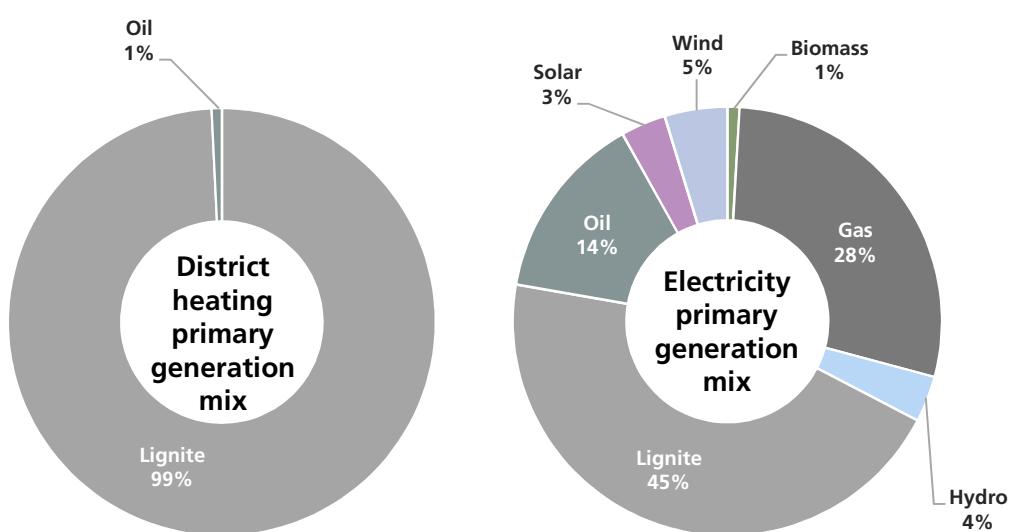
Overview of energy demand

Greece 2017
6





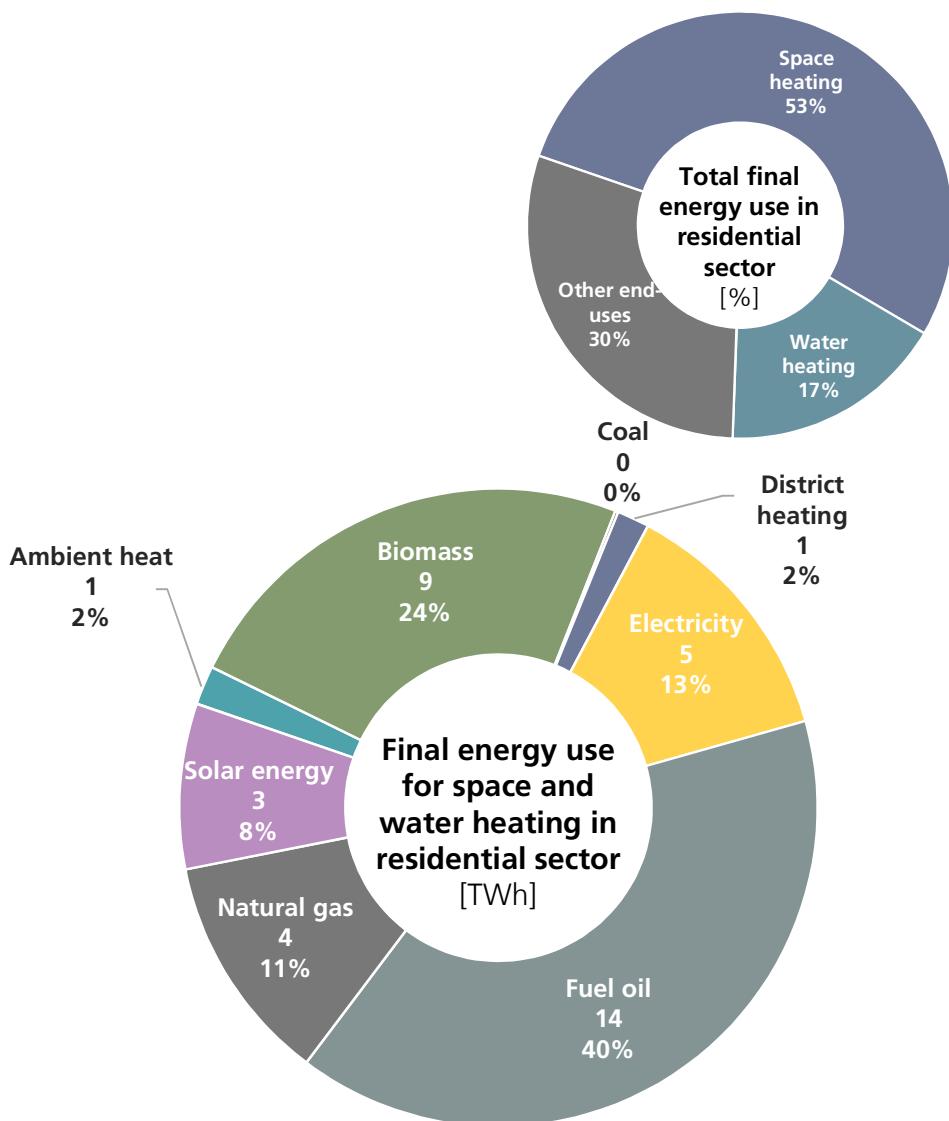
Generation mix



Space & water heating in residential sector

Greece 2017

8



Specific energy demand

97

kWh/m²yr

Final energy demand

110

kWh/m²yr

Primary energy demand

115

kWh/m²yr

Single-family dwellings

128

kWh/m²yr

Single-family dwellings

83

kWh/m²yr

Multi-family dwellings

97

kWh/m²yr

Multi-family dwellings

Technology mix

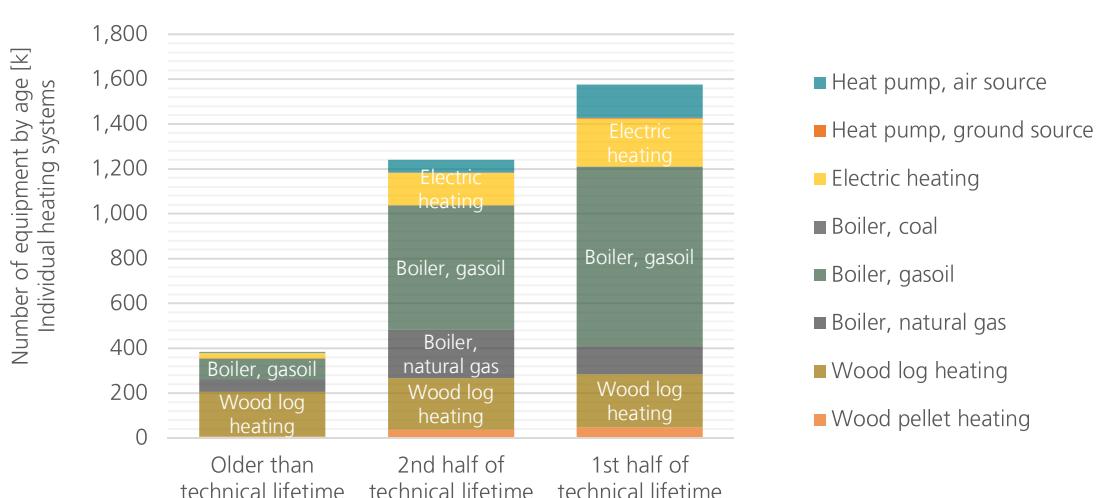
Greece 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	211	3%	27%	70%	4.2	1.2
Heat pump ground source	6	3%	27%	70%	4.0	0.1
Solar thermal	4,681*	3%	27%	70%	0.5	3.3
Electric heating	383	7%	38%	56%	1.0	0.4
Boiler, coal	2	8%	41%	51%	0.8	0.0
Boiler, gasoil	1,445	6%	38%	55%	0.9	39.8
Boiler, natural gas	398	14%	54%	32%	1.0	10.7
Wood log heating	666	30%	35%	36%	0.7	9.0
Wood pellet heating	91	8%	41%	51%	0.8	3.2

* unit 1000 m²

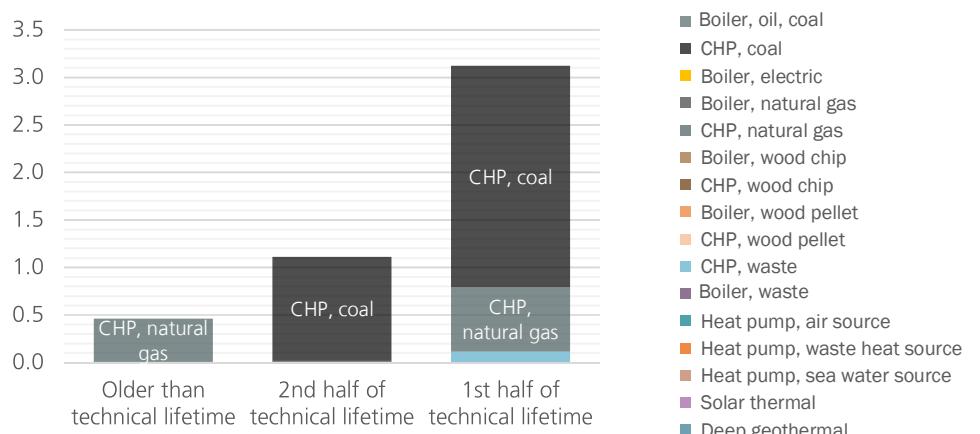
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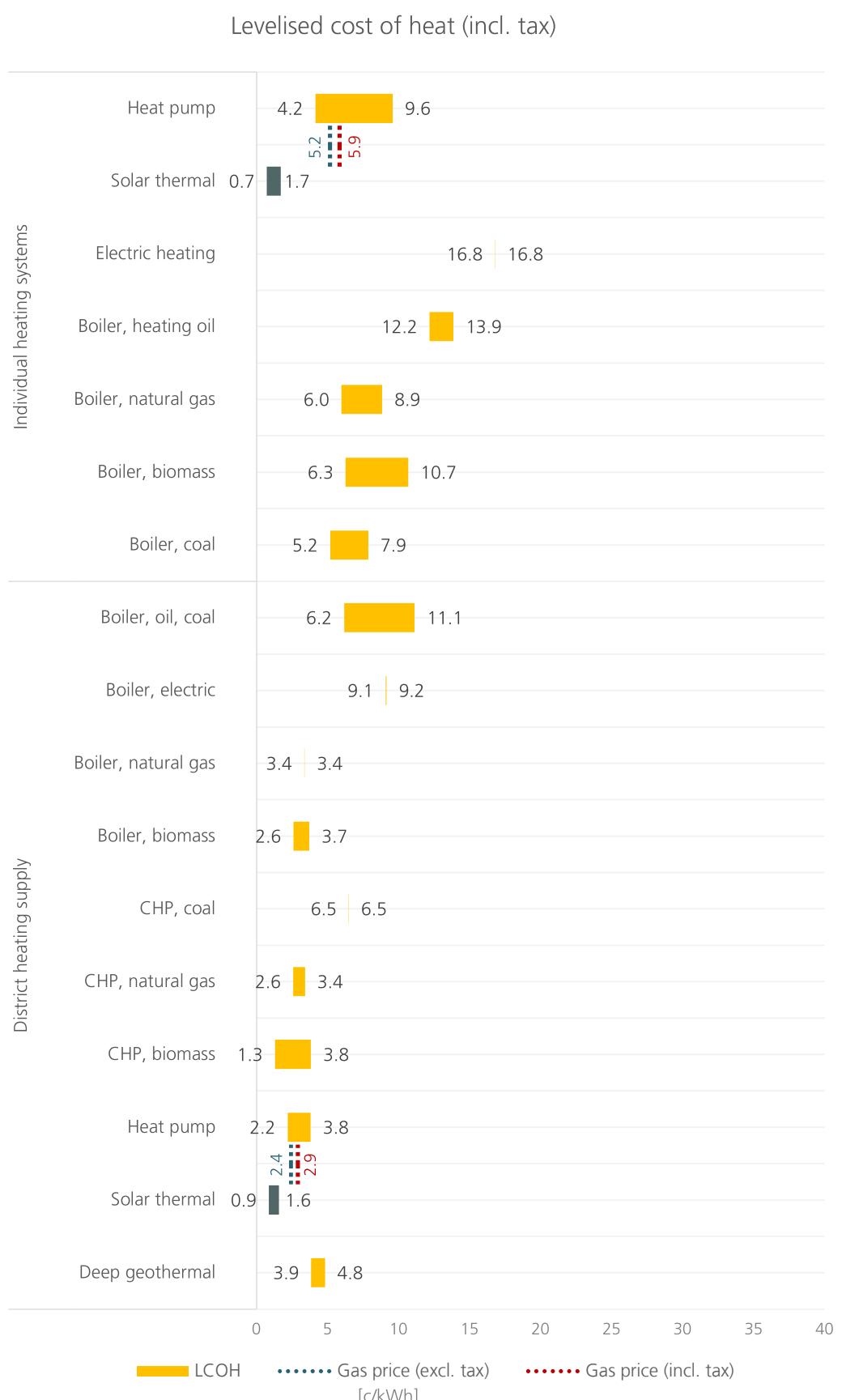


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	3	0%	33%	67%	0.5	3.4
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	62	35%	3%	61%	0.4	1.1
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	-	-	-	-	0.9	-
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	1	0%	100%	0%	0.7	0.0
CHP, waste	2	50%	0%	50%	0.8	0.1
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	3.9	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	3.8	-
Solar thermal	5	0%	100%	0%	0.5	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	No measure
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO₂ pricing	
CO ₂ pricing	No measure
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	Measures in place
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Trigger point: Major renovation	No measure
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	Measures in development
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

█ No measure

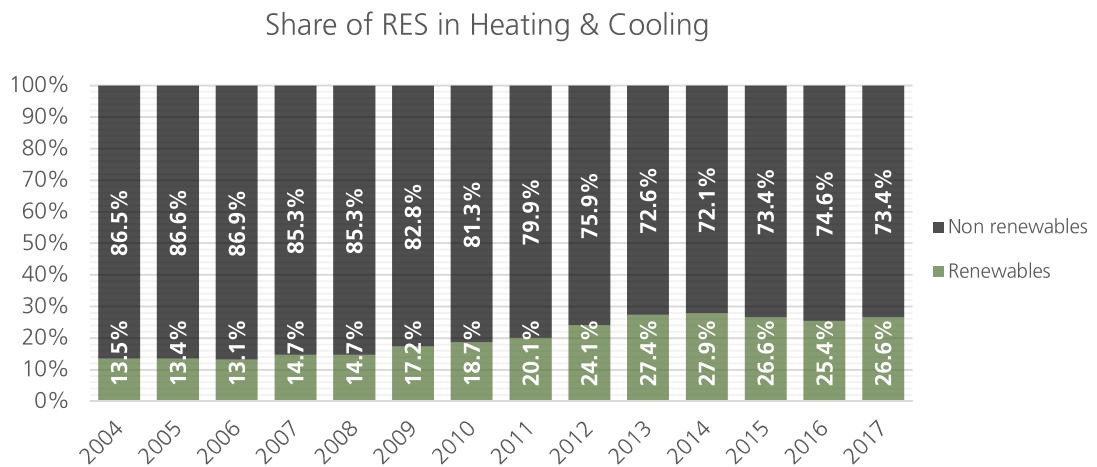
█ Measures in development

█ Measures in place

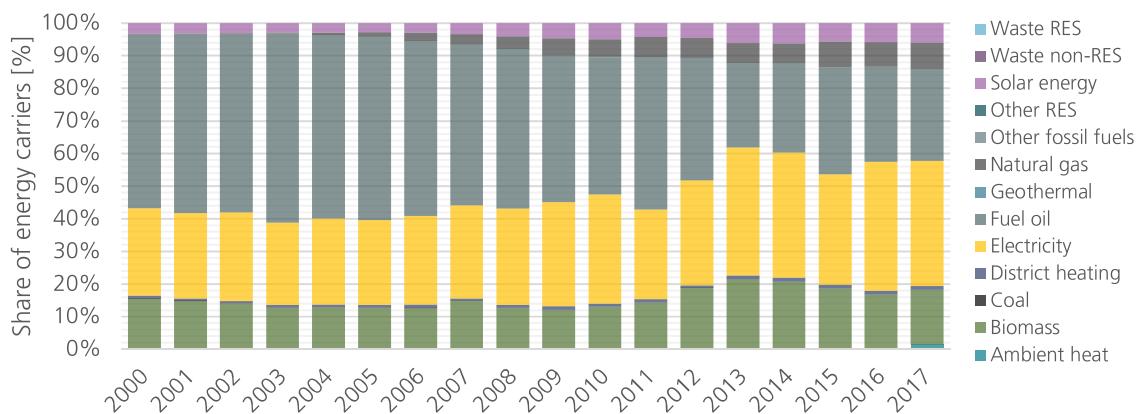
Historical trends

Greece 2017

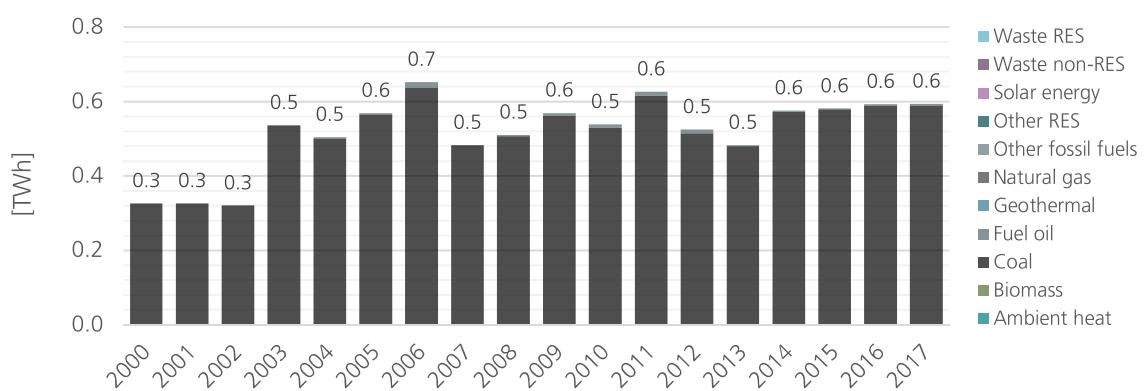
13



Final energy consumption in residential sector



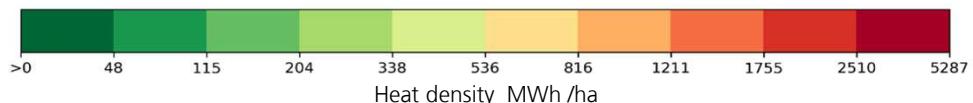
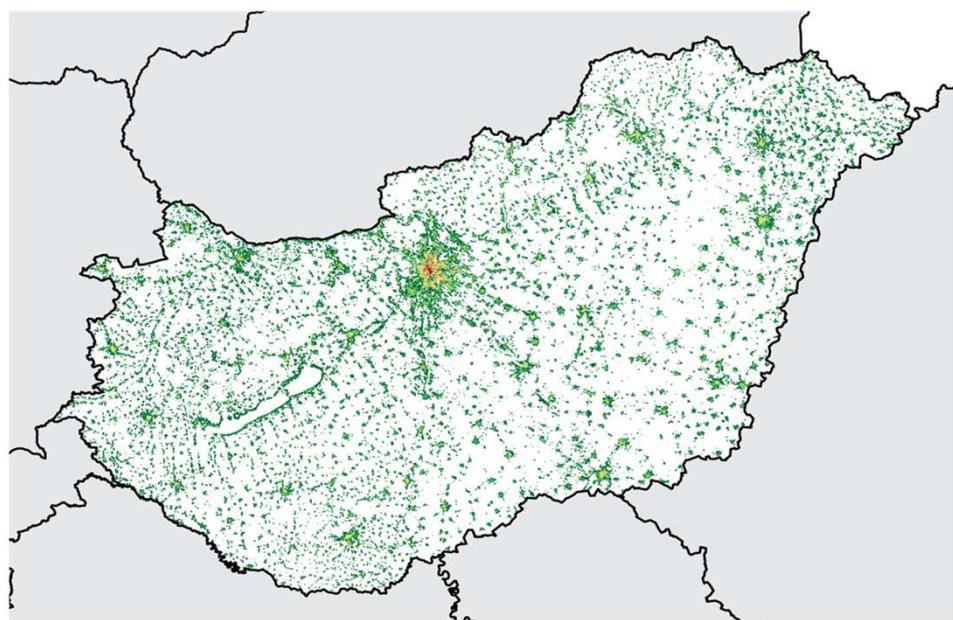
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Hungary



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI



Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
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Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
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Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

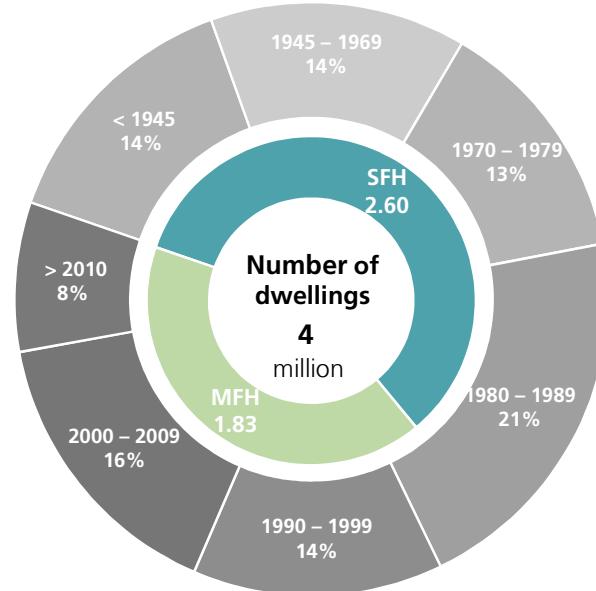
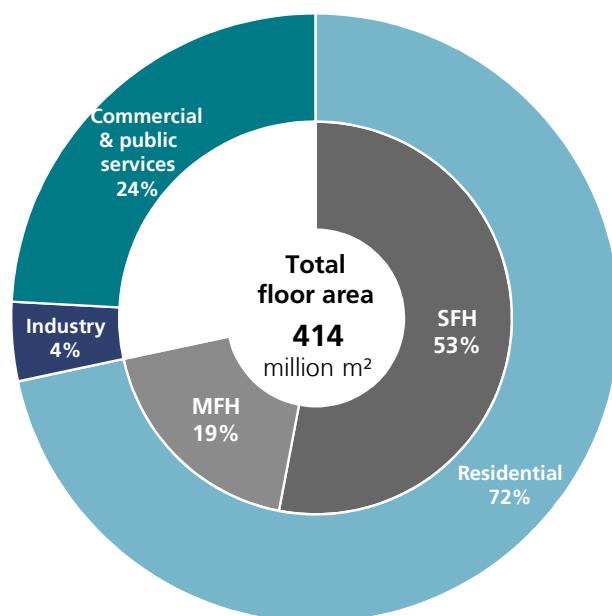
- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

SFH: Single family house
MFH: Multi-family house

Hungary 2017

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Climate Data

Heating degree days

Hungary

EU-27

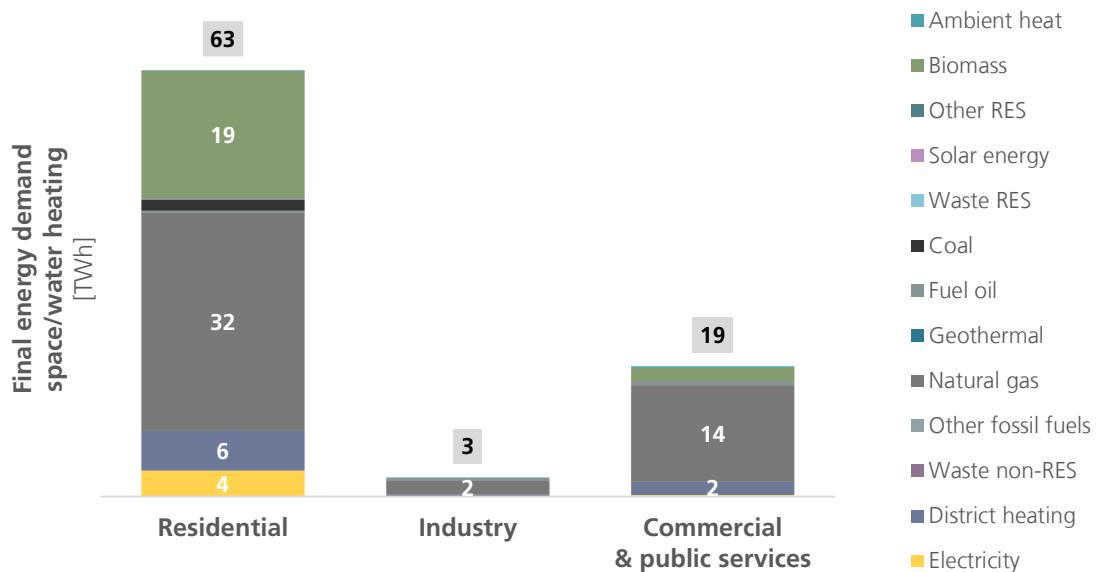
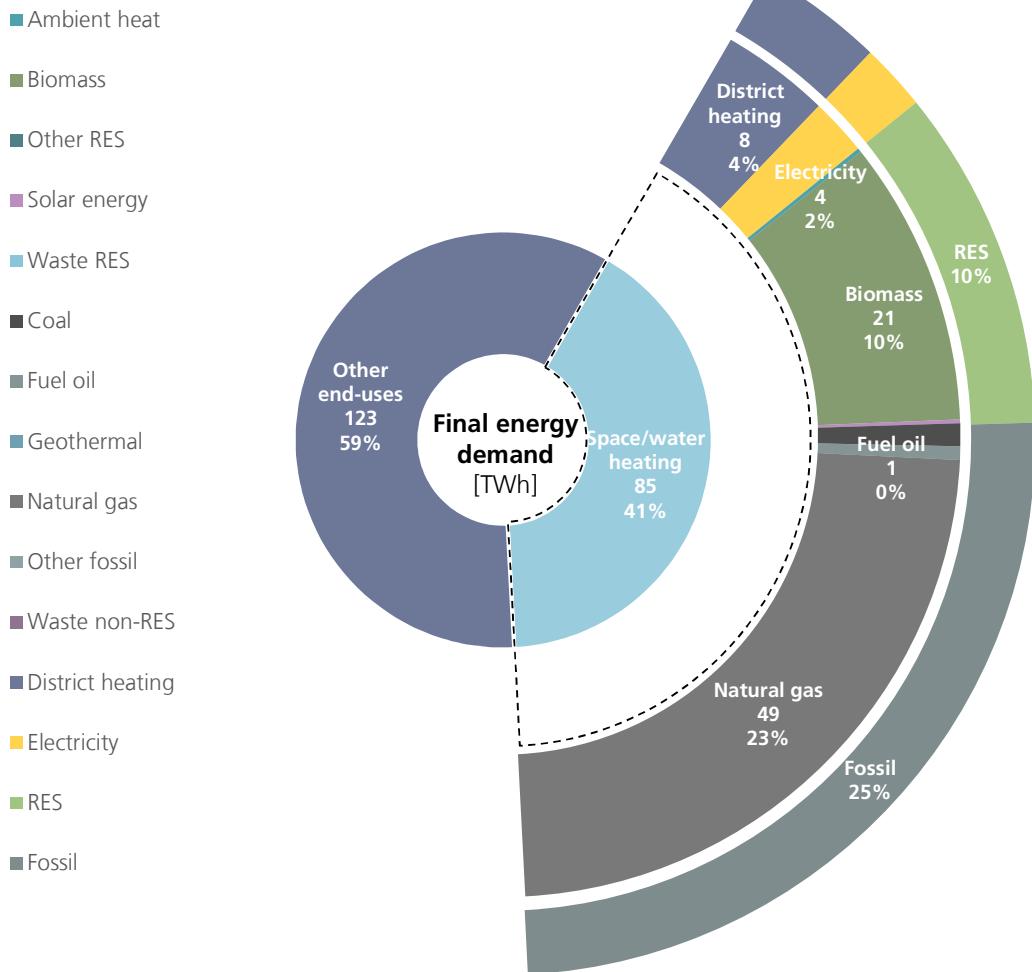
Average value 2000-2017

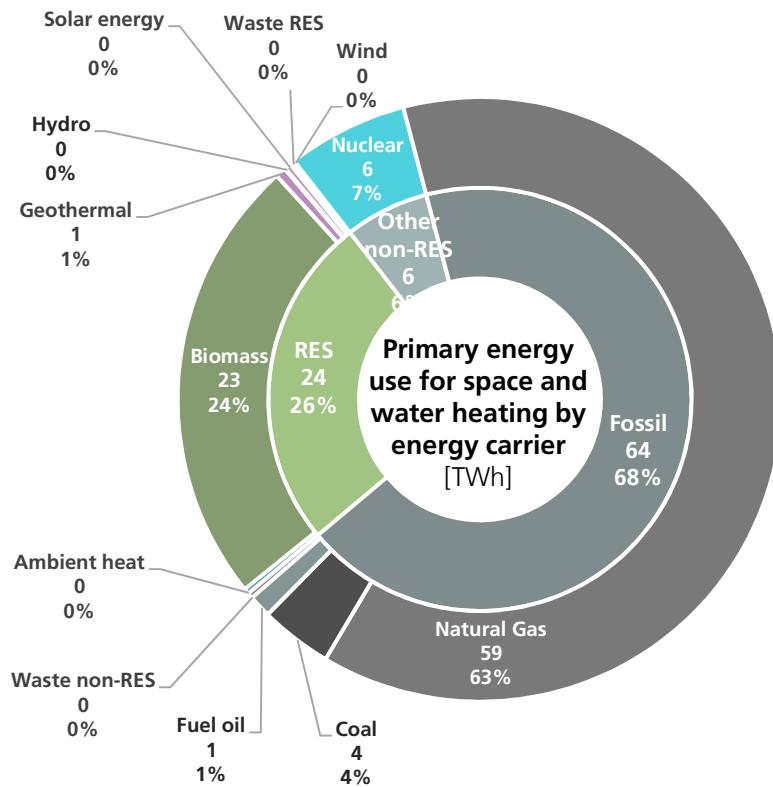
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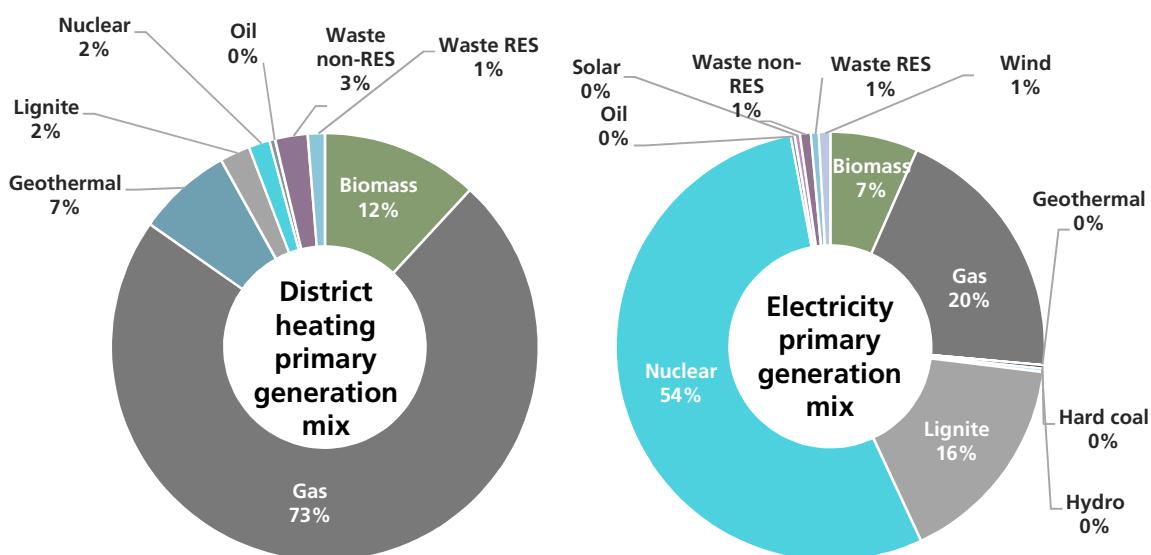
Overview of energy demand

Hungary 2017
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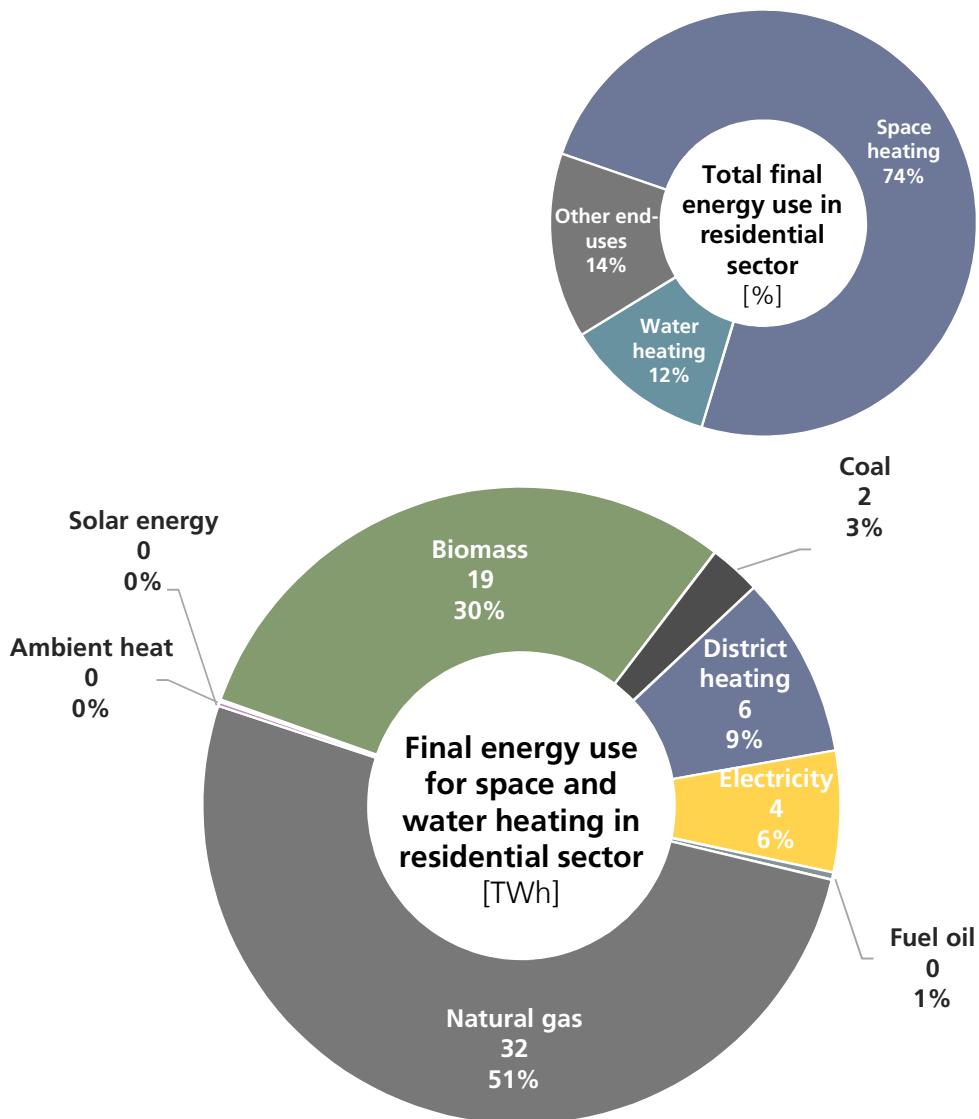
Generation mix



Space & water heating in residential sector

Hungary 2017

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Specific energy demand

212 kWh/m²yr
Final energy demand

239 kWh/m²yr
Primary energy demand

242 kWh/m²yr
Single-family dwellings

268 kWh/m²yr
Single-family dwellings

127 kWh/m²yr
Multi-family dwellings

156 kWh/m²yr
Multi-family dwellings

Technology mix

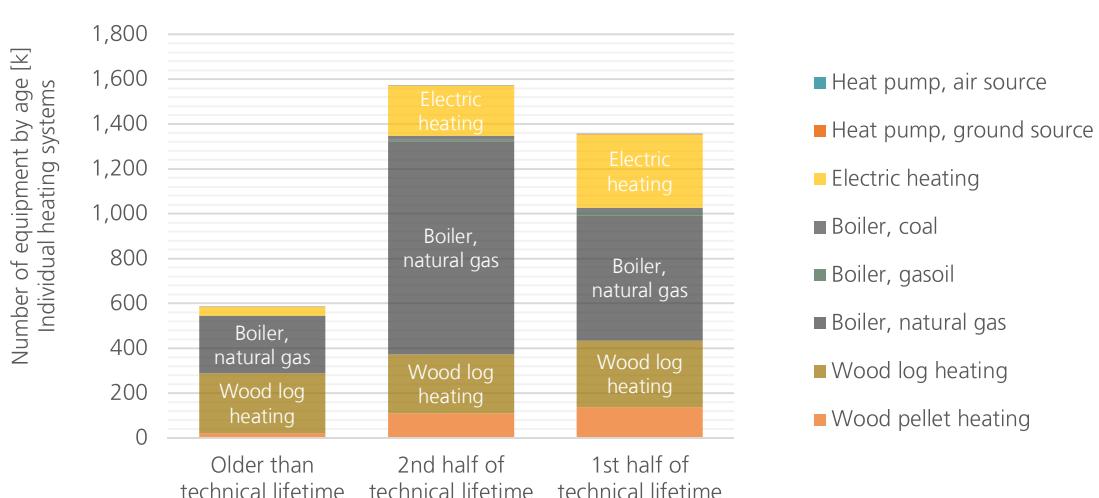
Hungary 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	2	6%	51%	43%	3.3	0.0
Heat pump ground source	5	4%	34%	62%	3.5	0.1
Solar thermal	324*	3%	27%	70%	0.5	0.2
Electric heating	587	7%	38%	56%	1.0	0.6
Boiler, coal	45	8%	41%	51%	0.8	0.7
Boiler, gasoil	20	6%	38%	55%	0.9	0.5
Boiler, natural gas	1,759	14%	54%	32%	1.0	38.0
Wood log heating	828	32%	32%	36%	0.7	9.8
Wood pellet heating	266	8%	41%	51%	0.8	5.2

* unit 1000 m²

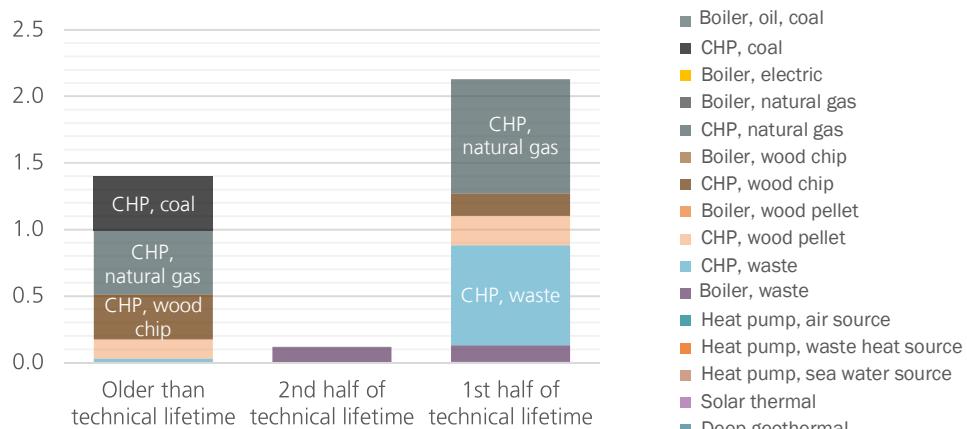
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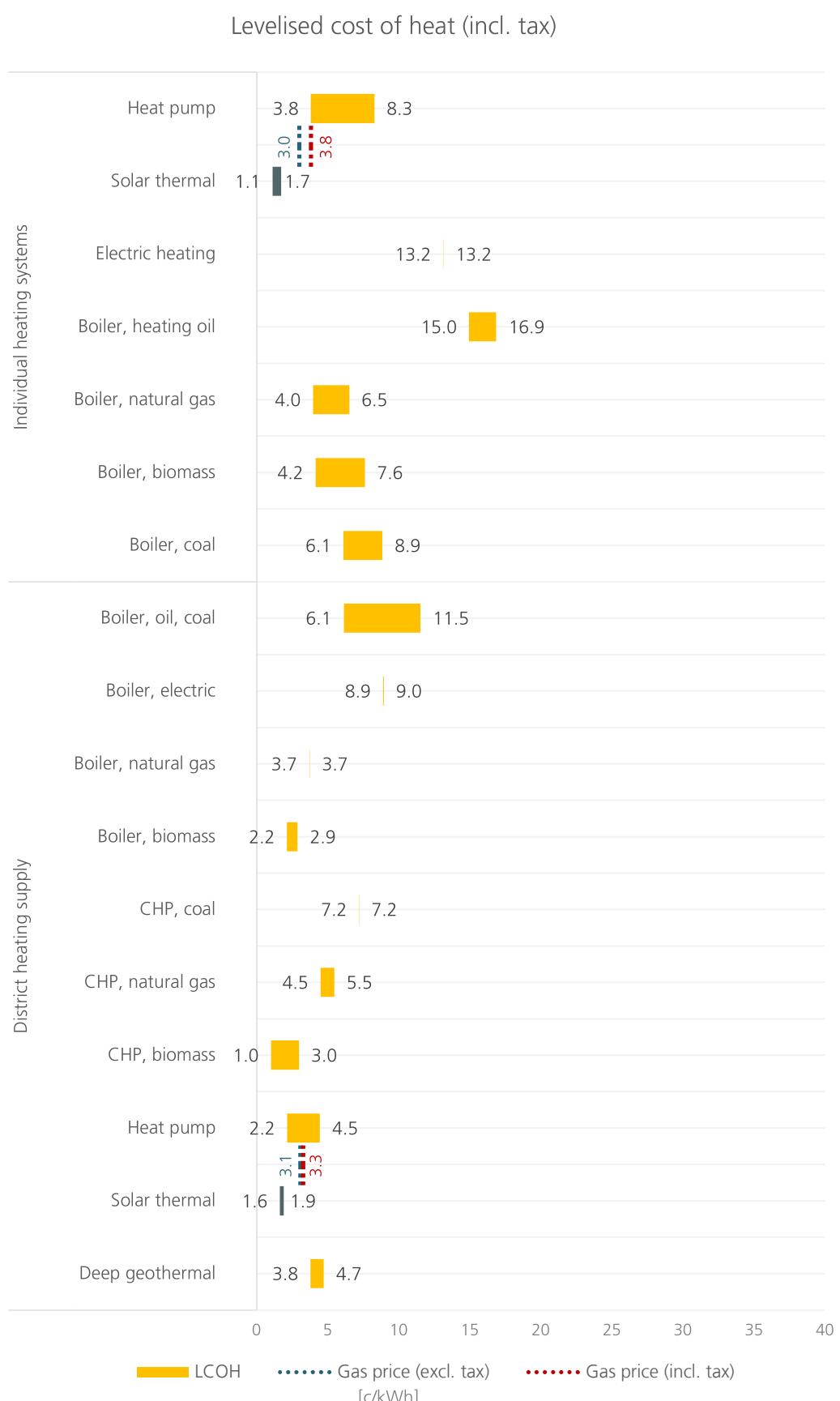


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	4	100%	0%	0%	0.5	0.4
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	136	23%	2%	75%	0.4	1.3
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	6	67%	0%	33%	0.9	0.5
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	5	60%	0%	40%	0.7	0.4
CHP, waste	5	40%	0%	60%	0.8	0.8
Boiler, waste	8	6%	33%	61%	1.1	0.2
Heat pump air source	1	2%	15%	83%	2.7	0.0
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	0.0
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	No measure
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	Measures in place
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	Measures in place
National requirements for urban heat planning	No measure

No measure

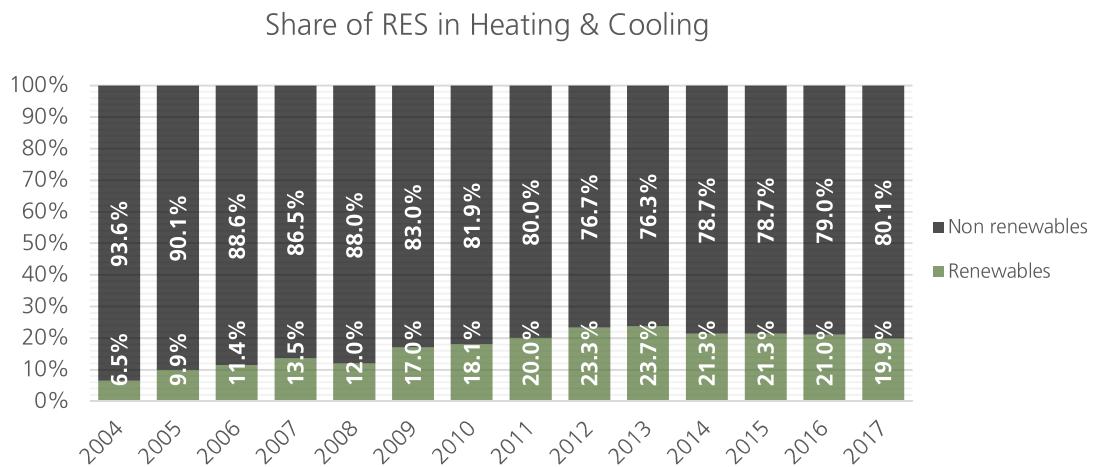
Measures in development

Measures in place

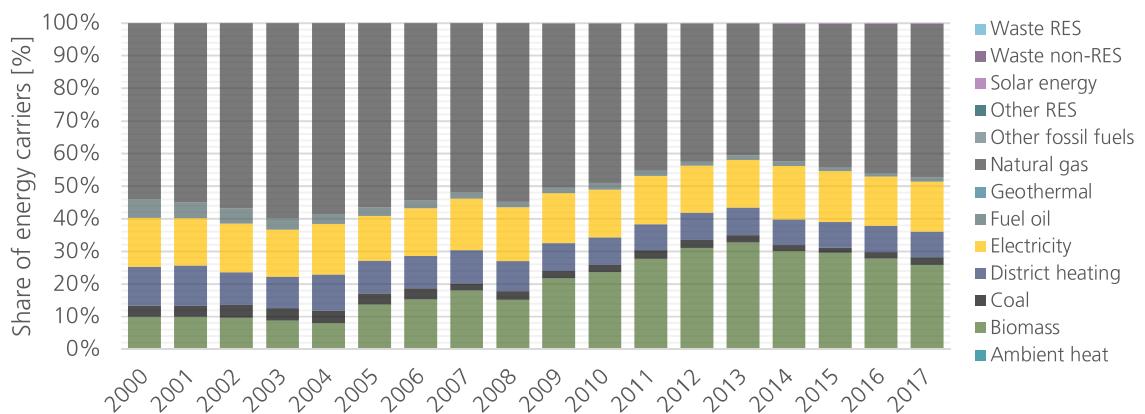
Historical trends

Hungary 2017

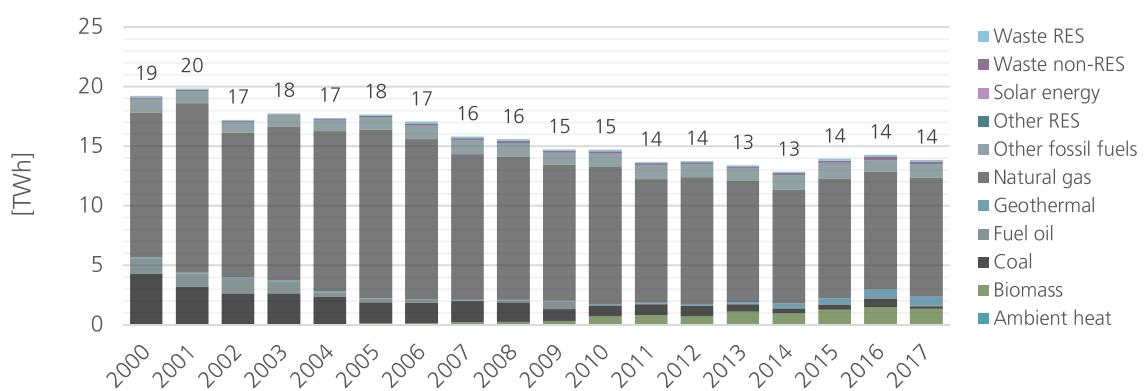
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Final energy consumption in residential sector



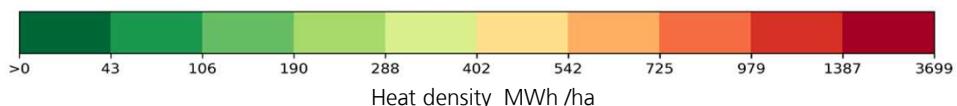
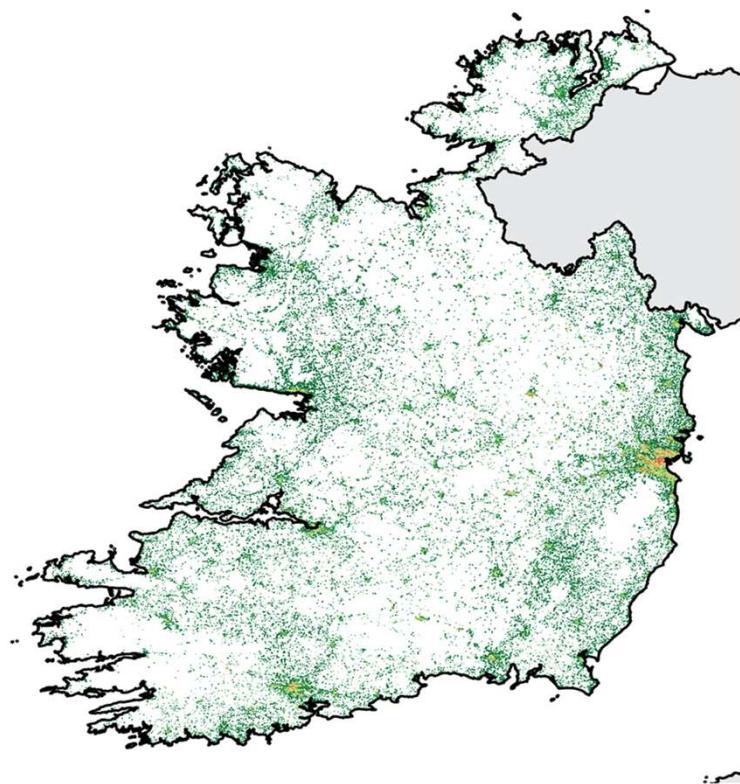
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Ireland



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI



Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

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3. Methodology: Calculation of heating energy balances

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Part 3: Policies and historical trends

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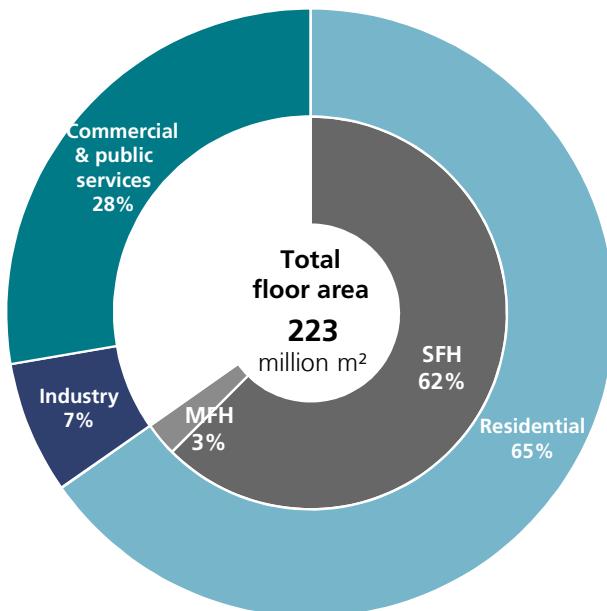
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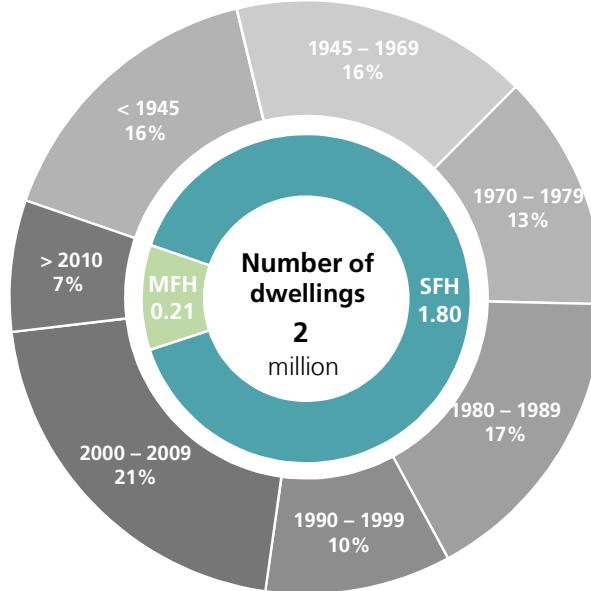
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Ireland 2017

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Climate Data

Heating degree days

Ireland

EU-27

Average value 2000-2017

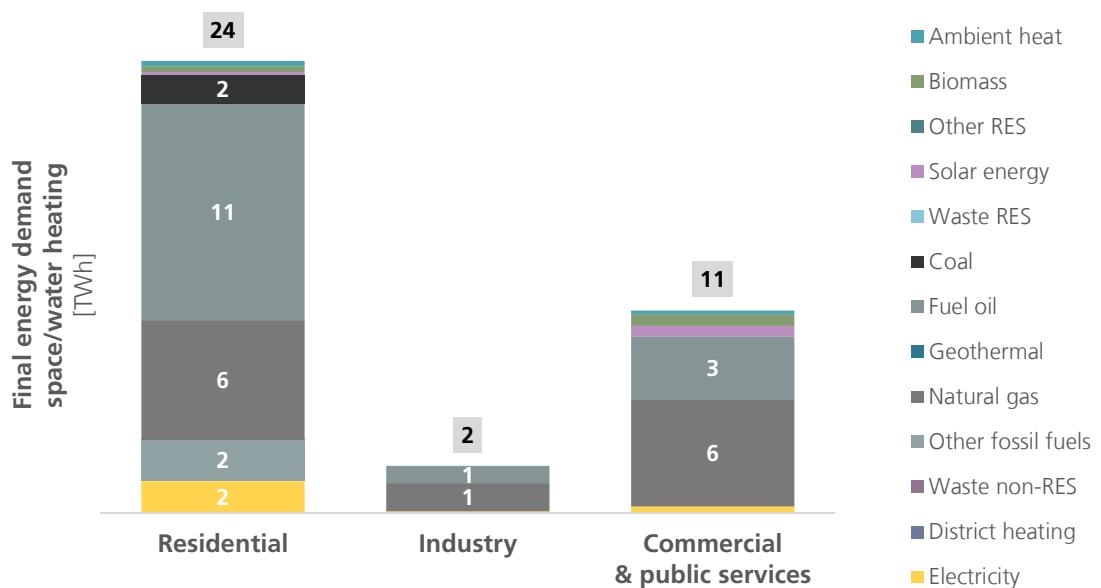
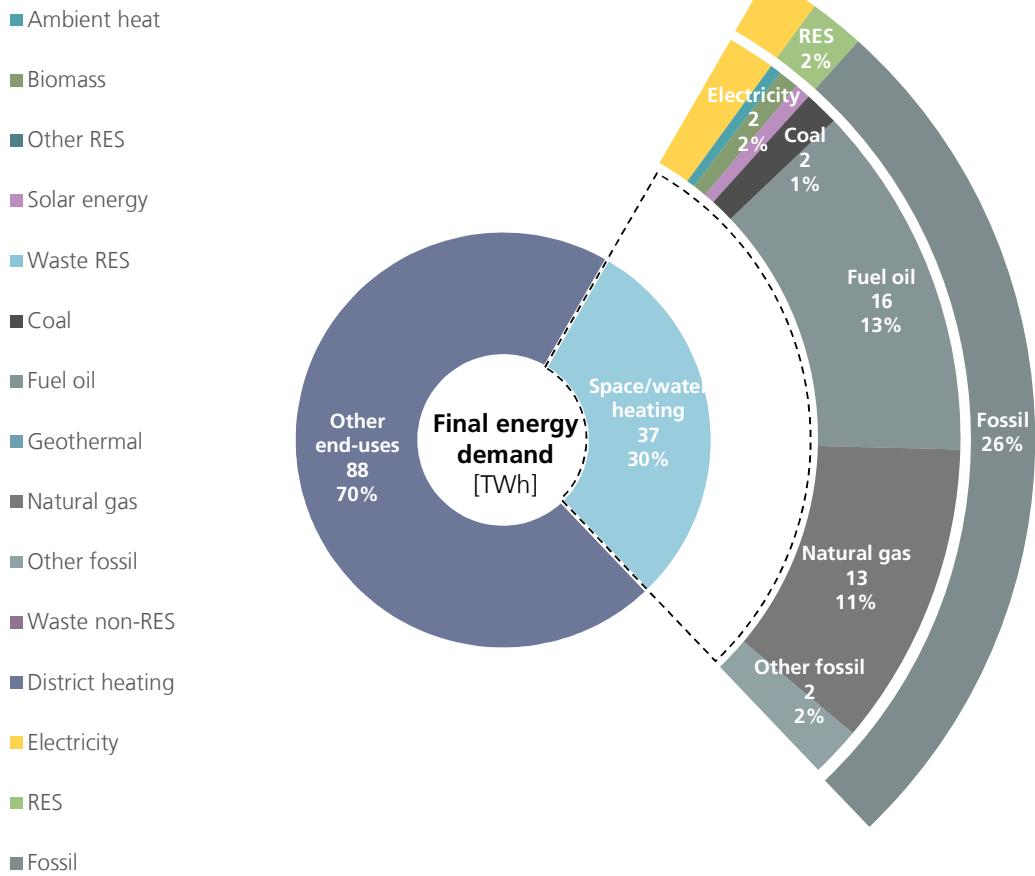
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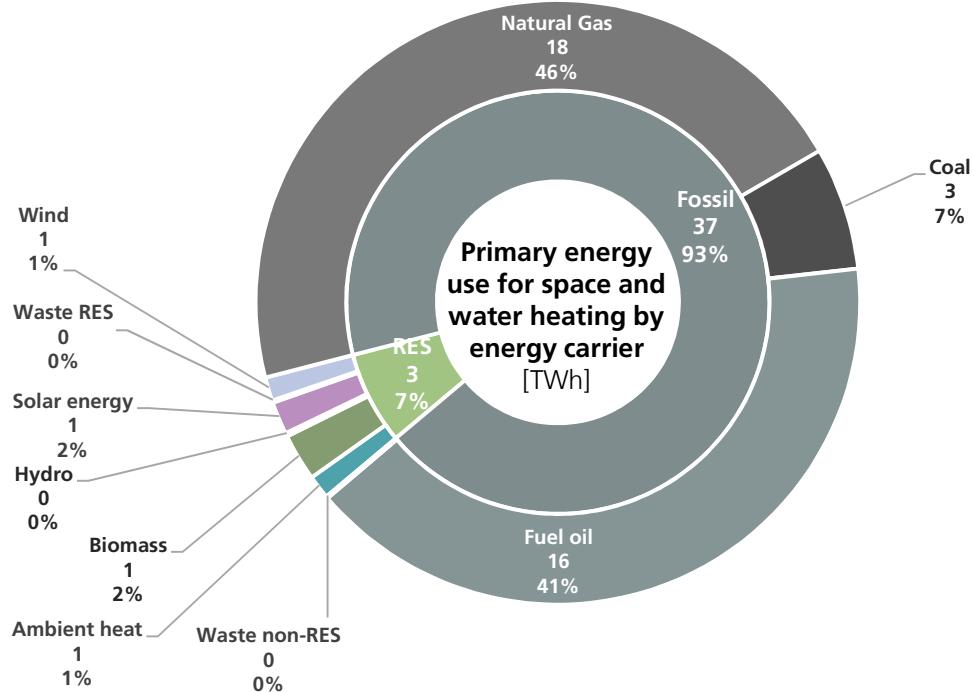
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Overview of energy demand

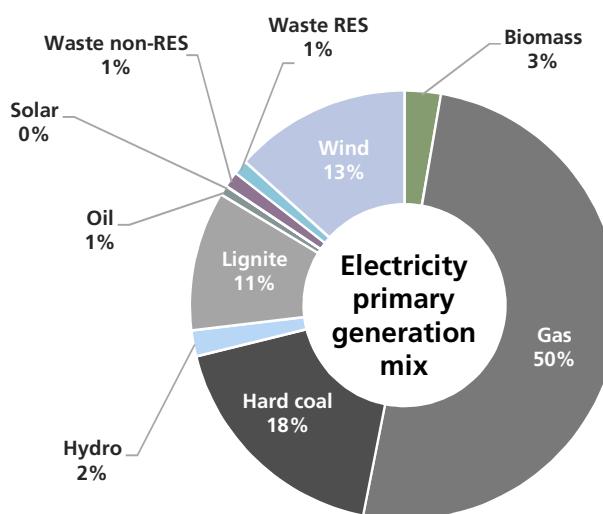
Ireland 2017

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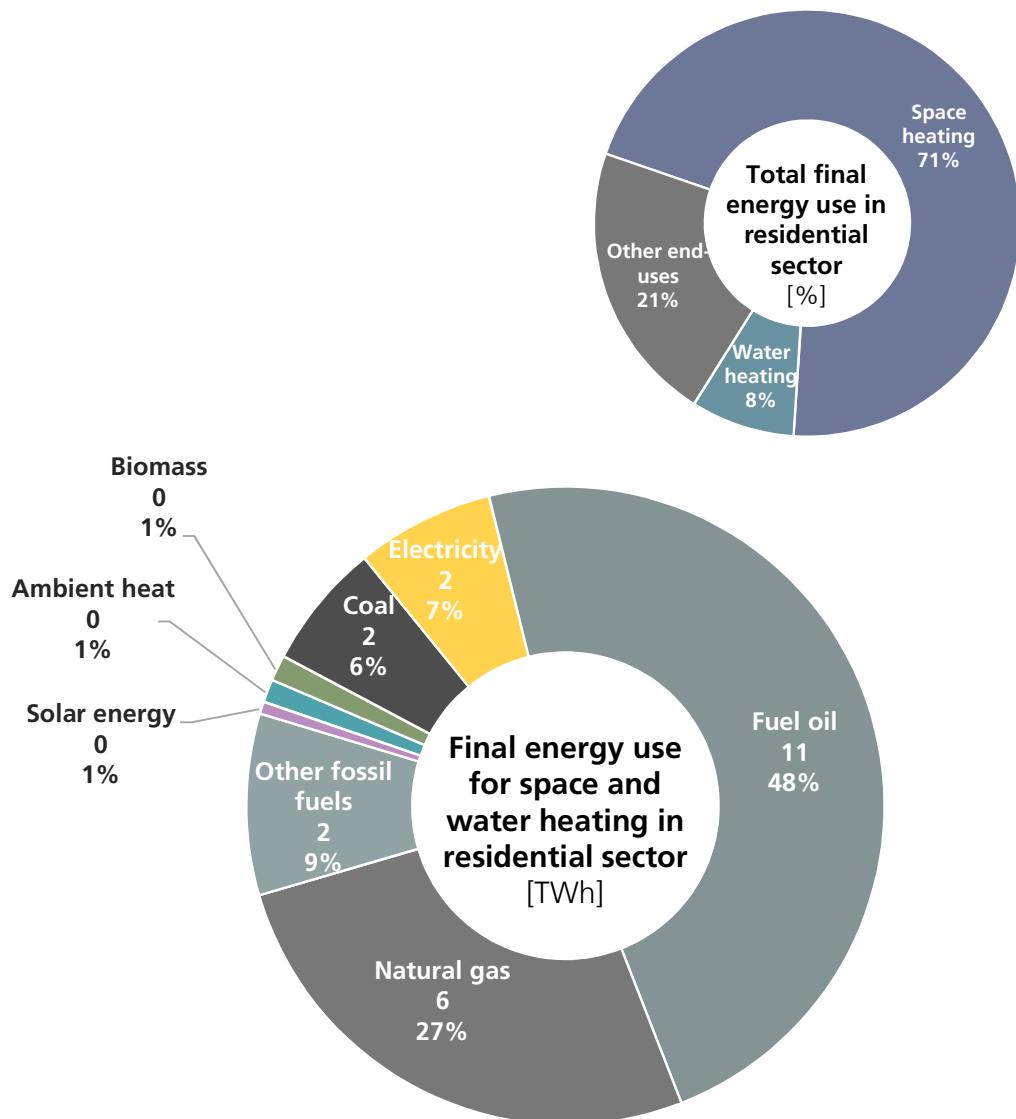
Generation mix



Space & water heating in residential sector

Ireland 2017

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Specific energy demand

163 kWh/m²yr
Final energy demand

177 kWh/m²yr
Primary energy demand

165 kWh/m²yr
Single-family dwellings

178 kWh/m²yr
Single-family dwellings

137 kWh/m²yr
Multi-family dwellings

151 kWh/m²yr
Multi-family dwellings

Technology mix

Ireland 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	23	3%	28%	69%	4.6	0.3
Heat pump ground source	4	5%	43%	52%	4.2	0.0
Solar thermal	336*	3%	27%	70%	0.4	0.2
Electric heating	306	7%	38%	56%	1.0	0.3
Boiler, coal	92	8%	41%	51%	0.8	1.4
Boiler, gasoil	1,485	6%	38%	55%	0.9	30.7
Boiler, natural gas	1,024	12%	50%	38%	1.0	16.9
Wood log heating	604	32%	32%	35%	0.7	7.1
Wood pellet heating	12	8%	41%	51%	0.8	0.3

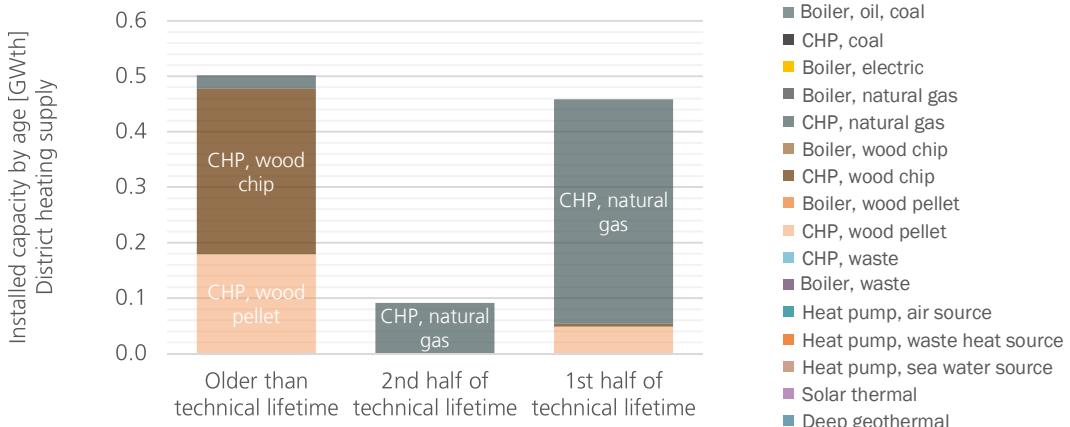
* unit 1000 m²

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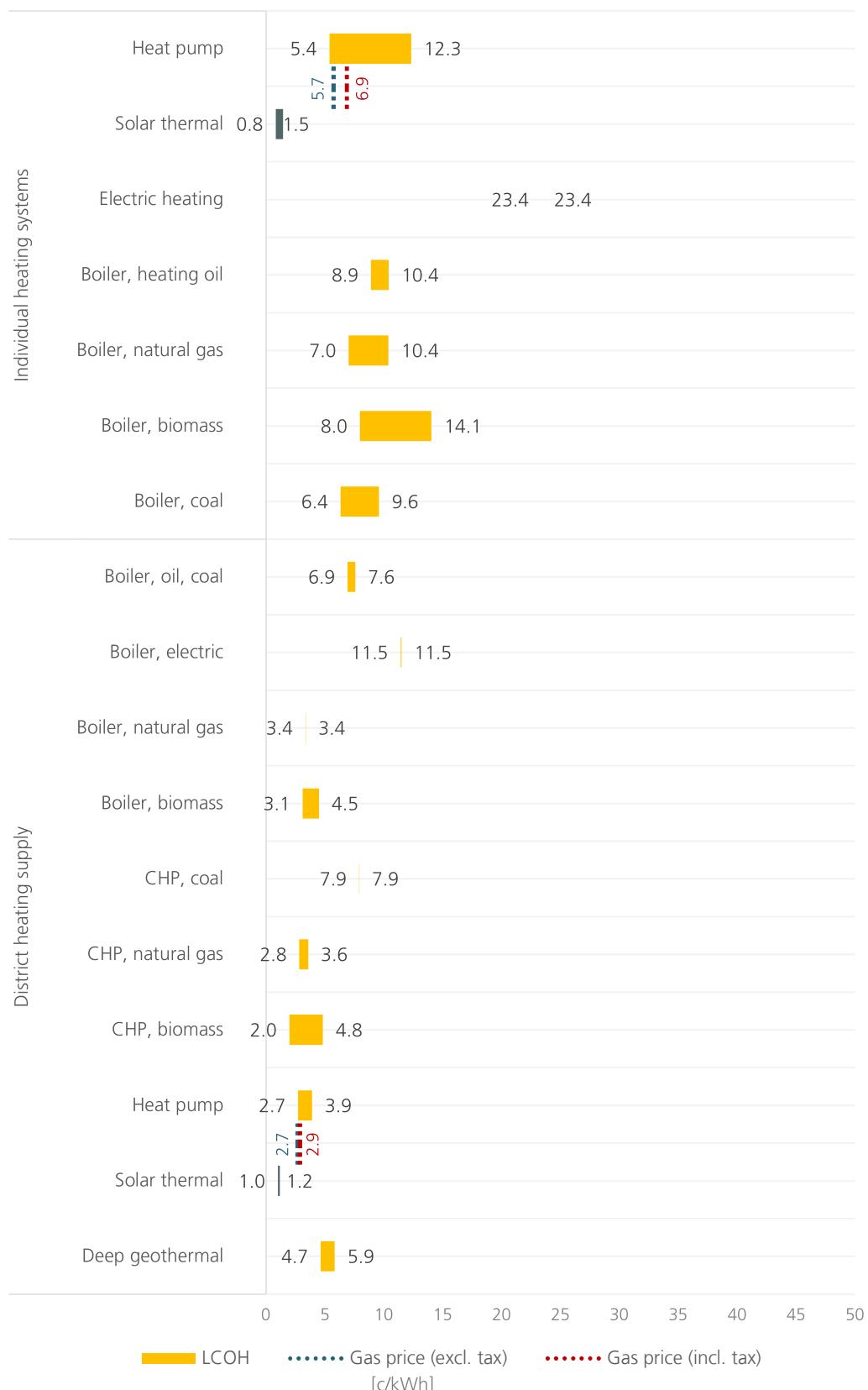


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	52	6%	37%	58%	0.4	0.5
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	2	50%	0%	50%	0.9	0.3
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	2	50%	0%	50%	0.7	0.2
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	4.3	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	4.2	-
Solar thermal	-	-	-	-	0.5	-
Deep geothermal	-	-	-	-	6.5	-

- no data



Levelised cost of heat (incl. tax)



Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	Measures in place
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	Measures in place
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	No measure
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	Measures in place
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	Measures in development
Zoning regulations for DH and/or Gas	Measures in place
Information and planning	
National Database for EPC	Measures in place
National requirements for urban heat planning	No measure

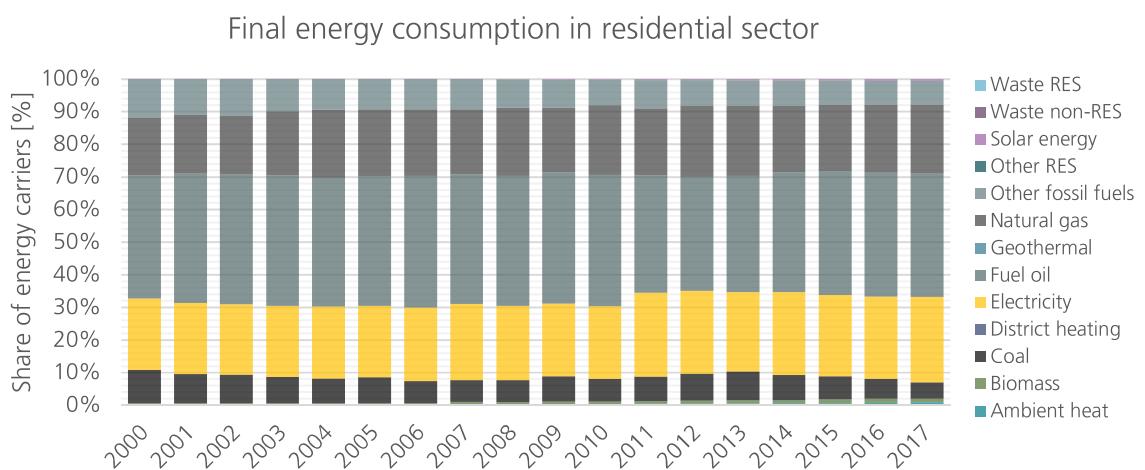
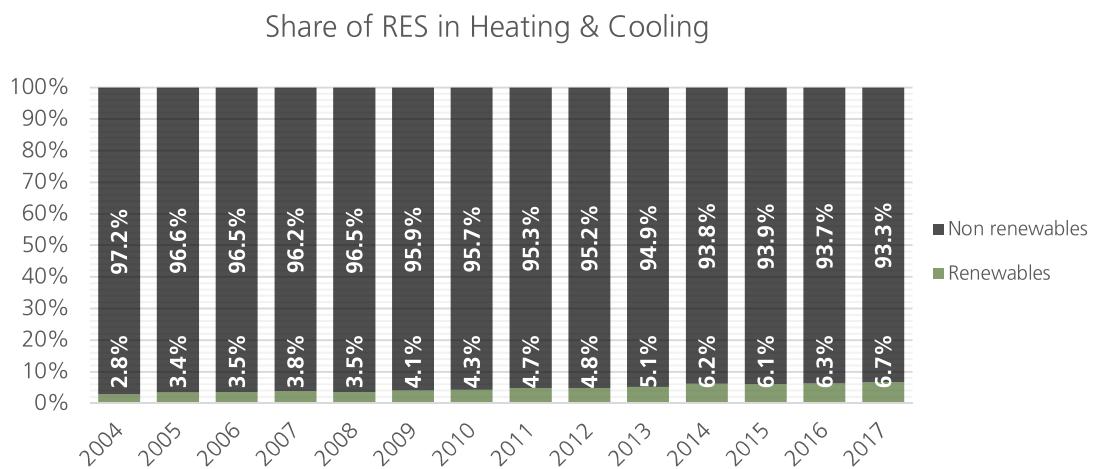
 No measure

 Measures in development

 Measures in place

Historical trends

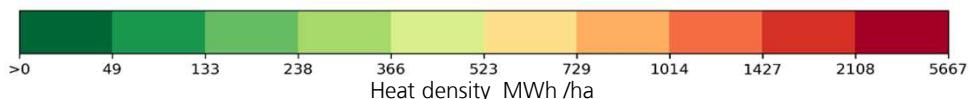
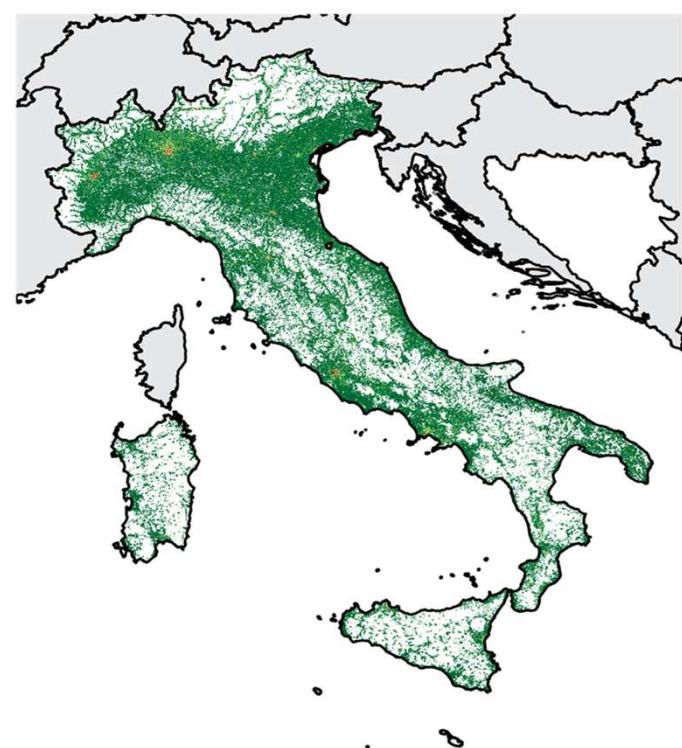
Ireland 2017
13



Space heating market summary

2017

Italy



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI



Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

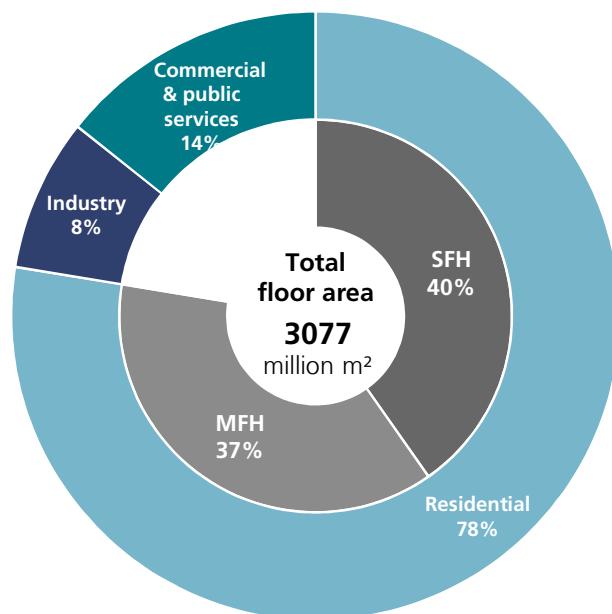
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

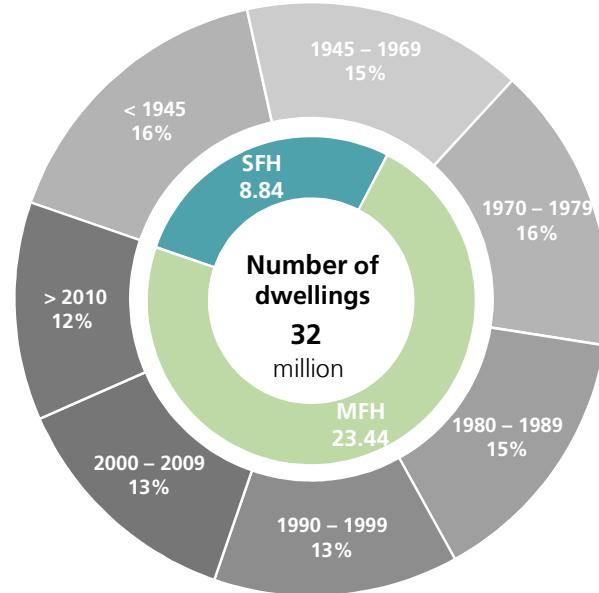
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Italy 2017

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Climate Data

Heating degree days

Italy

EU-27

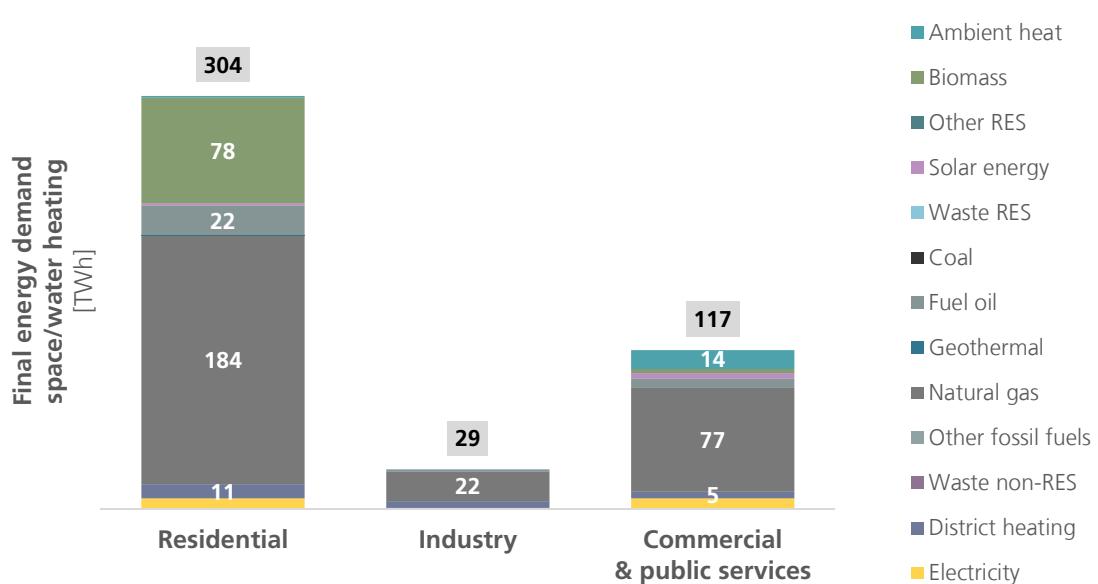
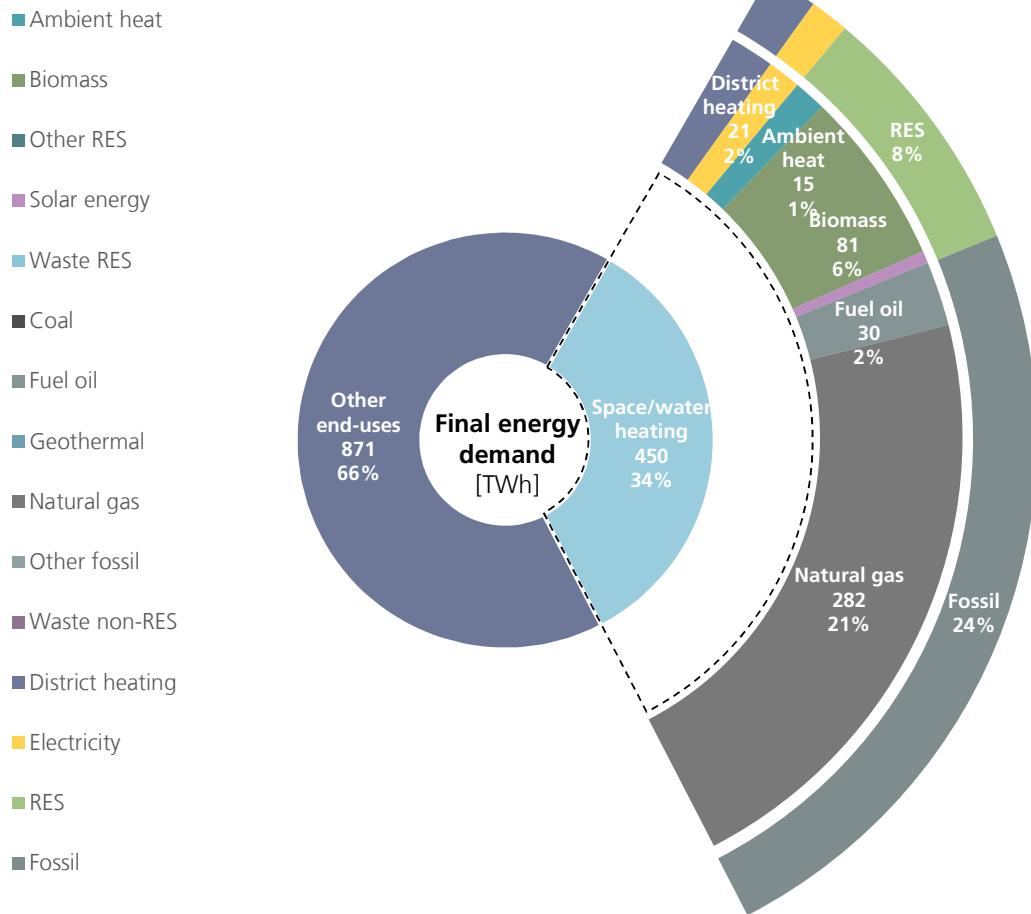
Average value 2000-2017

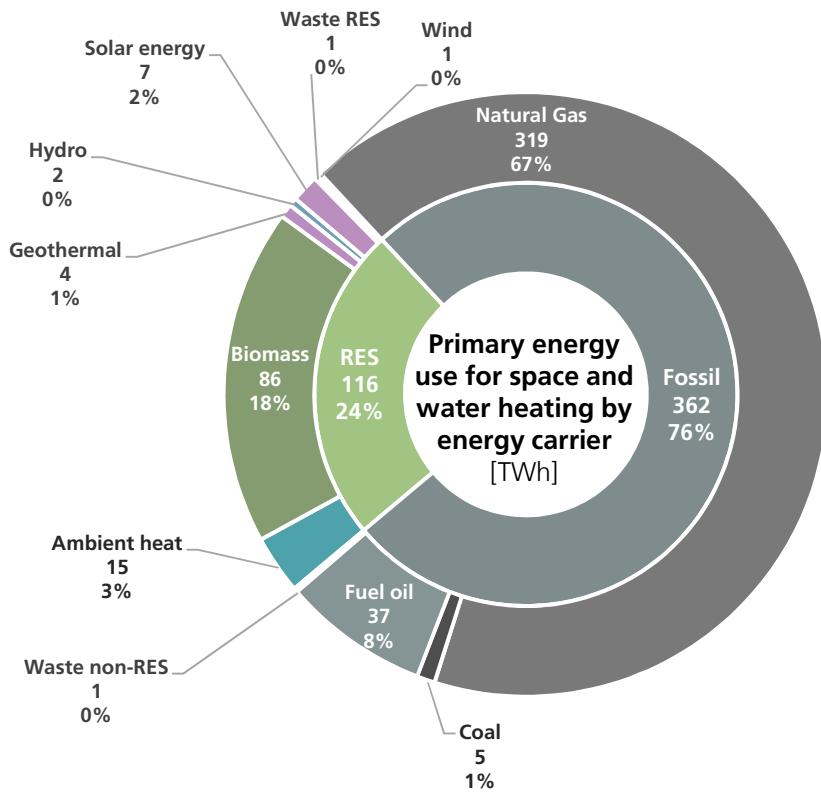
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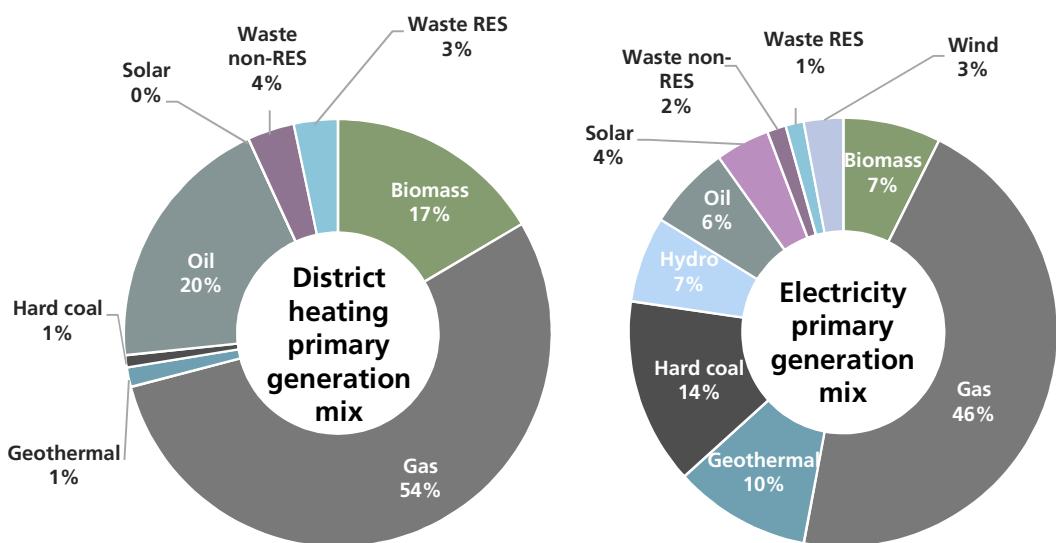
Overview of energy demand

Italy 2017





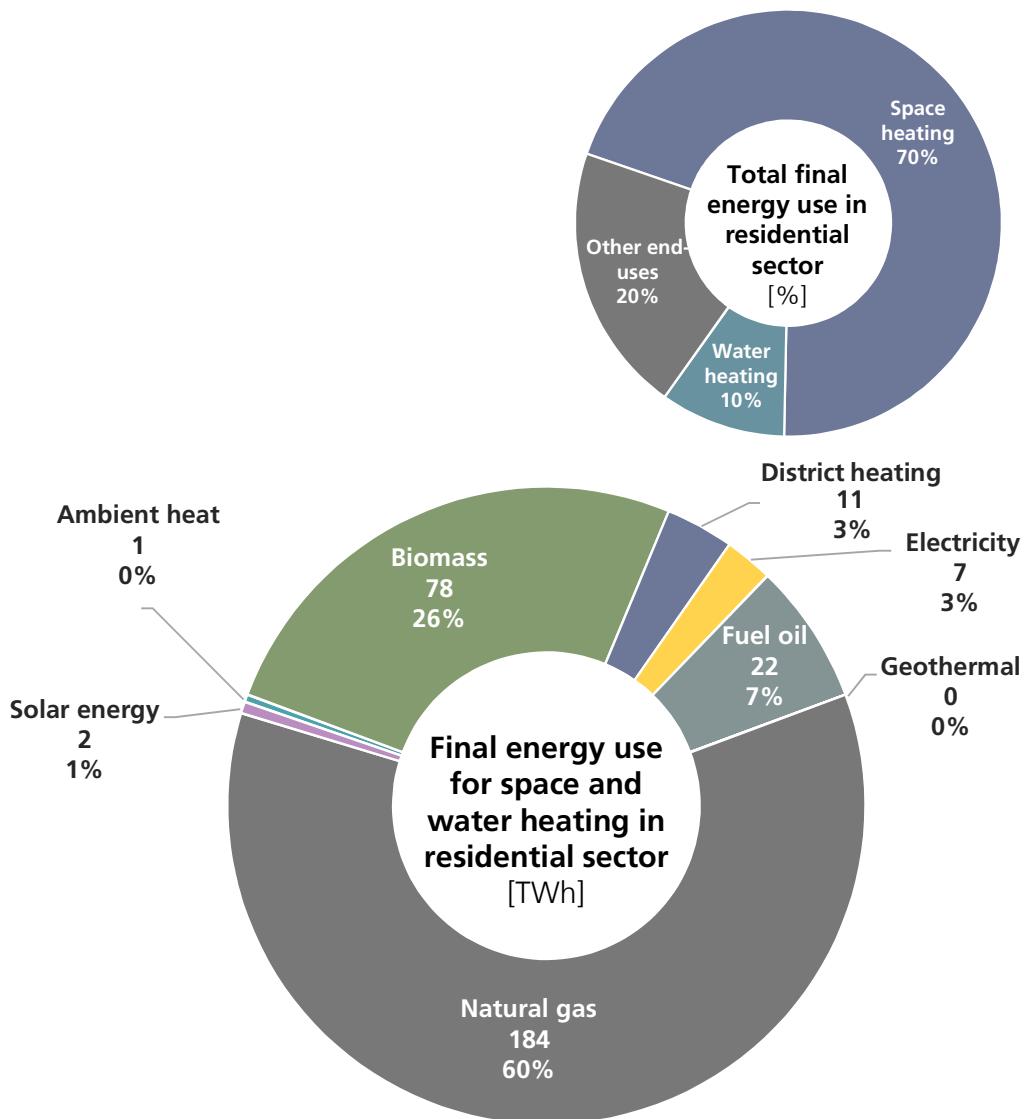
Generation mix



Space & water heating in residential sector

Italy 2017

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Specific energy demand

128 kWh/m²yr
Final energy demand

134 kWh/m²yr
Primary energy demand

155 kWh/m²yr
Single-family dwellings

162 kWh/m²yr
Single-family dwellings

98 kWh/m²yr
Multi-family dwellings

104 kWh/m²yr
Multi-family dwellings

Technology mix

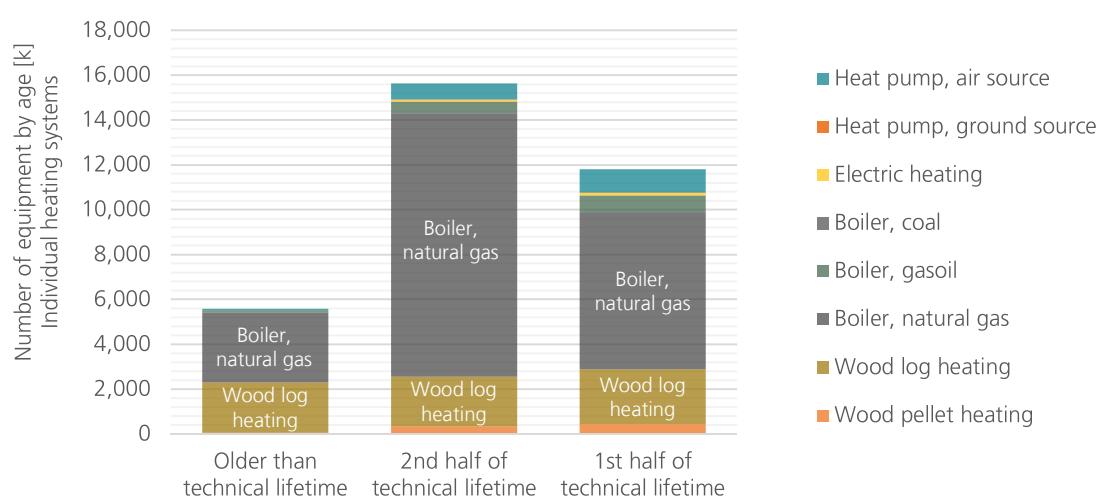
Italy 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	1,857	4%	39%	57%	3.9	12.4
Heat pump ground source	21	5%	47%	48%	3.8	0.3
Solar thermal	4,182*	3%	27%	70%	0.5	2.9
Electric heating	204	7%	38%	56%	1.0	0.2
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	1,341	6%	38%	55%	0.9	39.8
Boiler, natural gas	21,876	14%	54%	32%	1.0	415.4
Wood log heating	6,878	32%	32%	35%	0.7	82.4
Wood pellet heating	861	8%	41%	51%	0.8	23.8

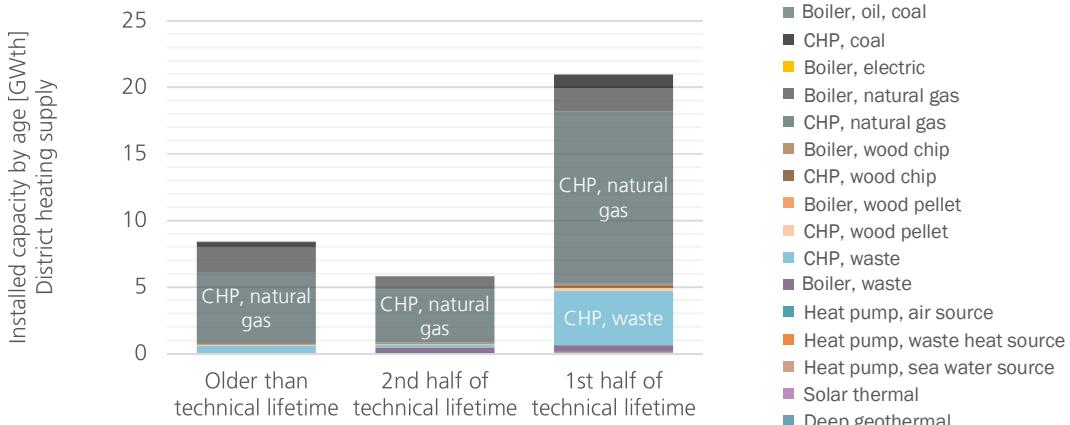
* unit 1000 m²

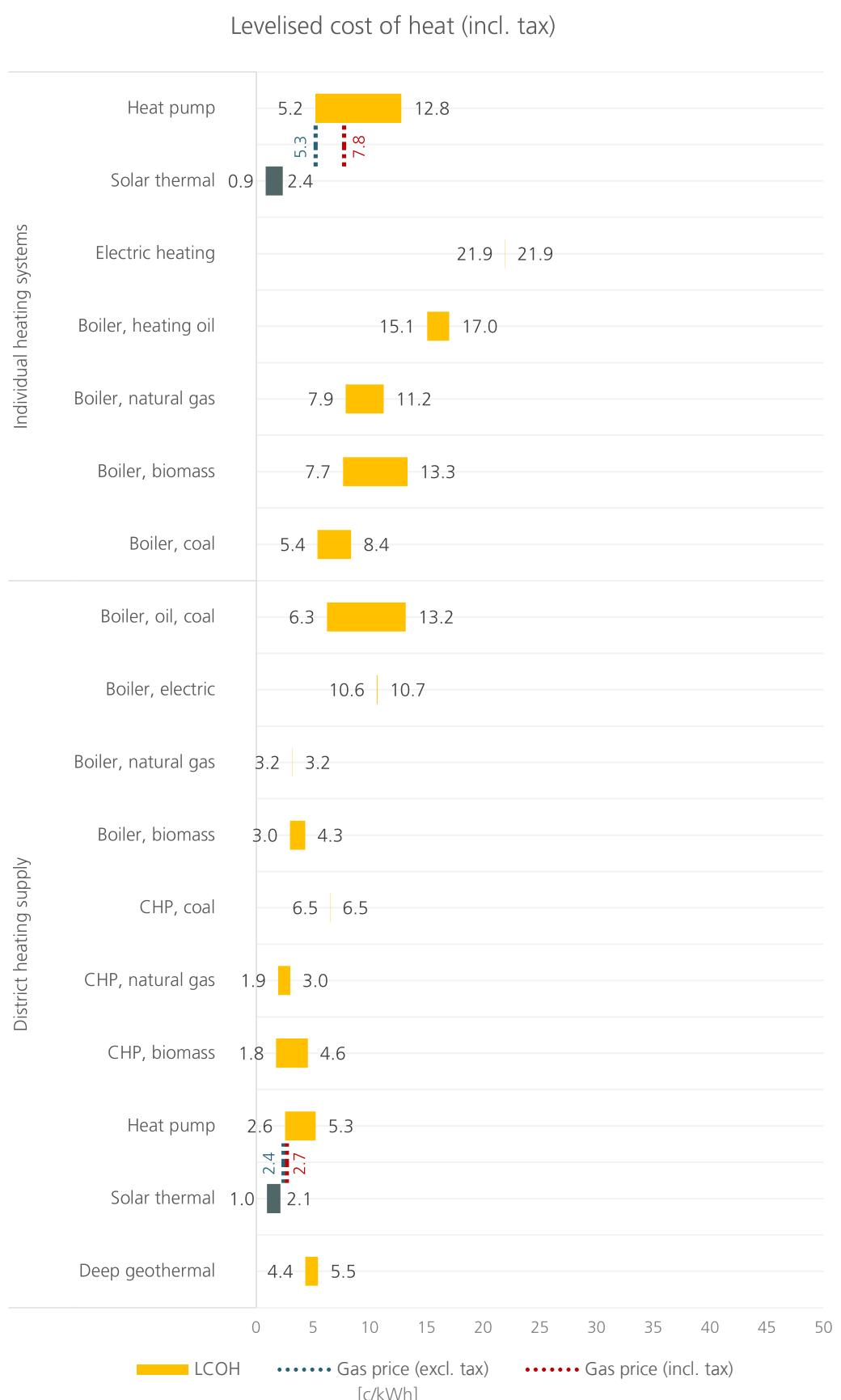
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
District heating supply	Boiler, oil, coal	4	47%	29%	24%	0.9
	CHP, coal	3	67%	0%	33%	0.5
	Boiler, electric	-	-	-	1.0	-
	Boiler, natural gas	417	33%	26%	40%	1.1
	CHP, natural gas	820	18%	39%	44%	0.4
	Boiler, wood chip	48	0%	53%	48%	1.1
	CHP, wood chip	14	14%	0%	86%	0.9
	Boiler, wood pellet	-	-	-	1.0	-
	CHP, wood pellet	15	27%	7%	67%	0.7
	CHP, waste	56	16%	9%	75%	0.8
	Boiler, waste	29	6%	33%	61%	1.1
	Heat pump air source	29	2%	15%	83%	3.5
	Heat pump waste heat source	3	33%	0%	67%	5.0
	Heat pump sea water source	137	4%	36%	60%	3.4
	Solar thermal	2	0%	0%	100%	0.5
	Deep geothermal	-	-	-	-	6.5

- no data





Overview of policies

Italy 2017

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Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Green
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Green
Energy- and CO₂ pricing	
CO ₂ pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Green
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Red
New installations in existing buildings	Red
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

Measures in development

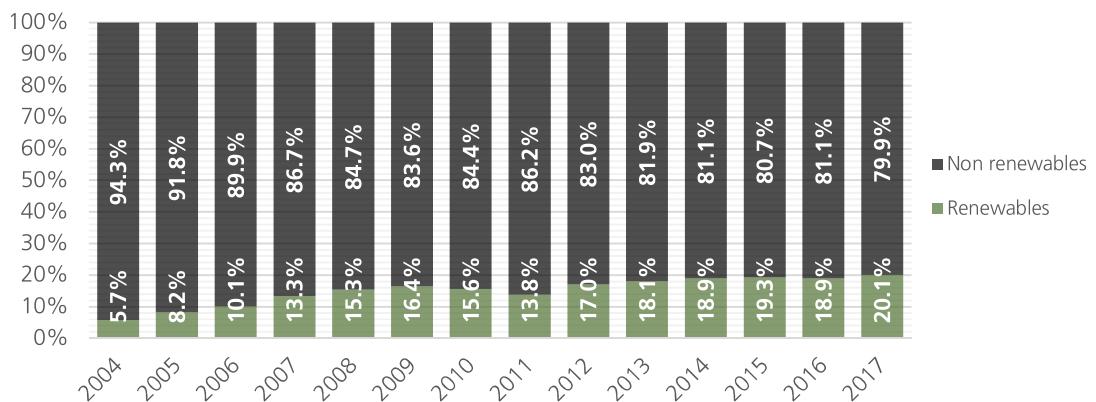
Measures in place

Historical trends

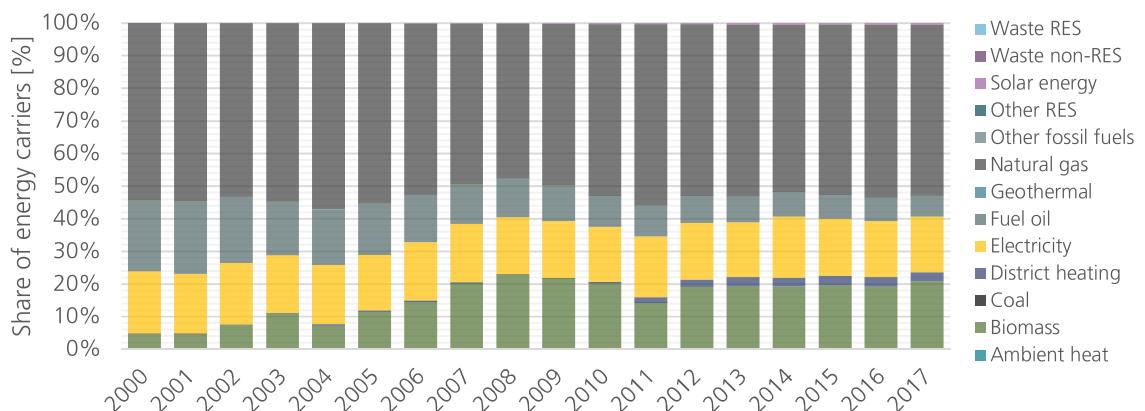
Italy 2017

13

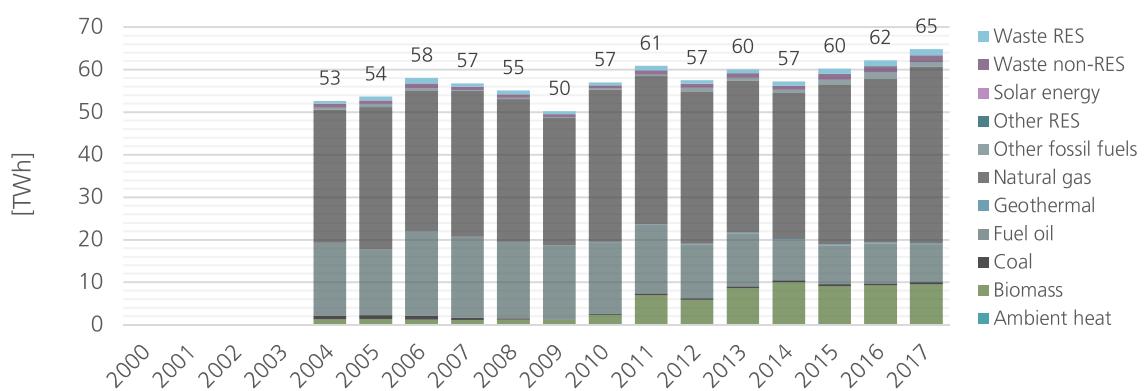
Share of RES in Heating & Cooling



Final energy consumption in residential sector



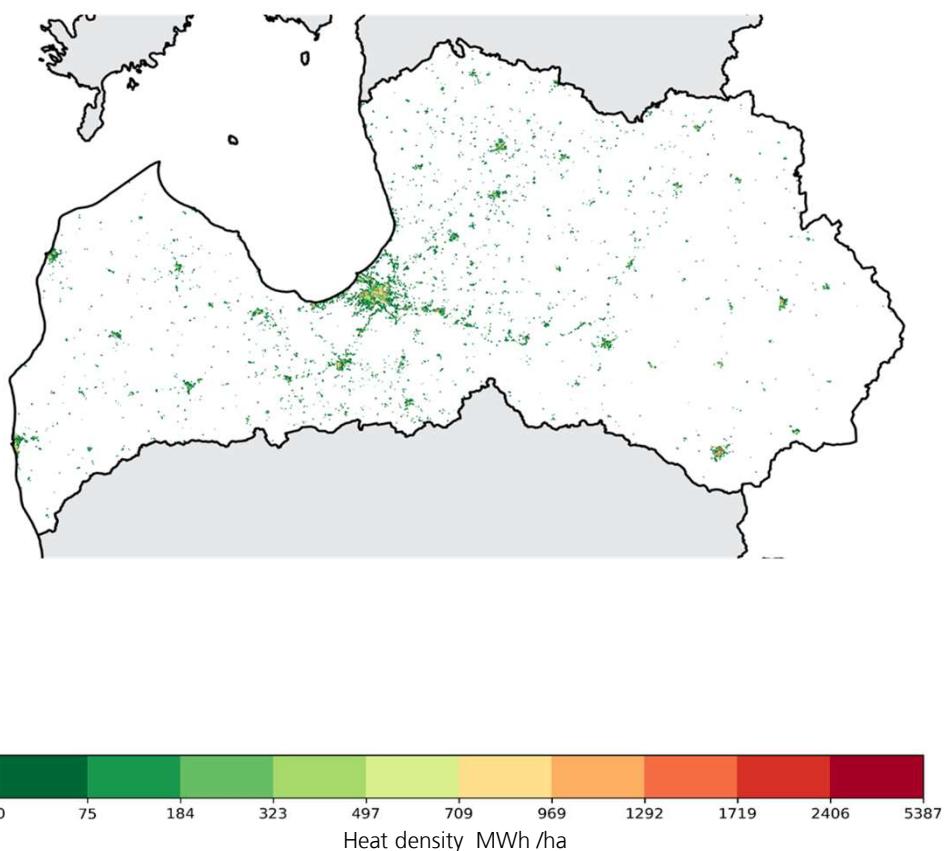
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Latvia



Fraunhofer
ISI



Öko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

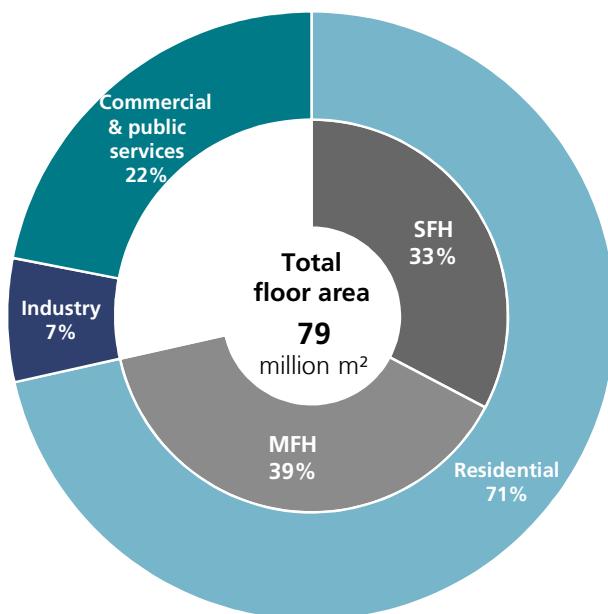
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

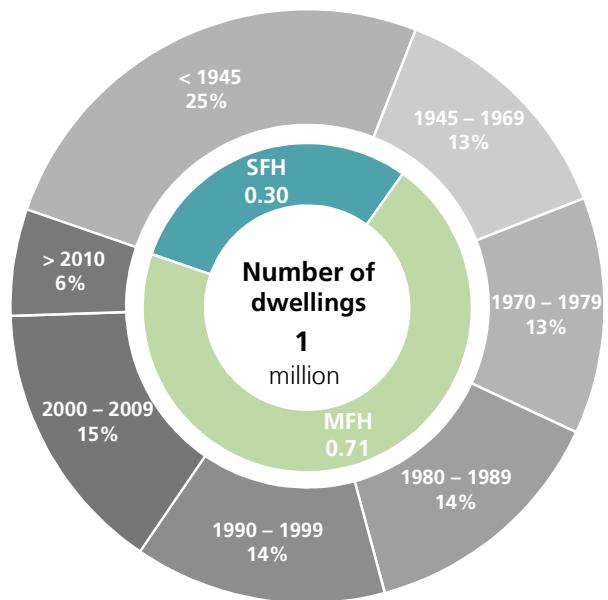
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Latvia 2017

5



Climate Data

Heating degree days

Latvia

EU-27

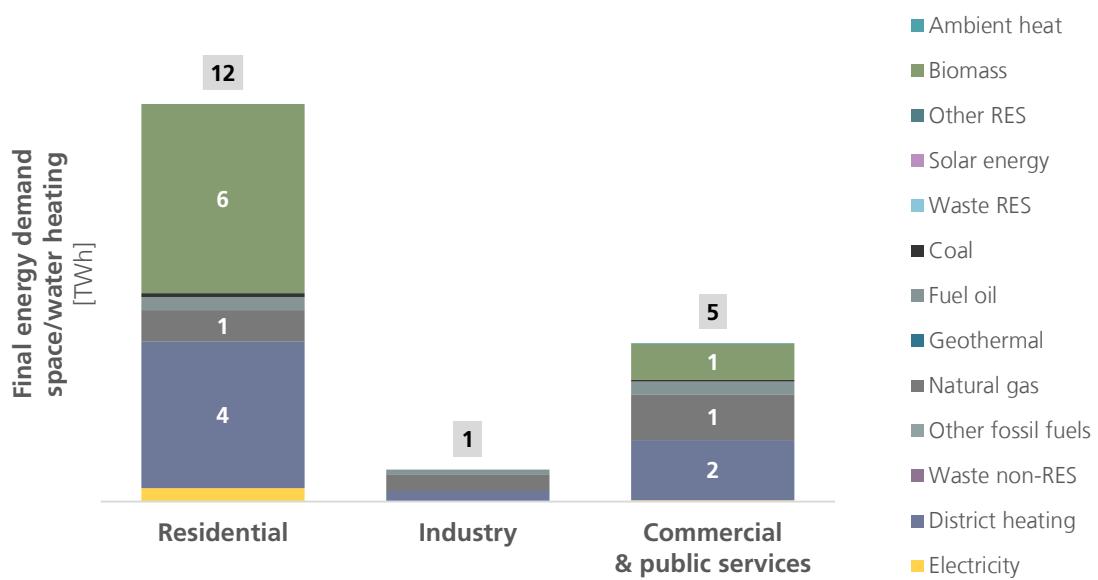
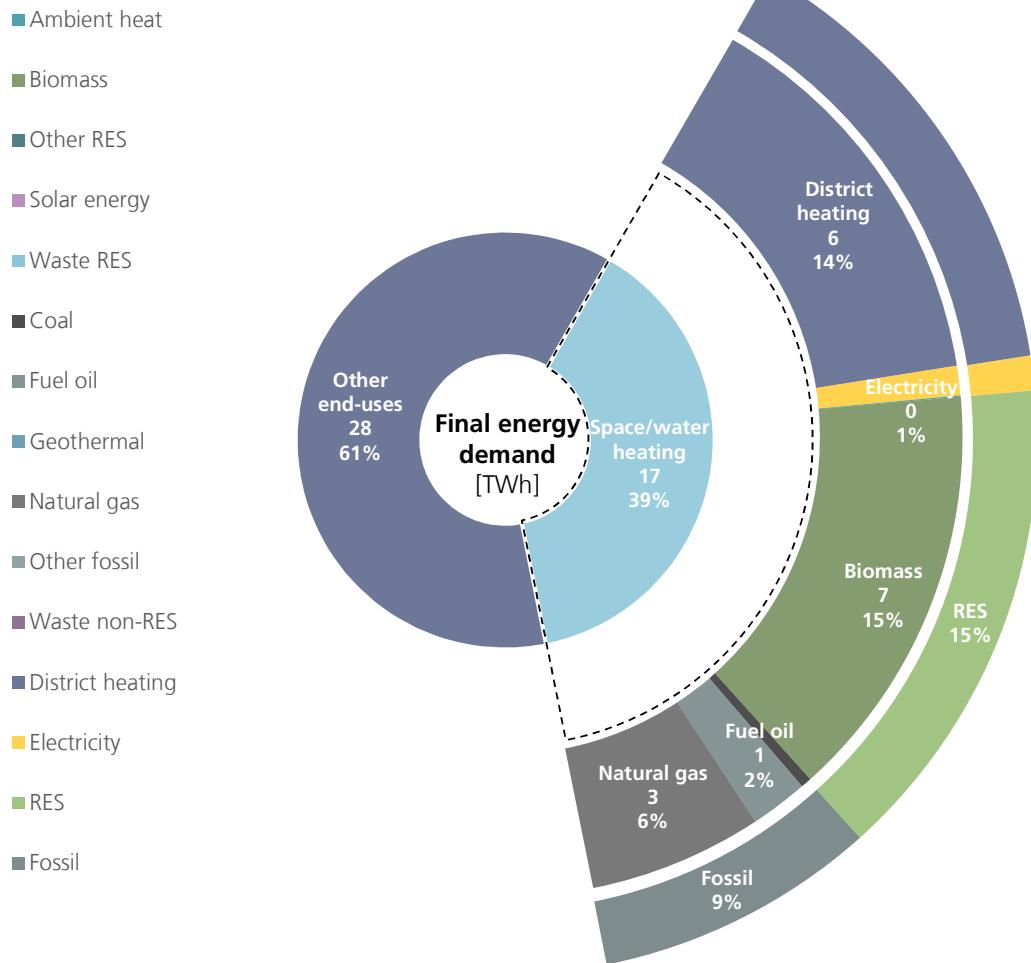
Average value 2000-2017

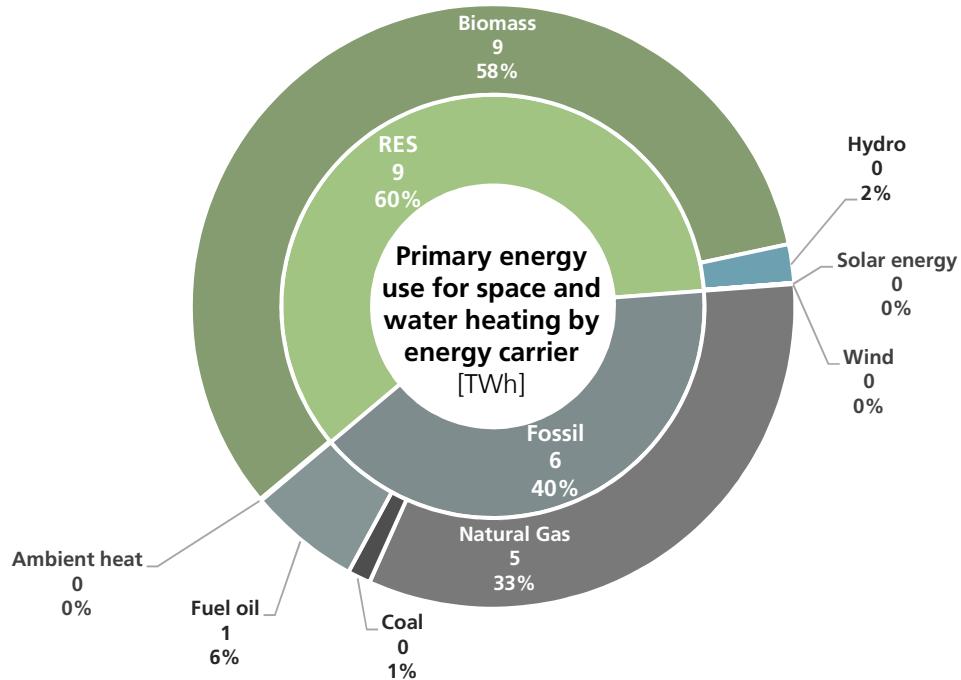
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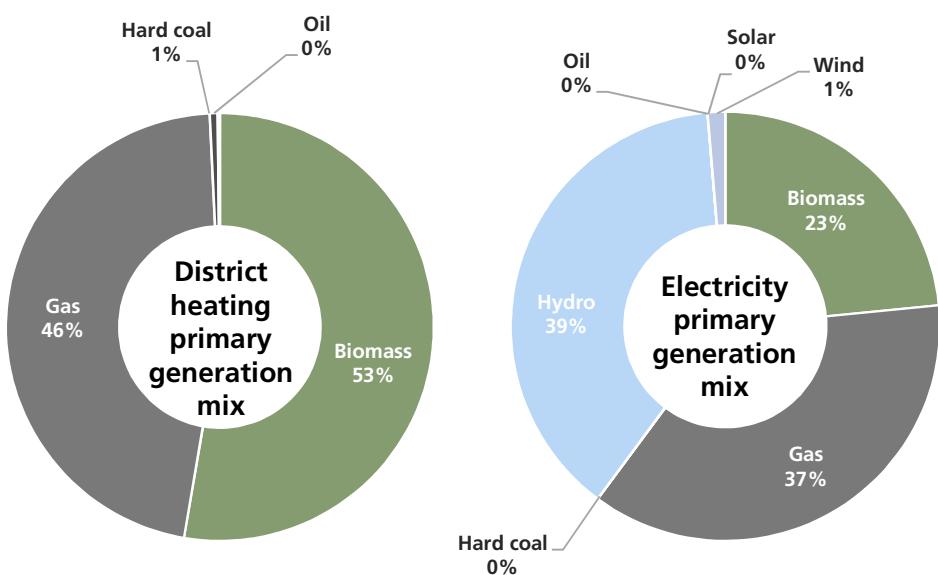
Overview of energy demand

Latvia 2017





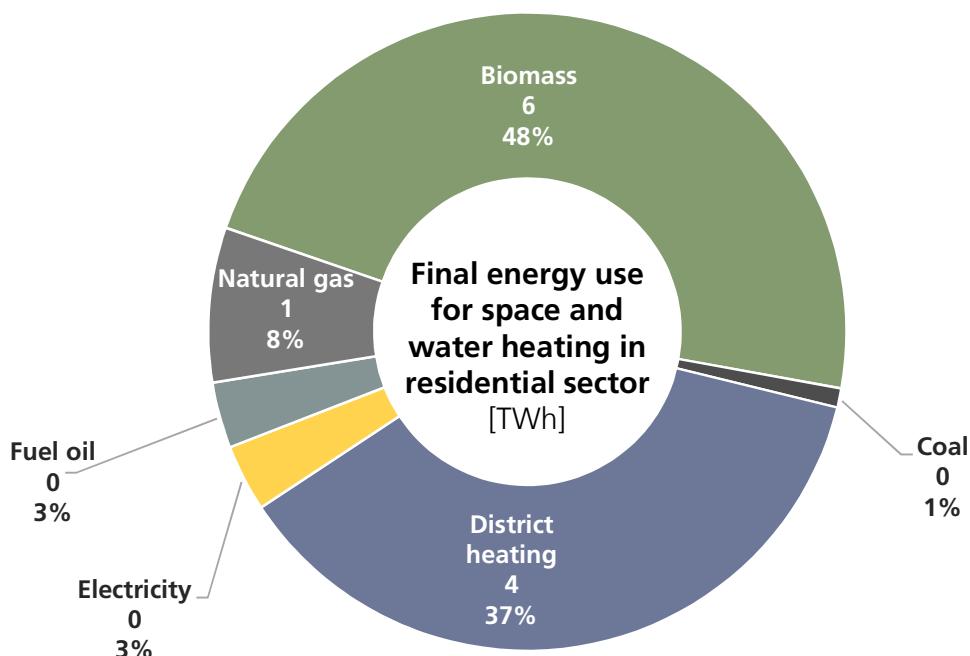
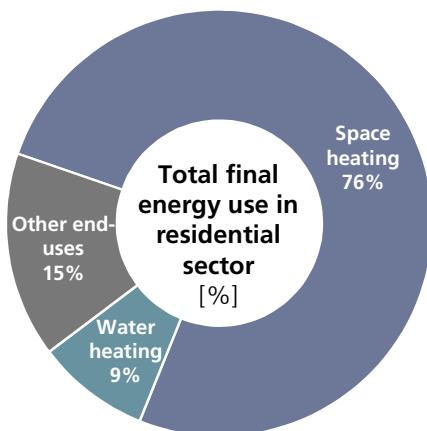
Generation mix



Space & water heating in residential sector

Latvia 2017

8



Specific energy demand

208 kWh/m²yr
Final energy demand

186 kWh/m²yr
Primary energy demand

240 kWh/m²yr
Single-family dwellings

212 kWh/m²yr
Single-family dwellings

182 kWh/m²yr
Multi-family dwellings

164 kWh/m²yr
Multi-family dwellings

Technology mix

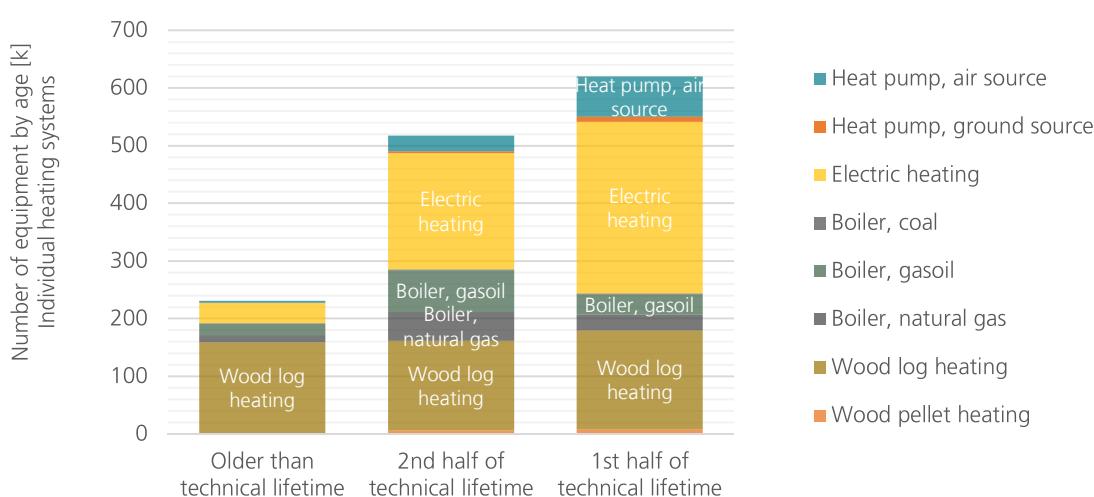
Latvia 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	100	3%	27%	70%	3.3	0.6
Heat pump ground source	12	3%	27%	70%	3.5	0.1
Solar thermal	25*	3%	27%	70%	0.5	0.0
Electric heating	536	7%	38%	56%	1.0	0.5
Boiler, coal	3	8%	41%	51%	0.8	0.1
Boiler, gasoil	128	16%	57%	27%	0.9	1.9
Boiler, natural gas	91	15%	55%	31%	1.0	4.2
Wood log heating	484	32%	32%	35%	0.7	5.7
Wood pellet heating	15	8%	41%	51%	0.8	1.1

* unit 1000 m²

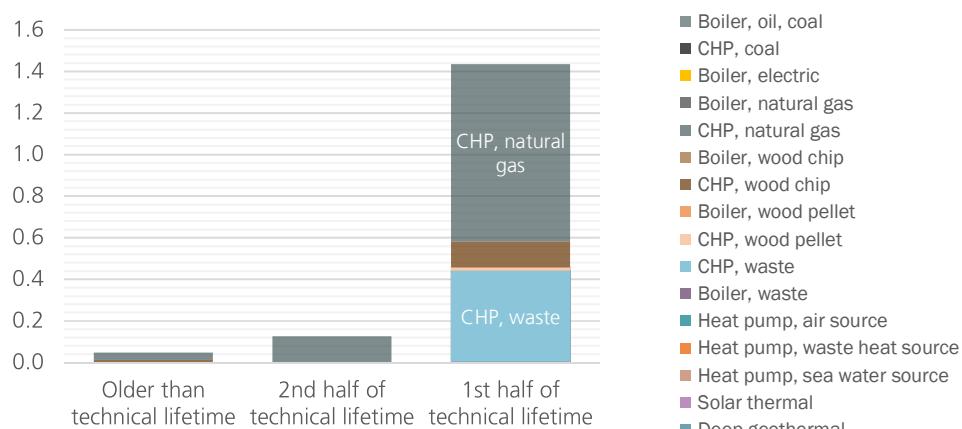
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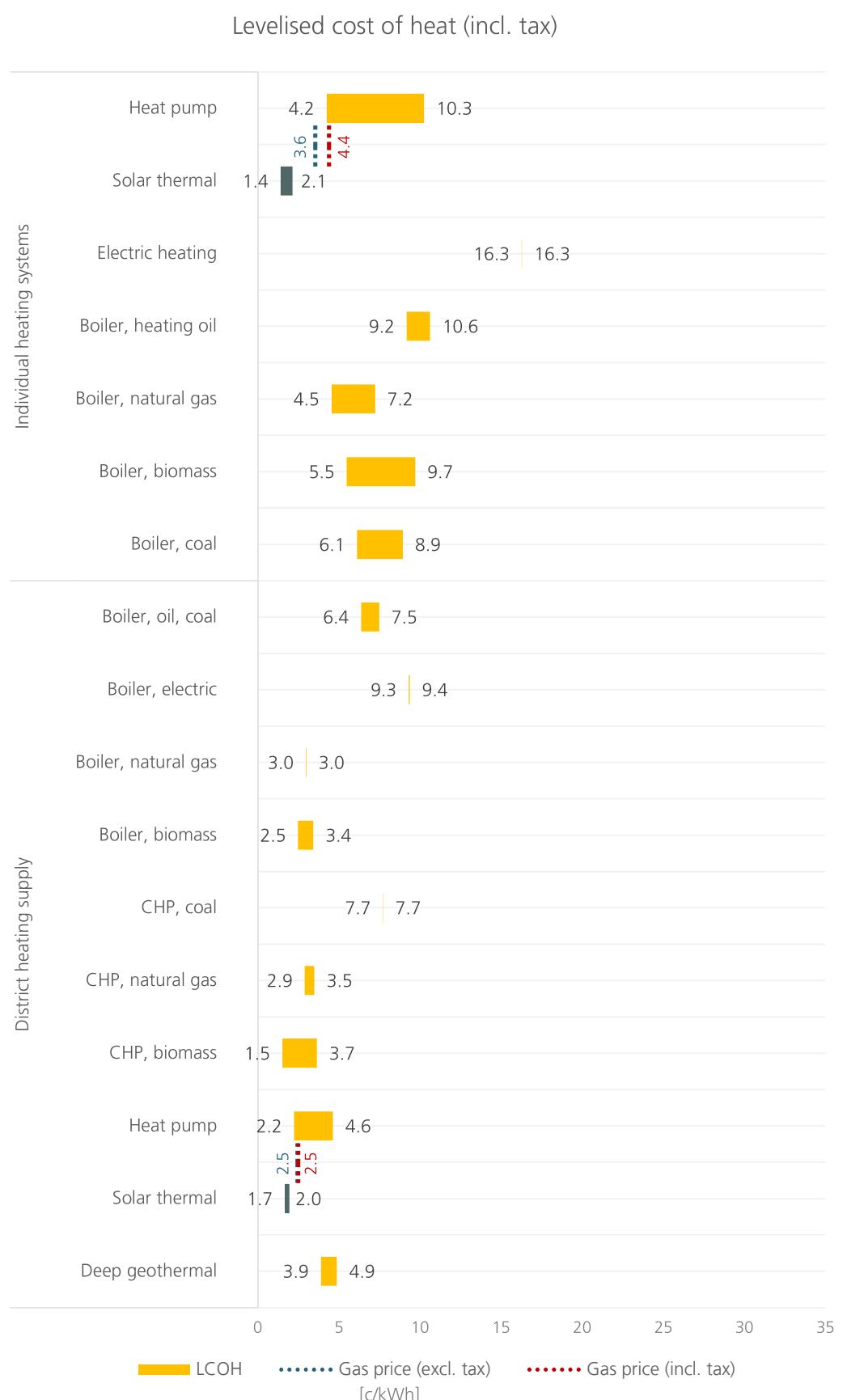


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	53	2%	25%	74%	0.4	1.0
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	12	8%	0%	92%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	4	0%	0%	100%	0.7	0.0
CHP, waste	3	0%	0%	100%	0.8	0.4
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Overview of policies

Latvia 2017

12

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO₂ pricing	
CO ₂ pricing	Green
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Red
RES-H obligation for existing buildings	Red
Trigger point: Major renovation	Red
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Yellow
New installations in existing buildings	Yellow
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

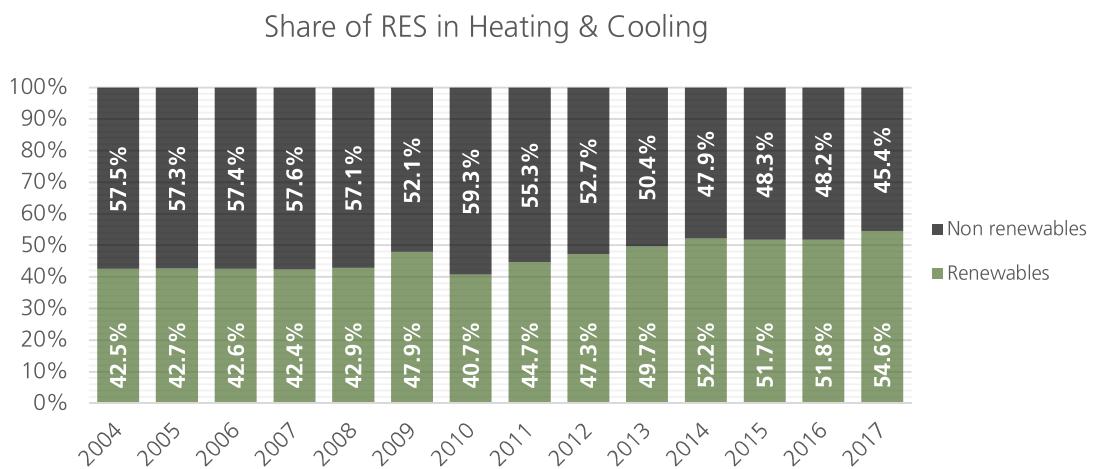
Measures in development

Measures in place

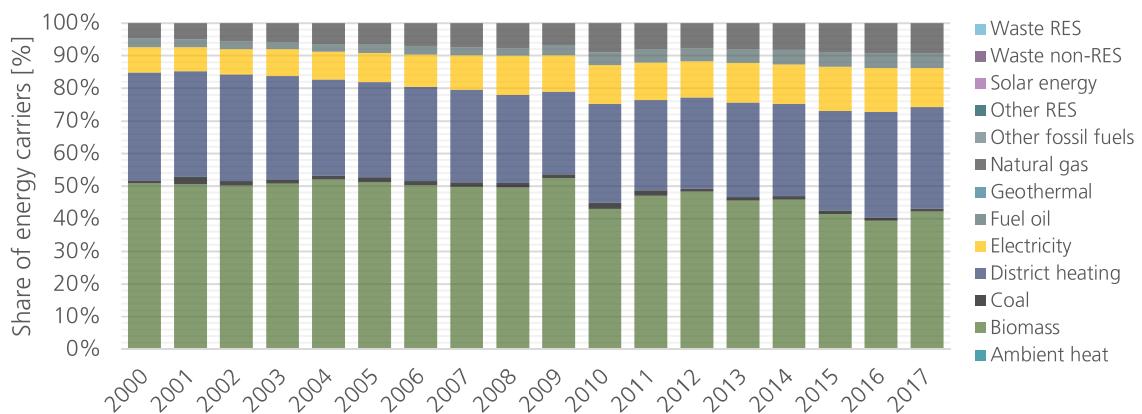
Historical trends

Latvia 2017

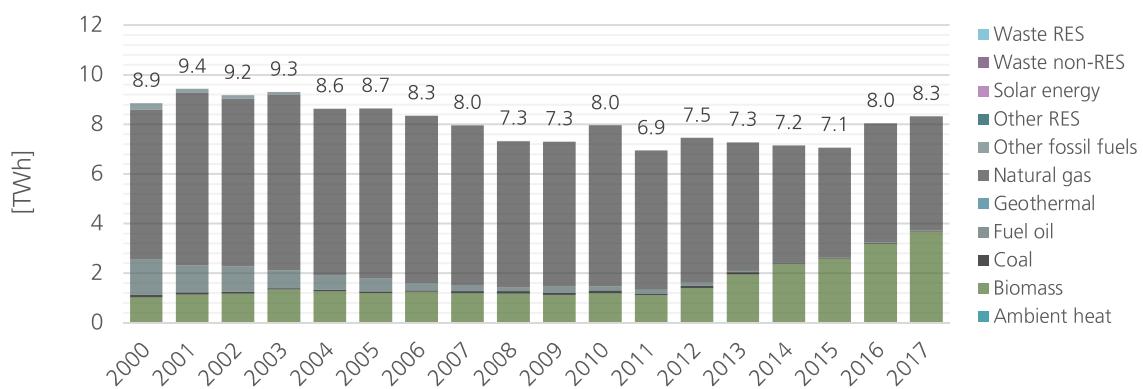
13



Final energy consumption in residential sector



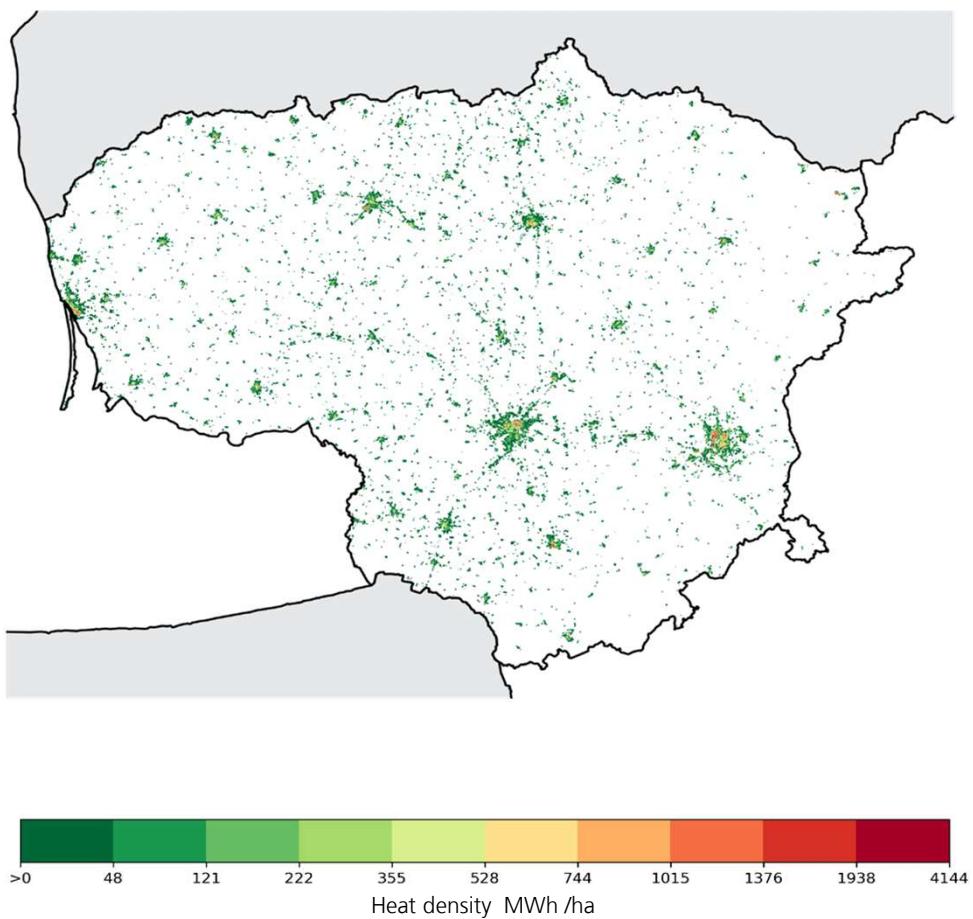
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Lithuania



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

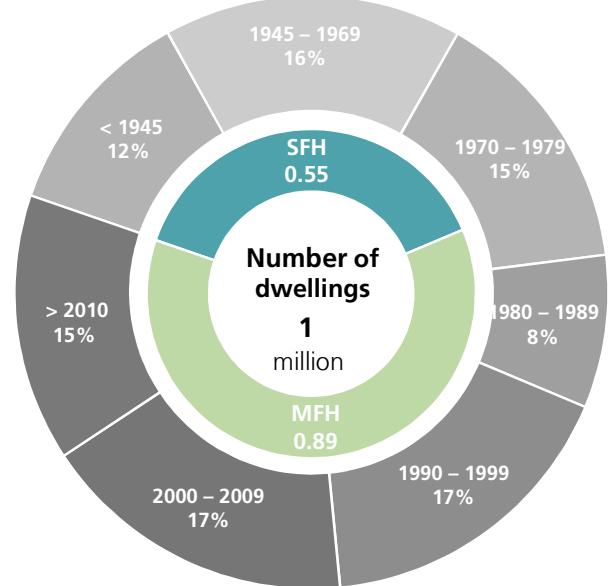
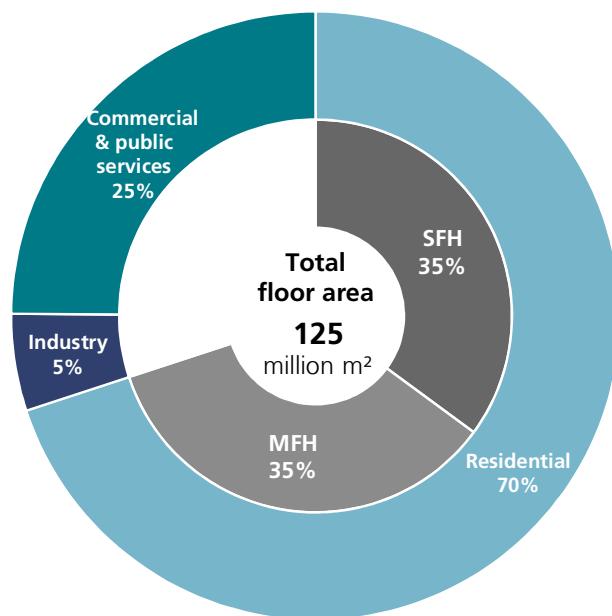
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Building Stock Data

SFH: Single family house
MFH: Multi-family house

Lithuania 2017

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Climate Data

Heating degree days

Lithuania

EU-27

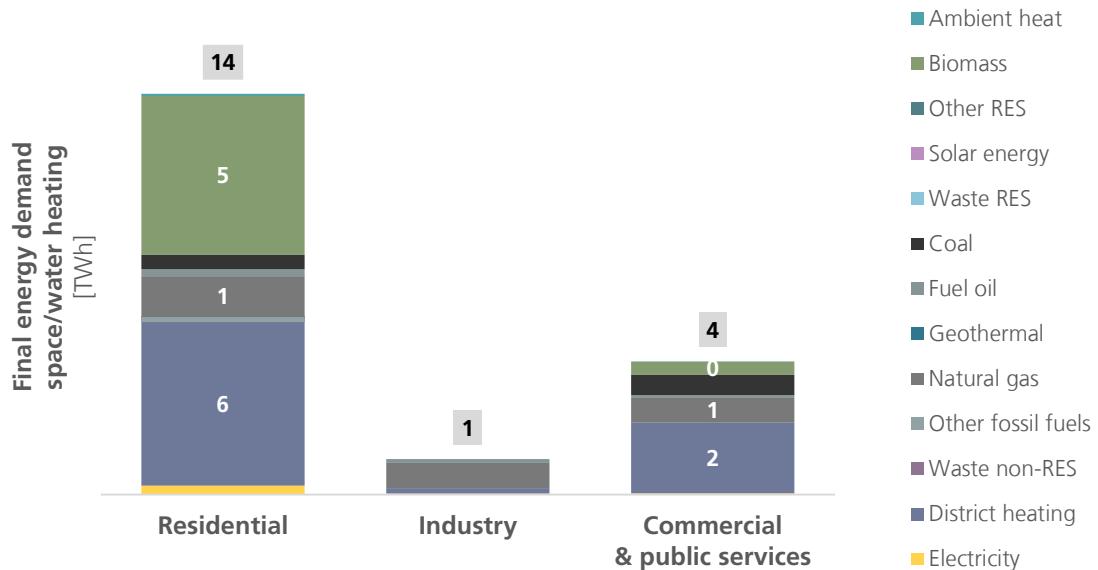
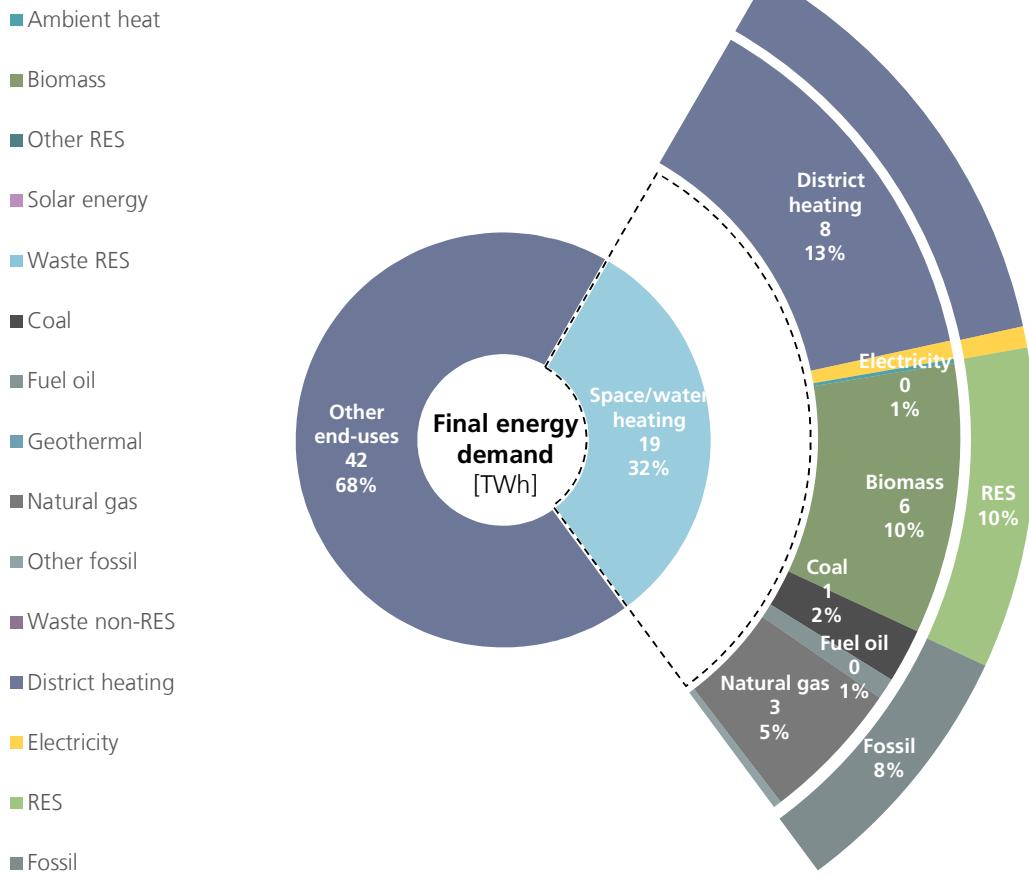
Average value 2000-2017

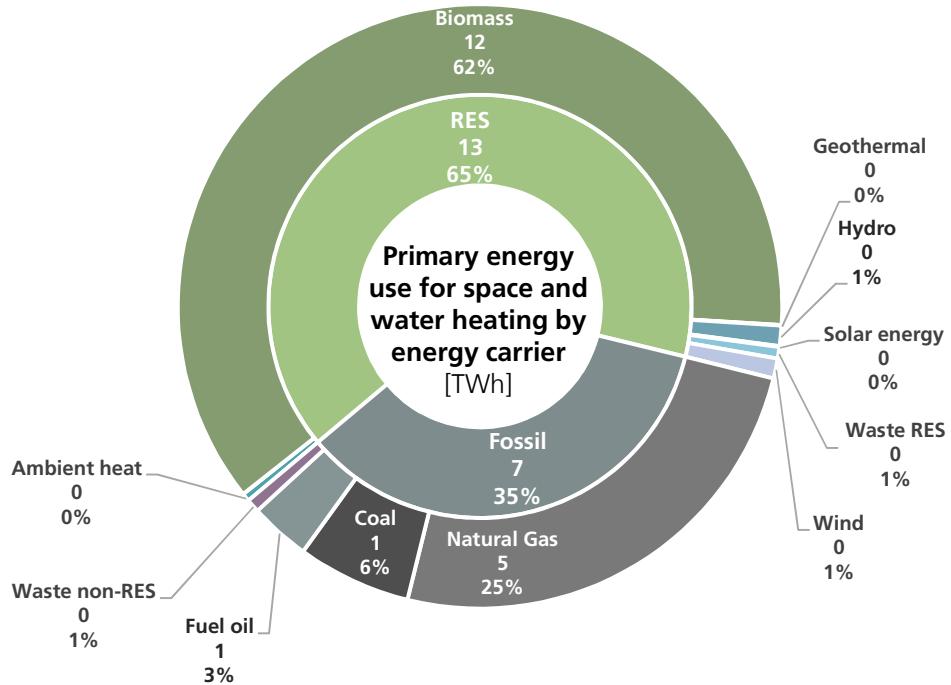
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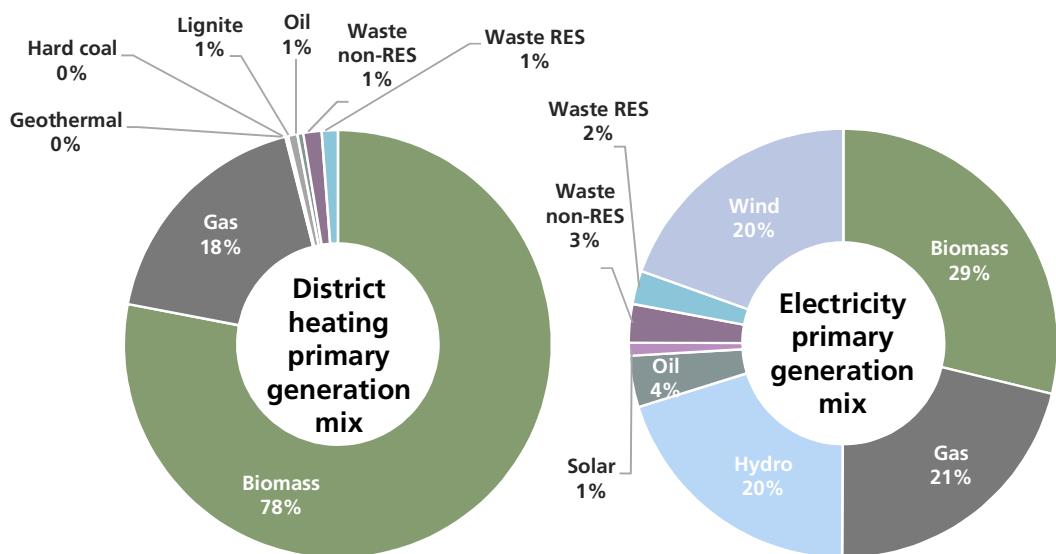
Overview of energy demand

Lithuania 2017
6





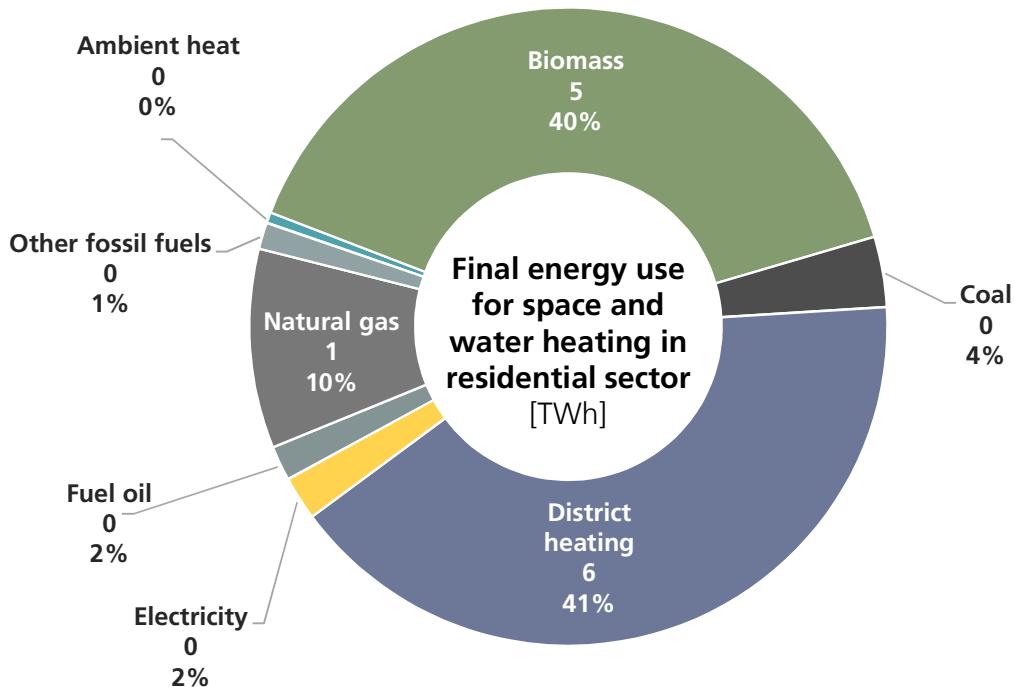
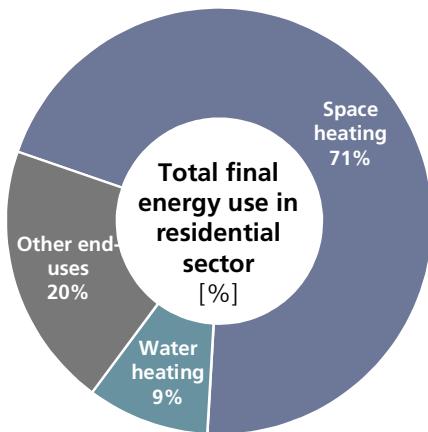
Generation mix



Space & water heating in residential sector

Lithuania 2017

8



Specific energy demand

154 kWh/m²yr
Final energy demand

161 kWh/m²yr
Primary energy demand

176 kWh/m²yr
Single-family dwellings

183 kWh/m²yr
Single-family dwellings

133 kWh/m²yr
Multi-family dwellings

139 kWh/m²yr
Multi-family dwellings

Technology mix

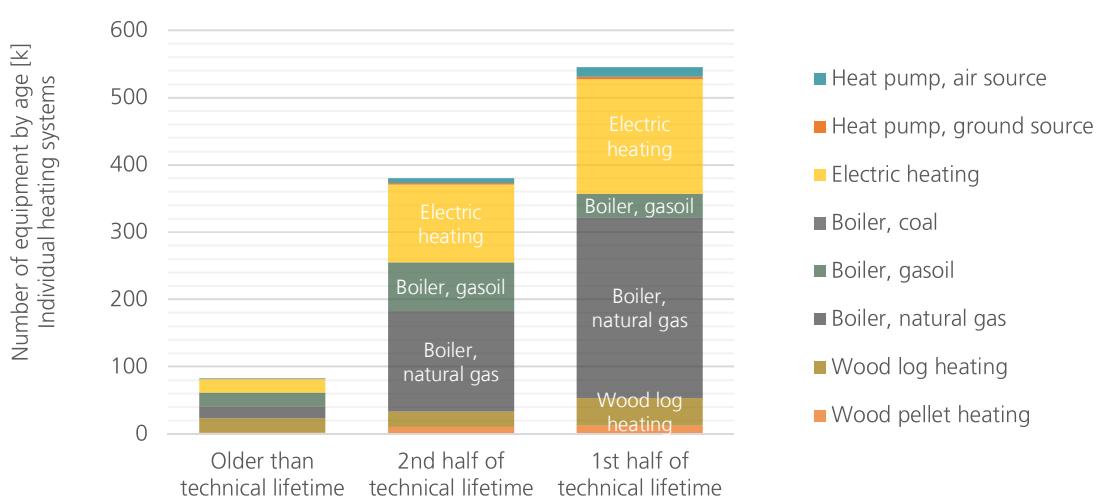
Lithuania 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	23	3%	31%	65%	3.3	0.1
Heat pump ground source	6	4%	39%	56%	3.5	0.1
Solar thermal	20*	3%	27%	70%	0.5	0.0
Electric heating	306	7%	38%	56%	1.0	0.3
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	128	16%	57%	27%	0.9	1.9
Boiler, natural gas	436	4%	34%	62%	1.0	4.5
Wood log heating	85	25%	27%	48%	0.7	1.0
Wood pellet heating	25	8%	41%	51%	0.8	2.1

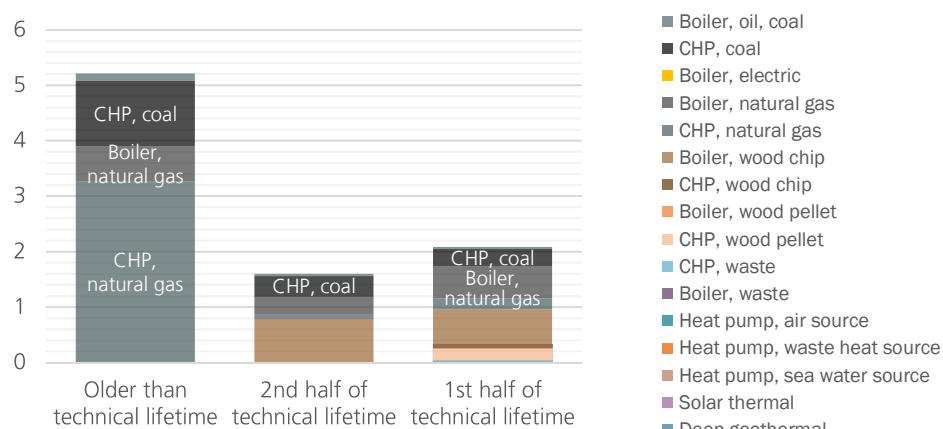
* unit 1000 m²

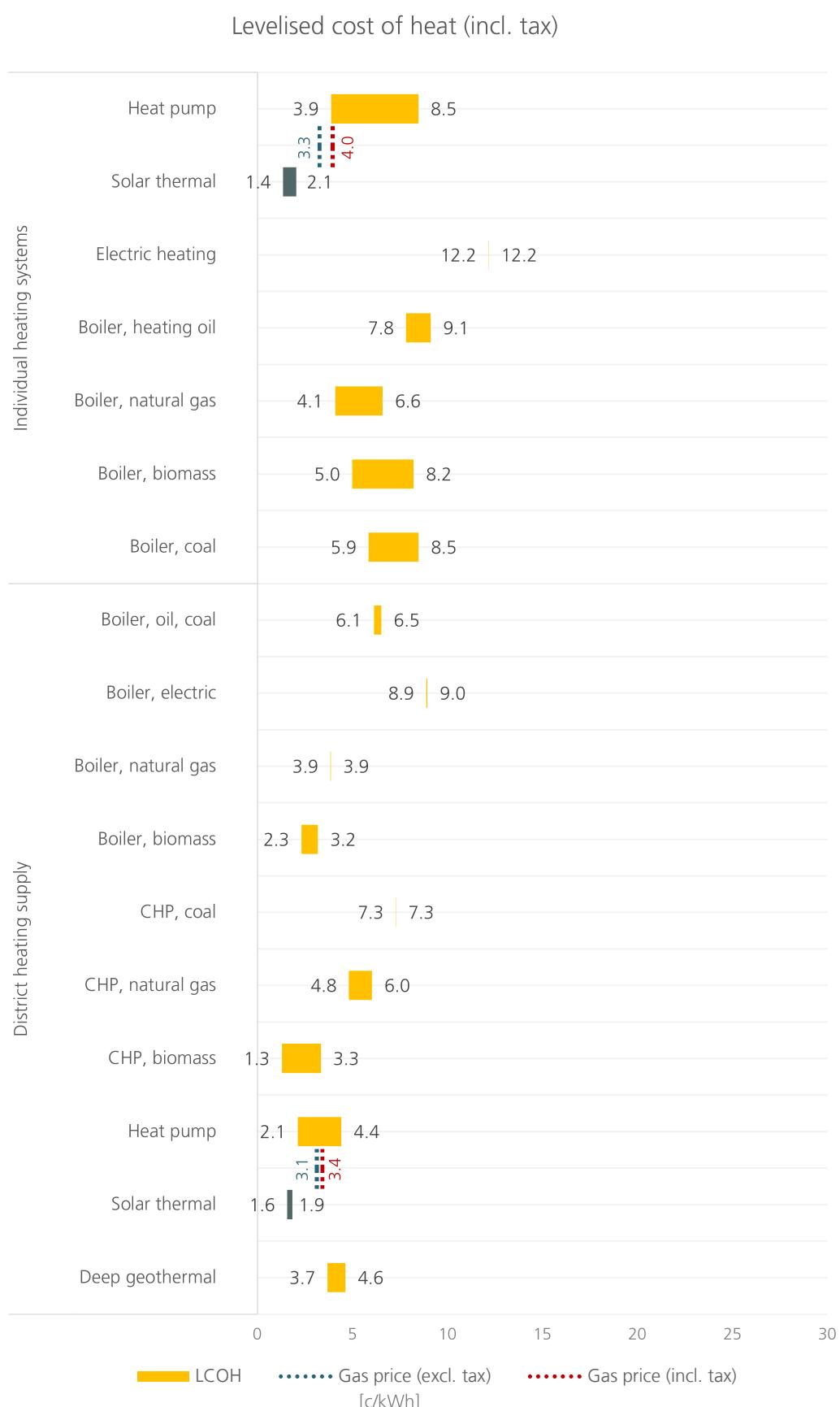
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	0.2
CHP, coal	32	52%	21%	27%	0.5	1.9
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	1.5
CHP, natural gas	33	36%	4 %	60%	0.4	3.5
Boiler, wood chip	-	-	-	-	1.1	1.4
CHP, wood chip	2	0%	0%	100%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	3	0%	0%	100%	0.7	0.2
CHP, waste	1	0%	0%	100%	0.8	0.0
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply
Installed capacity by age [GWth]



Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Green
Heat incentives for decentral heating systems	Red
Energy- and CO₂ pricing	
CO ₂ pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Green
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Red
New installations in existing buildings	Red
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

 No measure

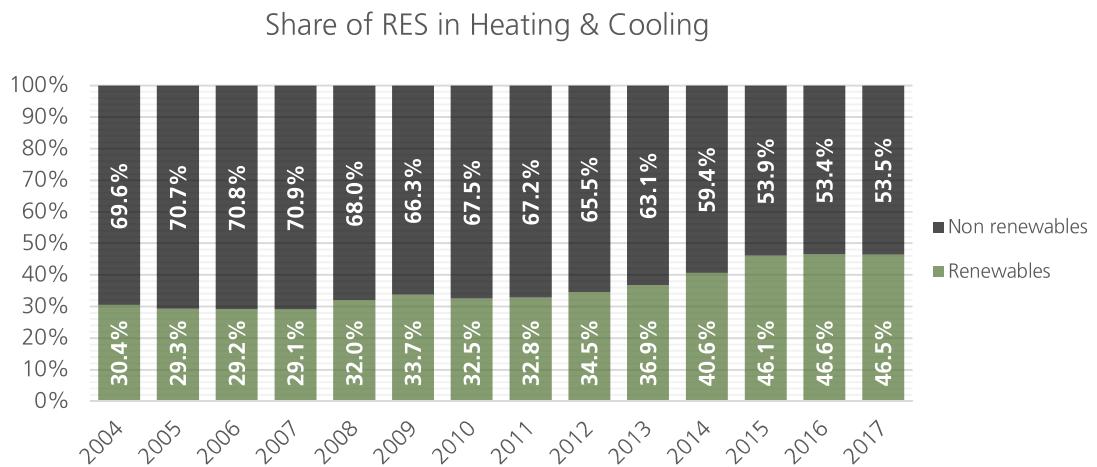
 Measures in development

 Measures in place

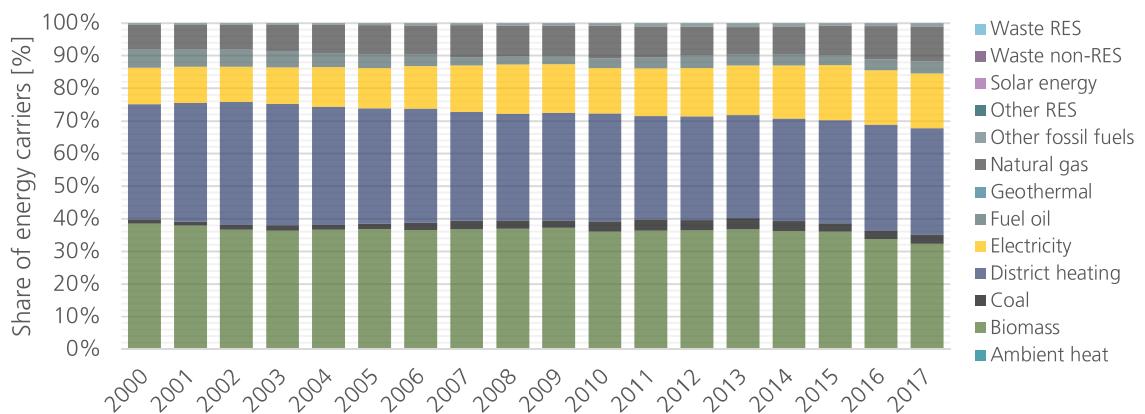
Historical trends

Lithuania 2017

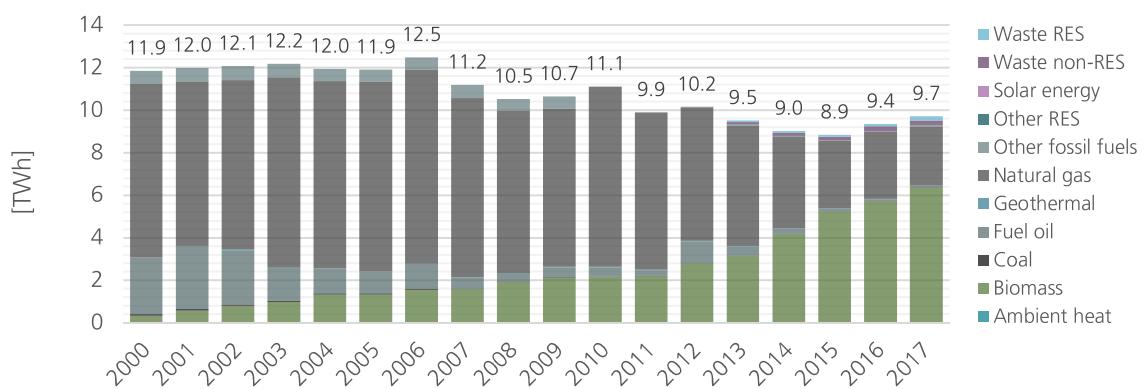
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Final energy consumption in residential sector



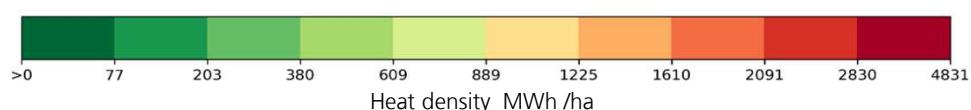
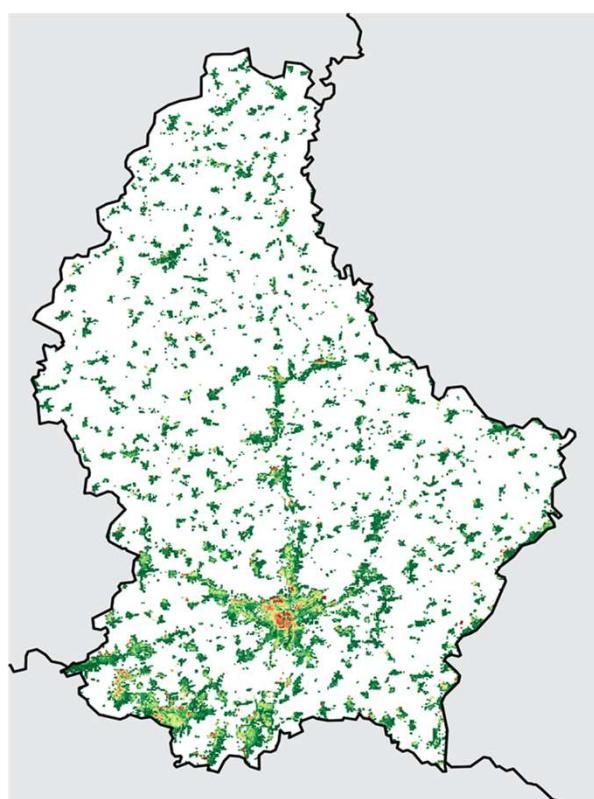
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Luxembourg



Source: <https://www.hotmaps.eu/map>



Fraunhofer
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Institut für angewandte Ökologie
Institute for Applied Ecology

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maagøe
energy people

Introduction

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The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

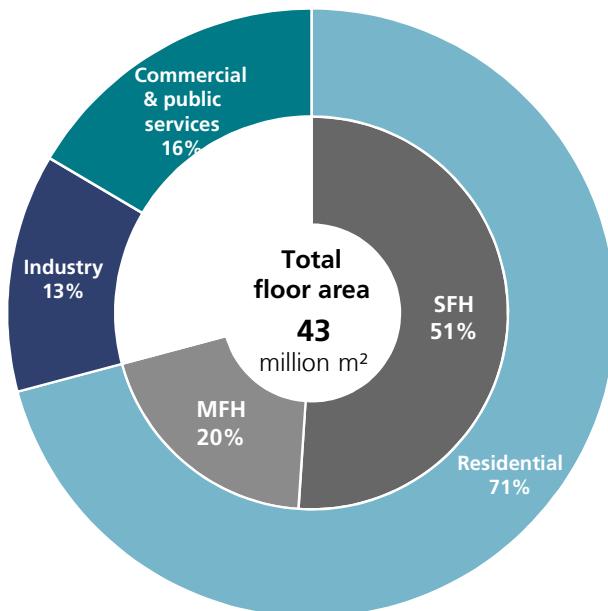
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

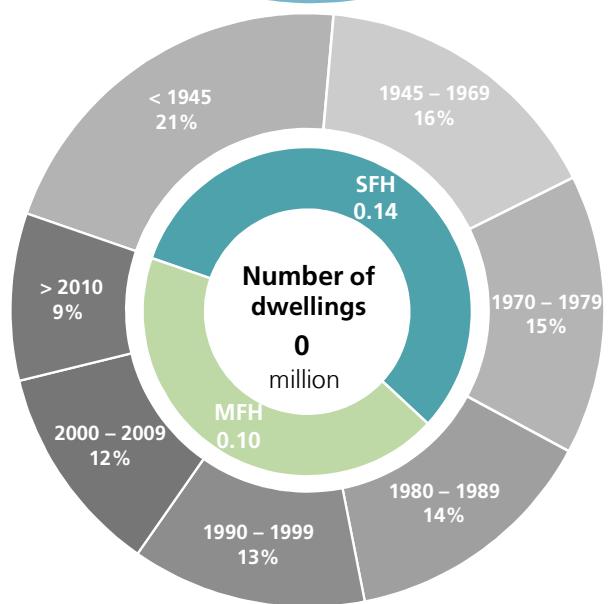
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Luxembourg 2017

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Climate Data

Heating degree days

Luxembourg

EU-27

Average value 2000-2017

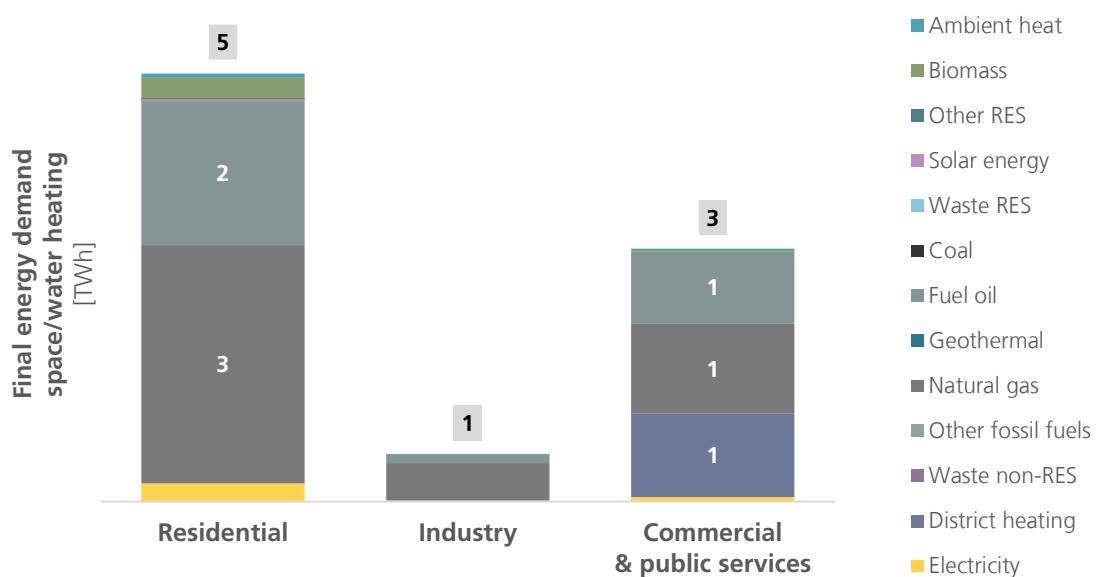
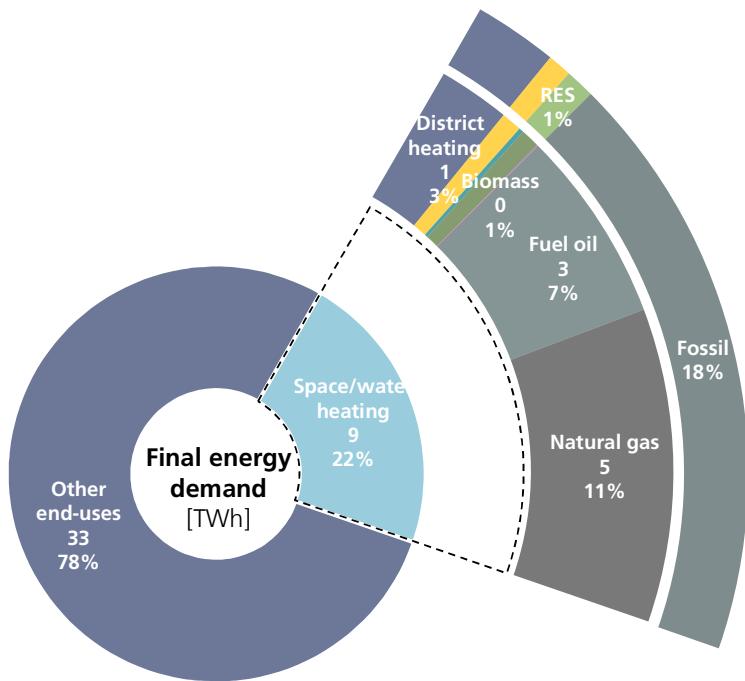
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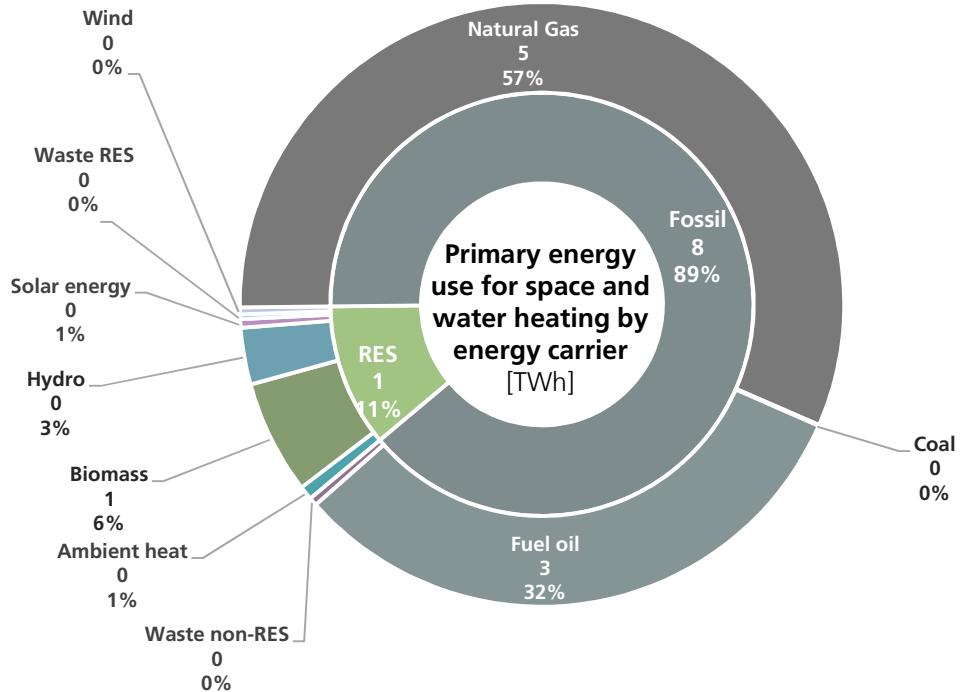
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Overview of energy demand

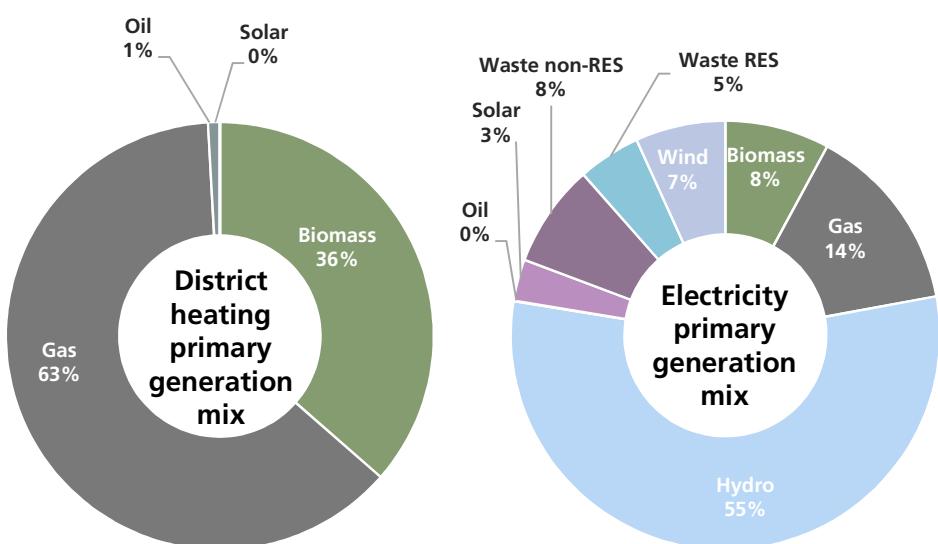
Luxembourg 2017
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- Ambient heat
- Biomass
- Other RES
- Solar energy
- Waste RES
- Coal
- Fuel oil
- Geothermal
- Natural gas
- Other fossil
- Waste non-RES
- District heating
- Electricity
- RES
- Fossil





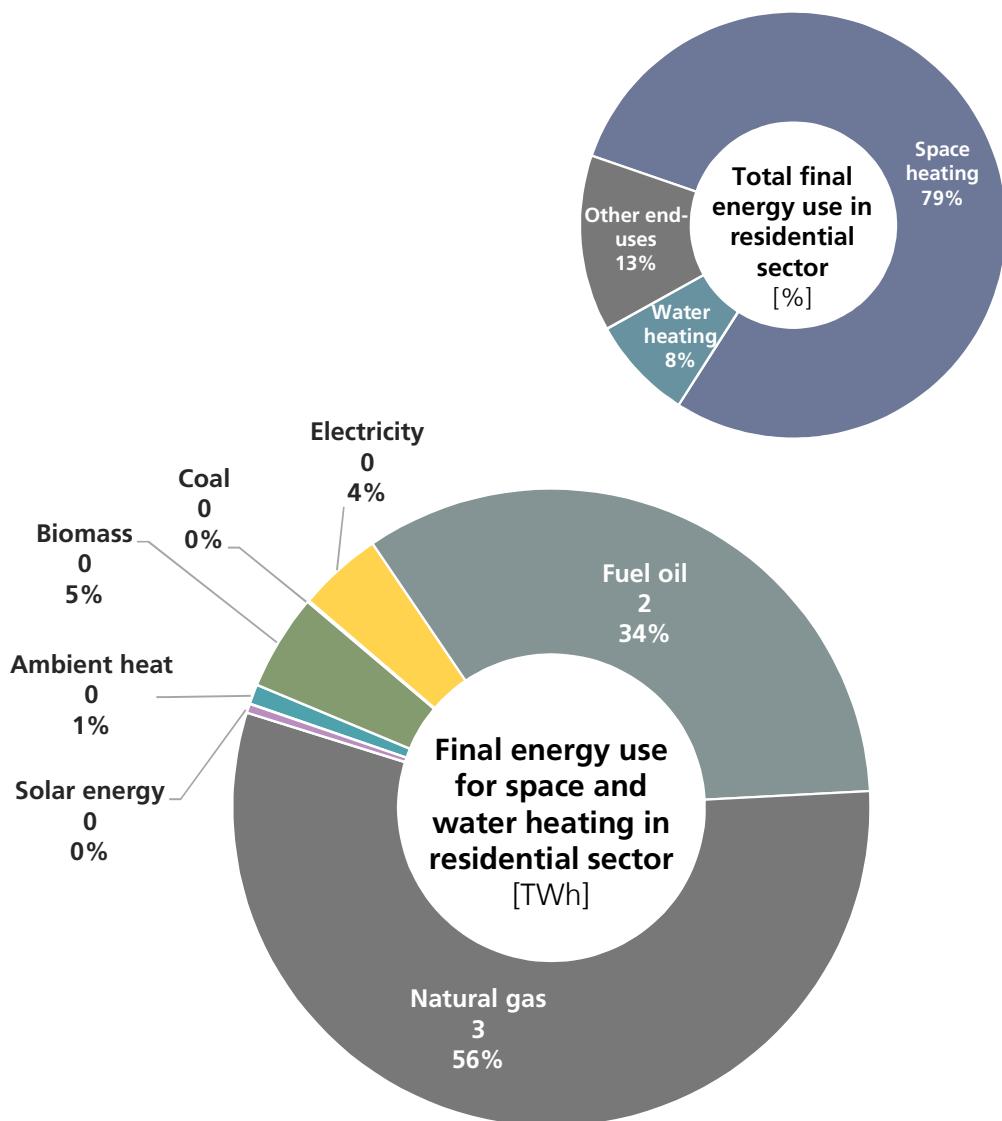
Generation mix



Space & water heating in residential sector

Luxembourg 2017

8



Specific energy demand

177

kWh/m²yr

Final energy demand

181

kWh/m²yr

Primary energy demand

223

kWh/m²yr

Single-family dwellings

229

kWh/m²yr

Single-family dwellings

56

kWh/m²yr

Multi-family dwellings

57

kWh/m²yr

Multi-family dwellings

Technology mix

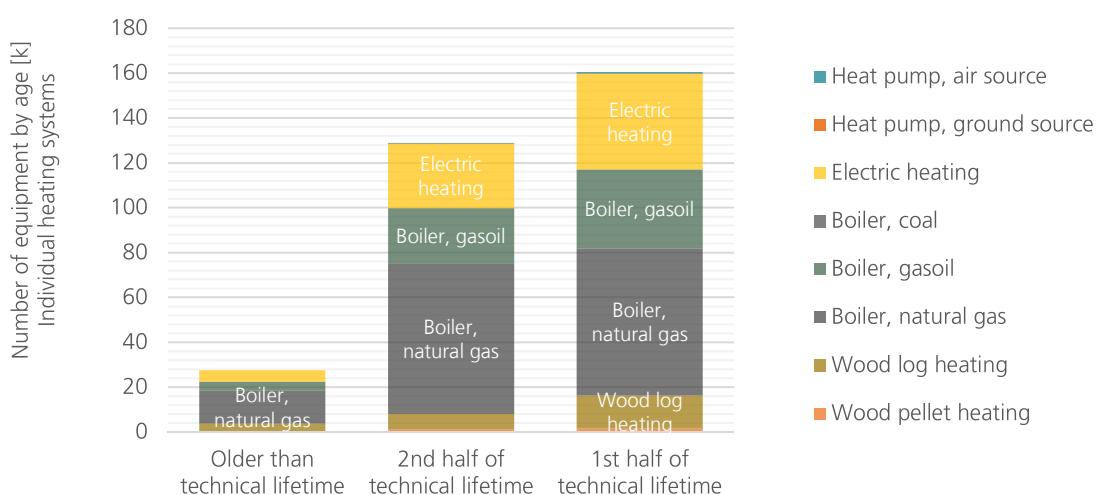
Luxembourg 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	1	3%	27%	70%	3.8	0.0
Heat pump ground source	0	3%	27%	70%	3.7	0.0
Solar thermal	67*	3%	27%	70%	0.5	0.0
Electric heating	77	7%	38%	56%	1.0	0.1
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	64	6%	38%	55%	0.9	1.3
Boiler, natural gas	148	10%	46%	44%	1.0	2.0
Wood log heating	25	14%	27%	59%	0.7	0.2
Wood pellet heating	3	8%	41%	51%	0.8	0.1

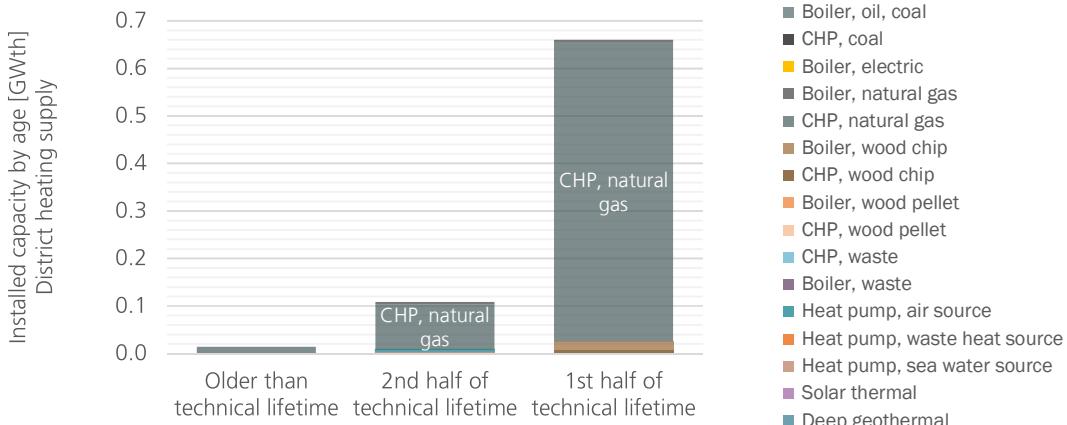
* unit 1000 m²

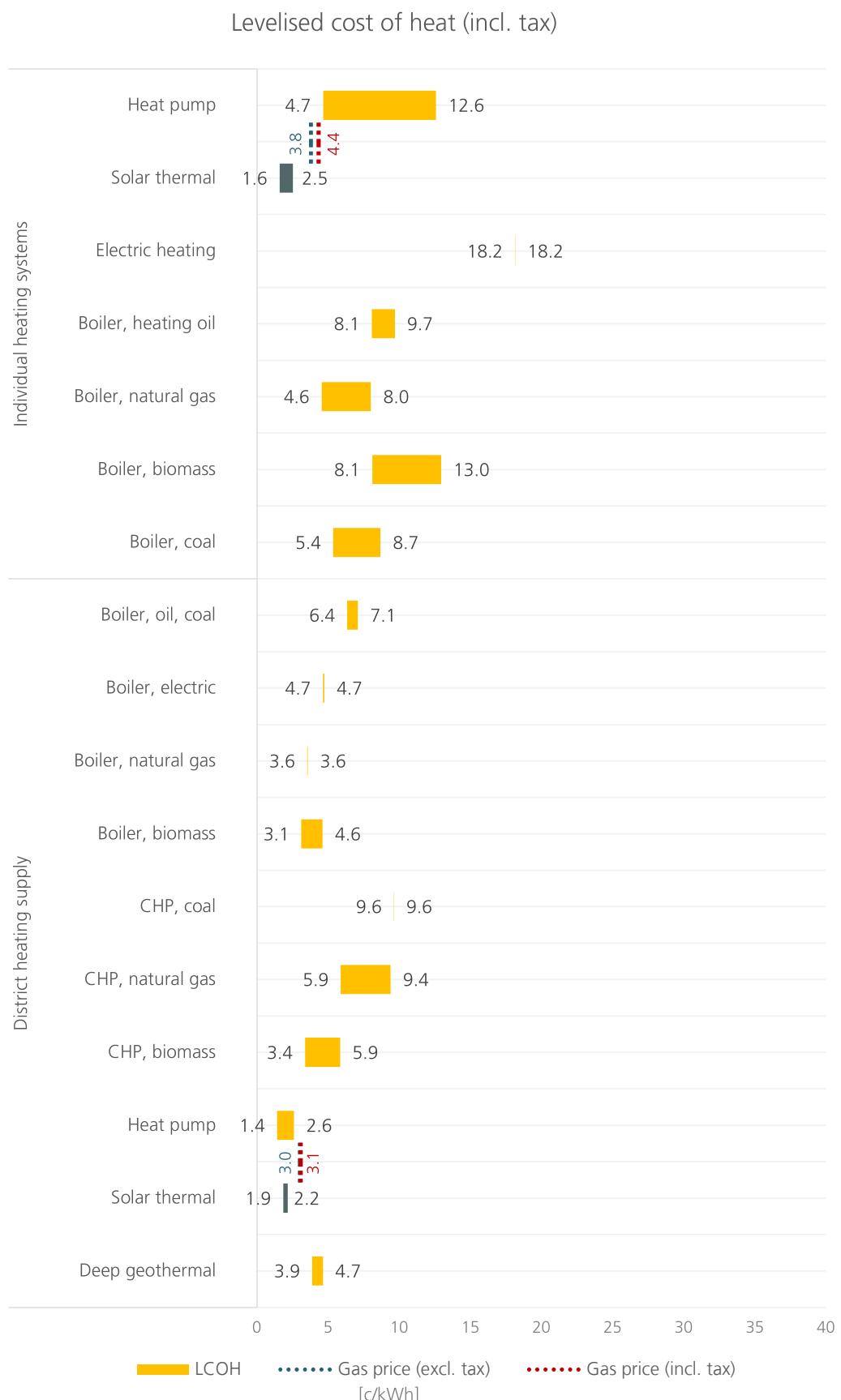
- no data



Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	0	0%	0%	0%	0.9	0.0
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	1	0%	44%	56%	1.1	0.0
CHP, natural gas	103	5%	56%	39%	0.4	0.7
Boiler, wood chip	3	0%	0%	100%	1.1	0.0
CHP, wood chip	1	0%	0%	100%	0.9	0.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	3	0%	100%	0%	3.4	0.0
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	1	0%	100%	0%	3.3	0.0
Solar thermal	-	-	-	-	0.5	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	No measure
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
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Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	Measures in place
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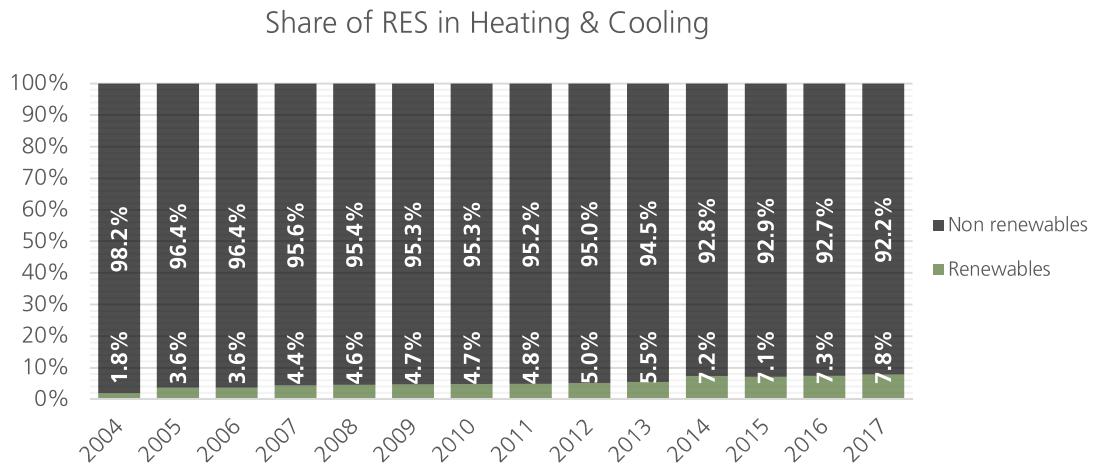
Measures in development

Measures in place

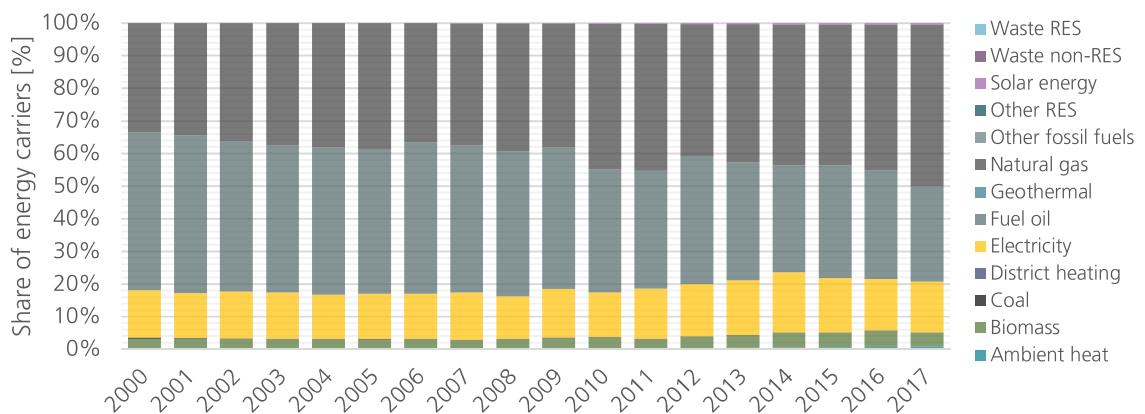
Historical trends

Luxembourg 2017

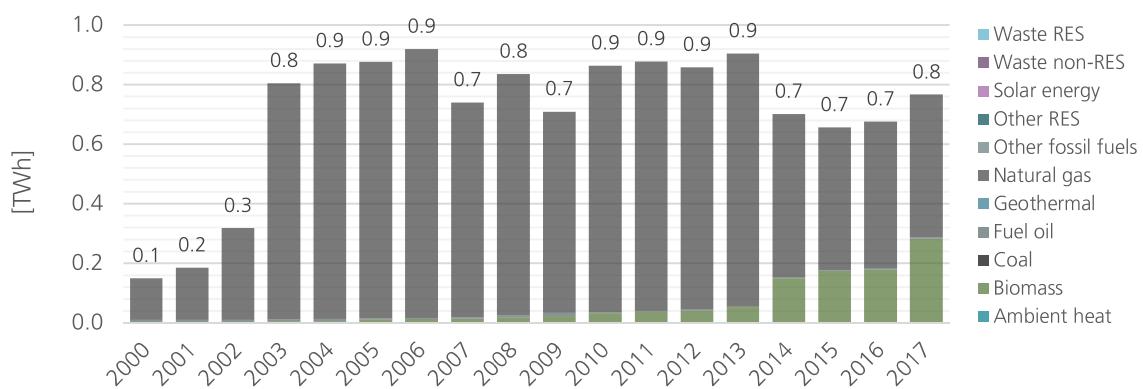
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Final energy consumption in residential sector



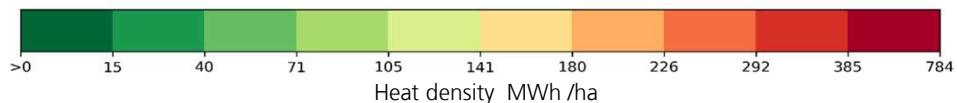
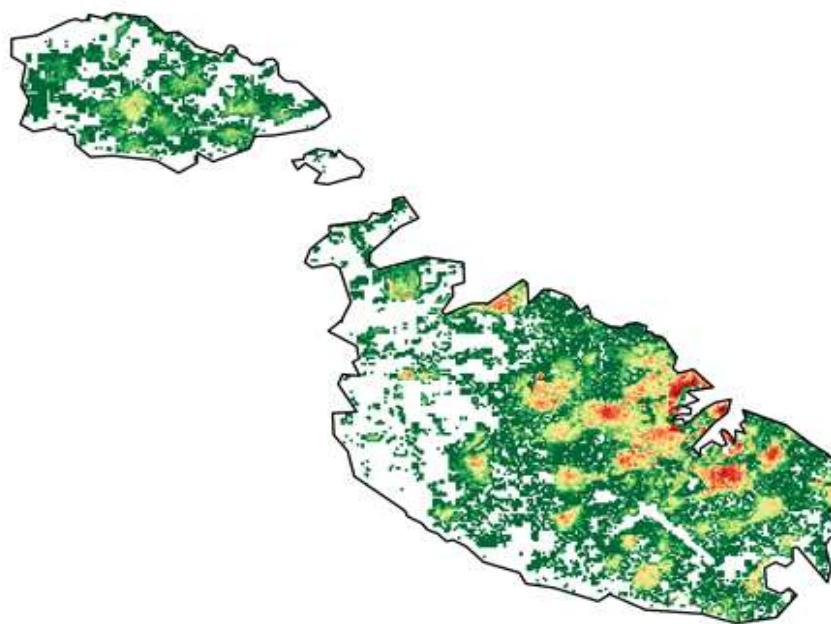
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Malta



Source: <https://www.hotmaps.eu/map>



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Heat pumps

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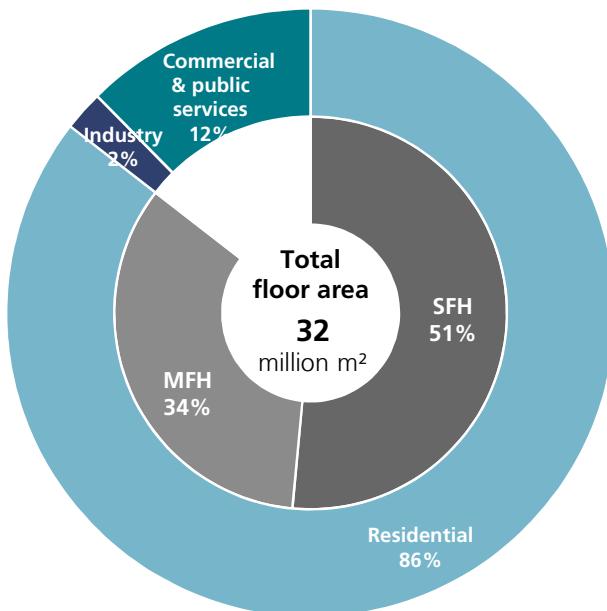
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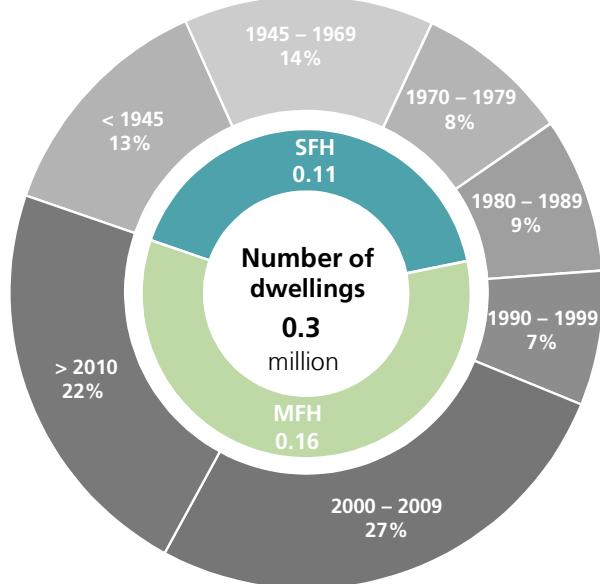
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Malta 2017

5



Climate Data

Heating degree days

Malta

EU-27

Average value 2000-2017

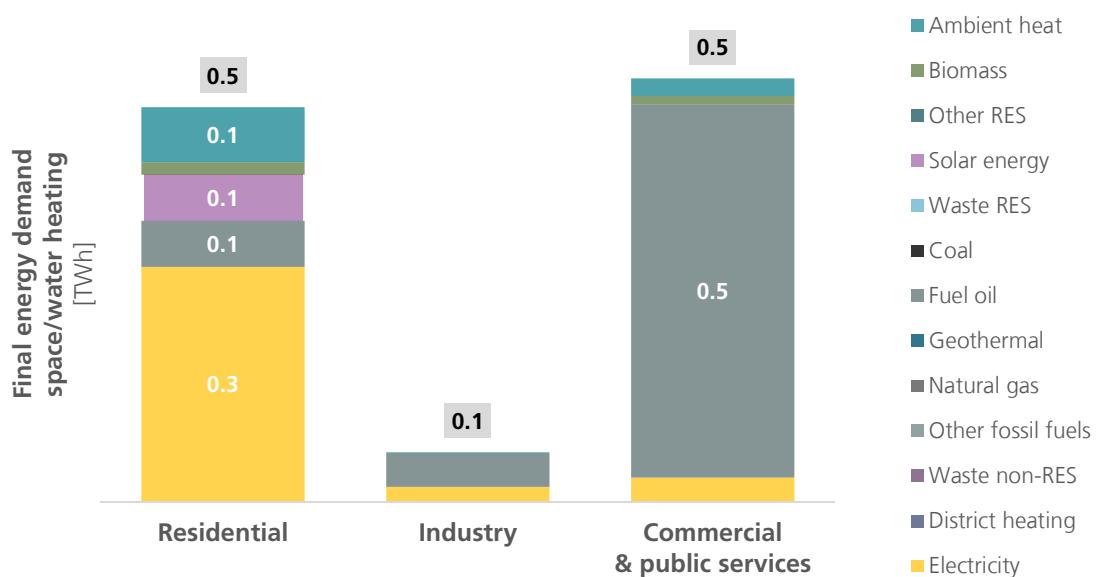
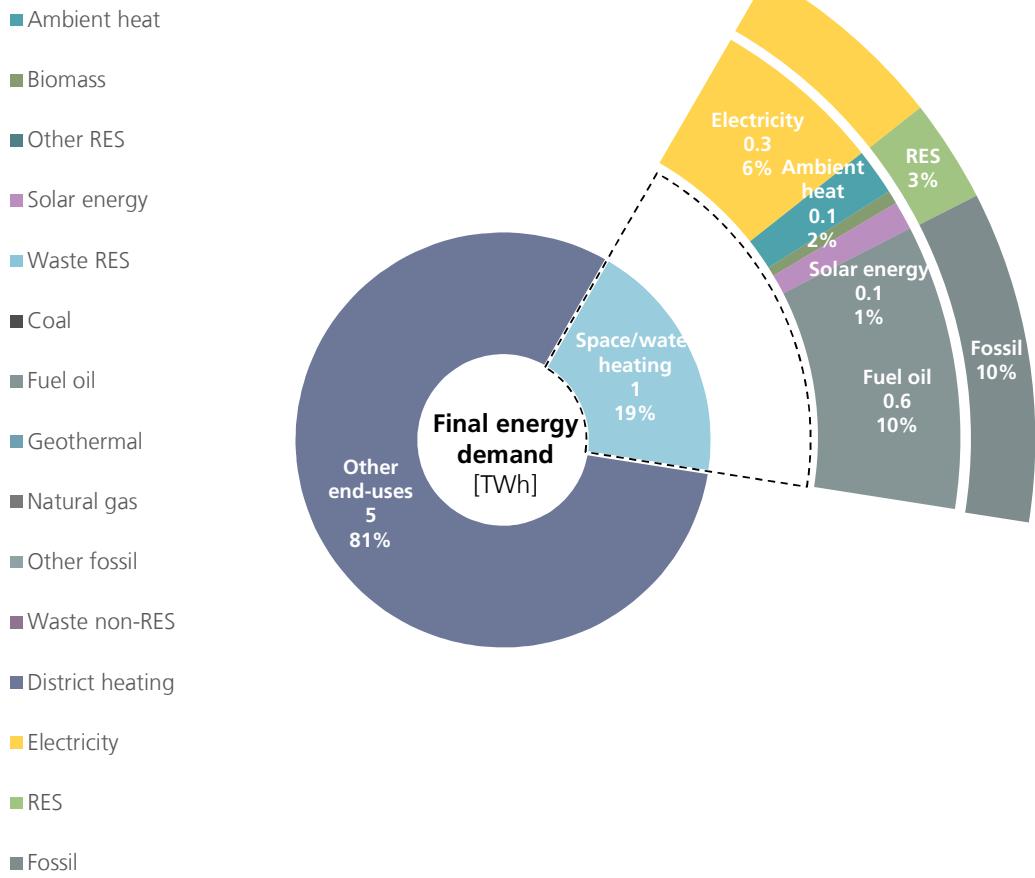
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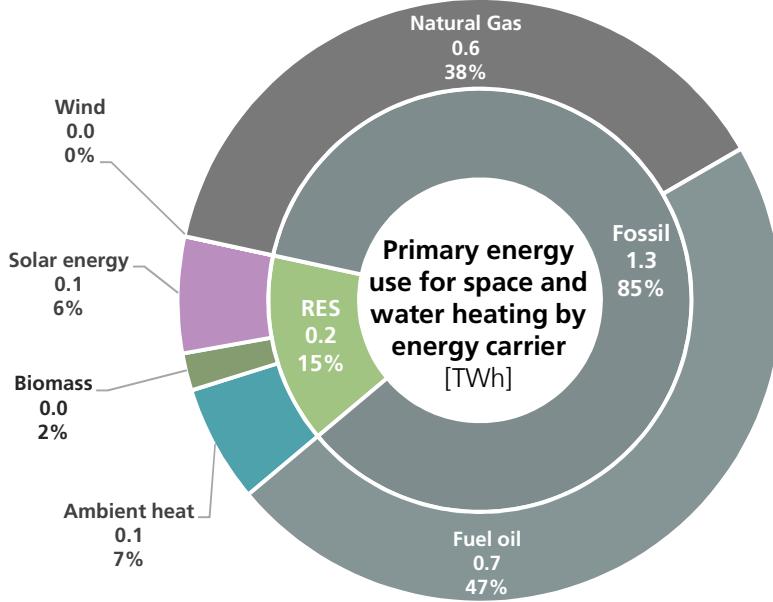
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Overview of energy demand

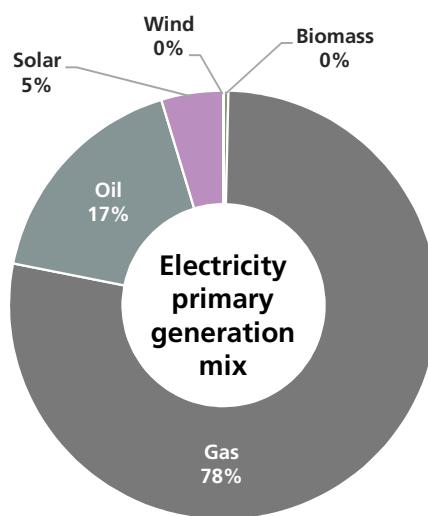
Malta 2017

6





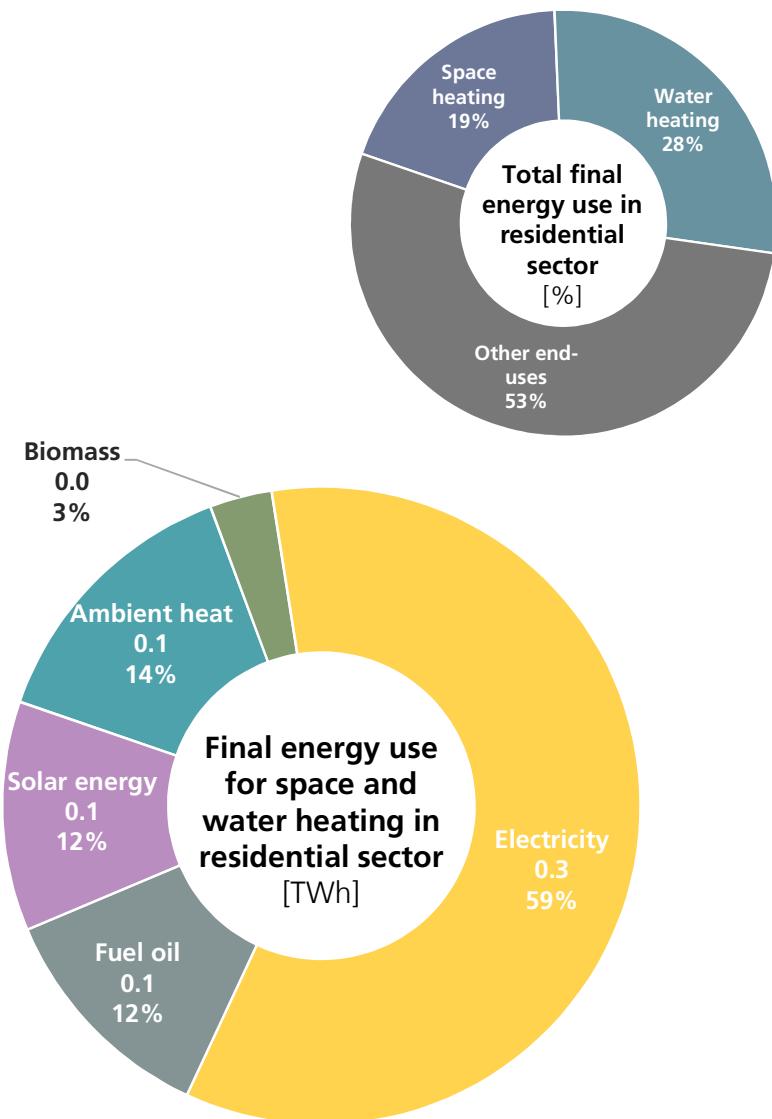
Generation mix



Space & water heating in residential sector

Malta 2017

8



Specific energy demand

18

kWh/m²yr

Final energy demand

30

kWh/m²yr

Primary energy demand

18

kWh/m²yr

Single-family dwellings

30

kWh/m²yr

Single-family dwellings

18

kWh/m²yr

Multi-family dwellings

30

kWh/m²yr

Multi-family dwellings

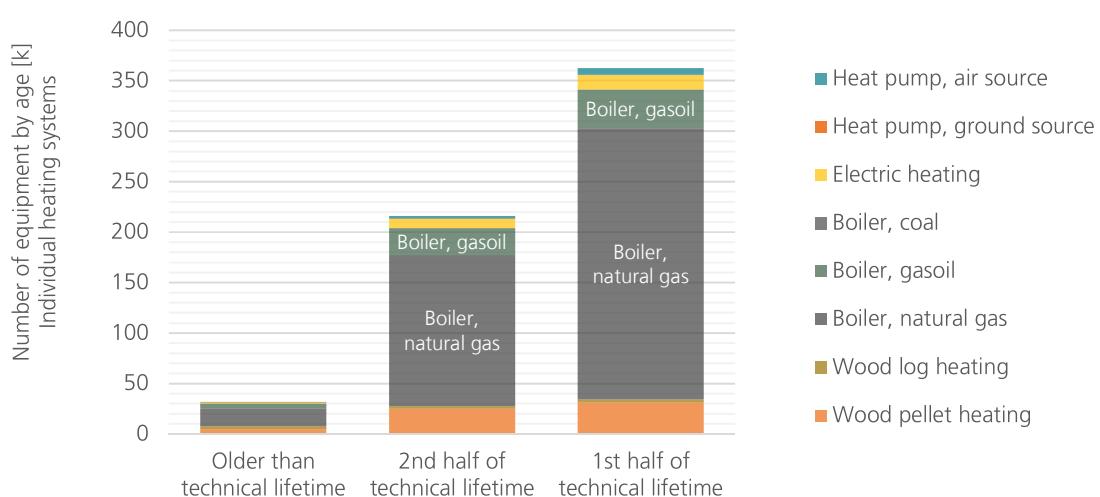
Technology mix

Malta 2017
9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	9	3%	27%	70%	4.6	0.1
Heat pump ground source	0	3%	27%	70%	4.2	0.0
Solar thermal	73*	3%	27%	70%	0.4	0.1
Electric heating	26	7%	38%	56%	1.0	0.0
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	69	6%	38%	55%	0.9	1.7
Boiler, natural gas	436	4%	34%	62%	1.0	4.5
Wood log heating	9	31%	32%	36%	0.7	0.0
Wood pellet heating	61	8%	41%	51%	0.8	0.7

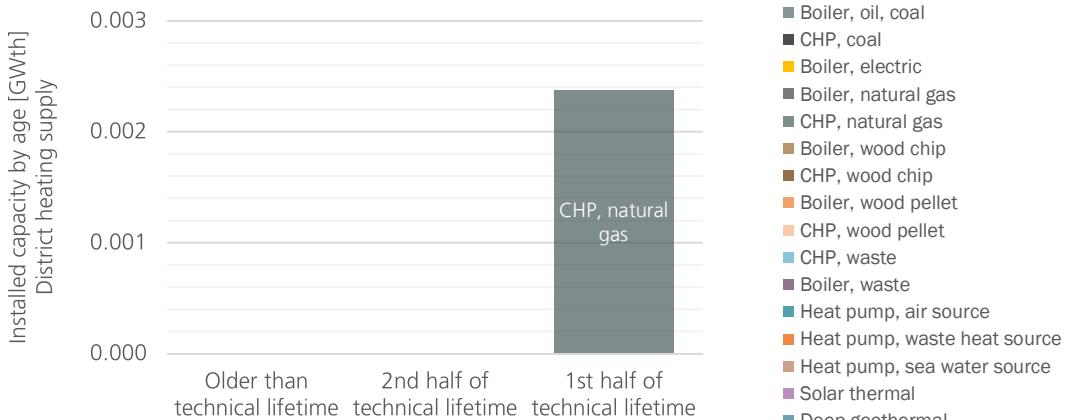
* unit 1000 m²

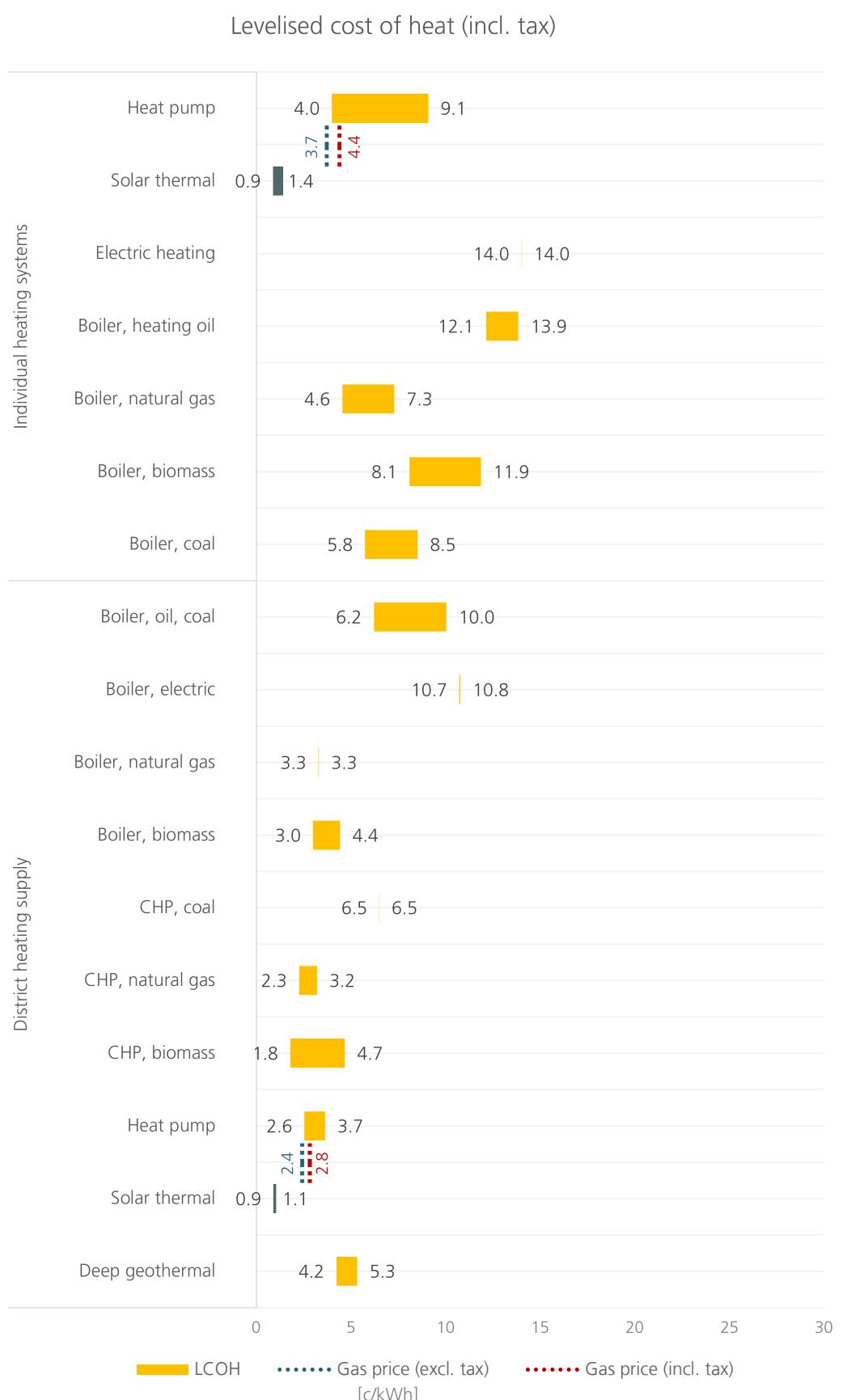
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	2	0%	0%	100%	0.4	0.0
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	-	-	-	-	0.9	-
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	4.3	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	4.2	-
Solar thermal	-	-	-	-	0.5	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	Red
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO2 pricing	
CO2 pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Red
Trigger point: Major renovation	Red
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Red
New installations in existing buildings	Red
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	Yellow
Zoning regulations for DH and/or Gas	Red
Information and planning	
National Database for EPC	Green
National requirements for urban heat planning	Red

No measure

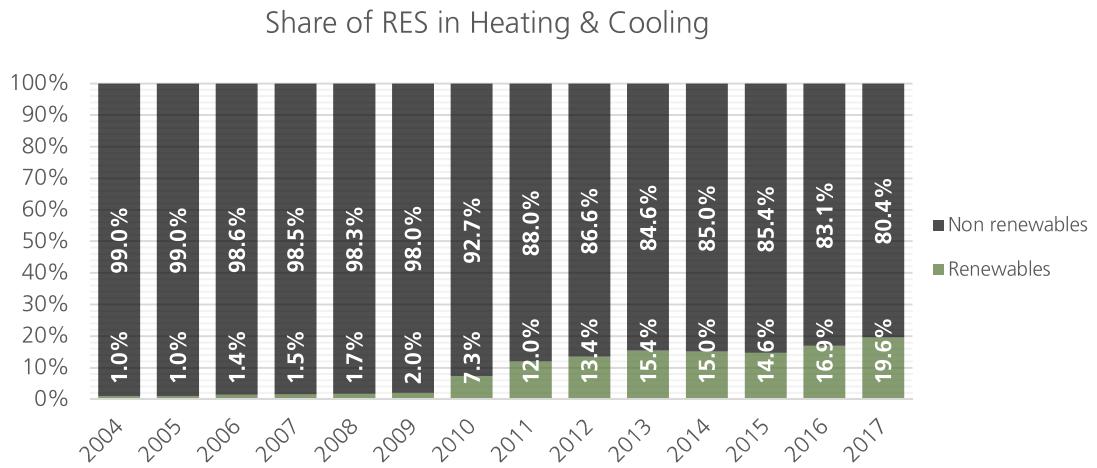
Measures in development

Measures in place

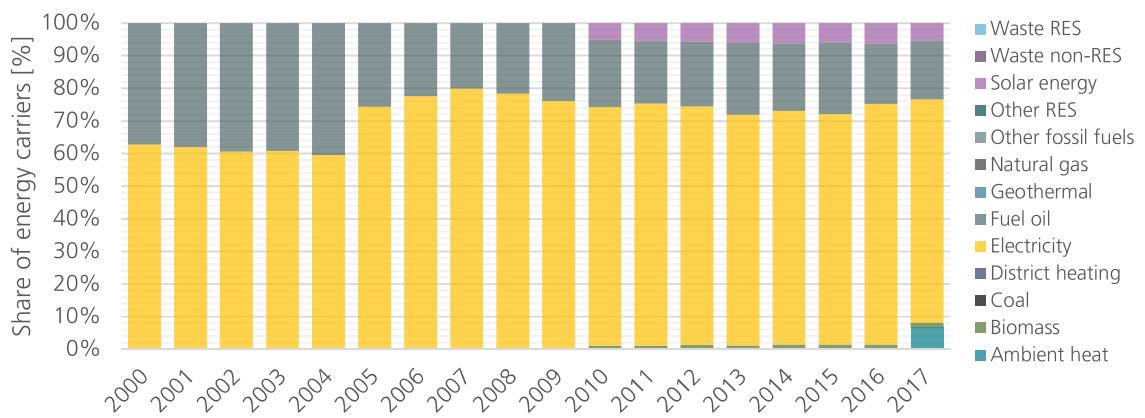
Historical trends

Malta 2017

13



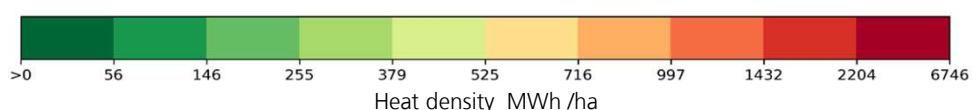
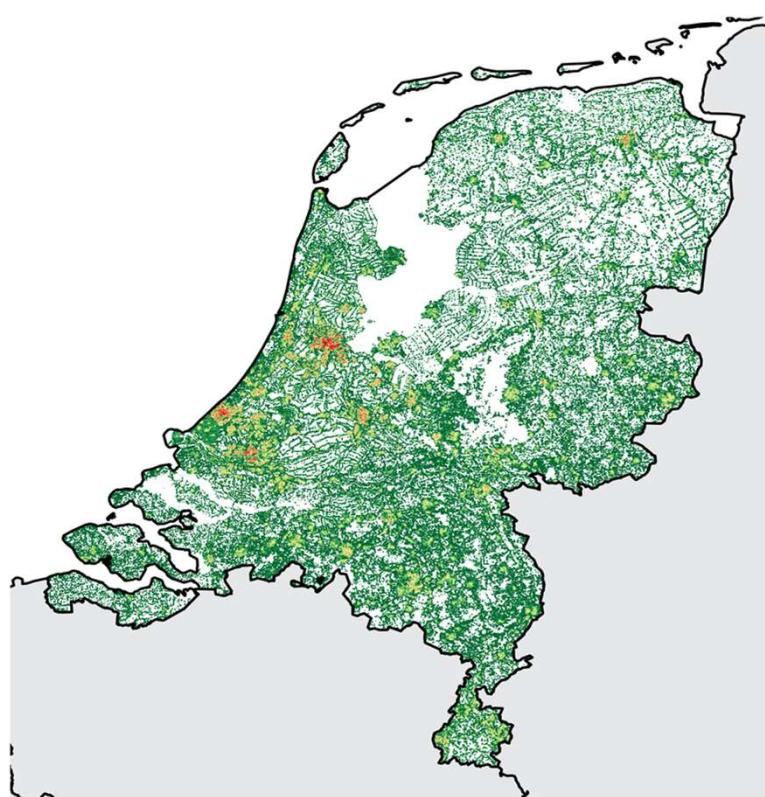
Final energy consumption in residential sector



Space heating market summary

2017

Netherlands



Source: <https://www.hotmaps.eu/map>



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Institut für angewandte Ökologie
Institute for Applied Ecology

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energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

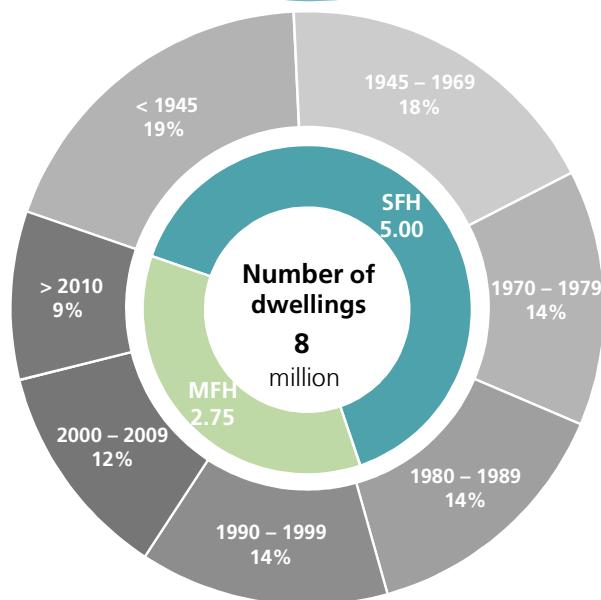
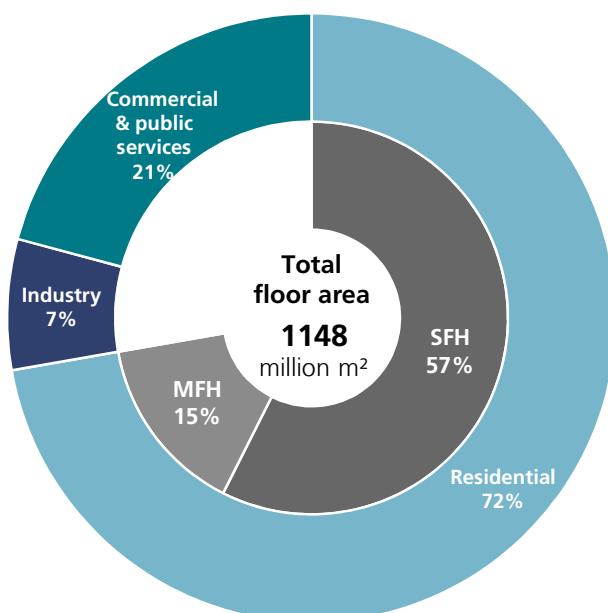
- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

Building Stock Data

SFH: Single family house
MFH: Multi-family house

Netherlands 2017

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Climate Data

Heating degree days

Netherlands

EU-27

Average value 2000-2017

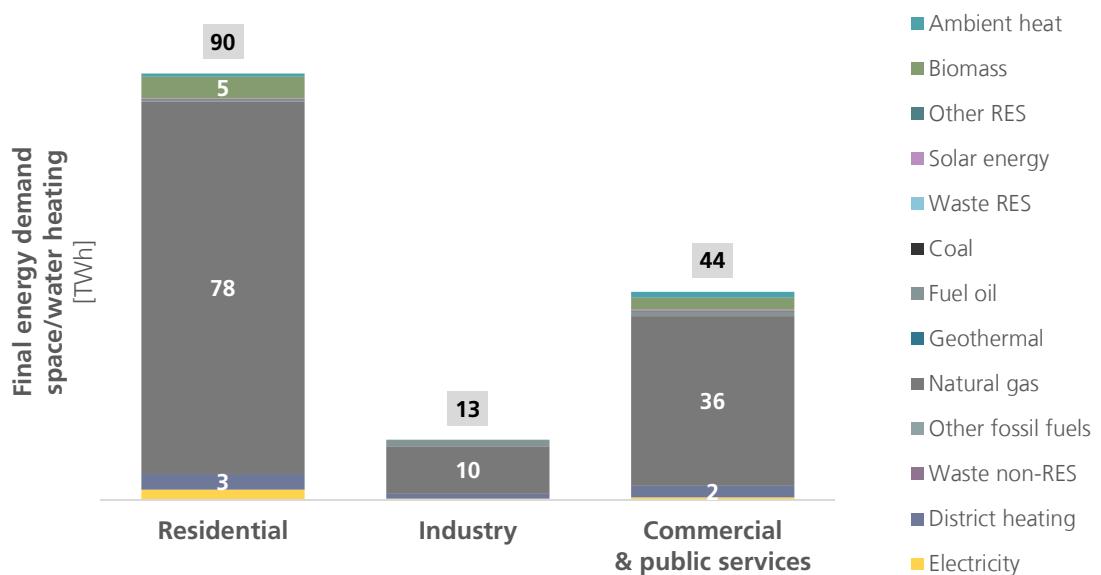
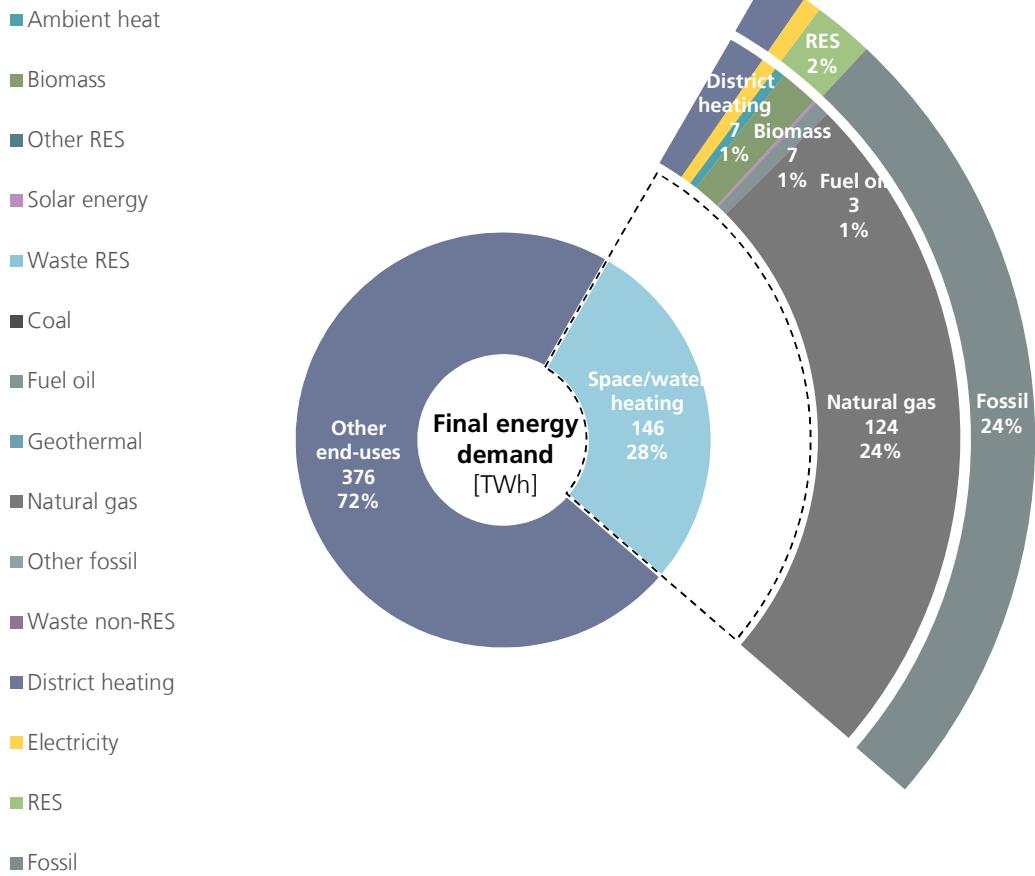
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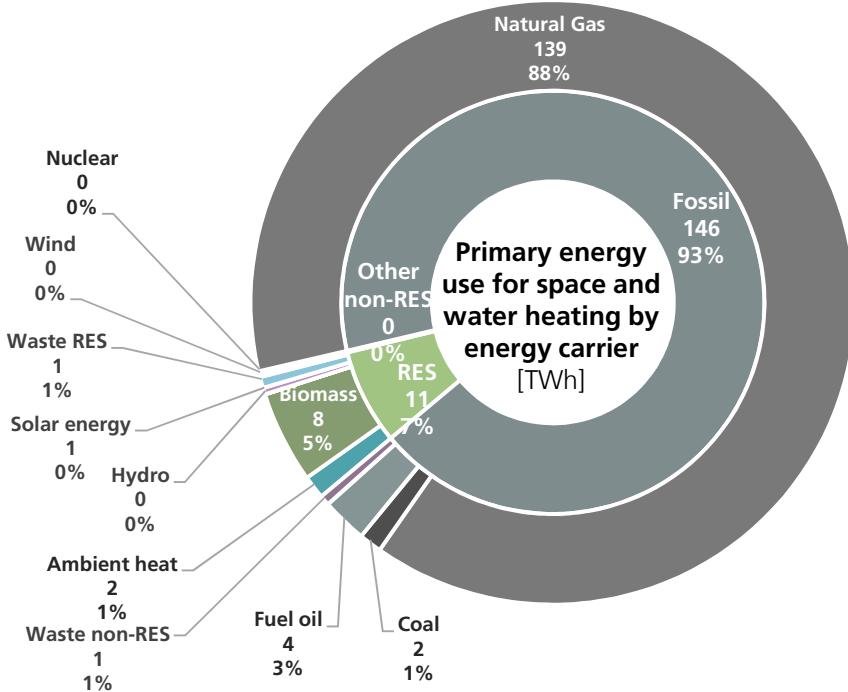
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Overview of energy demand

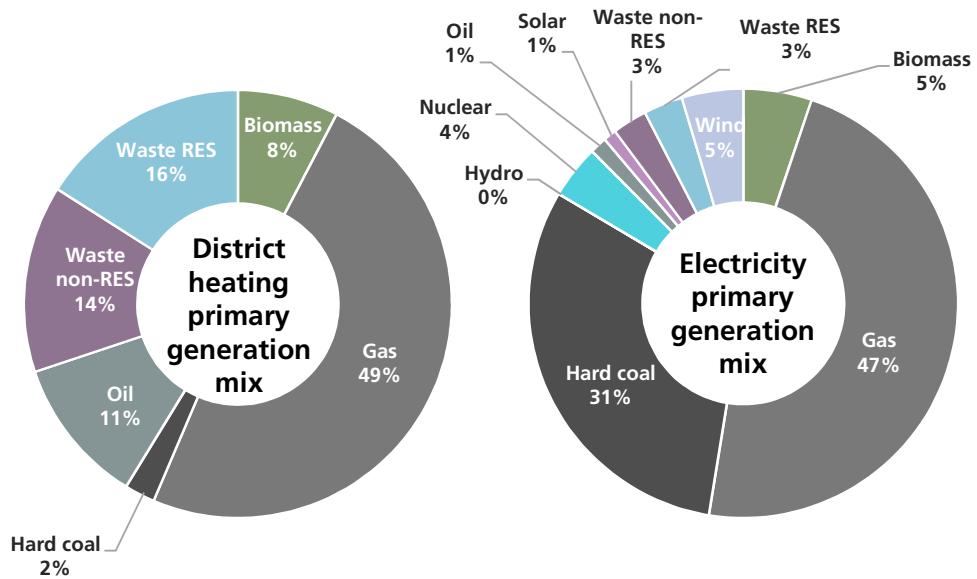
Netherlands 2017

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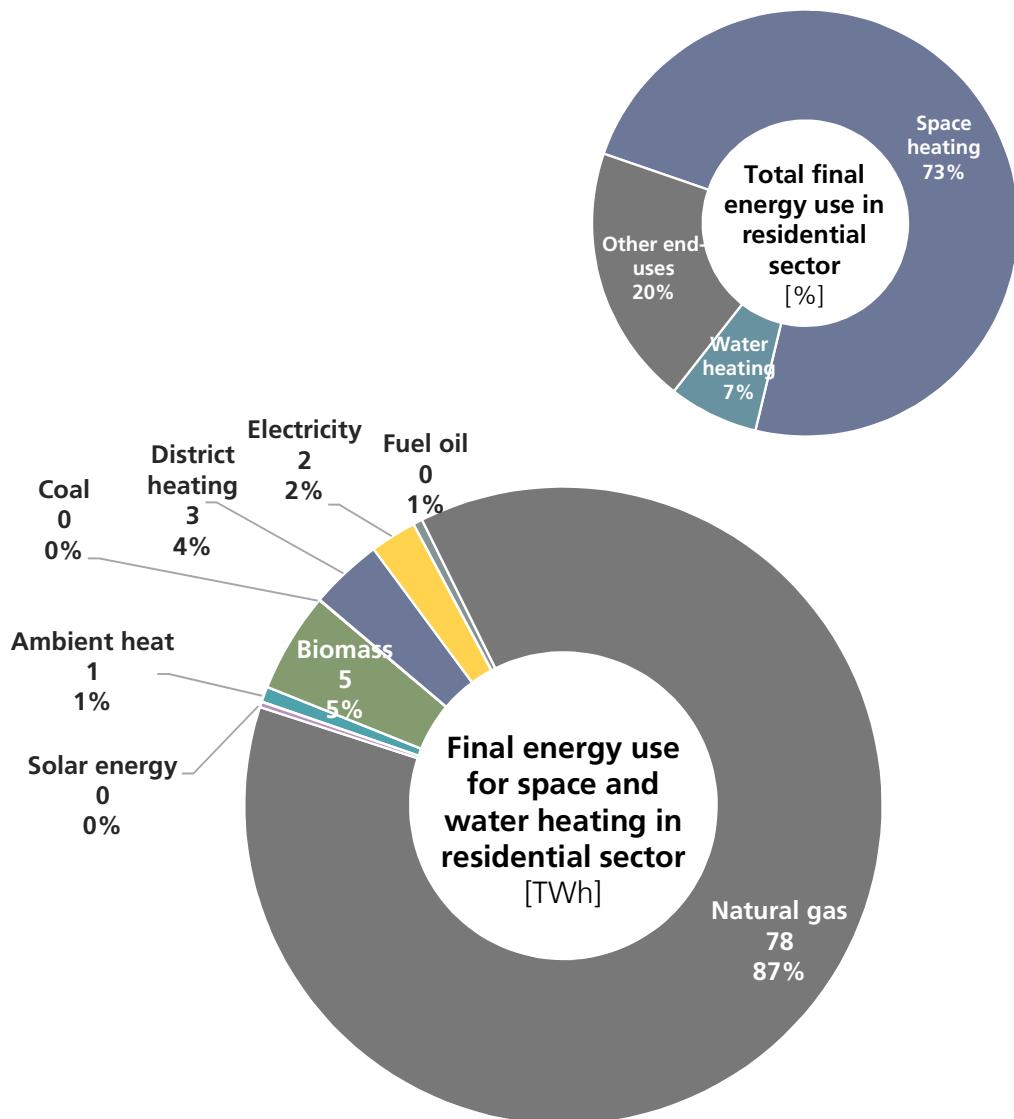
Generation mix



Space & water heating in residential sector

Netherlands 2017

8



Specific energy demand

108 kWh/m²yr
Final energy demand

117 kWh/m²yr
Primary energy demand

128 kWh/m²yr
Single-family dwellings

139 kWh/m²yr
Single-family dwellings

31 kWh/m²yr
Multi-family dwellings

34 kWh/m²yr
Multi-family dwellings

Technology mix

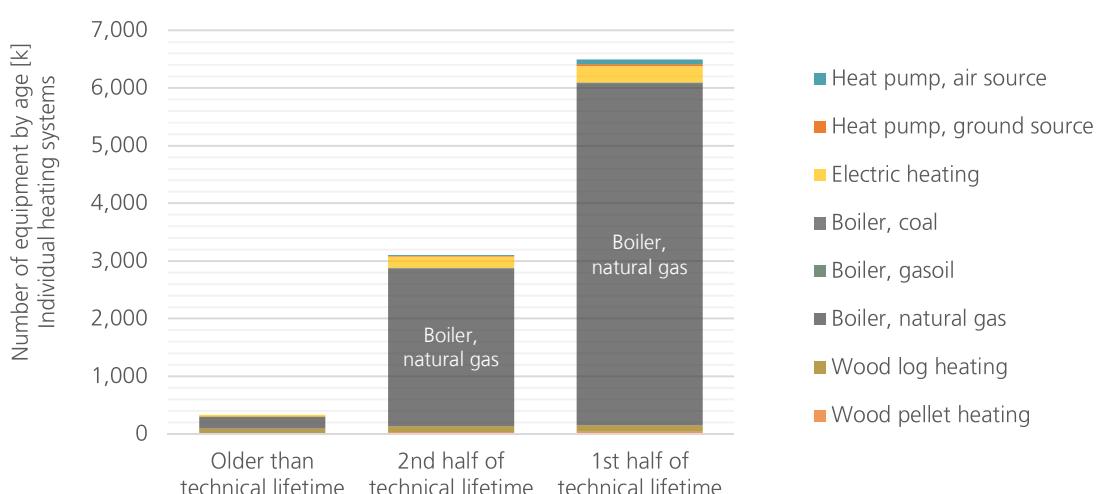
Netherlands 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	96	2%	16%	83%	3.8	0.5
Heat pump ground source	49	3%	29%	67%	3.7	0.3
Solar thermal	639*	3%	27%	70%	0.5	0.4
Electric heating	510	7%	38%	56%	1.0	0.5
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	20	6%	38%	55%	0.9	0.6
Boiler, natural gas	8,882	2%	31%	67%	1.0	199.5
Wood log heating	294	29%	34%	36%	0.7	3.4
Wood pellet heating	82	8%	41%	51%	0.8	1.6

* unit 1000 m²

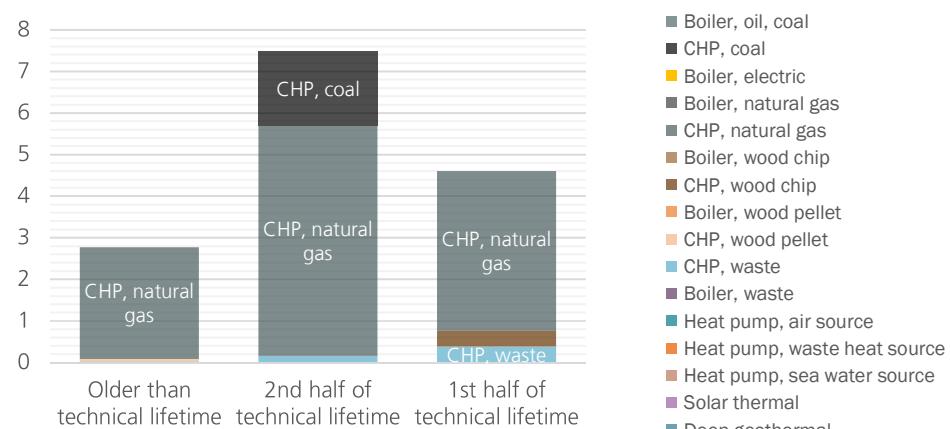
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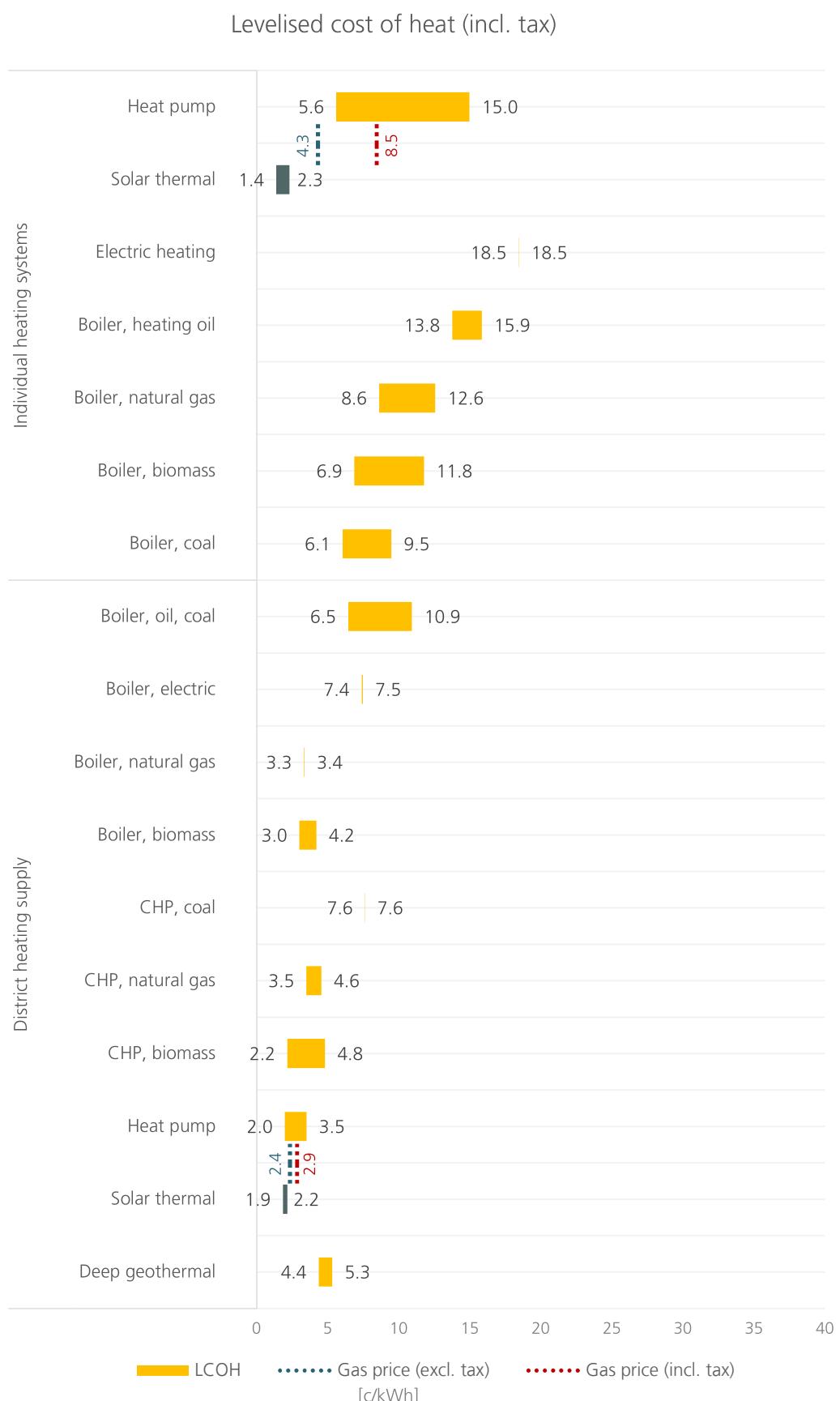


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	1	0%	100%	0%	0.5	1.8
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	1,096	16%	71%	13%	0.4	12.1
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	9	0%	11%	89%	0.9	0.4
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	3	67%	0%	33%	0.7	0.1
CHP, waste	5	20%	40%	40%	0.8	0.6
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	3.4	-
Heat pump waste heat source	1	0%	0%	100%	5.0	0.0
Heat pump sea water source	-	-	-	-	3.3	-
Solar thermal	4	0%	75%	25%	0.5	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Red
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Green
Heat incentives for decentral heating systems	Green
Energy- and CO2 pricing	
CO2 pricing	Green
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Yellow
RES-H obligation for existing buildings	Red
Trigger point: Major renovation	Red
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
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Ban on fossil fuel heating technologies (oil and/or gas)	
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Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

 No measure

 Measures in development

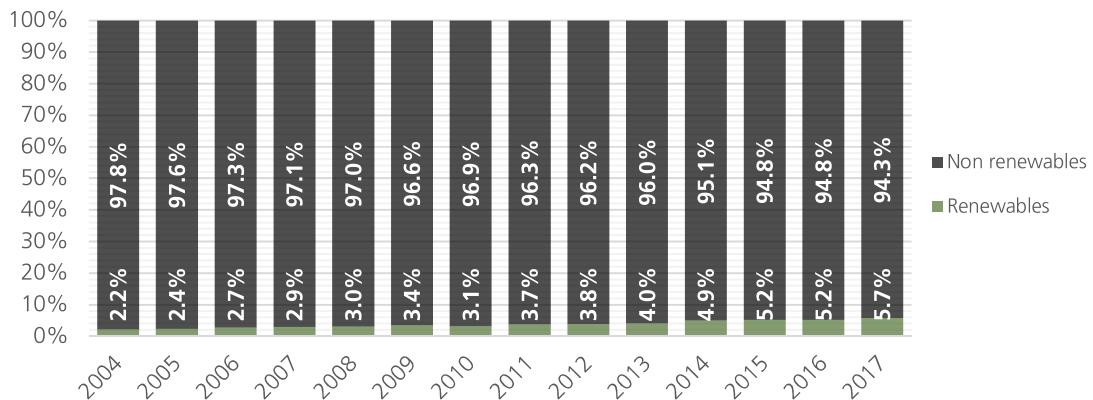
 Measures in place

Historical trends

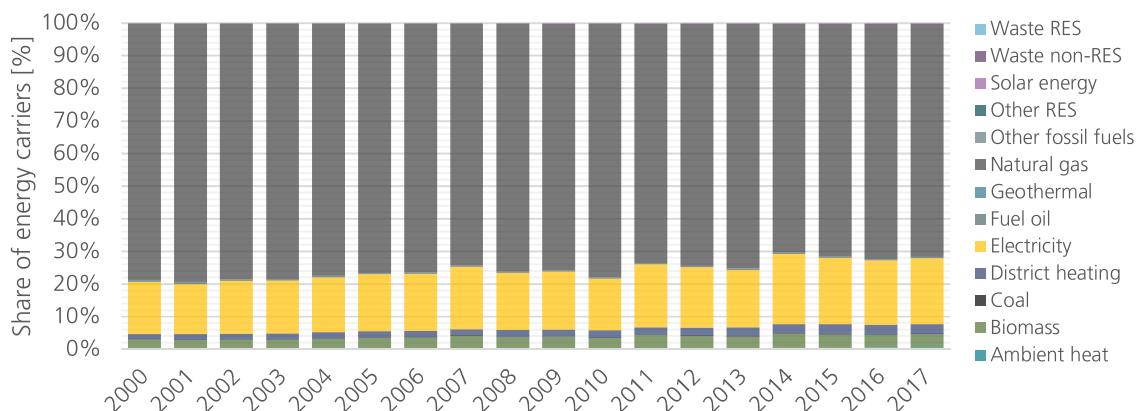
Netherlands 2017

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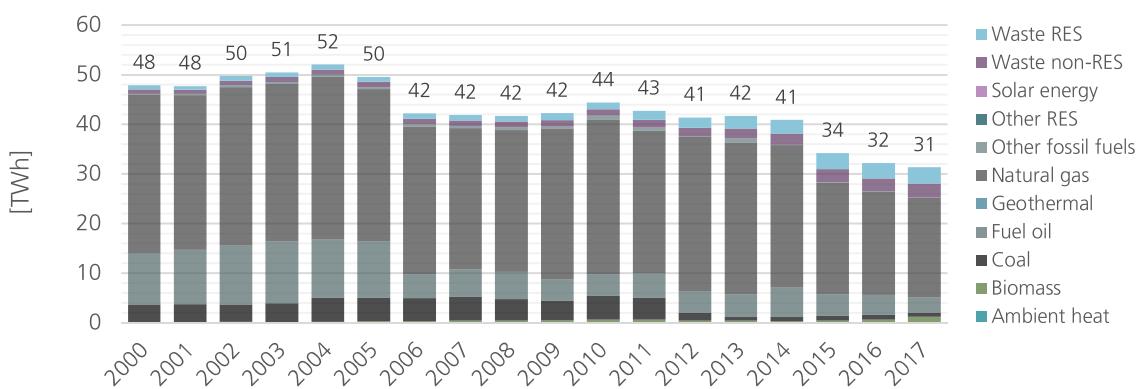
Share of RES in Heating & Cooling



Final energy consumption in residential sector



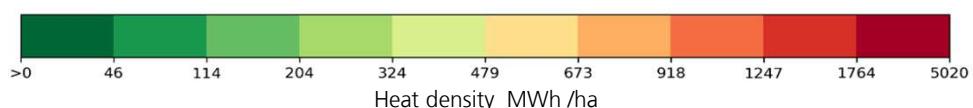
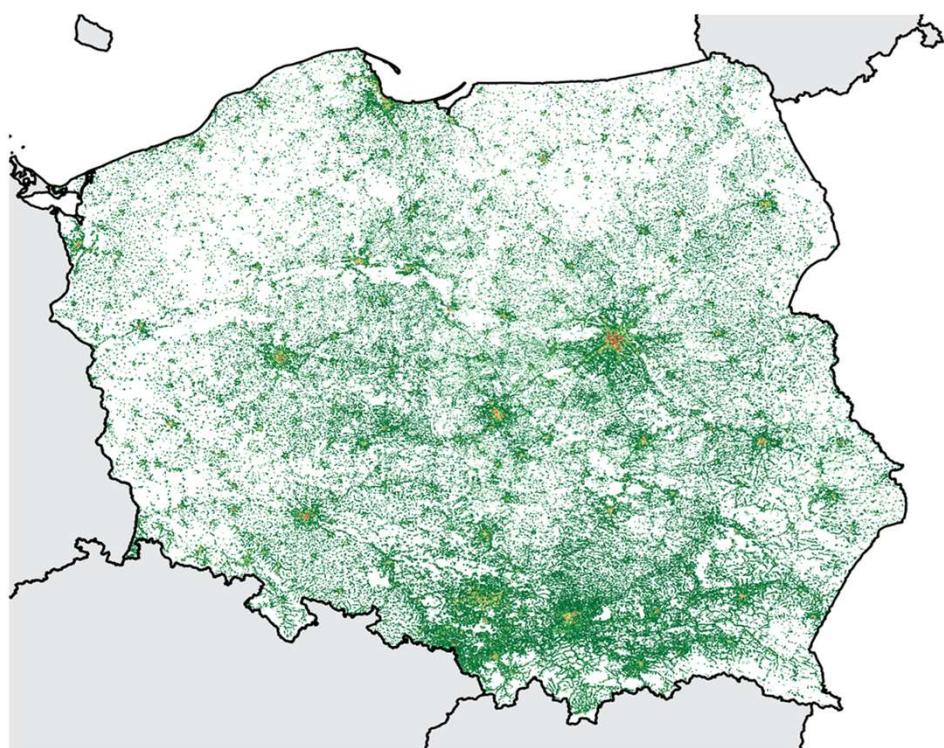
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Poland



Source: <https://www.hotmaps.eu/map>



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Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
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Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

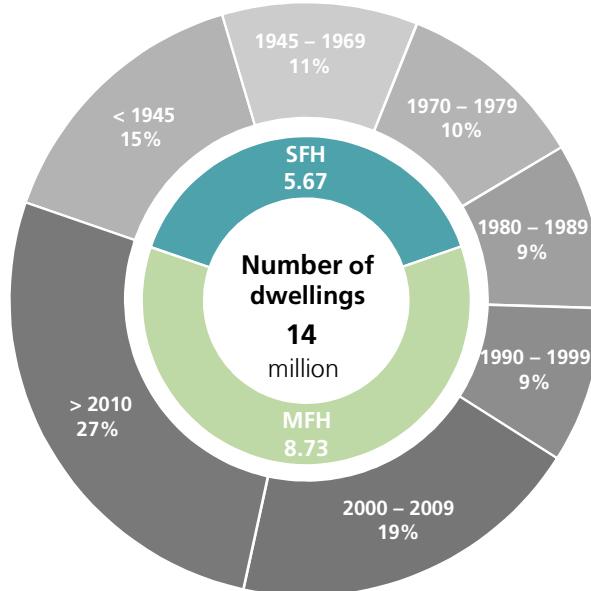
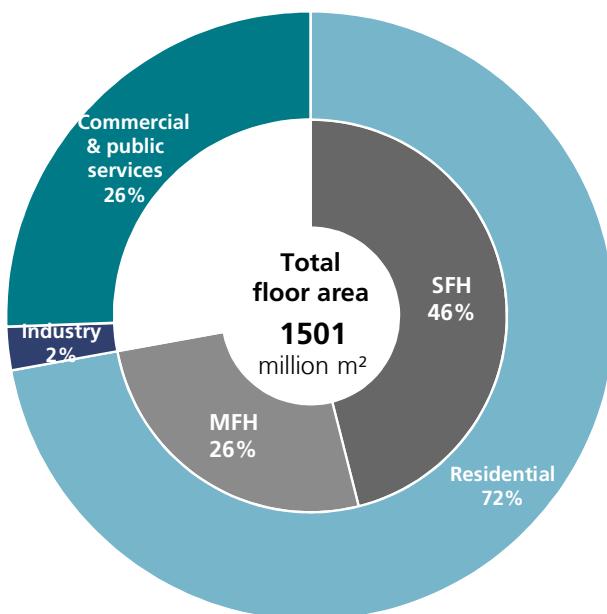
- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
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Building Stock Data

SFH: Single family house
MFH: Multi-family house

Poland 2017

5



Climate Data

Heating degree days

Poland

EU-27

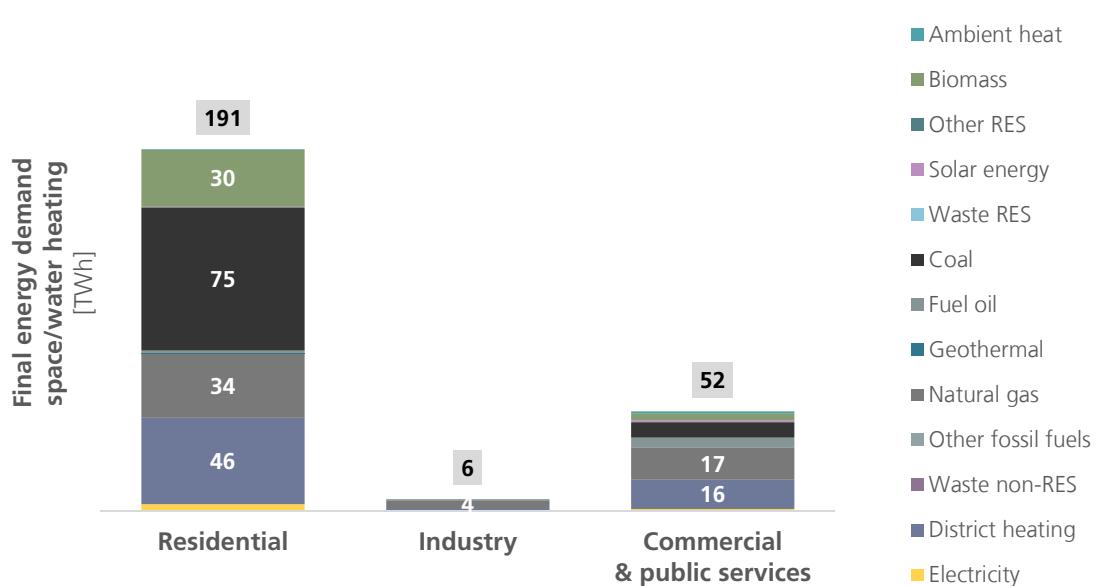
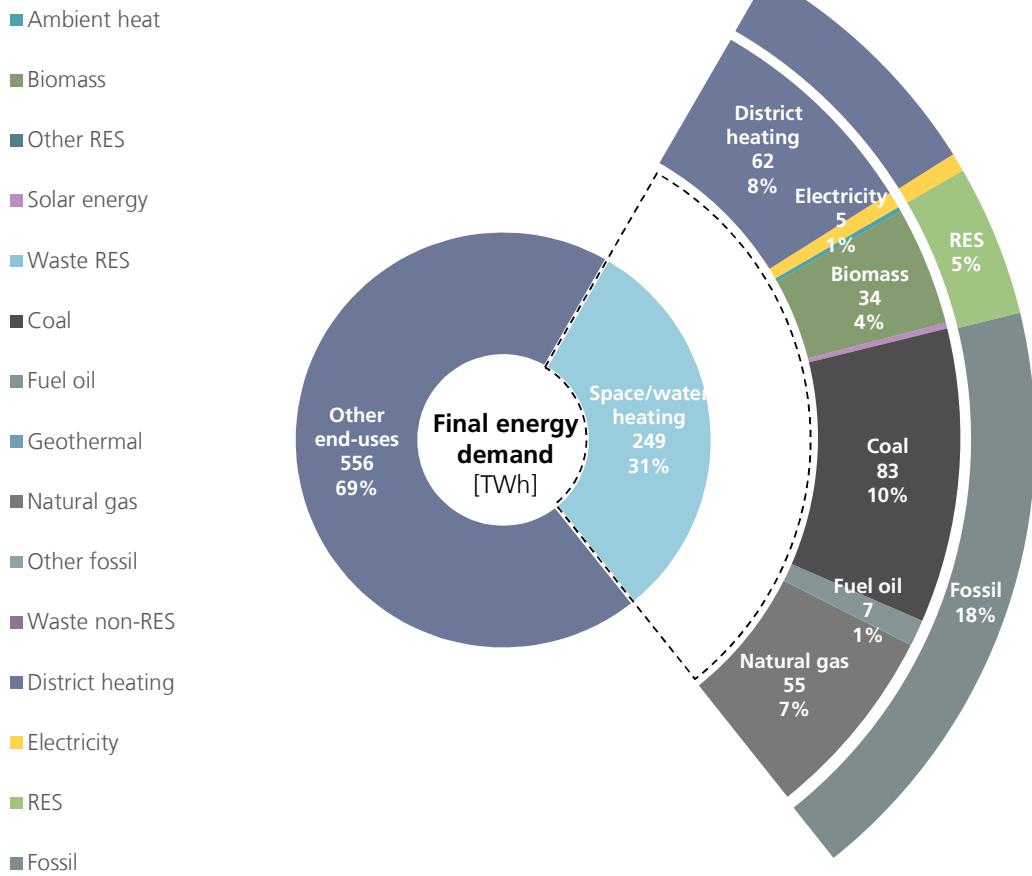
Average value 2000-2017

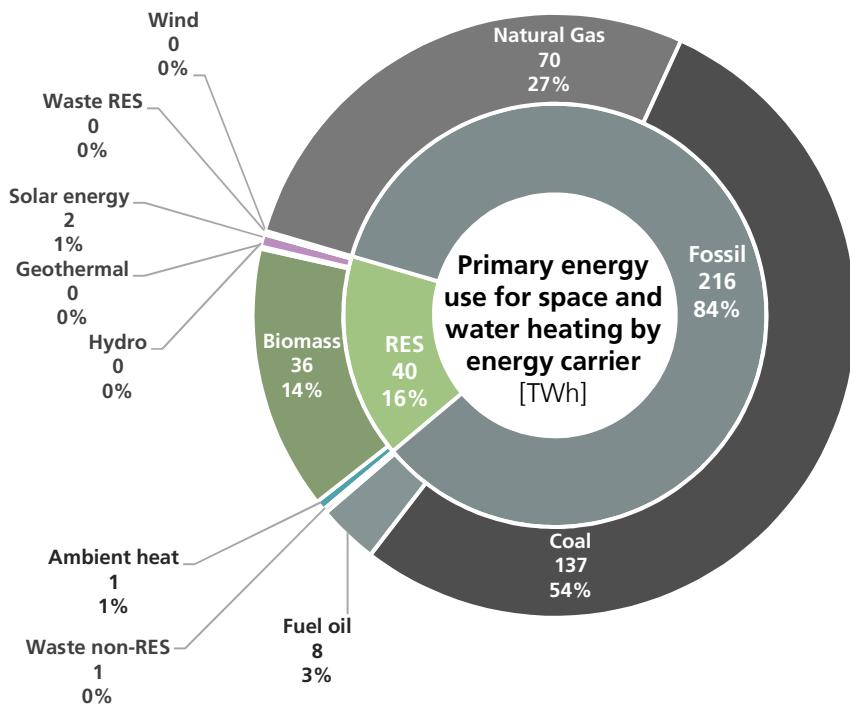
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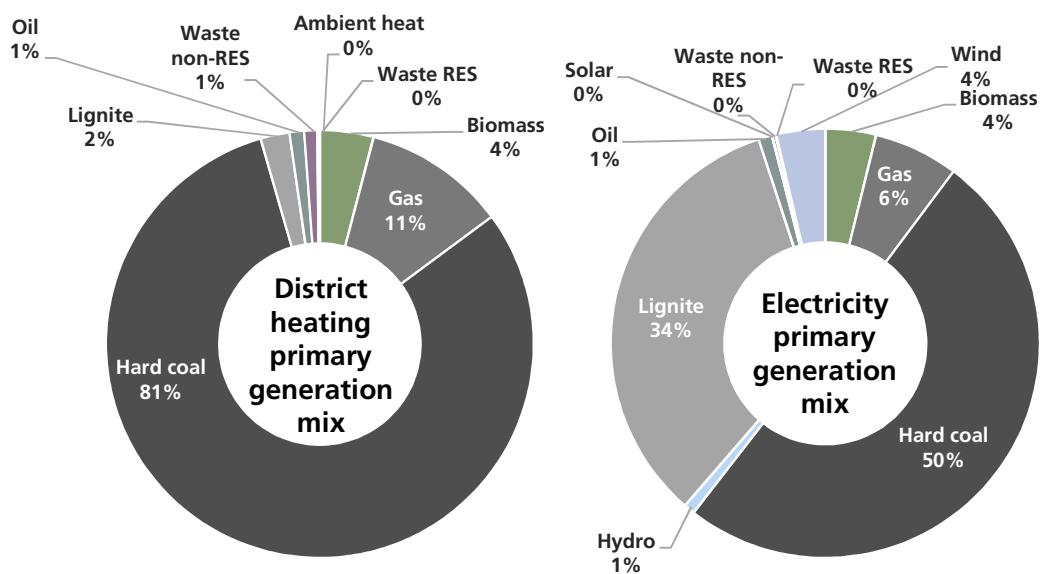
Overview of energy demand

Poland 2017
6





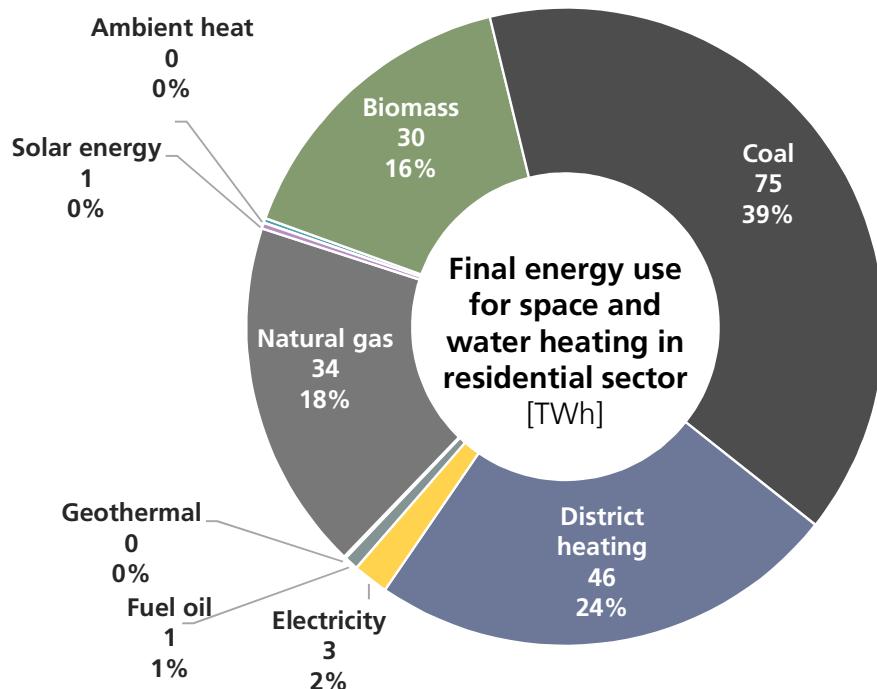
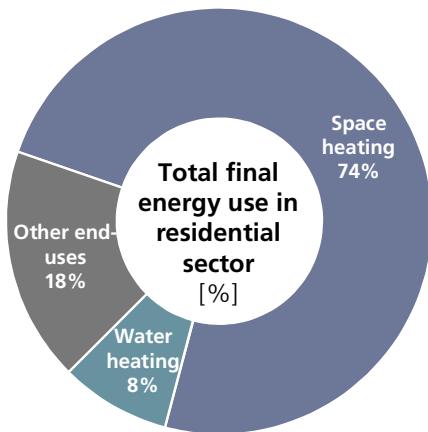
Generation mix



Space & water heating in residential sector

Poland 2017

8



Specific energy demand

176 kWh/m²yr
Final energy demand

203 kWh/m²yr
Single-family dwellings

128 kWh/m²yr
Multi-family dwellings

180 kWh/m²yr
Primary energy demand

207 kWh/m²yr
Single-family dwellings

132 kWh/m²yr
Multi-family dwellings

Technology mix

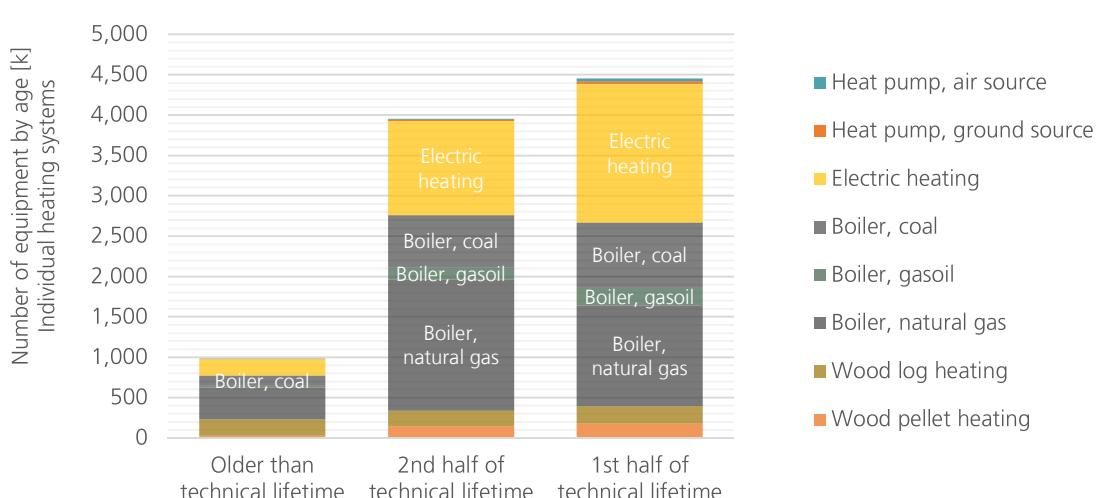
Poland 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	48	3%	24%	73%	3.3	0.5
Heat pump ground source	49	4%	37%	59%	3.5	0.6
Solar thermal	2,542*	3%	27%	70%	0.5	1.8
Electric heating	3,086	7%	38%	56%	1.0	3.1
Boiler, coal	1,587	8%	41%	51%	0.8	32.7
Boiler, gasoil	390	6%	38%	55%	0.9	10.4
Boiler, natural gas	3,264	12%	50%	38%	1.0	202.3
Wood log heating	612	32%	32%	35%	0.7	7.2
Wood pellet heating	349	8%	41%	51%	0.8	15.4

* unit 1000 m²

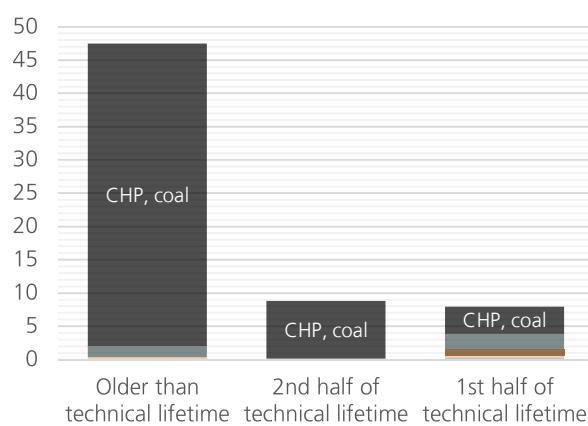
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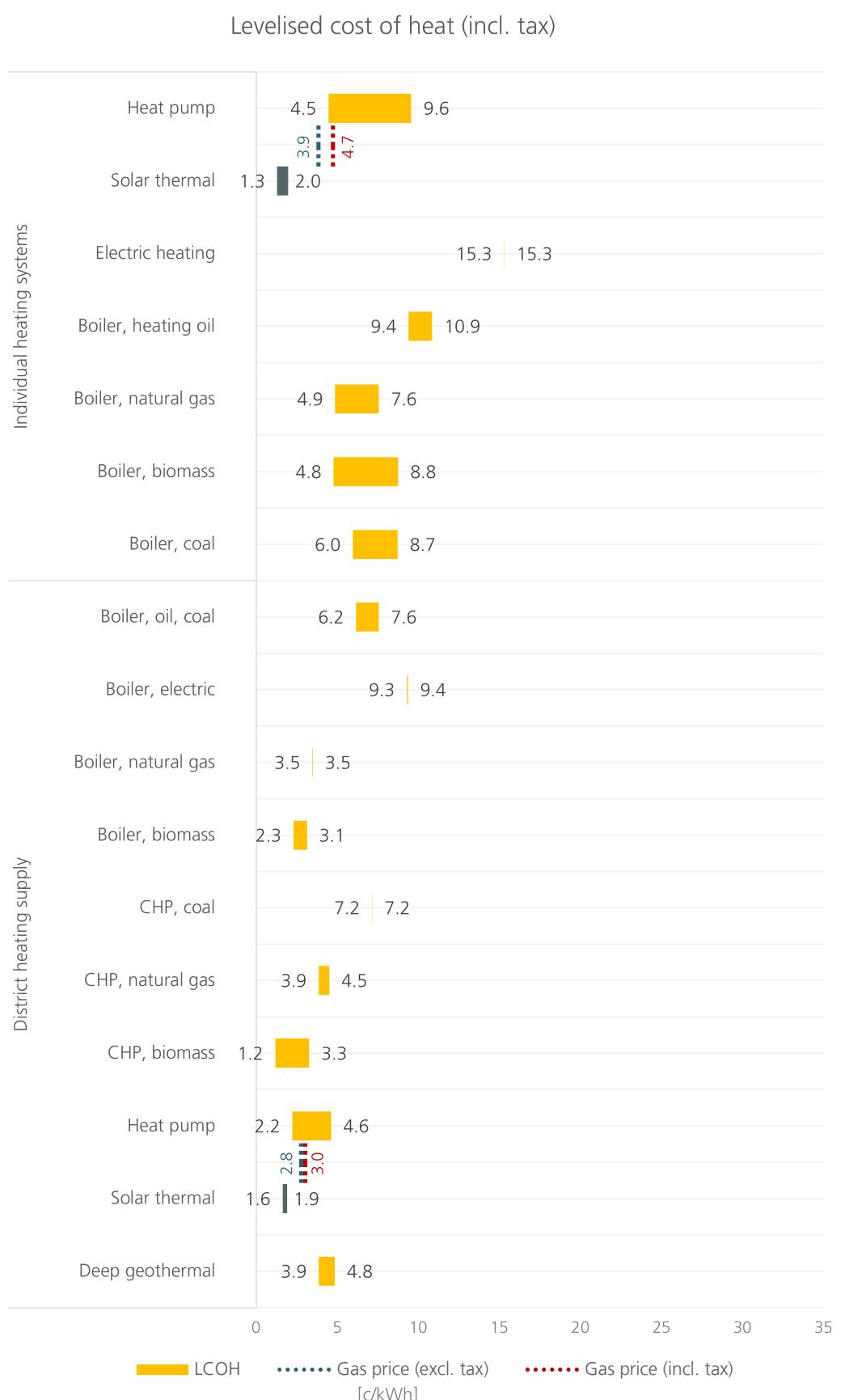
Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	416	81%	14%	6%	0.5	58.1
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	158	34%	10%	56%	0.4	4.2
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	7	0%	0%	100%	0.9	1.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	8	38%	0%	63%	0.7	0.6
CHP, waste	4	0%	50%	50%	0.8	0.2
Boiler, waste	2	6%	33%	61%	1.1	0.1
Heat pump air source	5	2%	15%	83%	2.7	0.0
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	7	4%	36%	60%	2.6	0.0
Solar thermal	6	0%	17%	83%	0.4	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply



- Boiler, oil, coal
- CHP, coal
- Boiler, electric
- Boiler, natural gas
- CHP, natural gas
- Boiler, wood chip
- CHP, wood chip
- Boiler, wood pellet
- CHP, wood pellet
- CHP, waste
- Boiler, waste
- Heat pump, air source
- Heat pump, waste heat source
- Heat pump, sea water source
- Solar thermal
- Deep geothermal



Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	Measures in place
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	No measure
RES-H obligation for existing buildings	No measure
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

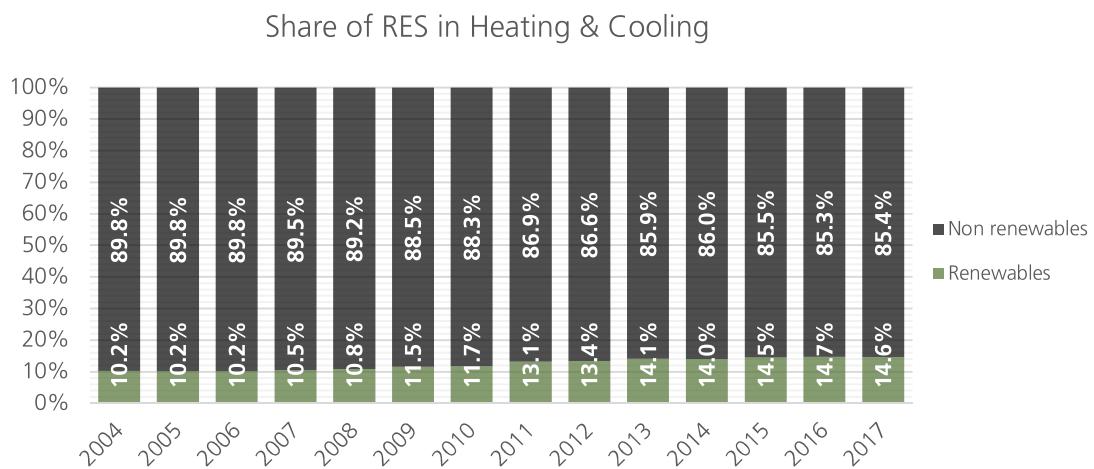
█ No measure

█ Measures in development

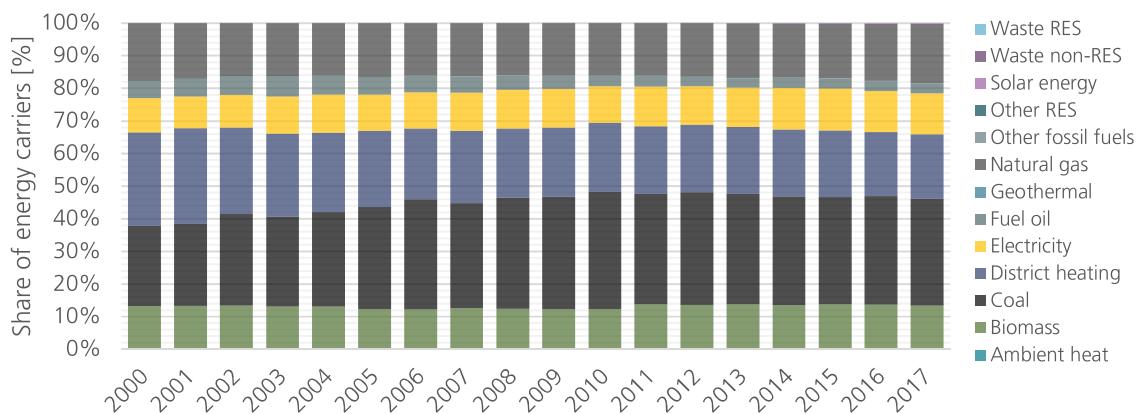
█ Measures in place

Historical trends

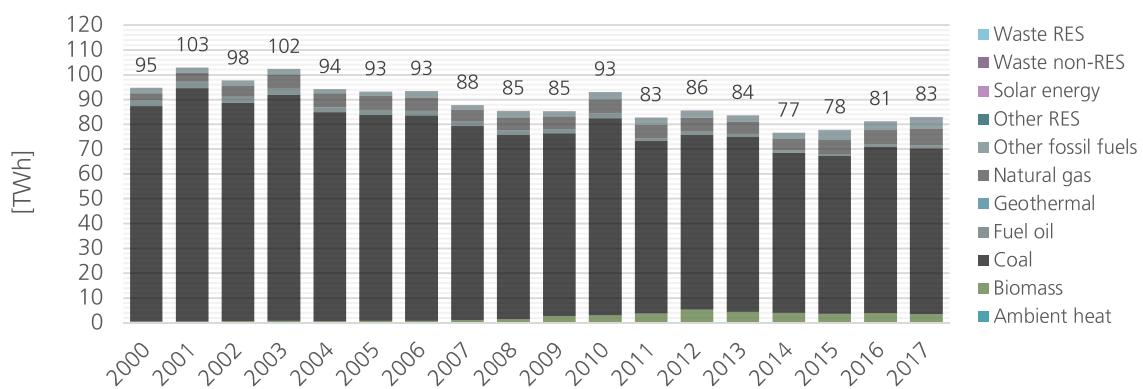
Poland 2017



Final energy consumption in residential sector



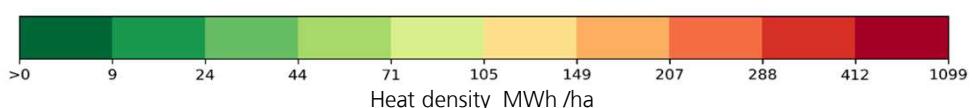
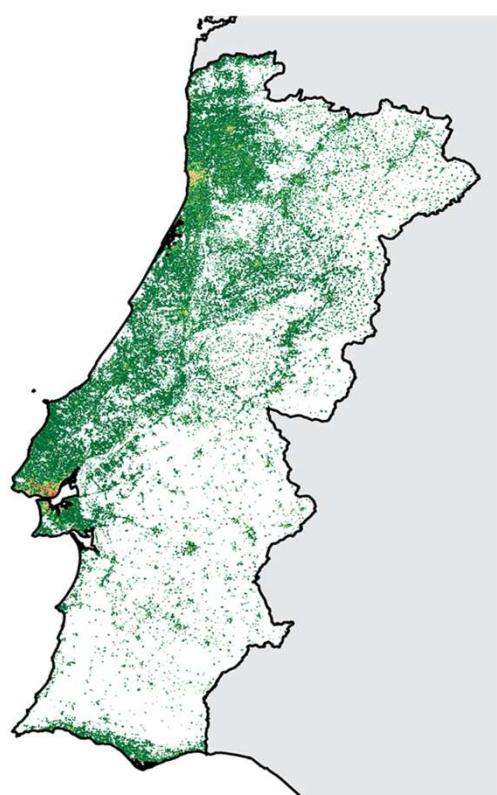
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Portugal



Source: <https://www.hotmaps.eu/map>



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

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Part 2: Technology stock

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- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
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- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

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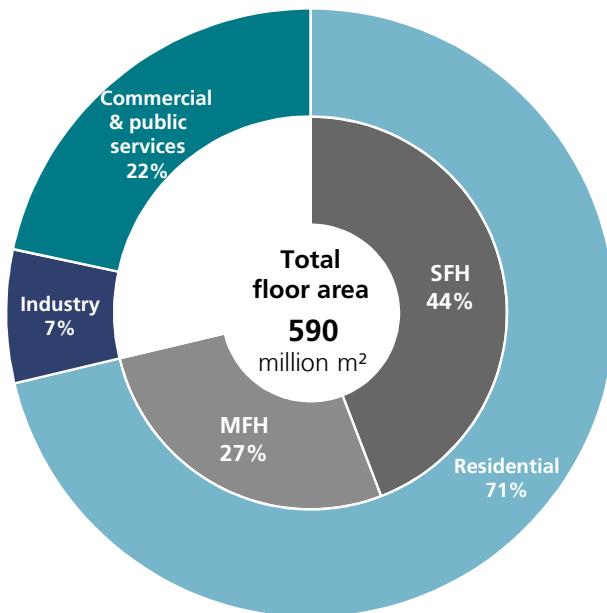
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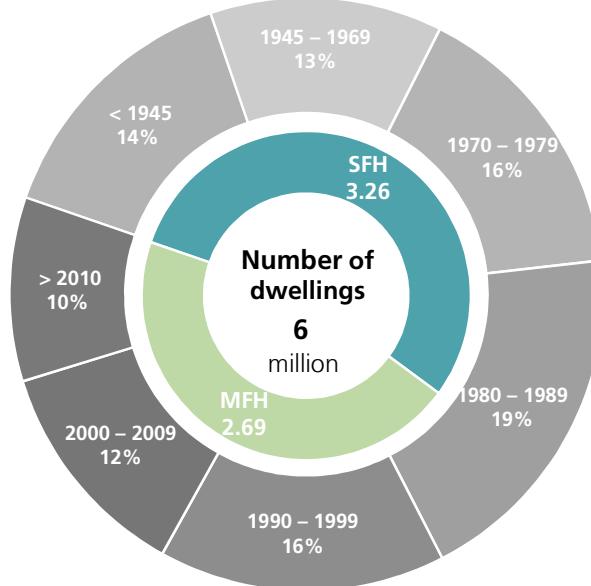
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Portugal 2017

5



Climate Data

Heating degree days

Portugal

EU-27

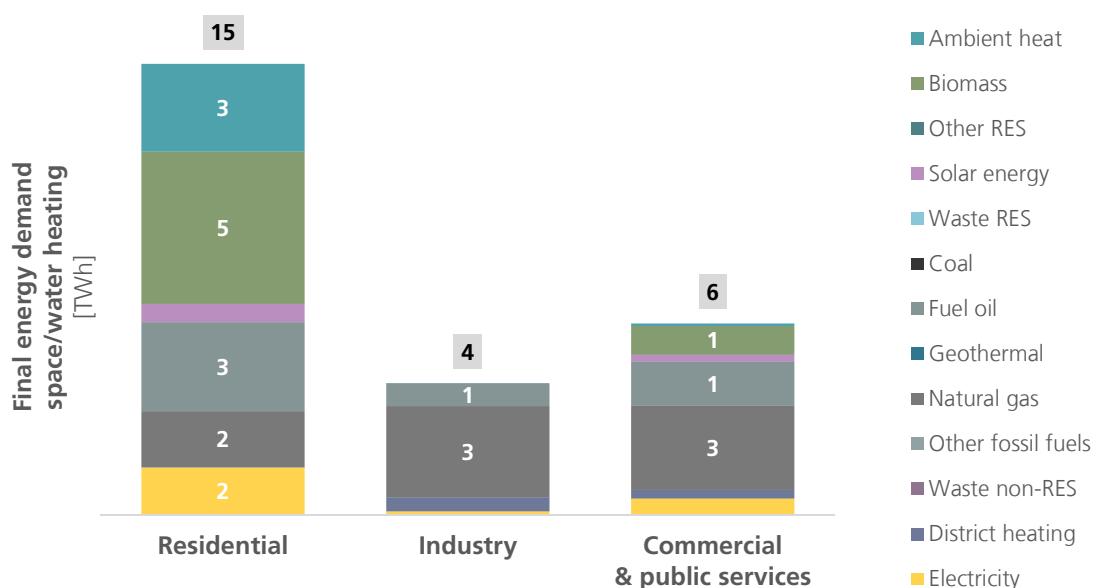
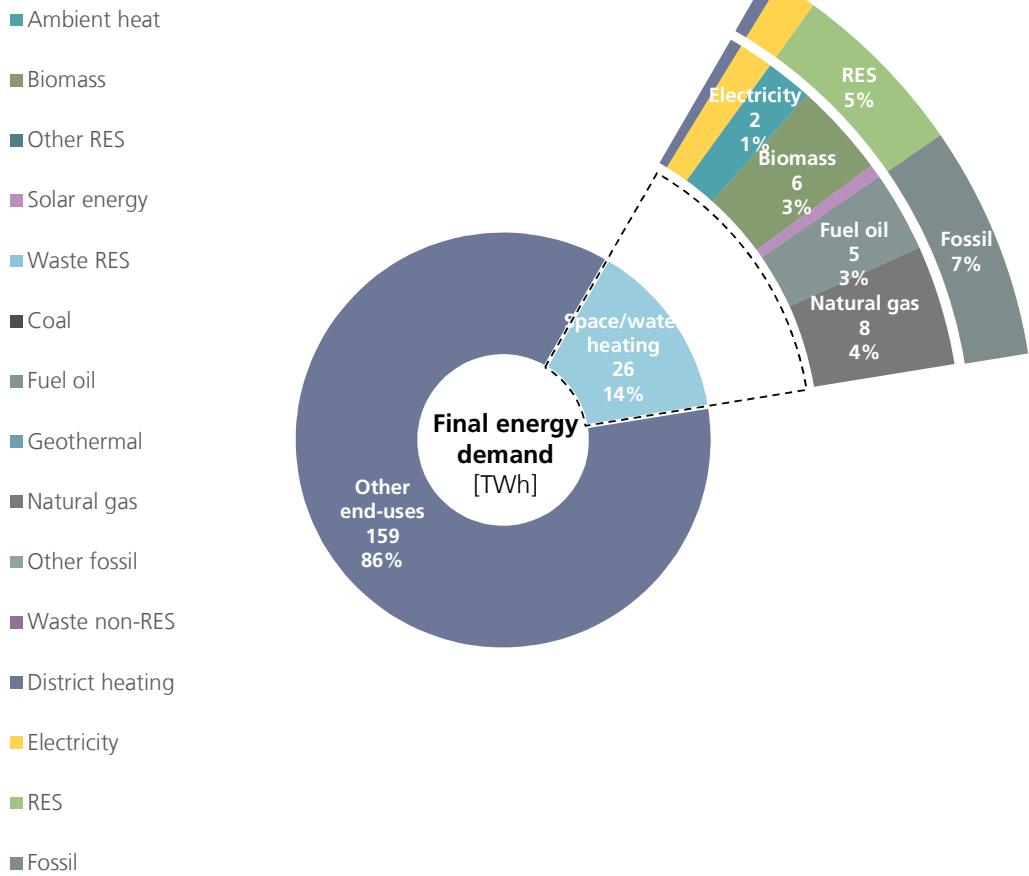
Average value 2000-2017

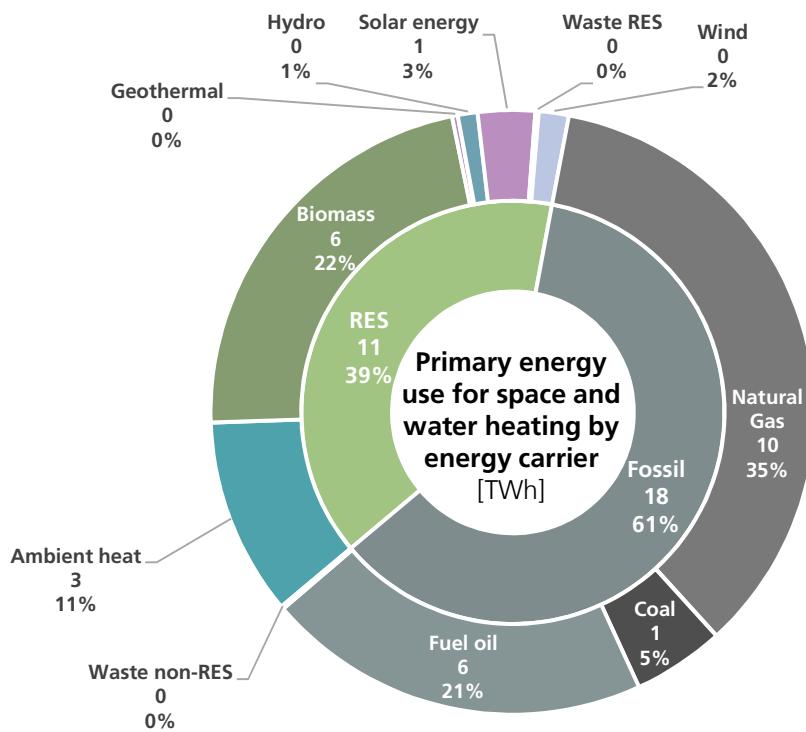
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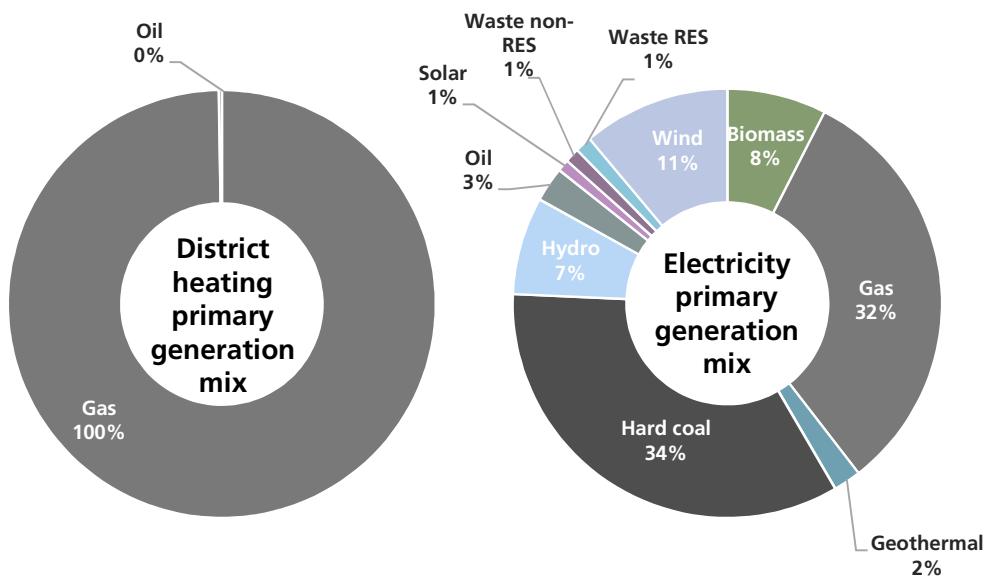
Overview of energy demand

Portugal 2017
6





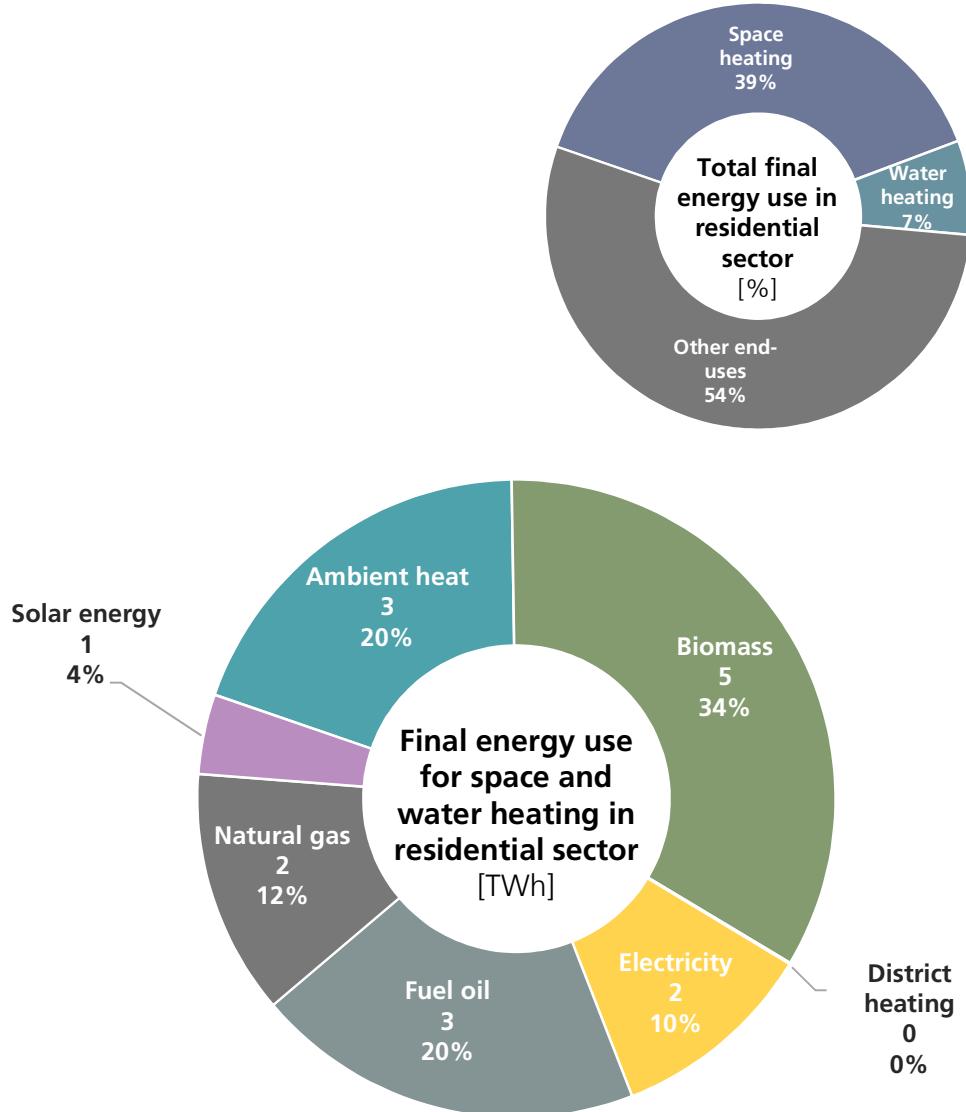
Generation mix



Space & water heating in residential sector

Portugal 2017

8



Specific energy demand

36

kWh/m²yr

Final energy demand

40

kWh/m²yr

Primary energy demand

40

kWh/m²yr

Single-family dwellings

45

kWh/m²yr

Single-family dwellings

30

kWh/m²yr

Multi-family dwellings

34

kWh/m²yr

Multi-family dwellings

Technology mix

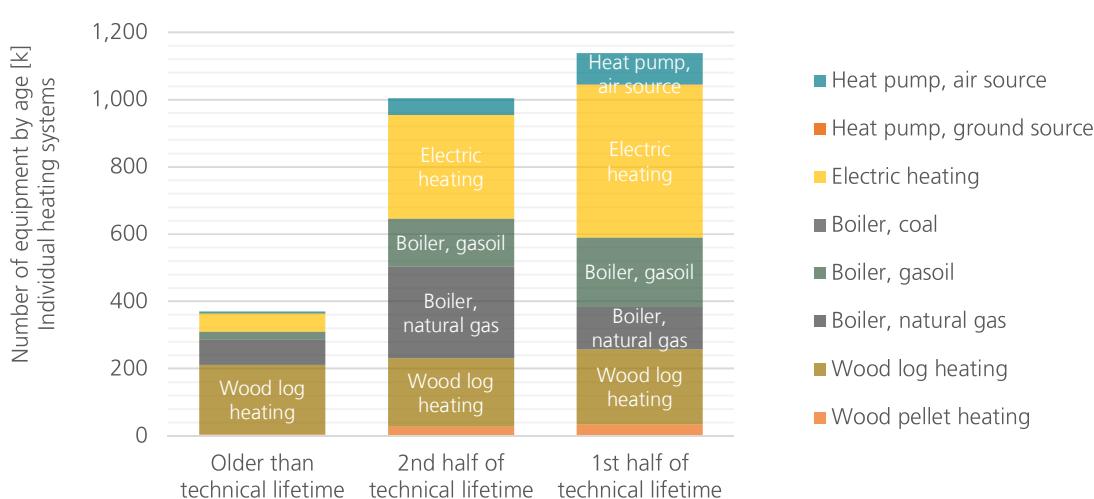
Portugal 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	148	4%	33%	63%	4.6	0.8
Heat pump ground source	1	4%	35%	61%	4.2	0.0
Solar thermal	1,284*	3%	27%	70%	0.4	0.9
Electric heating	816	7%	38%	56%	1.0	0.8
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	373	6%	38%	55%	0.9	9.0
Boiler, natural gas	474	16%	57%	26%	1.0	9.2
Wood log heating	633	32%	32%	35%	0.7	7.5
Wood pellet heating	67	8%	41%	51%	0.8	0.7

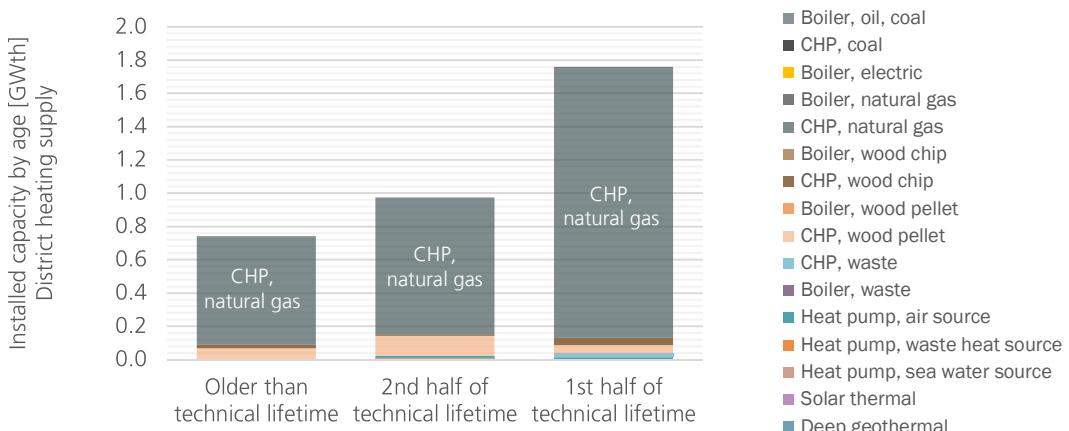
* unit 1000 m²

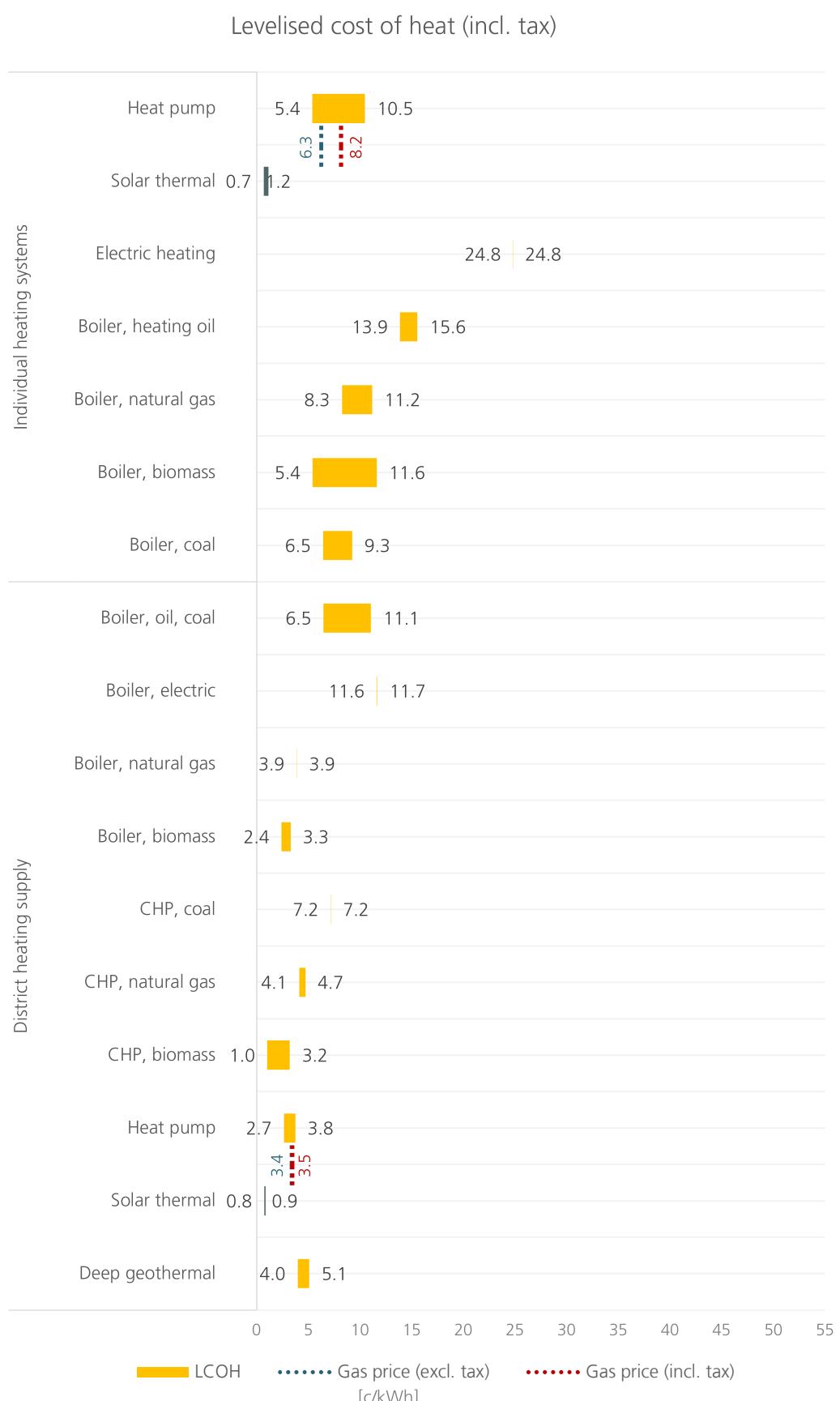
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	-	-	-	-	0.5	-
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	1	33%	26%	40%	1.1	0.0
CHP, natural gas	260	7%	45%	47%	0.4	3.1
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	6	50%	17%	33%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	4	25%	50%	25%	0.7	0.2
CHP, waste	1	0%	0%	100%	0.8	0.0
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	4	0%	50%	50%	4.3	0.0
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	2	0%	100%	0%	4.2	0.0
Solar thermal	1	0%	0%	100%	0.5	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	No measure
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	No measure
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in place
RES-H obligation for existing buildings	Measures in place
Trigger point: Major renovation	Measures in place
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

█ No measure

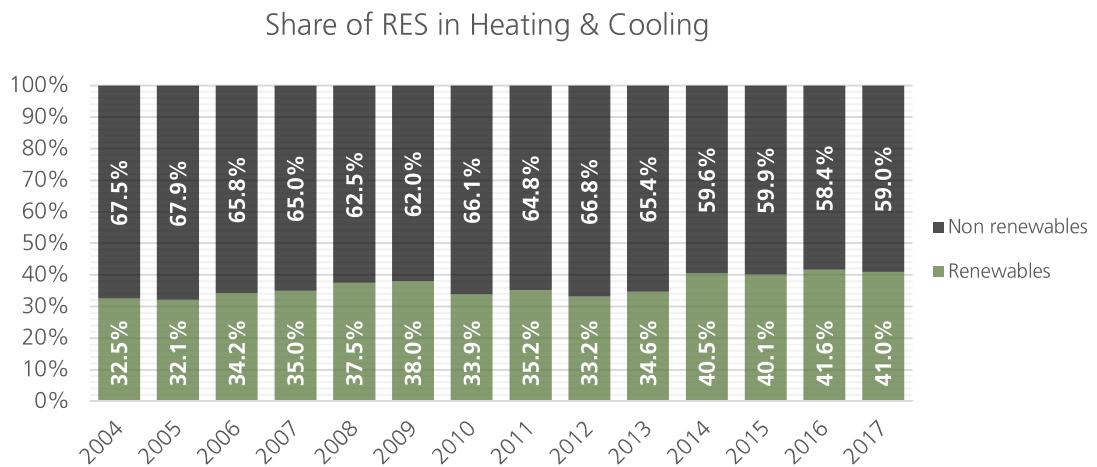
█ Measures in development

█ Measures in place

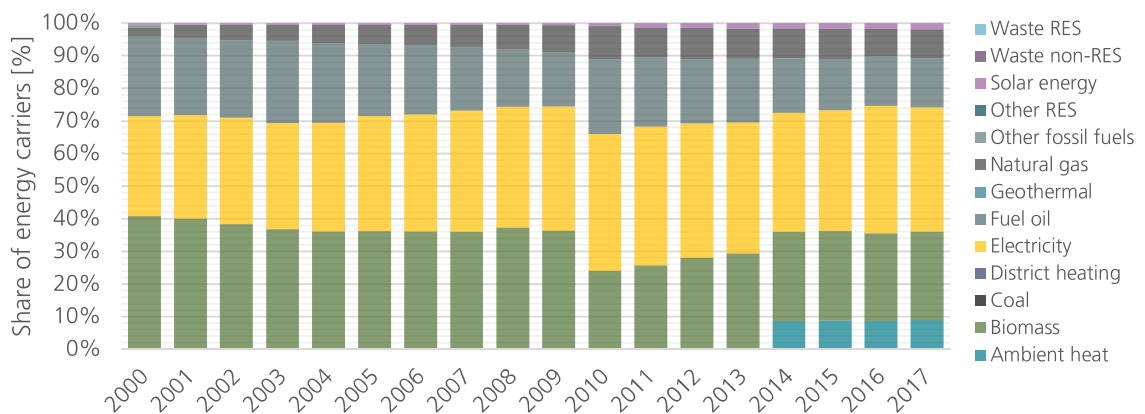
Historical trends

Portugal 2017

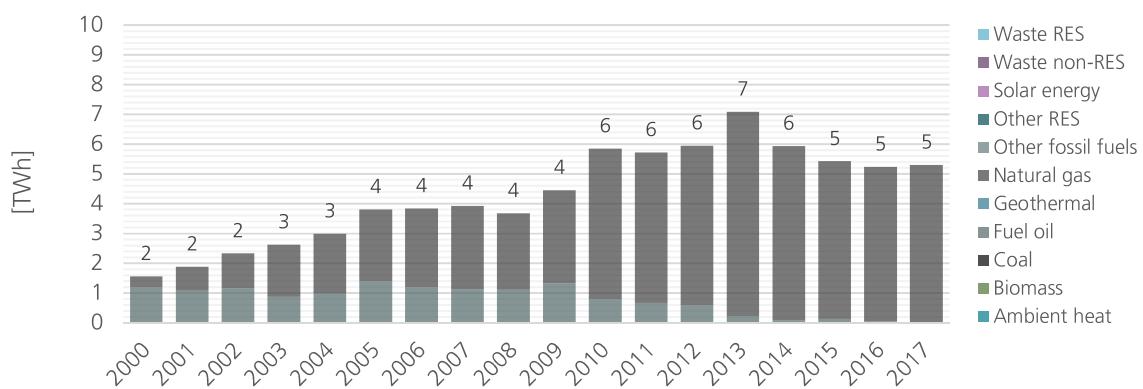
13



Final energy consumption in residential sector



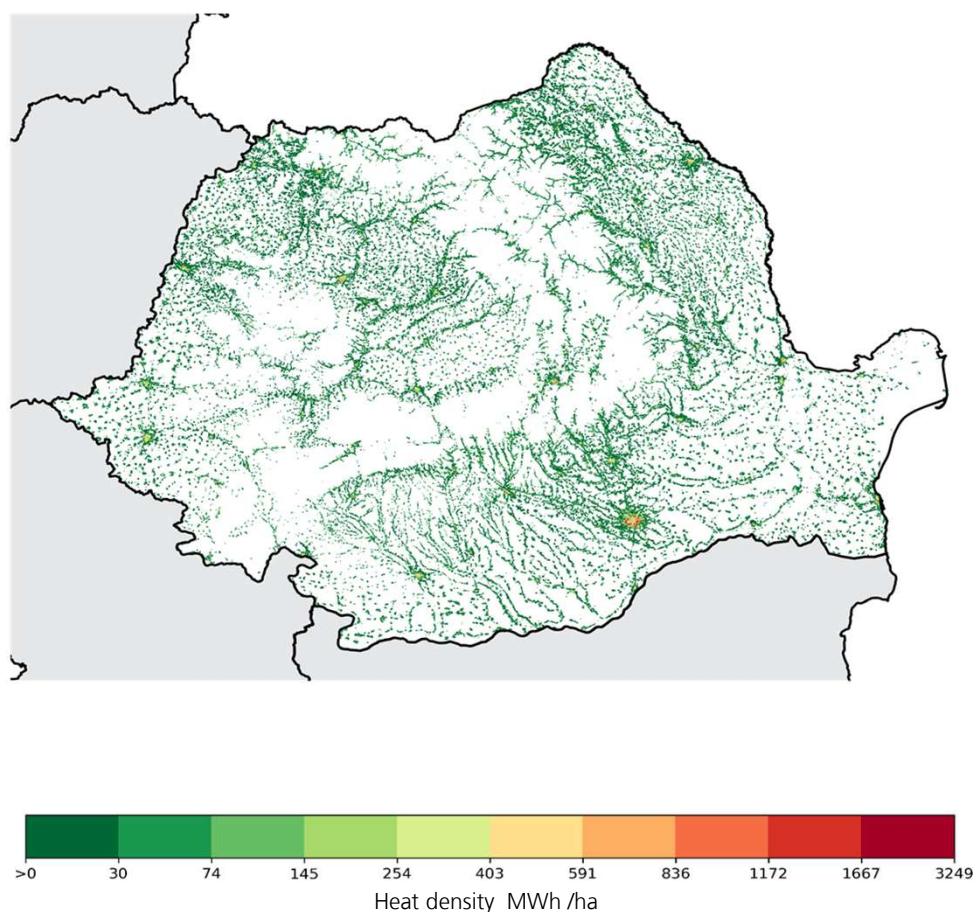
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Romania



Source: <https://www.hotmaps.eu/map>

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

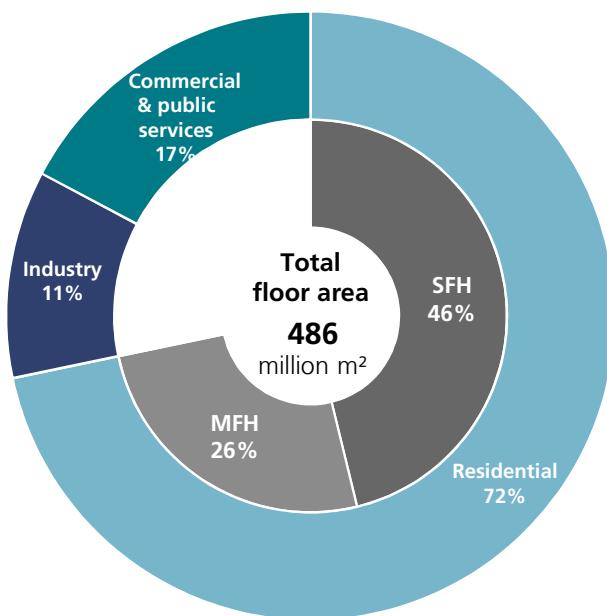
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

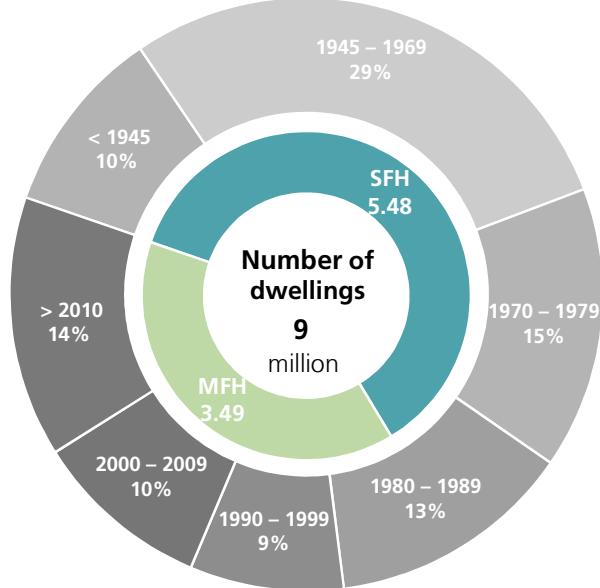
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Romania 2017

5



Climate Data

Heating degree days

Romania

EU-27

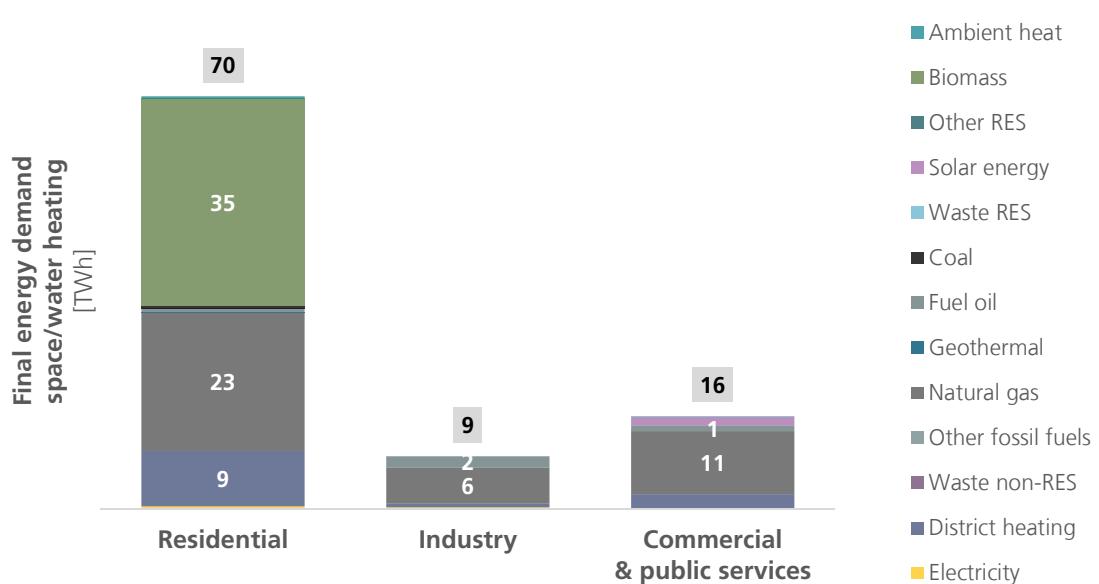
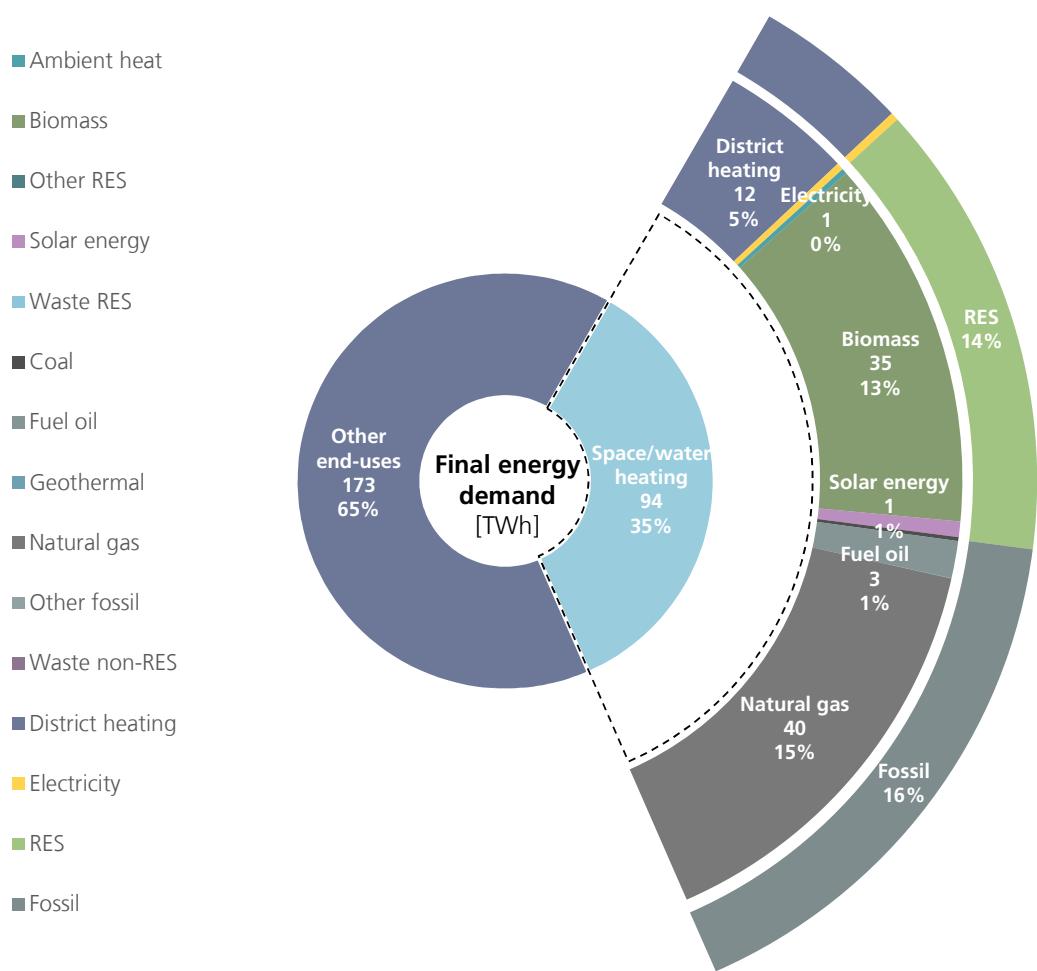
Average value 2000-2017

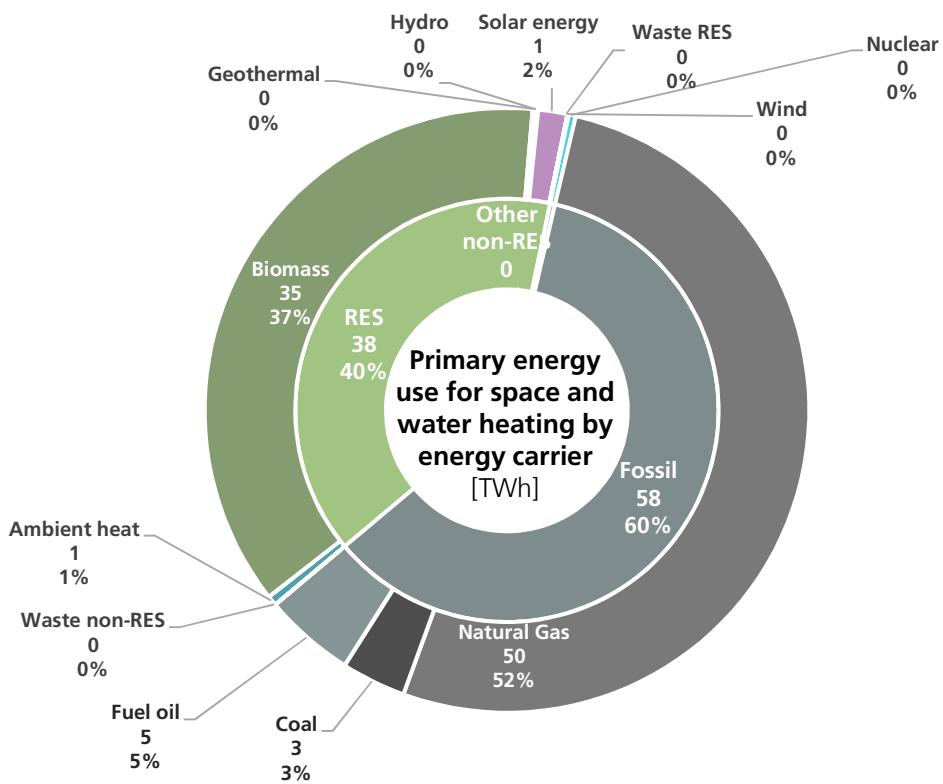
2995

3098

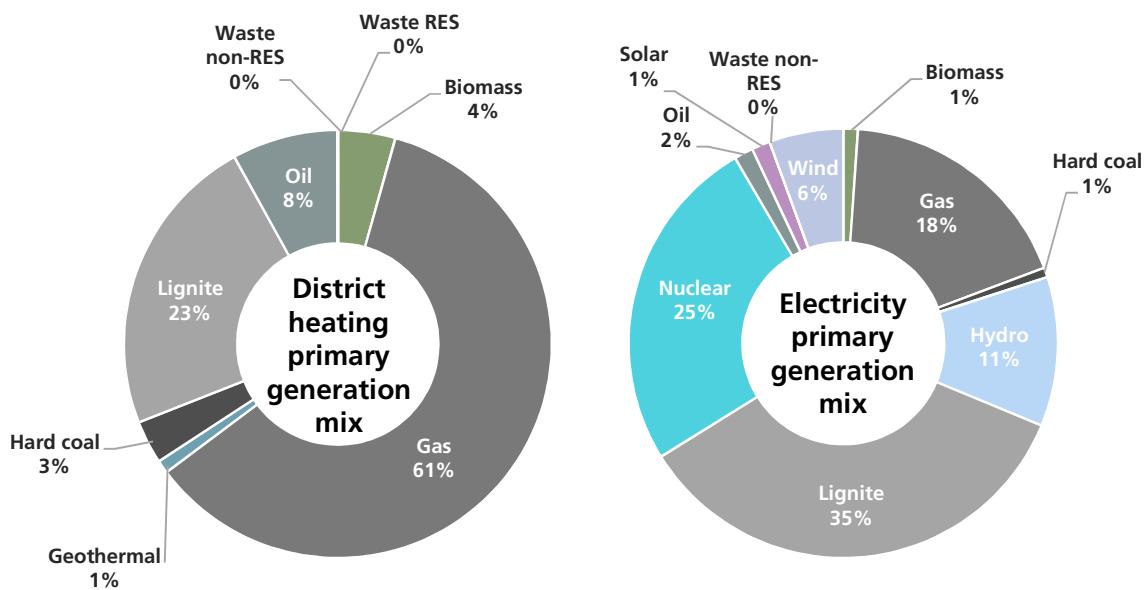
Overview of energy demand

Romania 2017





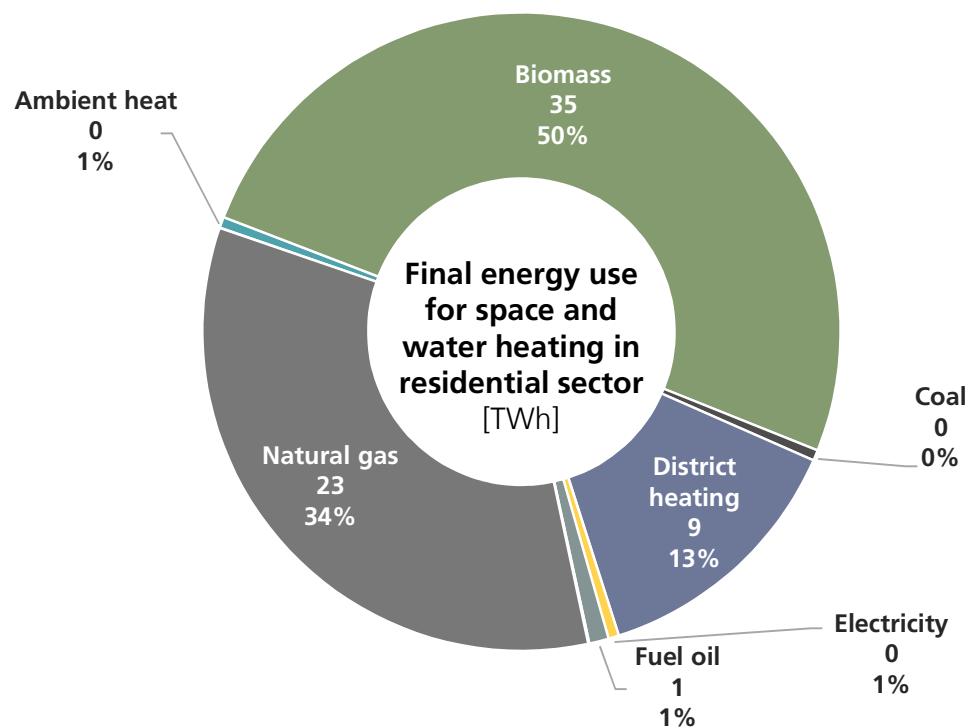
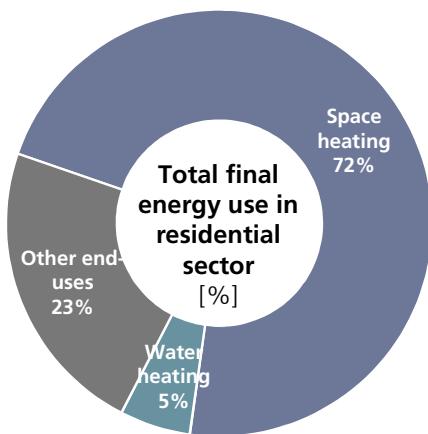
Generation mix



Space & water heating in residential sector

Romania 2017

8



Specific energy demand

199 kWh/m²yr
Final energy demand

201 kWh/m²yr
Primary energy demand

237 kWh/m²yr
Single-family dwellings

239 kWh/m²yr
Single-family dwellings

131 kWh/m²yr
Multi-family dwellings

132 kWh/m²yr
Multi-family dwellings

Technology mix

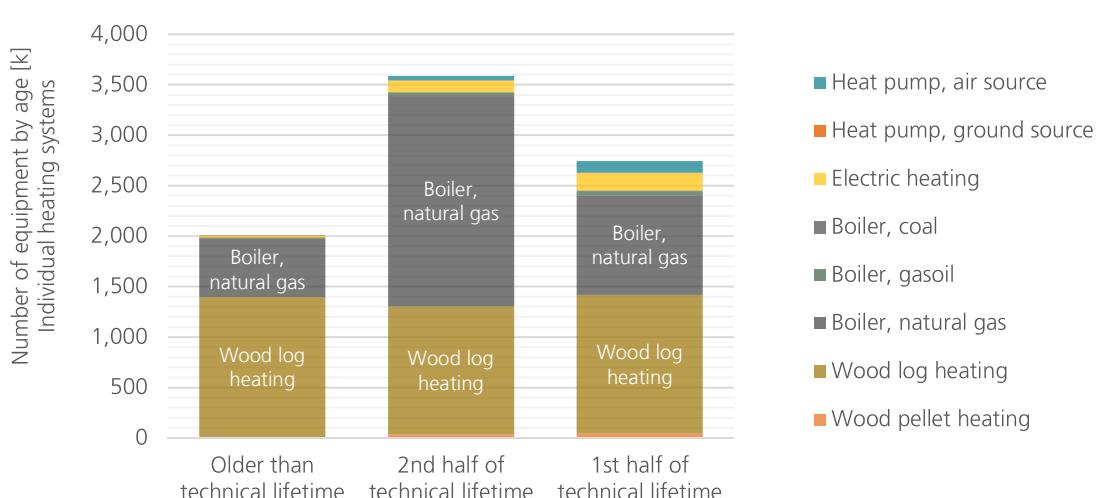
Romania 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	162	3%	27%	70%	3.3	1.3
Heat pump ground source	10	3%	27%	70%	3.5	0.1
Solar thermal	206*	3%	27%	70%	0.5	0.1
Electric heating	306	7%	38%	56%	1.0	0.3
Boiler, coal	11	8%	41%	51%	0.8	0.2
Boiler, gasoil	78	6%	39%	55%	0.9	1.9
Boiler, natural gas	3,656	16%	57%	27%	1.0	75.4
Wood log heating	4,034	34%	31%	34%	0.7	50.9
Wood pellet heating	85	8%	41%	51%	0.8	4.5

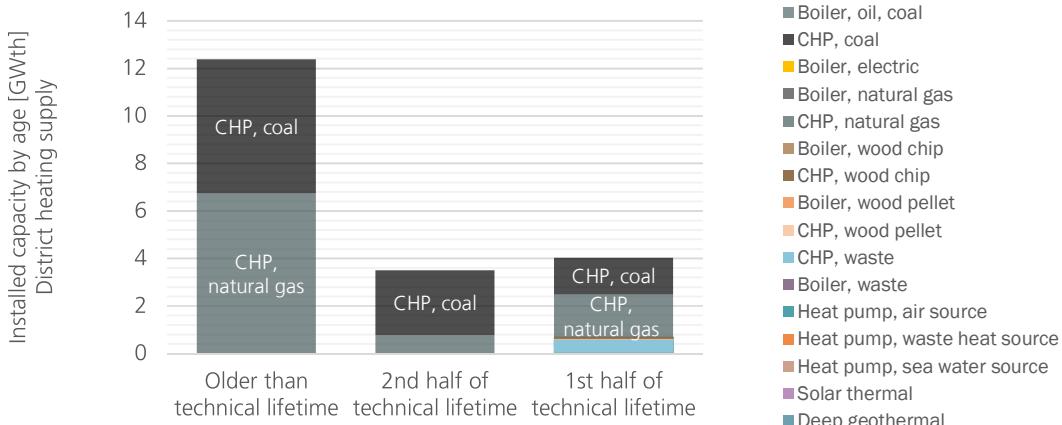
* unit 1000 m²

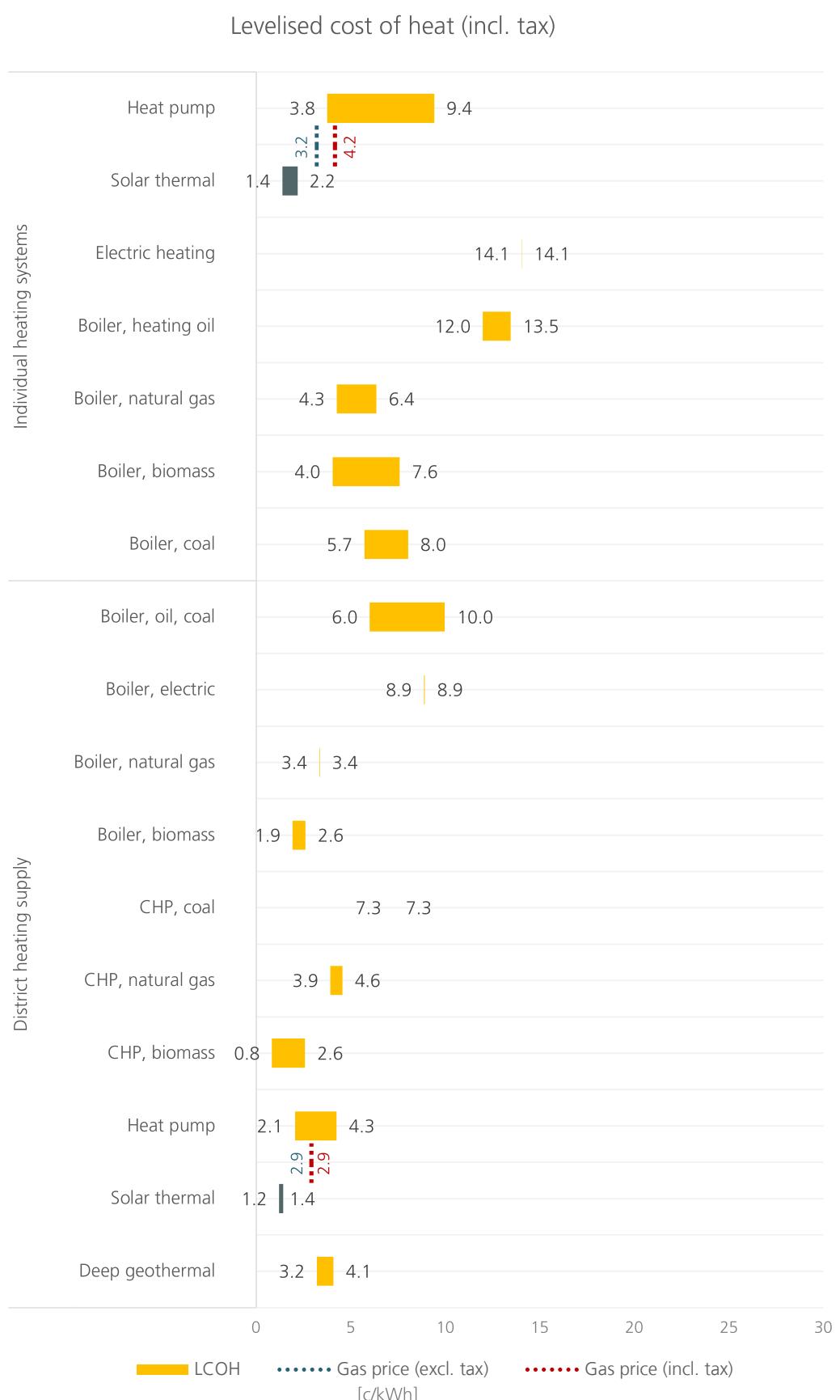
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Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	34	53%	41%	6%	0.5	9.9
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	125	50%	4%	46%	0.4	9.3
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	4	0%	0%	100%	0.9	0.1
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	2	0%	0%	100%	0.7	0.0
CHP, waste	3	0%	0%	100%	0.8	0.6
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data





Overview of policies

Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	Measures in place
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in place
Financial support specifically addressing public buildings	Measures in development
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	No measure
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Measures in development
RES-H obligation for existing buildings	Measures in development
Trigger point: Major renovation	Measures in development
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in development
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

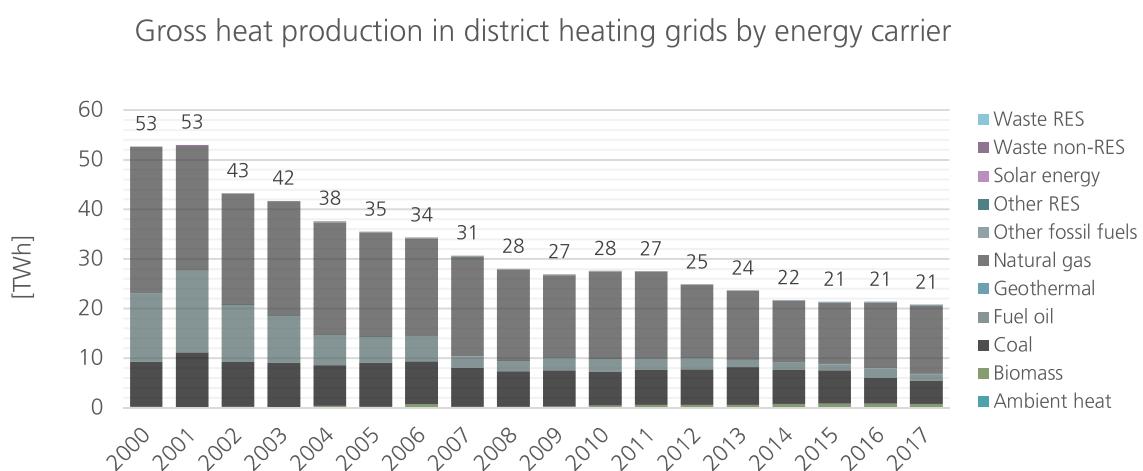
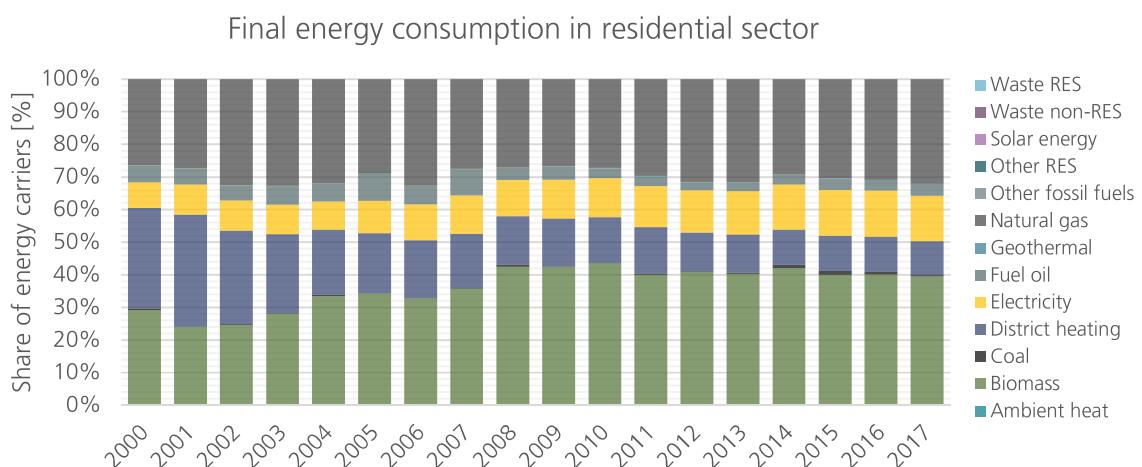
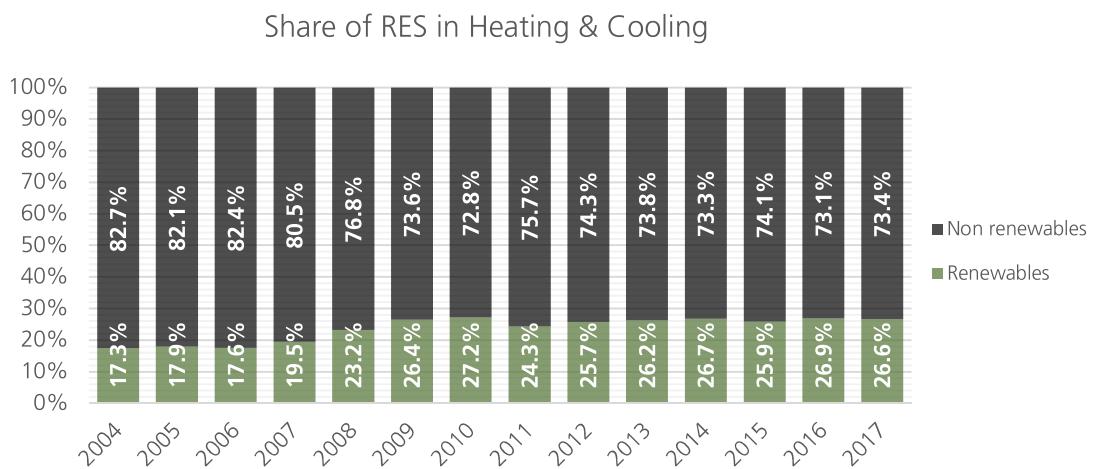
No measure

Measures in development

Measures in place

Historical trends

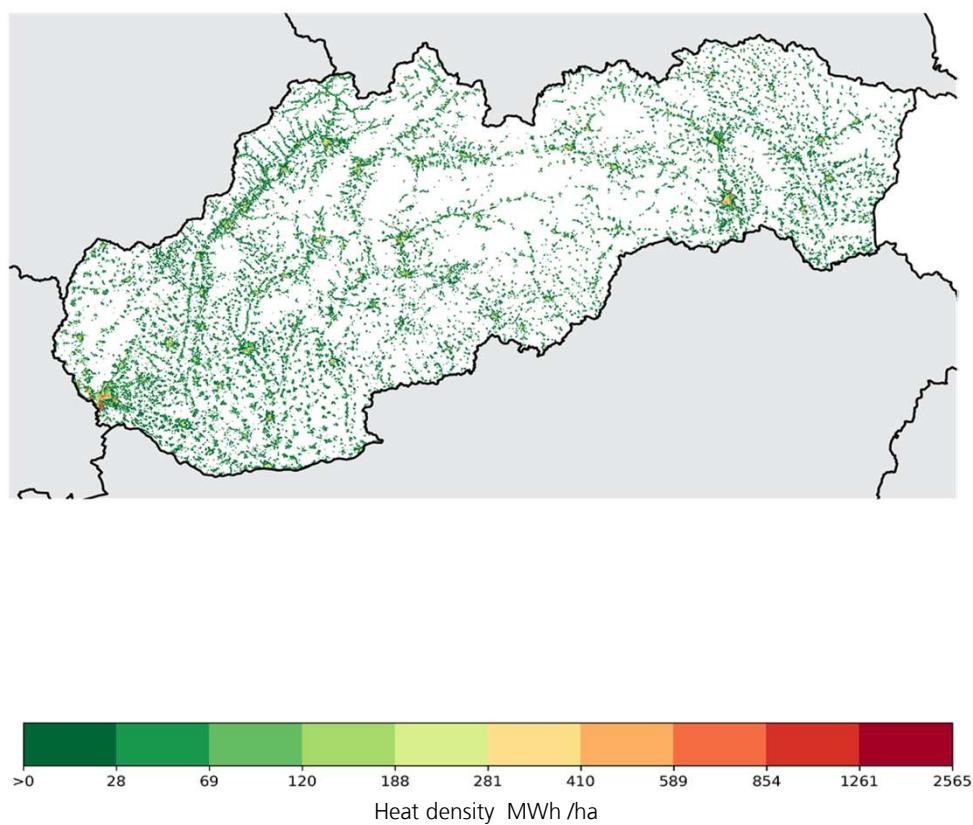
Romania 2017
13



Space heating market summary

2017

Slovakia



Fraunhofer
ISI

Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

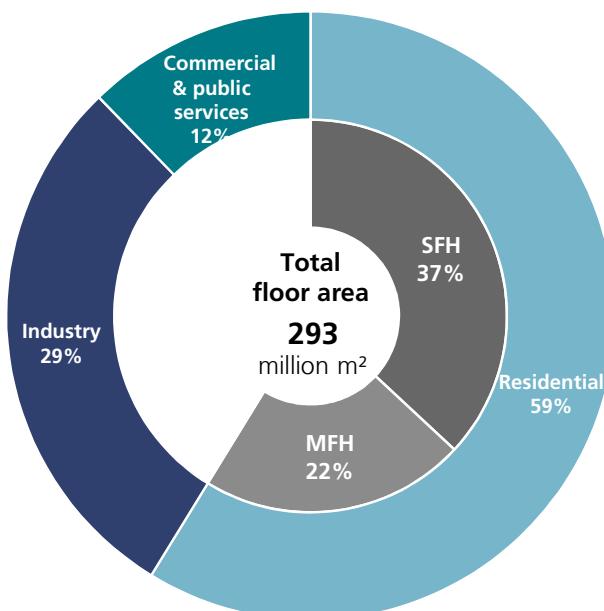
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.
- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

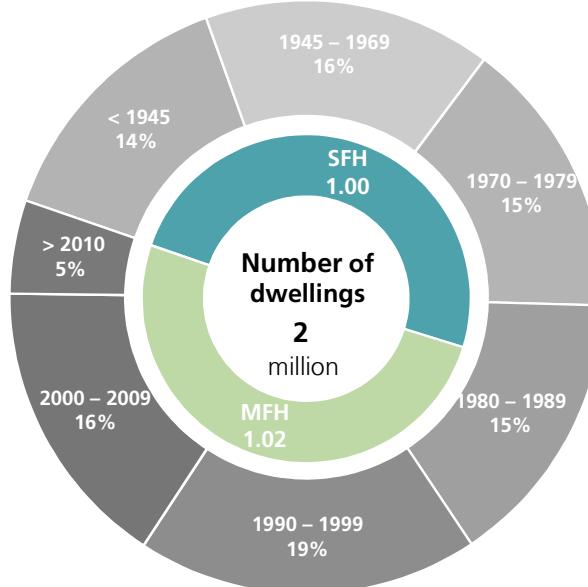
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Slovakia 2017

5



Climate Data

Heating degree days

Slovakia

EU-27

Average value 2000-2017

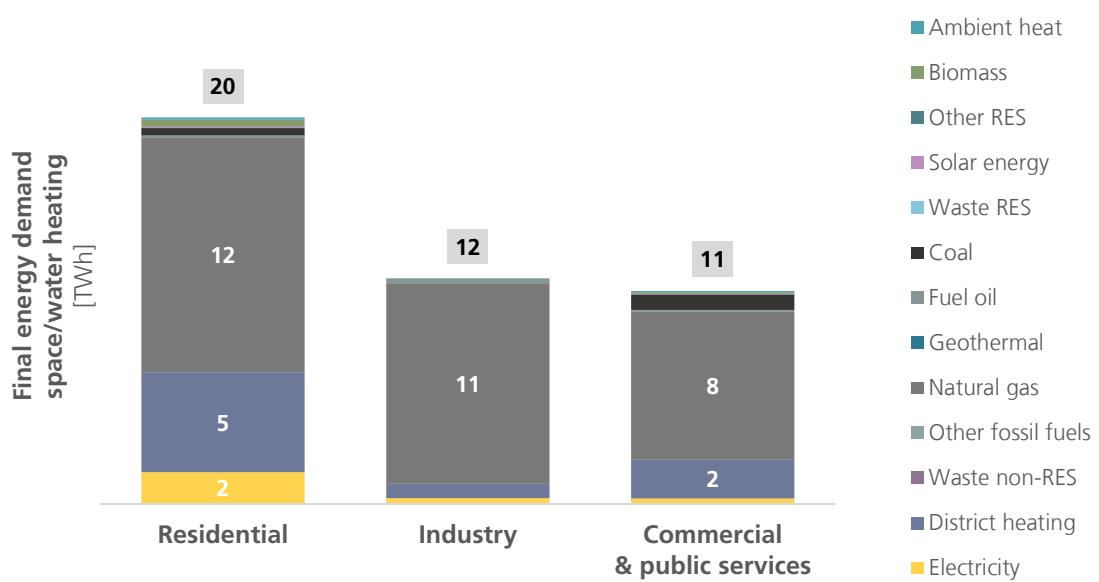
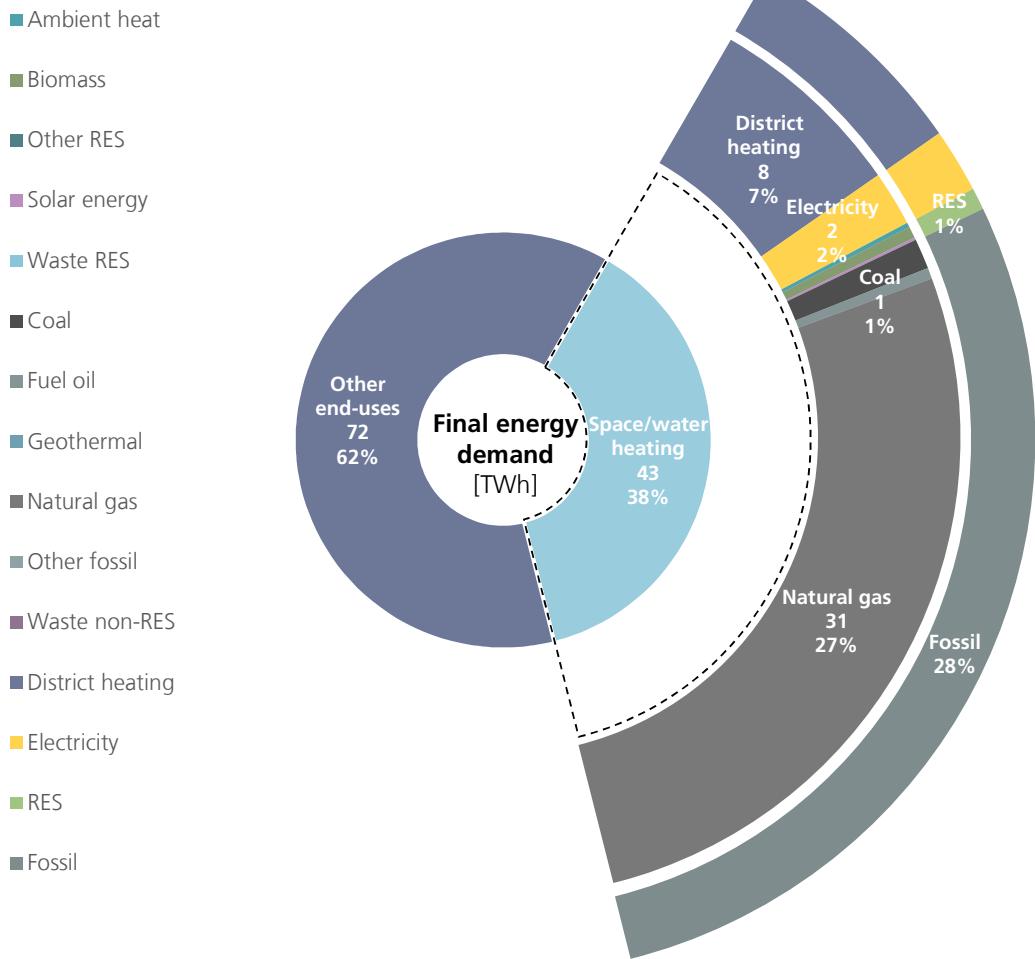
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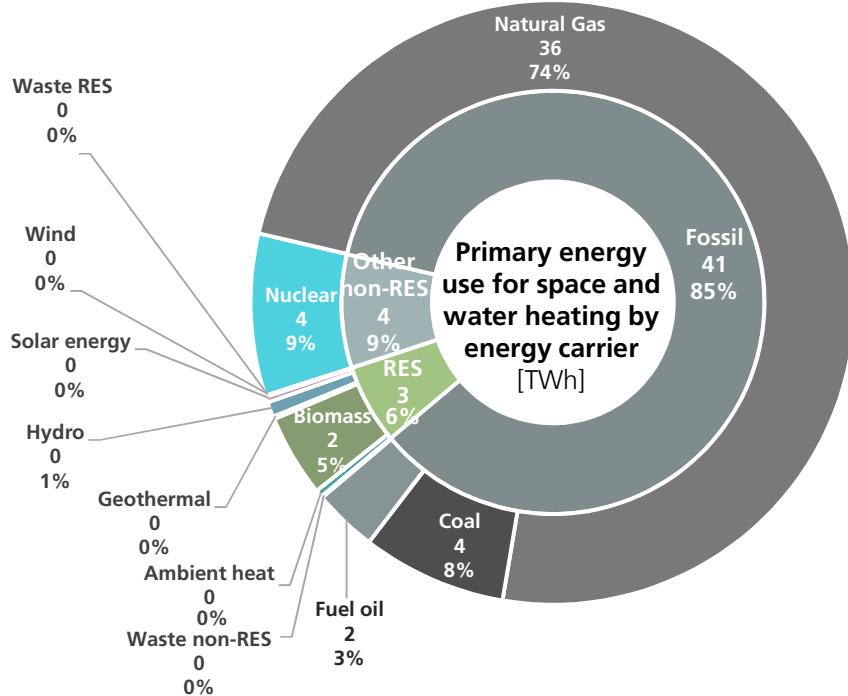
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Overview of energy demand

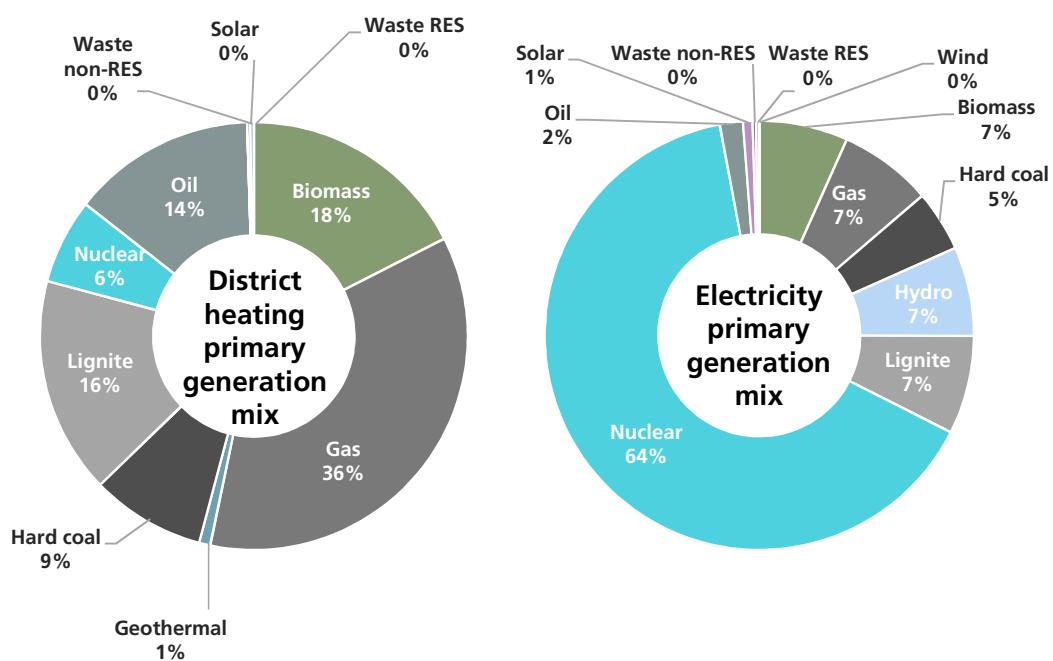
Slovakia 2017

6





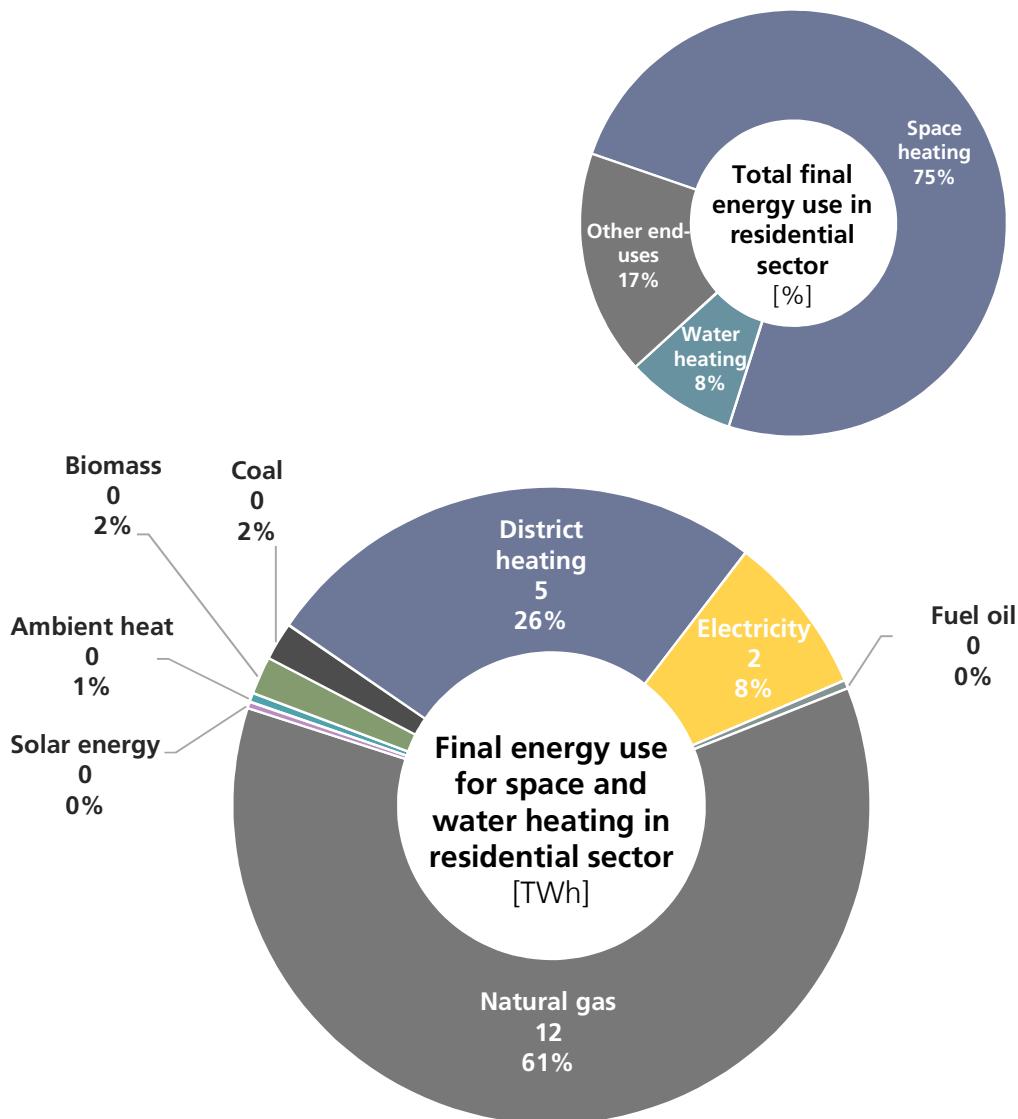
Generation mix



Space & water heating in residential sector

Slovakia 2017

8



Specific energy demand

118 kWh/m²yr
Final energy demand

135 kWh/m²yr
Primary energy demand

146 kWh/m²yr
Single-family dwellings

165 kWh/m²yr
Single-family dwellings

71 kWh/m²yr
Multi-family dwellings

85 kWh/m²yr
Multi-family dwellings

Technology mix

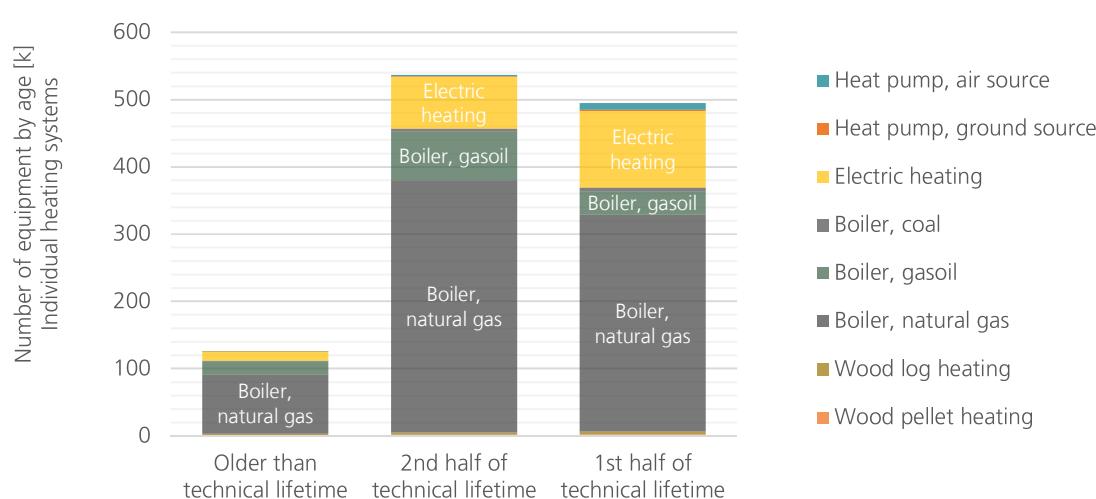
Slovakia 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	12	2%	16%	82%	3.3	0.1
Heat pump ground source	3	4%	38%	58%	3.5	0.0
Solar thermal	225*	3%	27%	70%	0.5	0.2
Electric heating	204	7%	38%	56%	1.0	0.2
Boiler, coal	11	8%	41%	51%	0.8	0.2
Boiler, gasoil	128	16%	57%	27%	0.9	1.9
Boiler, natural gas	784	11%	48%	41%	1.0	14.7
Wood log heating	10	30%	32%	38%	0.7	0.0
Wood pellet heating	5	8%	41%	51%	0.8	0.2

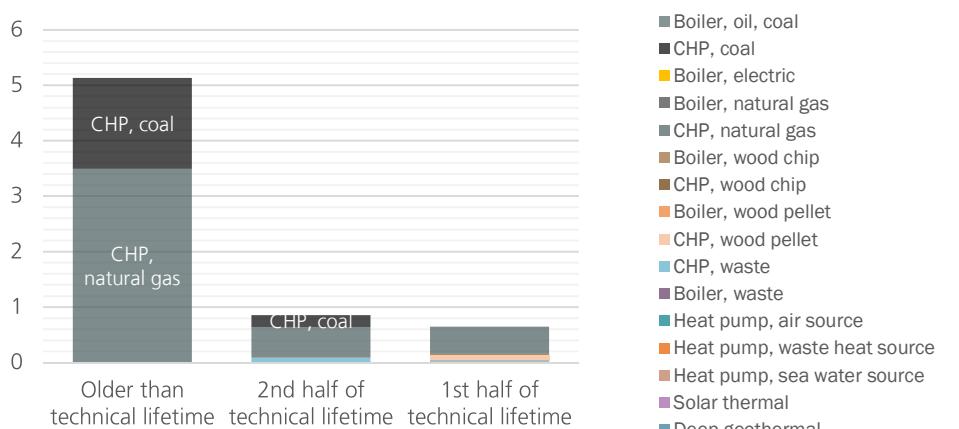
* unit 1000 m²

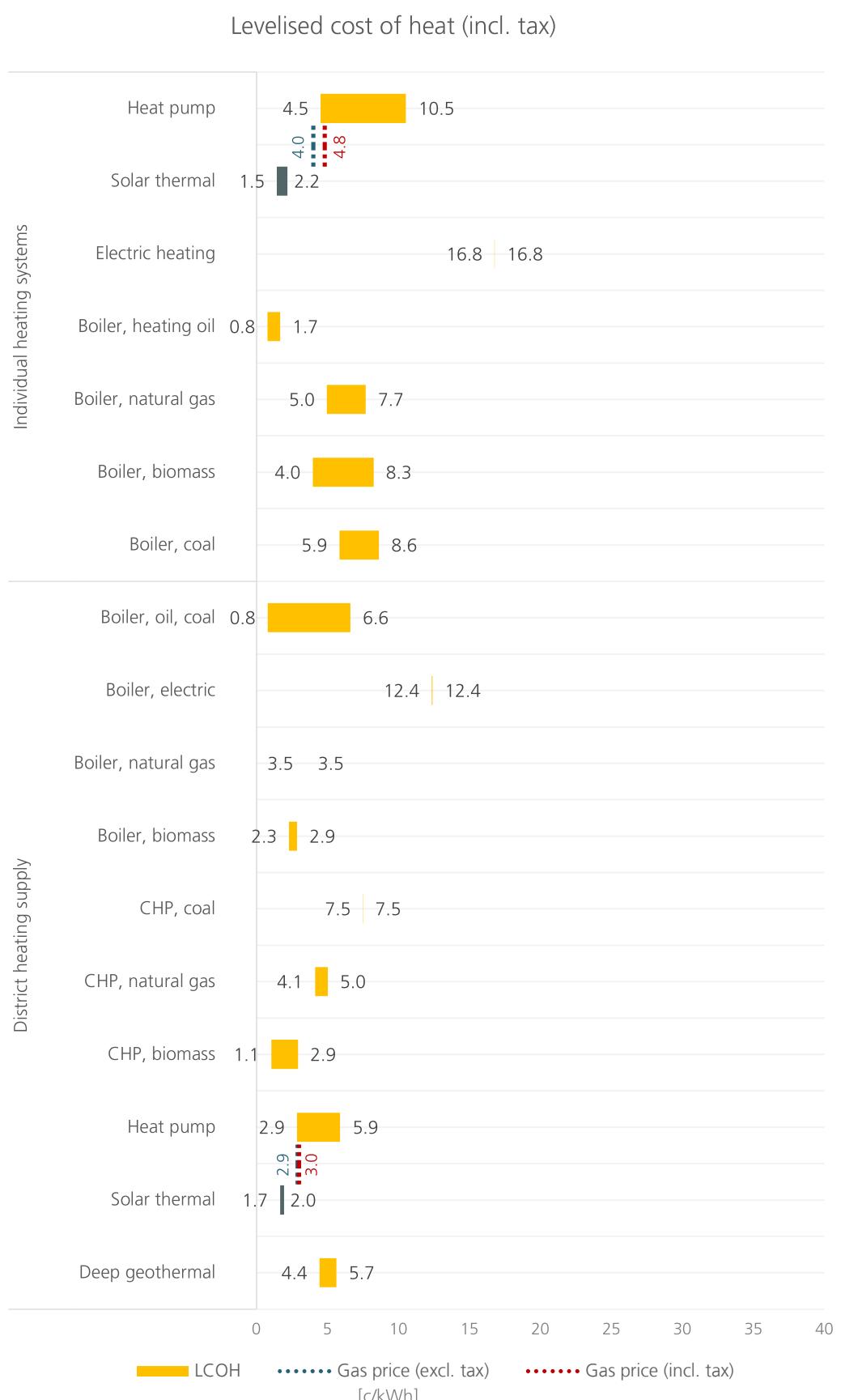
- no data



Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	20	75%	25%	0%	0.5	1.8
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	185	17%	32%	51%	0.4	4.5
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	2	0%	50%	50%	0.9	0.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	5	0%	0%	100%	0.7	0.1
CHP, waste	3	0%	33%	67%	0.8	0.1
Boiler, waste	0	6%	33%	61%	1.1	0.0
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	-	-	-	-	2.6	-
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply
Installed capacity by age [GWth]



Overview of policies

Financial support schemes	
Financial support for RES-H investments	Green
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Red
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	Green
Financial support specifically addressing low-income households	Red
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	Green
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO2 pricing	
CO2 pricing	Red
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Green
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	Yellow
Priority access for RES and/or waste heat in district heating	Red
Energy efficiency requirements for new buildings	Green
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Red
New installations in existing buildings	Red
Use of fossil fuel heating technologies	Red
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	Red
Zoning regulations for DH and/or Gas	Red
Information and planning	
National Database for EPC	Green
National requirements for urban heat planning	Red

 No measure

 Measures in development

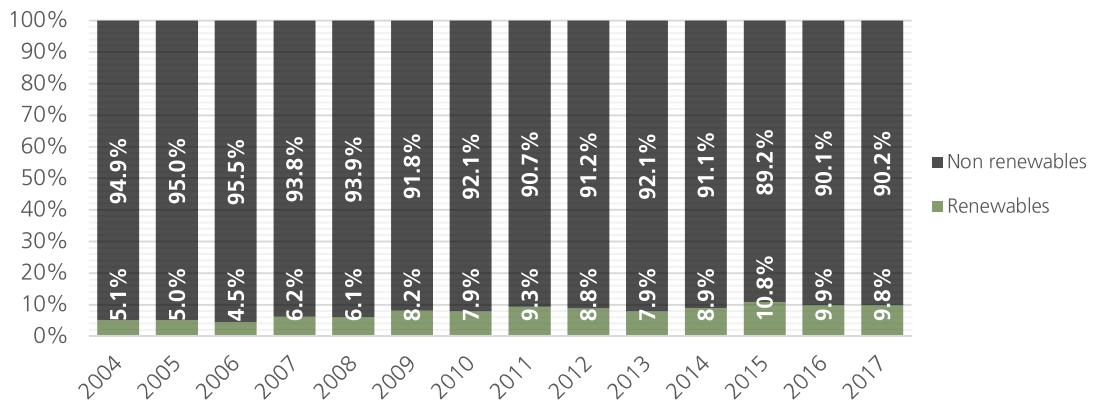
 Measures in place

Historical trends

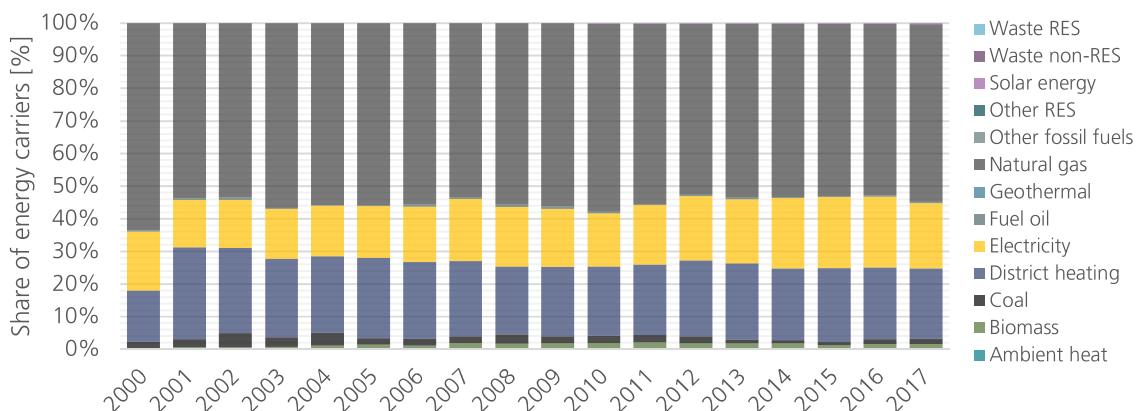
Slovakia 2017

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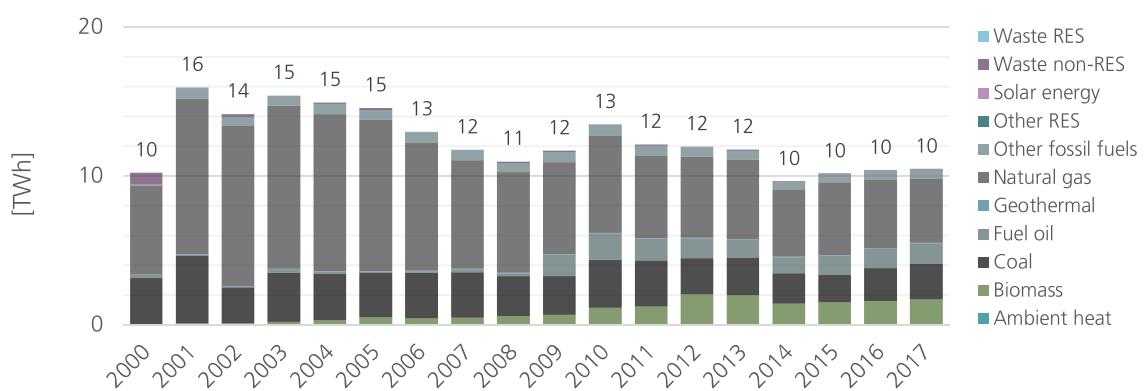
Share of RES in Heating & Cooling



Final energy consumption in residential sector



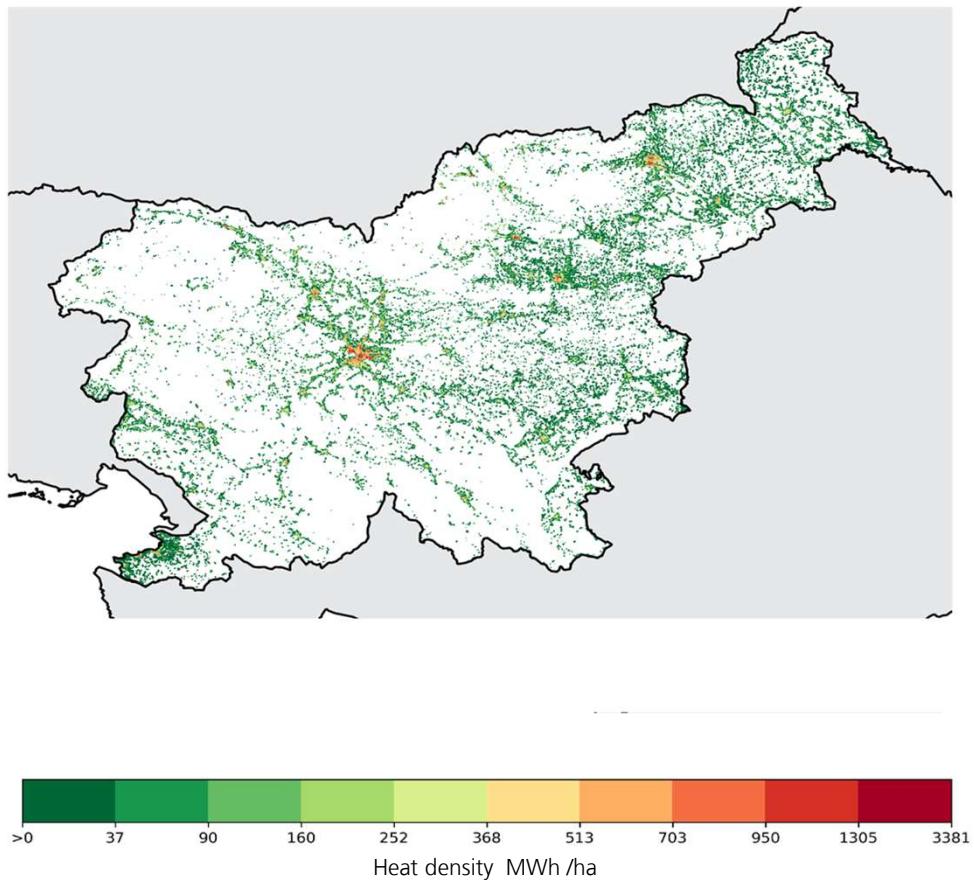
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Slovenia



Fraunhofer
ISI



Oko-Institut e.V.
Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

1. Further indication of data sources and methodologies is described in the main report of the project.
2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity and district heating generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
- The cost of individual solar thermal is calculated without storage solutions and as only covering a part of the domestic hot water demand.

Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

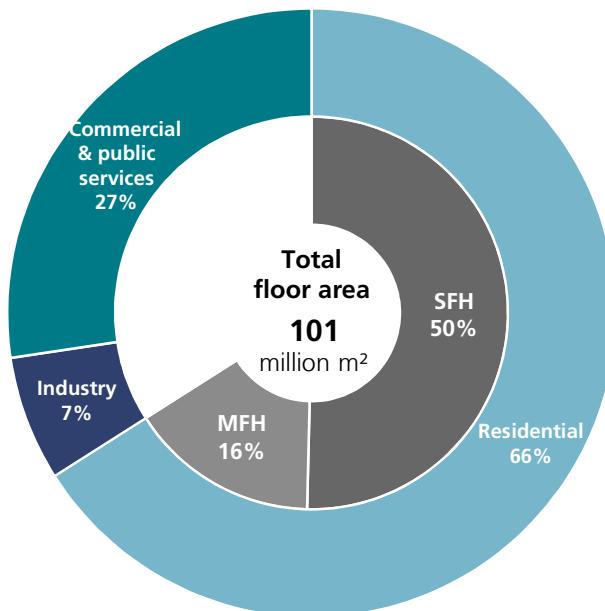
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRESNA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
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- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

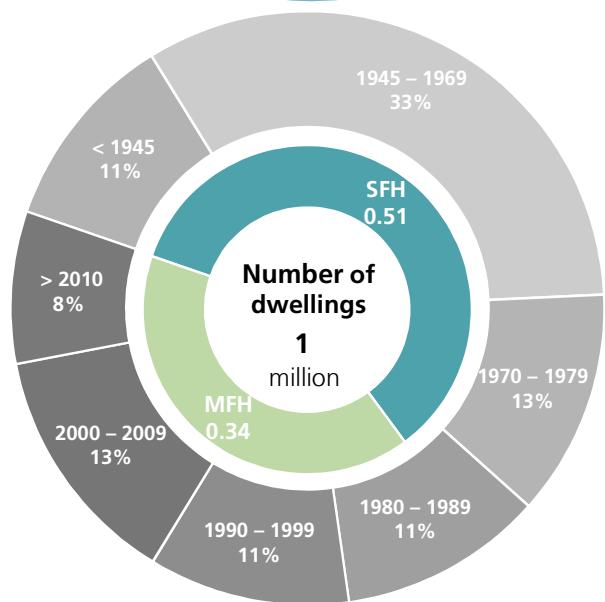
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Slovenia 2017

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Climate Data

Heating degree days

Slovenia

EU-27

Average value 2000-2017

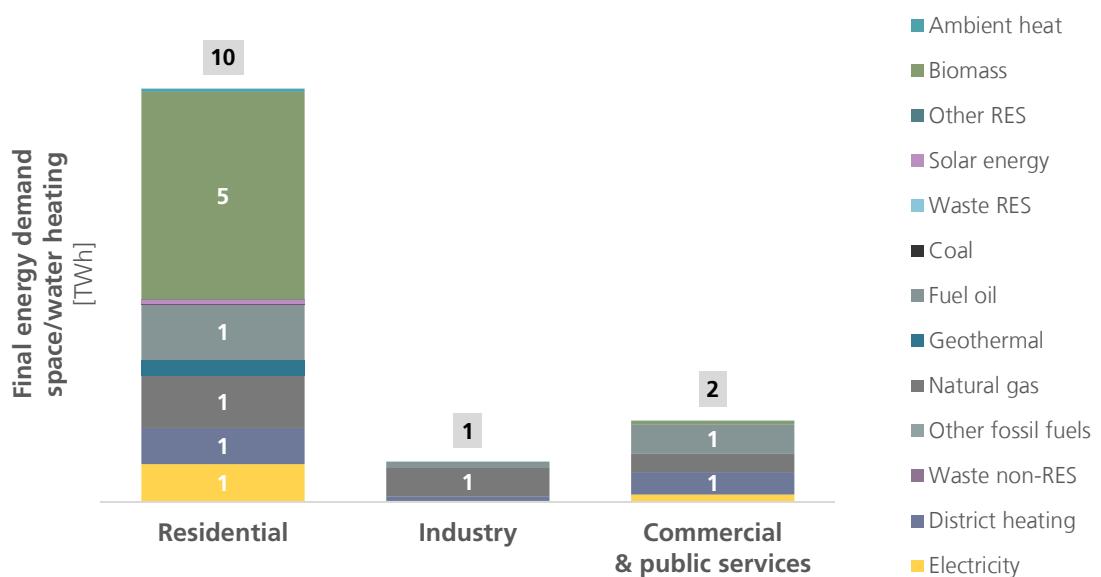
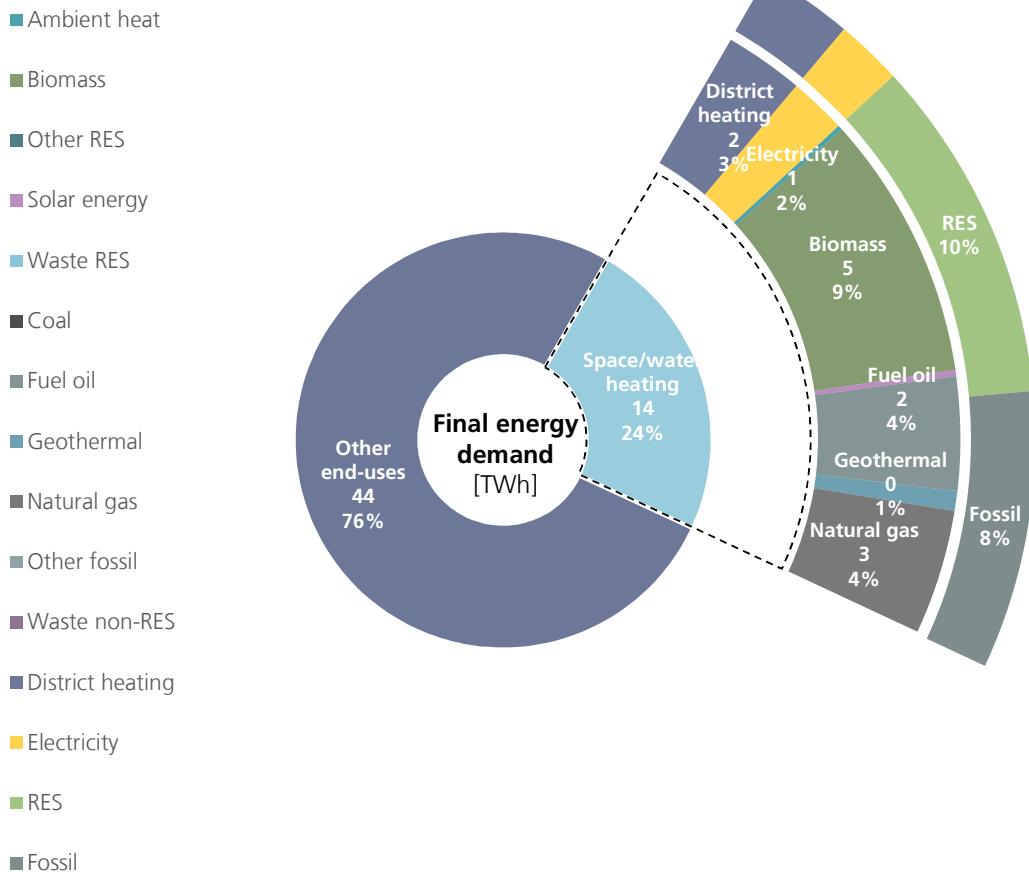
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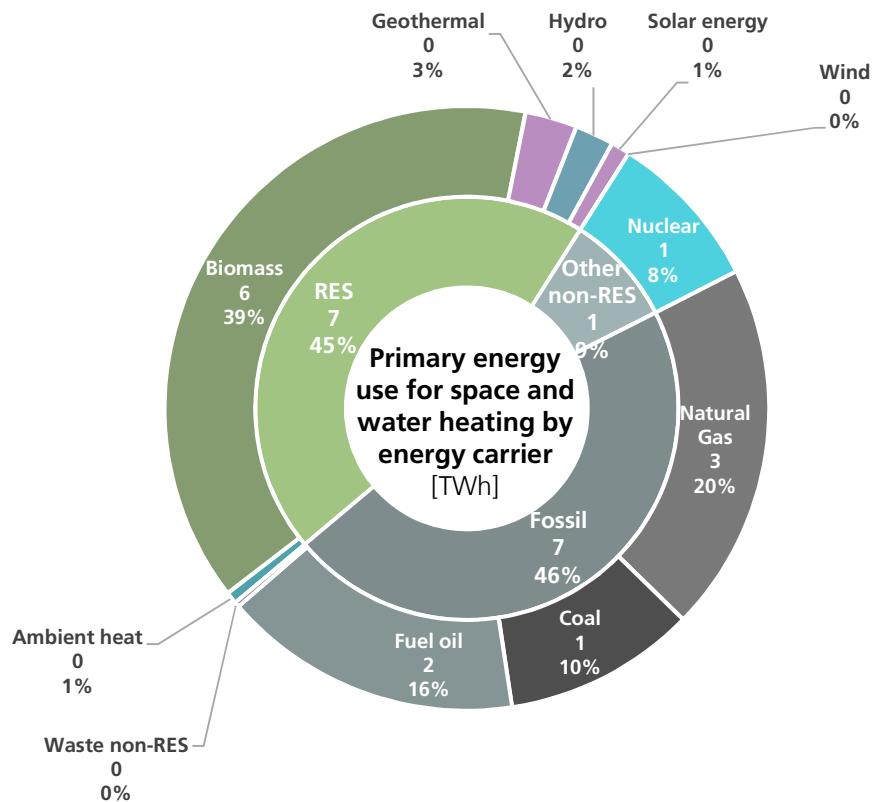
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Overview of energy demand

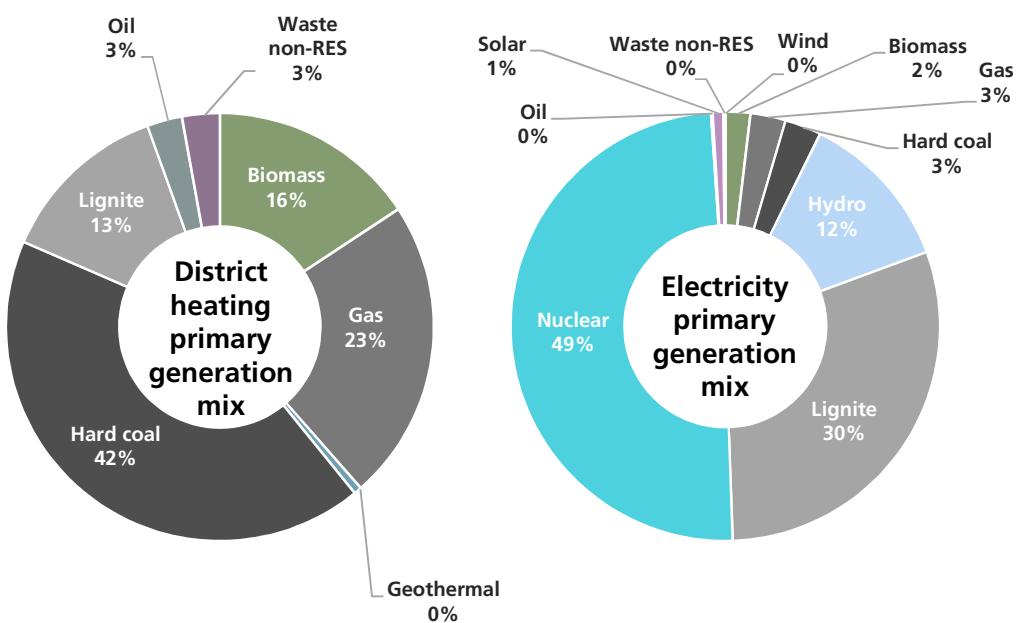
Slovenia 2017

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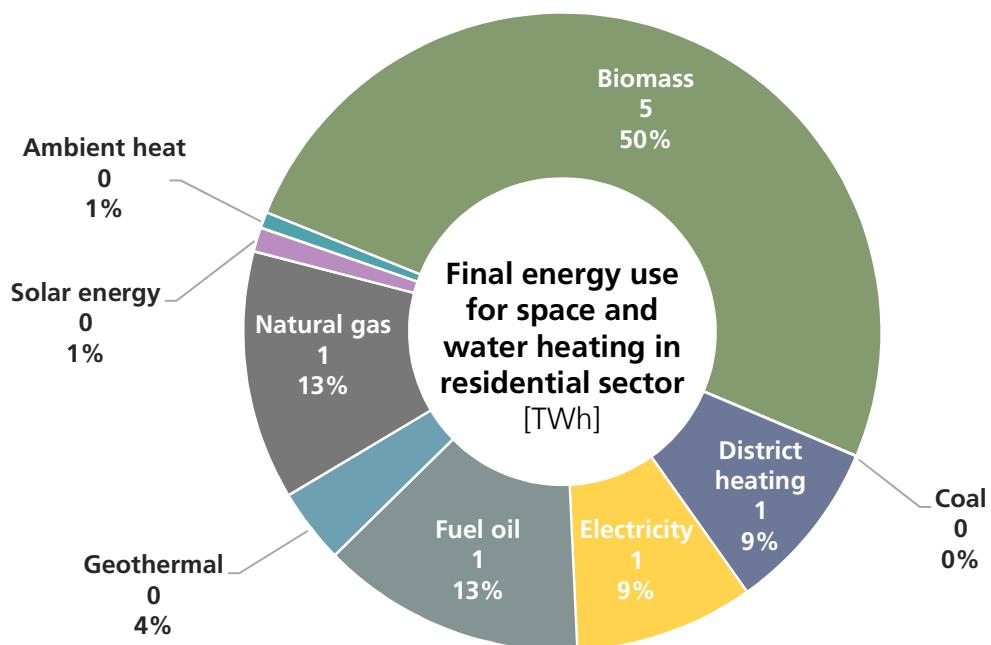
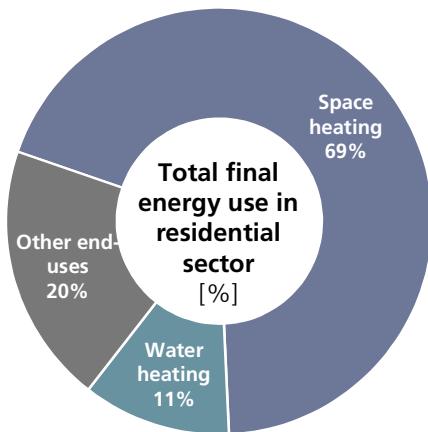
Generation mix



Space & water heating in residential sector

Slovenia 2017

8



Specific energy demand

157 kWh/m²yr
Final energy demand

170 kWh/m²yr
Primary energy demand

168 kWh/m²yr
Single-family dwellings

180 kWh/m²yr
Single-family dwellings

121 kWh/m²yr
Multi-family dwellings

136 kWh/m²yr
Multi-family dwellings

Technology mix

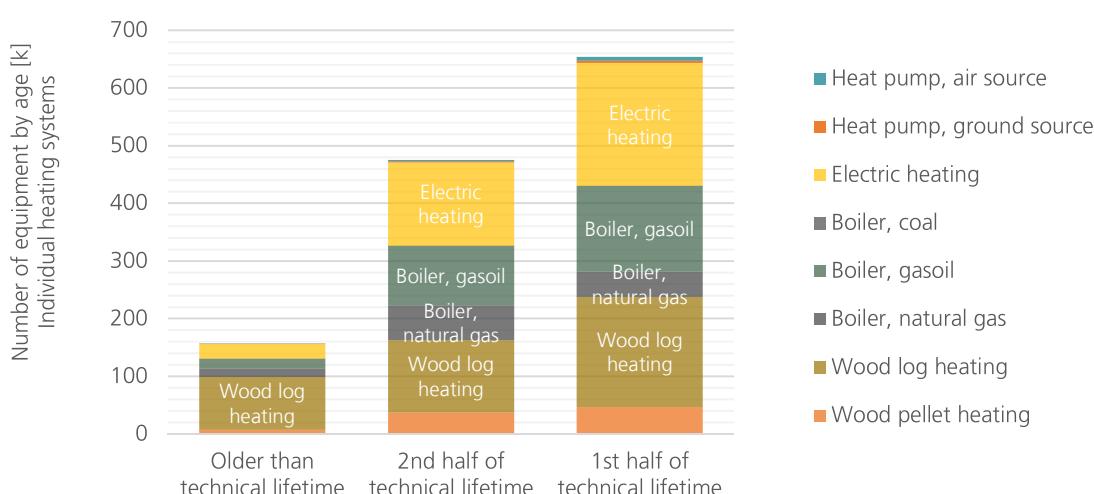
Slovenia 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	9	3%	27%	70%	3.3	0.1
Heat pump ground source	7	3%	27%	70%	3.5	0.1
Solar thermal	240*	3%	27%	70%	0.5	0.2
Electric heating	383	7%	38%	56%	1.0	0.4
Boiler, coal	0	8%	41%	51%	0.8	0.0
Boiler, gasoil	268	6%	38%	55%	0.9	7.5
Boiler, natural gas	120	13%	51%	37%	1.0	3.4
Wood log heating	408	22%	31%	47%	0.7	4.8
Wood pellet heating	91	8%	41%	51%	0.8	1.6

* unit 1000 m²

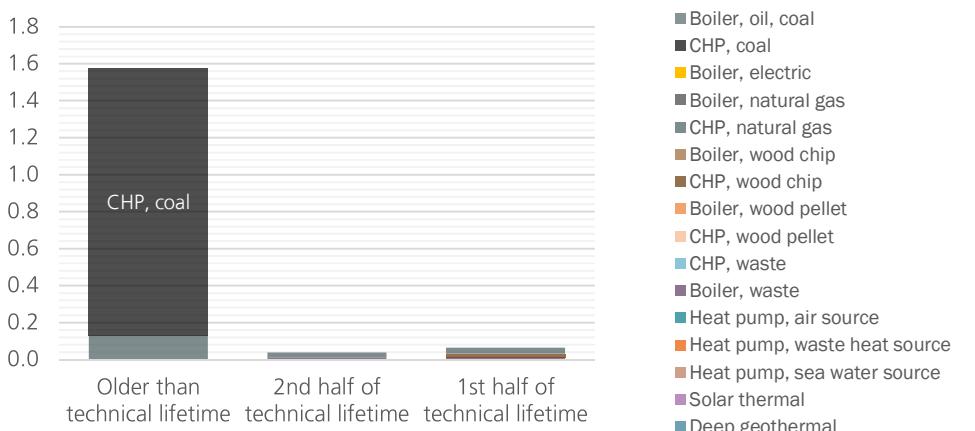
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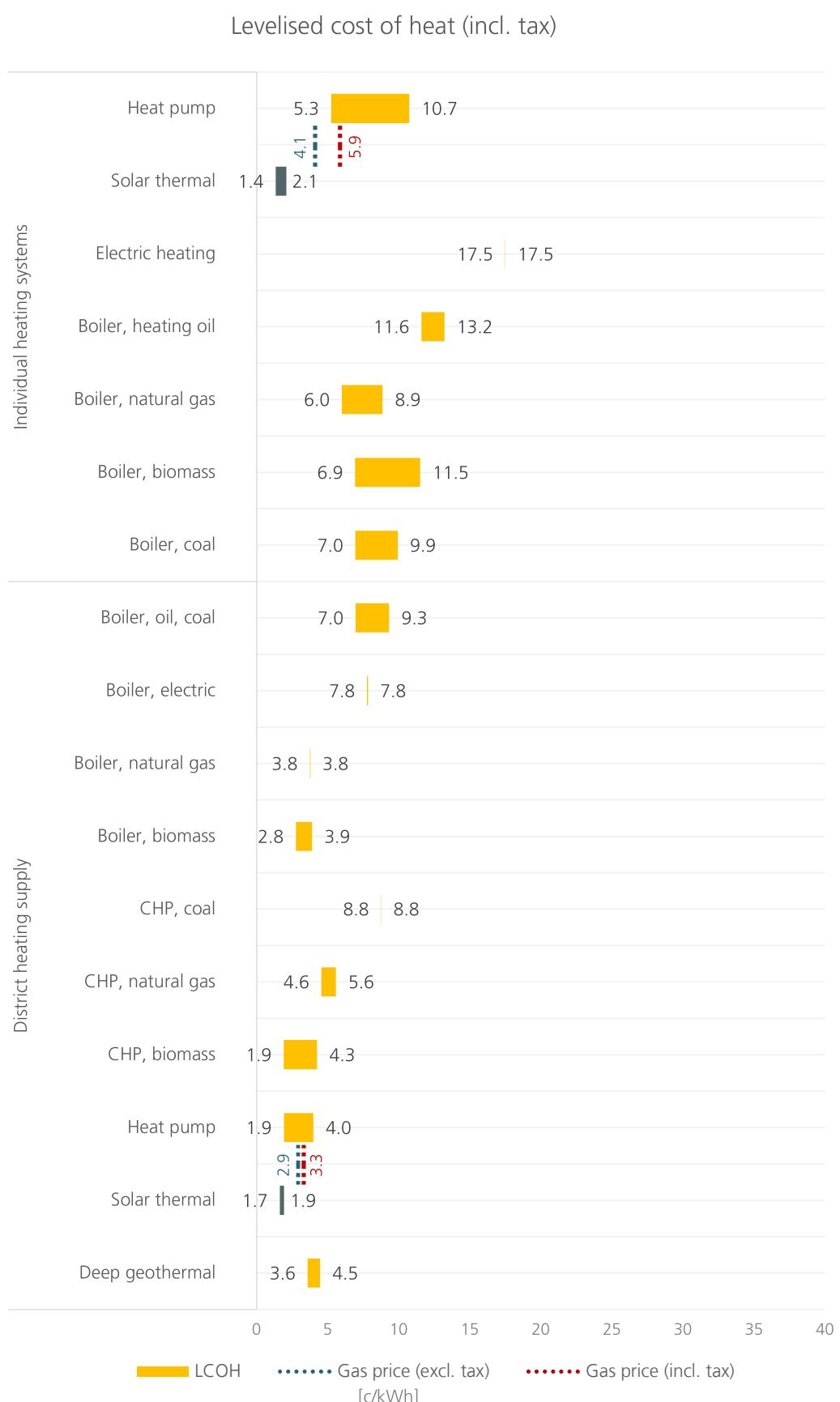


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	5	100%	0%	0%	0.5	1.4
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	36	19%	25%	56%	0.4	0.2
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	1	0%	0%	100%	0.9	0.0
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	-	-	-	-	0.7	-
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	1	6%	33%	61%	1.1	0.0
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	-	-	-	-	5.0	-
Heat pump sea water source	0	4%	36%	60%	2.6	0.0
Solar thermal	-	-	-	-	0.4	-
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Scrapping schemes for heating equipment based on fossil fuels	Red
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Green
Financial support specifically addressing public buildings	Green
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	Red
Heat incentives for decentral heating systems	Red
Energy- and CO₂ pricing	
CO ₂ pricing	Green
Tax exemptions for electricity for heat pumps	Red
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	Green
RES-H obligation for existing buildings	Green
Trigger point: Major renovation	Green
Trigger point: Exchange of heating system	Red
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Green
Trigger point: Transfer of ownership or new tenancy	Red
Trigger point: Efficiency class below certain level	Red
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	Green
New installations in existing buildings	Green
Use of fossil fuel heating technologies	Yellow
Phase-out for certain building segments (e.g. public buildings)	Red
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	
National requirements for urban heat planning	

No measure

Measures in development

Measures in place

Historical trends

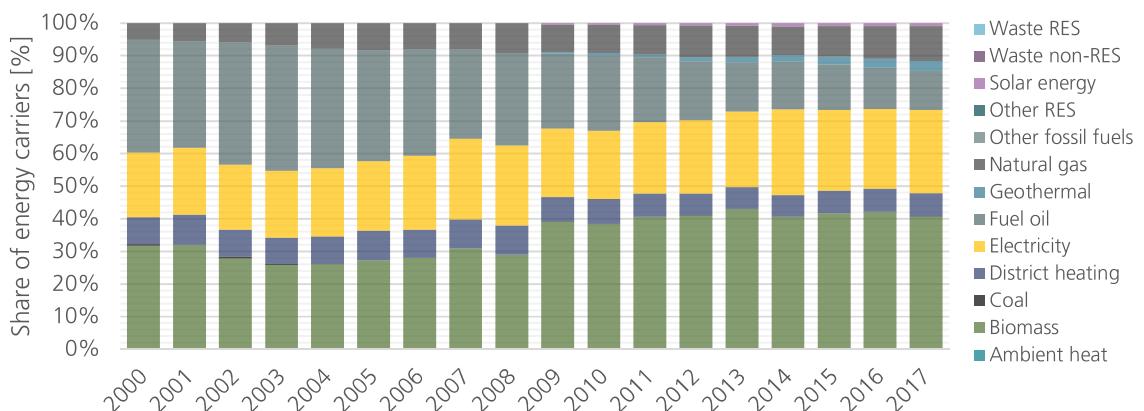
Slovenia 2017

13

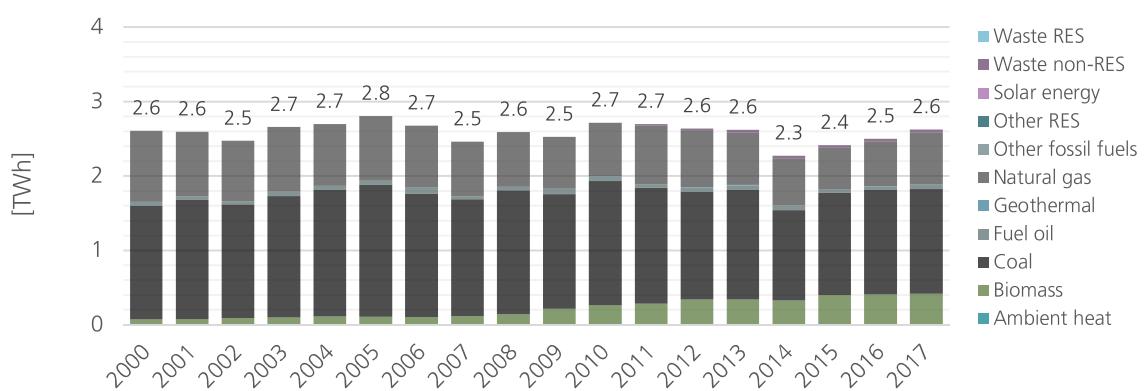
Share of RES in Heating & Cooling



Final energy consumption in residential sector



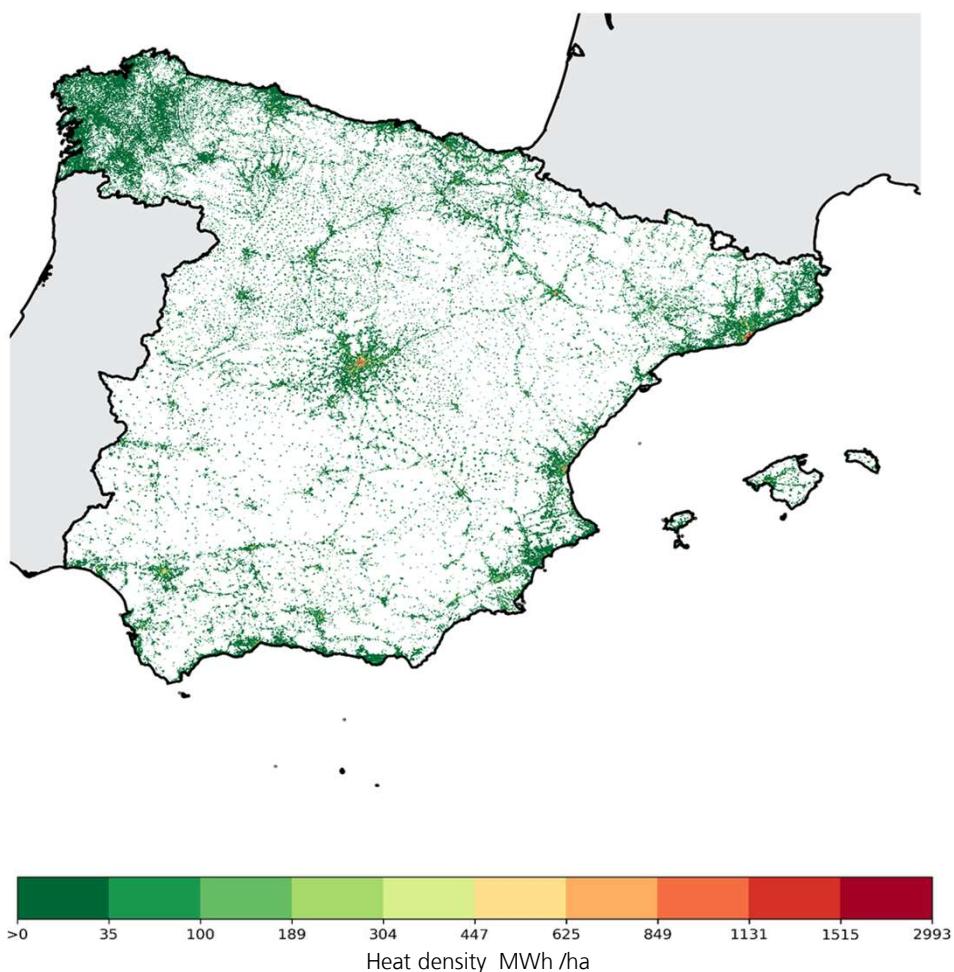
Gross heat production in district heating grids by energy carrier



Space heating market summary

2017

Spain



Source: <https://www.hotmaps.eu/map>



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Institut für angewandte Ökologie
Institute for Applied Ecology

viegand
maagøe
energy people

Introduction

This country report is prepared as part of the project **Renewable Space Heating under the Revised Renewable Energy Directive-ENER/C1/2018-494**. The report aims to provide a description of today's energy use and supply for space and water heating in the individual EU member states. The country report includes information on the energy consumption for space and water heating supply, the technology distribution, and building structure as well as the regulatory frame in place. Data is shown for the year 2017 if not stated otherwise.

The report is divided into three parts, and the content and data sources for each part are explained below. Different methods and sources are used for the various topics, and while some data is directly retrieved from Eurostat statistics, other data is calculated based on additional assumptions and modeling, which implies larger uncertainty.¹

Part 1: Heat demand structure and energy use for heat supply

The information shown in part 1 is mainly based on the data collected or calculated in section 2.1 of the project² unless otherwise specified. For this part, the following key data is included in the country reports:

Building stock data: this data provides an overview of the building stock structure, which is a central determinant of any heating and cooling transition. The data includes the total floor area of the buildings in each sector (Residential, Commercial & public services and Industry). For residential buildings, the data is further detailed for the main building types, single-family house (SFH) and multi-family house (MFH), and by the number of dwellings and total floor area for each type. The age classification of residential buildings is also covered in this part. The main consulted sources are Building Stock Observatory, ODYSSEE database, and the Hotmaps project.

Climate data: the climate of a country directly affects heating or cooling needs. We present heating degree days in comparison with the EU-27 average. Data is collected from Eurostat [nrg_chdd_a].

Overview of energy demand: this includes the final energy demand (FED) for space and water heating in total, by energy carrier, and by sector. It presents relative importance, by comparing the demand for space heating & hot water to the total final energy demand of a country. The final energy demand is depicted via energy commodities e.g. natural gas, electricity or district heating. In addition, the country sheets show the primary energy demand, which includes the primary energy carriers like coal, wind or nuclear energy instead of secondary energy carriers like electricity or district heating. Thus, it allows estimating the overall share of renewable energies used to provide space heating and hot water. Several national and EU sources and statistics have been used to cover the framework data needed for the calculation of the energy balances. The main data sources include Eurostat [nrg_bal] and [nrg_chdd_a], TABULA and ODYSSEE databases,

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2. Task 1: Establish energy consumption for space and water heating for EU

Hotmaps project and Building Stock Observatory. Eurostat energy balances are a major input and frame for the data set. The available figures on primary and final energy carriers in the energy balances are used as the reference for calibrations of the calculated energy demand in different sectors. A detailed summary of the methodology for the calculation of useful, final and primary energy is provided in section 2.1.2 of the project's report.³

Generation mix: the energy mix used for district heating and electricity generation directly affects the share of renewable energies in space heating and hot water supply. Here, we show the primary fuel mix for electricity generation by quantities of the type of fuels utilized. The primary data sources for this part are the Eurostat energy balances [nrg_bal].

Space and water heating in residential building sector: the residential sector is presented more in detail, as it is the most relevant demand sector of space and water heating in the EU. The data set shows the final energy demand by end use, final energy demand for space and water heating by energy carrier, and specific final and primary energy demand per building floor area by the main building types (SFH and MFH). The specific energy demand is an indication of the thermal efficiency of the building stock, but is also influenced by other factors like the climate, the characteristics of the building stock (e.g. age class and renovation status), or the user behavior. Data sources are similar to the overview of energy demand and building stock data above.

Part 2: Technology stock

The input for this part is mainly the output data from section 2.2 of the project's report⁴. The heating technologies are categorized in "district heating supply" and "individual heating systems" and each are shown in different graphs. The following key data is included in the country reports:

Technology mix: illustrating the data on heating equipment stock by installed capacities of the technologies and their age. The data is primarily based on the Danish Technology Catalogues and economic parameters are scaled relative to the Danish prices for each country. The investment cost based on the catalogues is the overnight cost. Key assumptions regarding technologies:

Solar thermal

- The heating efficiency is calculated for the three different climate zones based on irradiance and average temperatures.
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Heat pumps

- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
- Ventilation heat pumps have similar COP across climate zones based on an assumption of similar room temperatures.

Levelised cost of heat: compares the costs for heat generation for different heating technologies. Levelised cost of heat (LCOH) is calculated for each country, with and without taxes, and distributed into different climate zones and required supply temperatures. The LCOH for district heating describes the cost of supply and does not contain distribution costs. The LCOH is calculated by adding up the discounted investment cost, fuel costs, auxiliary electric costs, O&M costs and dividing by the discounted heat production throughout the technology's lifetime. Revenues from generated electricity are subtracted before division by the discounted heat production. For combined heat and power plants (CHPs), the electricity spot price is used. For individual technologies, the retail electricity price is used.

Stock for district heating technologies: stock for district heating technologies, except for electricity generating technologies, is estimated based on the development in gross heat production (GHP) from 2012 to 2018. The stock from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) is aggregated into the technology categories used in this analysis, and scaled with the difference in GHP. Geothermal, solar thermal, and heat pump stock is based on recent overviews of large-scale installations.

Stock for individual technologies: it is based on sales data from ecodesign studies, market statistics, previous heating and cooling studies, and the FED from part 1. Stock of heat pumps is taken from the annual report of 2019 from the European Heat Pump Association. Stock of non-solid fuel boilers, oil and gas, are based on an ecodesign study for Space and combination heaters that provided recent stock numbers and sales data for the European Union. Stock for solid fuel boilers is largely based on the FED in the residential sector, along with climate zone specific full load hours, average capacities to determine total installed capacity, and the stock. To determine the distribution of FED of biomass, the stock for individual biomass stoves from Mapping and analyses of the current and future (2020 – 2030) heating/cooling fuel deployment (fossil/renewables) was used to remove their share from the FED, and it is then assumed that the rest of the FED is covered by biomass boilers.

The stock was not available in the same technology categories as employed here, and thus assumptions have been made regarding distribution, i.e. distribution of gas boilers into condensing and non-condensing. Similarly, the distribution into different age categories are the same across countries due to the data being on EU-wide basis.

Part 3: Policies and historical trends

For this part, the following key data is included in the country reports:

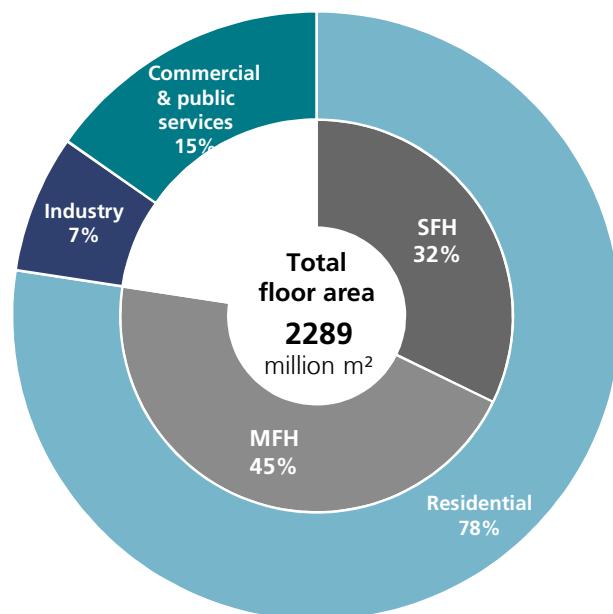
Overview of policies: covering existing policies for heating, renewable heating, and the decarbonisation of heat. This includes regulatory (e.g. zoning, building regulation), fuel taxes and other fiscal and financial measures (e.g. as carbon taxes), support measures, the distribution of regulatory and policy responsibilities at national, regional and local levels. The overview is based on literature review, desk research, and the following key databases: RES-Legal database, MURE database, IEA/IRENA Global Renewable Energy Policies and Measures Database, IEA Energy Efficiency Policies and Measures Database, Comprehensive assessments of the potential for efficient heating and cooling, National energy and climate plans (NECPs).

Historical trends: following indicators are selected to show the historical developments of the heat sector. Data for this part is extracted from Eurostat.

- **RES-H shares in heating and cooling 2004-2017:** They show the evolution of renewables in total heating and cooling energy demand. Note that by including process heating, this indicator goes beyond space heating. However, as space heating has the highest share in total heating, the trends give an important indication for space heating. Data is collected from Eurostat [nrg_ind_ren].
- **Energy carrier shares in residential sector 2000-2017:** The evolution of energy carrier shares in the household sector shows important structural shifts, like market share gains of natural gas or renewable energies. Note that this indicator has a broader scope than only space heating, as it also includes electricity consumption (mostly for non-heating end-uses), and gas use for stoves. However, space heating accounts for the major share of most energy carriers, and results show robust trends for space heating. This indicator can also be used to explain changes observed in the above RES-H indicator. Eurostat [nrg_bal_c] is used as the data source.

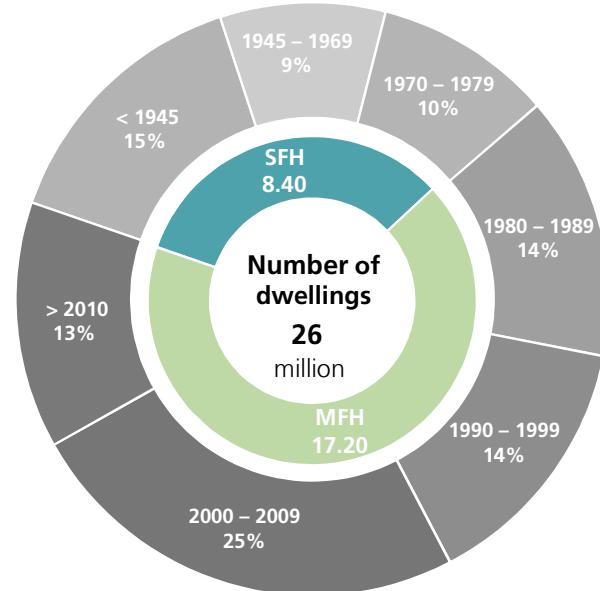
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Spain 2017

5



Number of dwellings 26 million

MFH 17.20

Climate Data

Heating degree days

Spain

EU-27

Average value 2000-2017

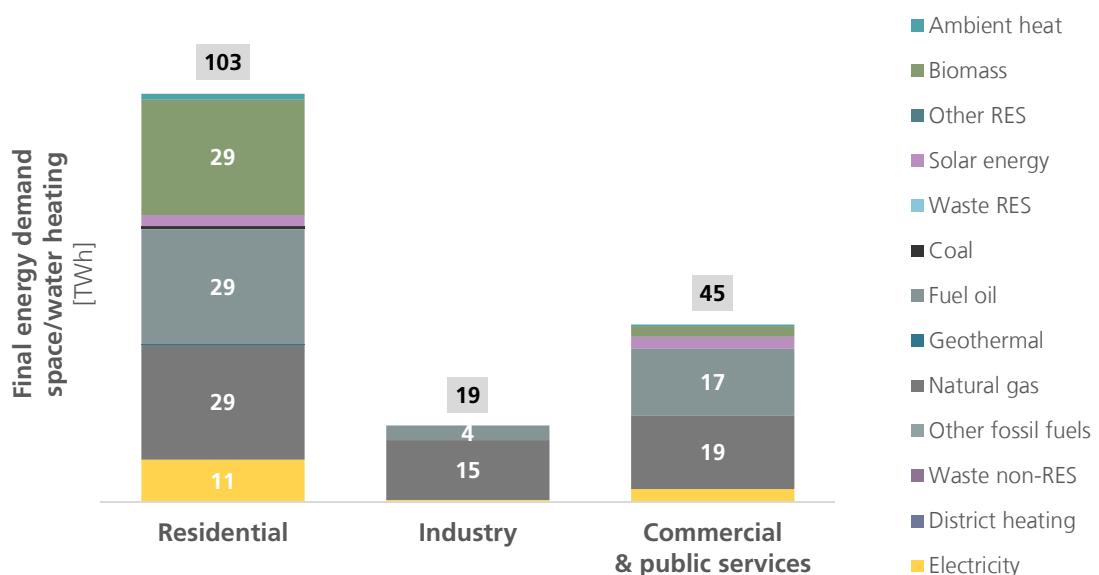
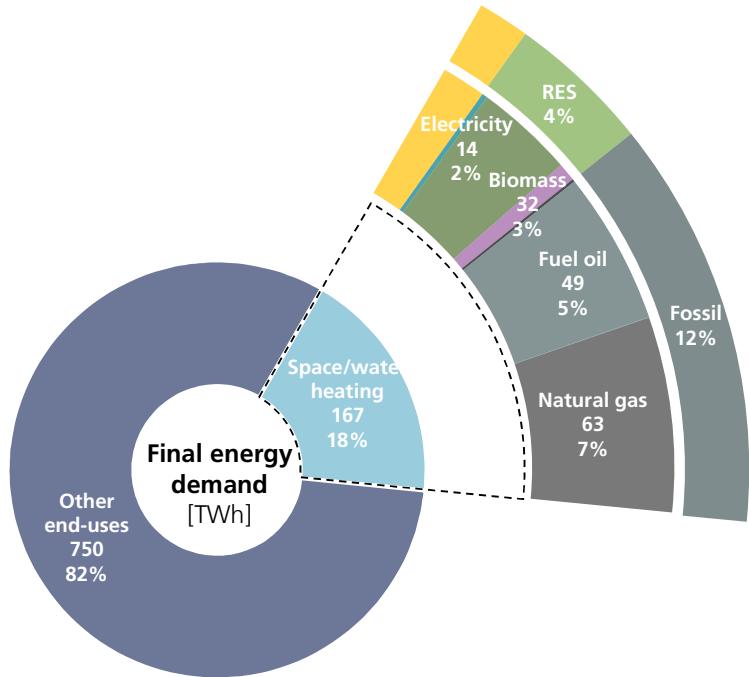
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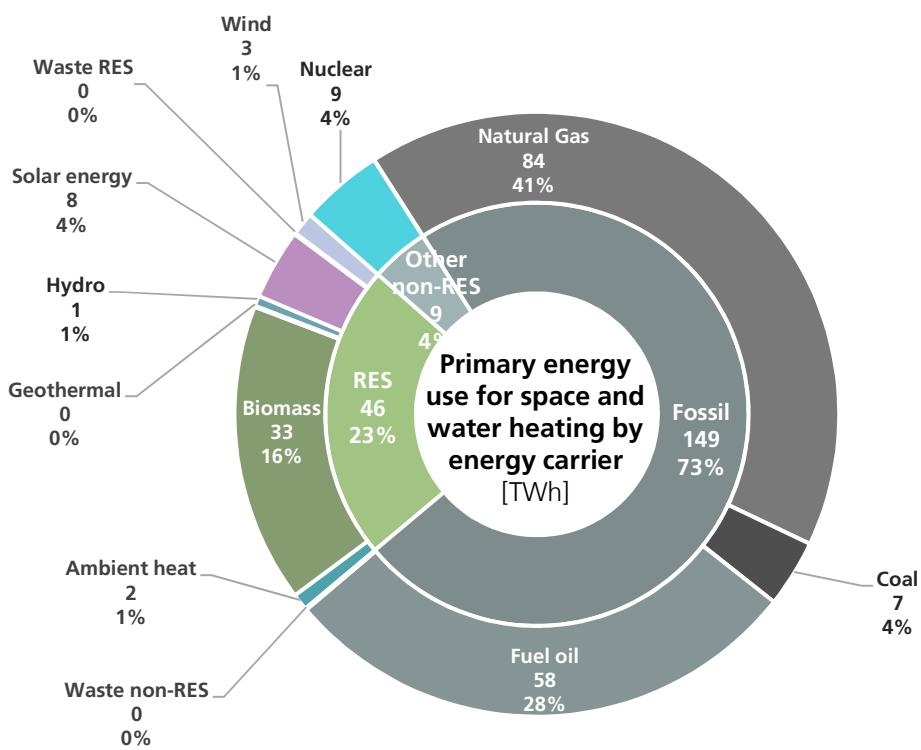
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Overview of energy demand

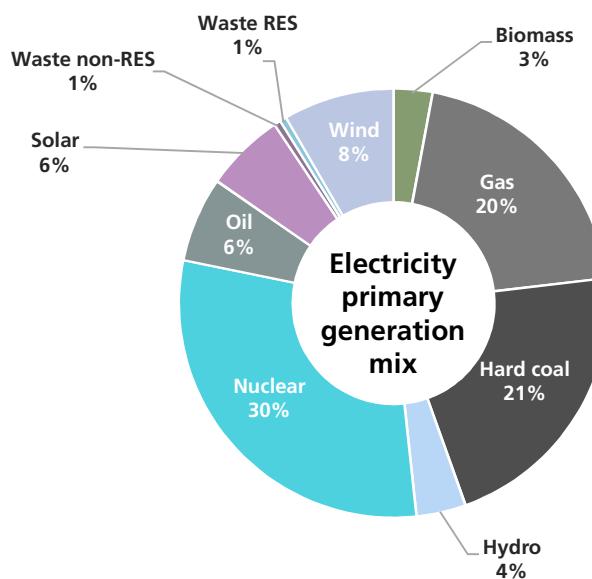
Spain 2017
6

- Ambient heat
- Biomass
- Other RES
- Solar energy
- Waste RES
- Coal
- Fuel oil
- Geothermal
- Natural gas
- Other fossil
- Waste non-RES
- District heating
- Electricity
- RES
- Fossil





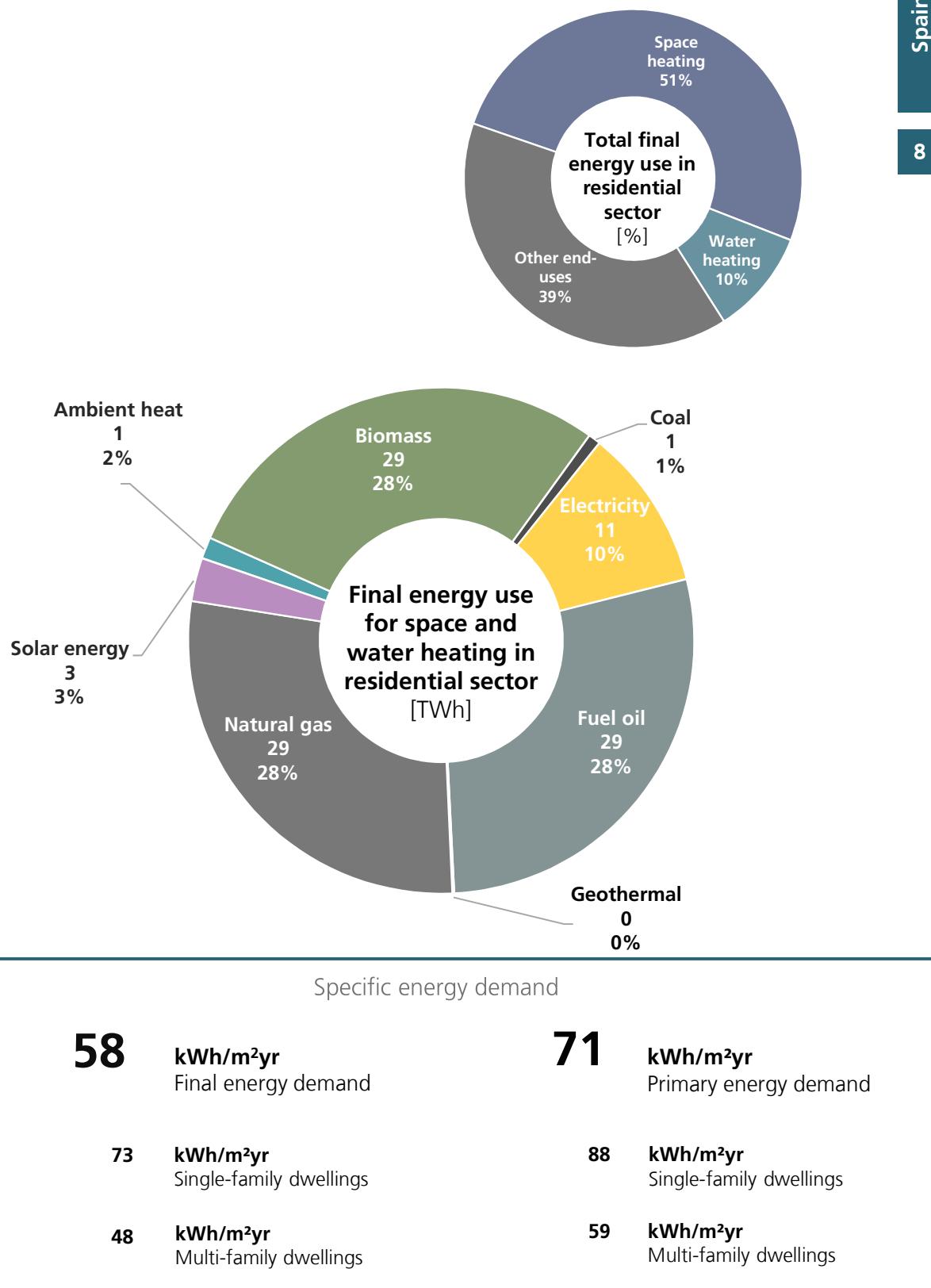
Generation mix



Space & water heating in residential sector

Spain 2017

8



Technology mix

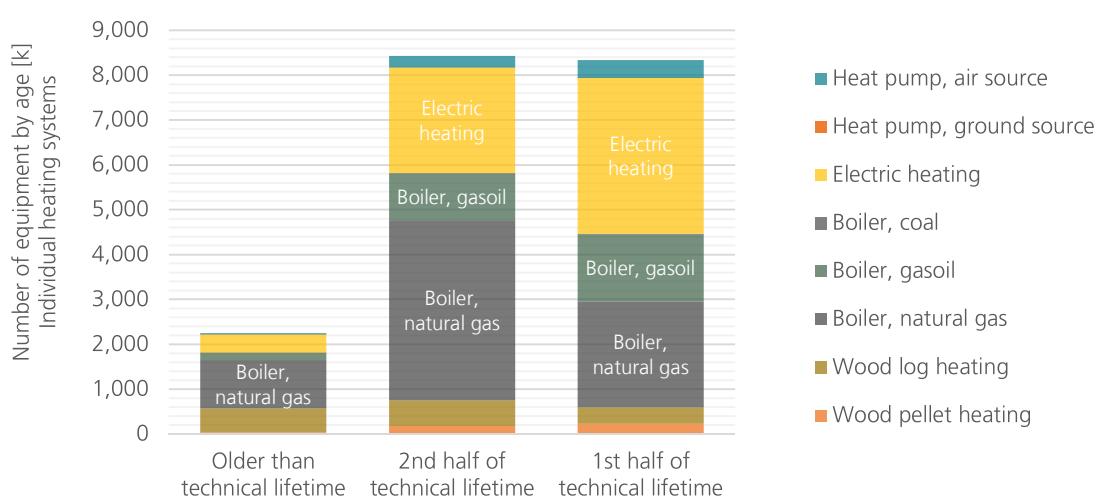
Spain 2017

9

Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	677	4%	37%	59%	4.2	4.1
Heat pump ground source	3	6%	52%	42%	4.0	0.0
Solar thermal	4,308*	3%	27%	70%	0.5	3.0
Electric heating	6,248	7%	38%	56%	1.0	6.2
Boiler, coal	22	8%	41%	51%	0.8	0.6
Boiler, gasoil	2,707	6%	38%	55%	0.9	85.1
Boiler, natural gas	7,440	14%	54%	32%	1.0	277.4
Wood log heating	1,471	37%	39%	25%	0.7	22.8
Wood pellet heating	448	8%	41%	51%	0.8	22.8

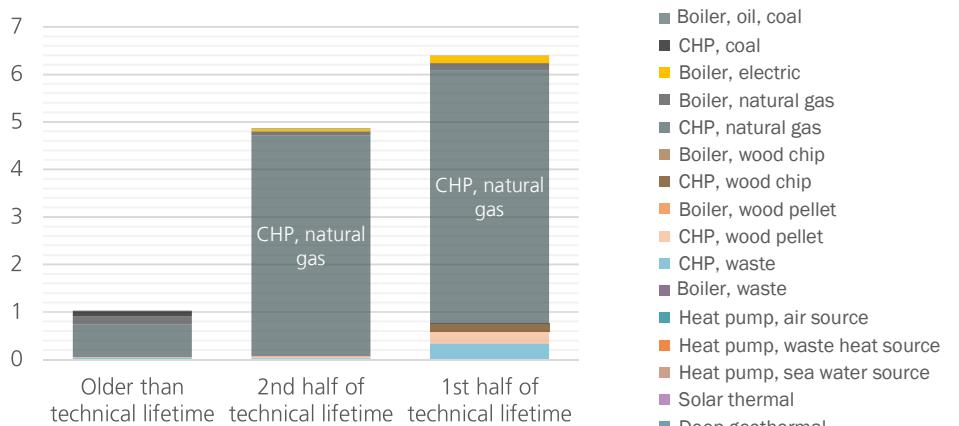
* unit 1000 m²

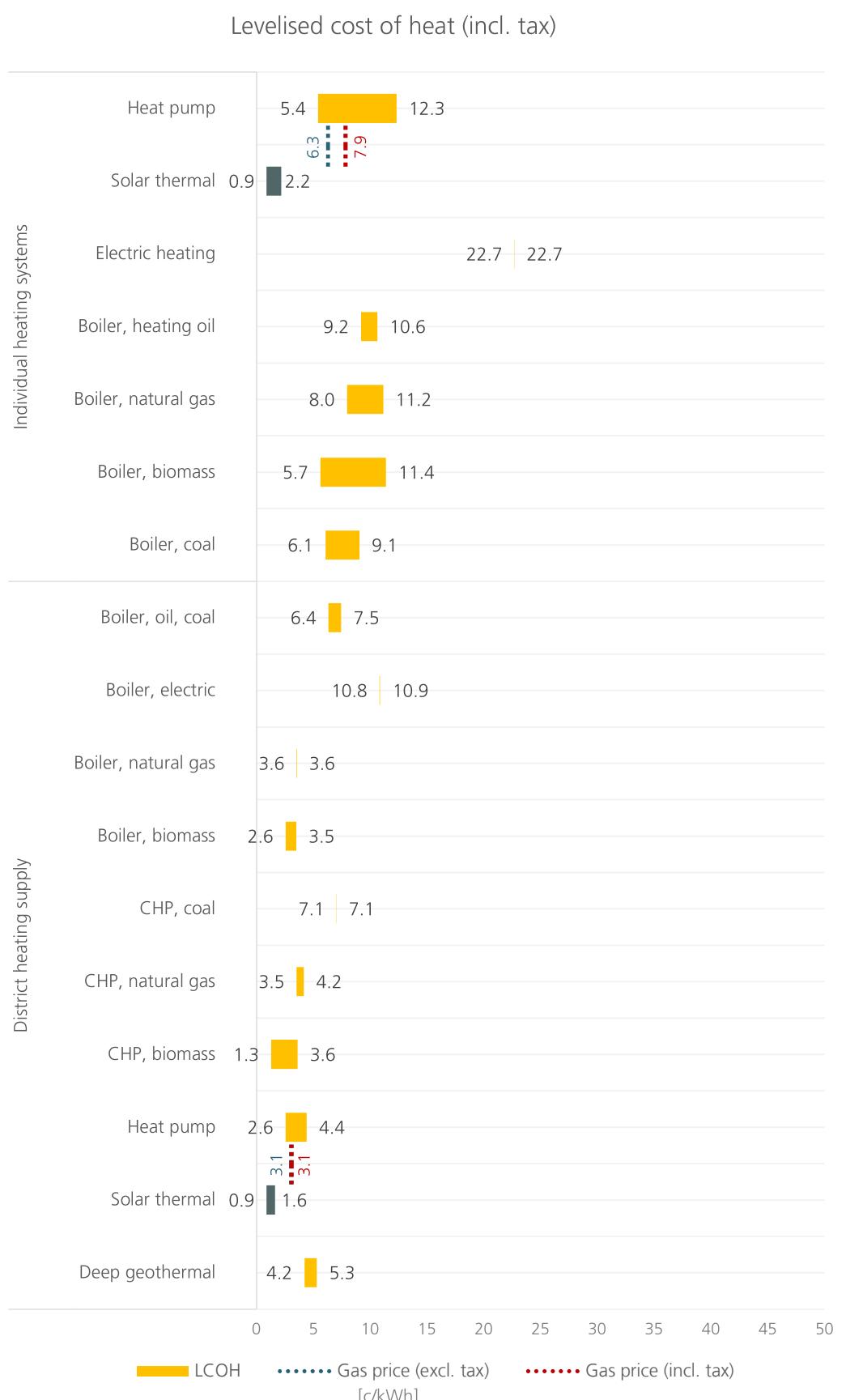
- no data



Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
District heating supply	Boiler, oil, coal	1	47%	29%	24%	0.9
	CHP, coal	2	50%	50%	0%	0.5
	Boiler, electric	14	0%	3%	97%	1.0
	Boiler, natural gas	36	33%	26%	40%	1.1
	CHP, natural gas	978	11%	59%	30%	0.4
	Boiler, wood chip	-	-	-	-	1.1
	CHP, wood chip	6	0%	0%	100%	0.9
	Boiler, wood pellet	-	-	-	-	1.0
	CHP, wood pellet	11	18%	9%	73%	0.7
	CHP, waste	12	8%	33%	58%	0.8
	Boiler, waste	-	-	-	-	1.1
	Heat pump air source	-	-	-	-	3.9
	Heat pump waste heat source	-	-	-	-	5.0
	Heat pump sea water source	-	-	-	-	3.8
	Solar thermal	3	0%	33%	67%	0.5
	Deep geothermal	-	-	-	-	6.5

- no data

District heating supply
Installed capacity by age [GWth]



Overview of policies

Financial support schemes	
Financial support for RES-H investments	
Financial support specifically addressing low-income households	
Financial support specifically addressing public buildings	
Scrapping schemes for heating equipment based on fossil fuels	
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	
Financial support specifically addressing public buildings	
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	
Heat incentives for decentral heating systems	
Energy- and CO2 pricing	
CO2 pricing	
Tax exemptions for electricity for heat pumps	
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	
RES-H obligation for existing buildings	
Trigger point: Major renovation	
Trigger point: Exchange of heating system	
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	
Trigger point: Transfer of ownership or new tenancy	
Trigger point: Efficiency class below certain level	
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	
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Information and planning	
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National requirements for urban heat planning	

No measure

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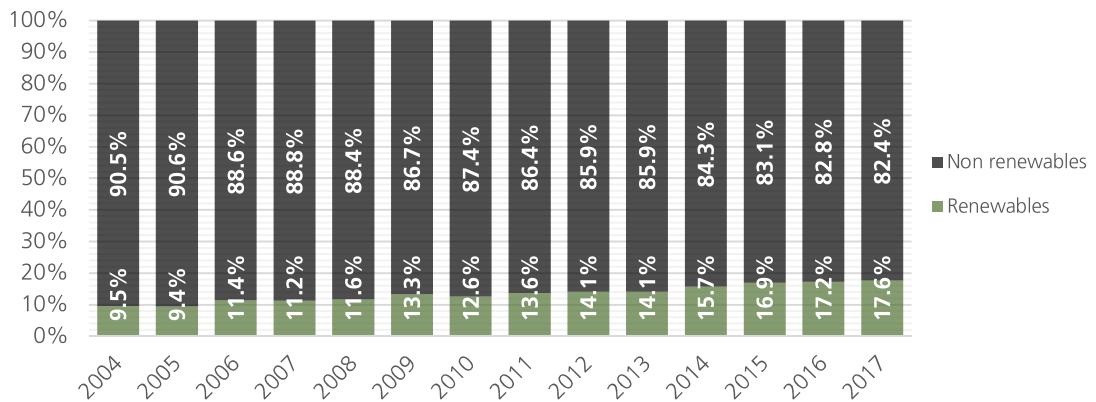
Measures in place

Historical trends

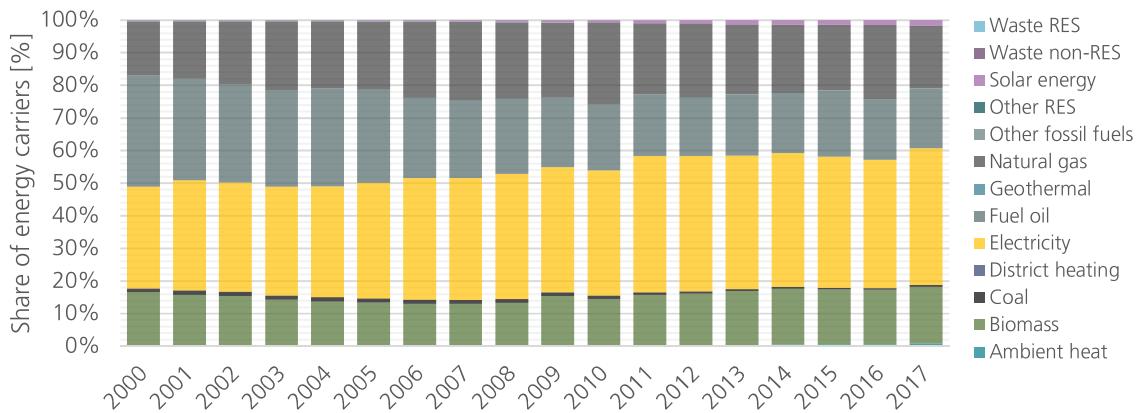
Spain 2017

13

Share of RES in Heating & Cooling



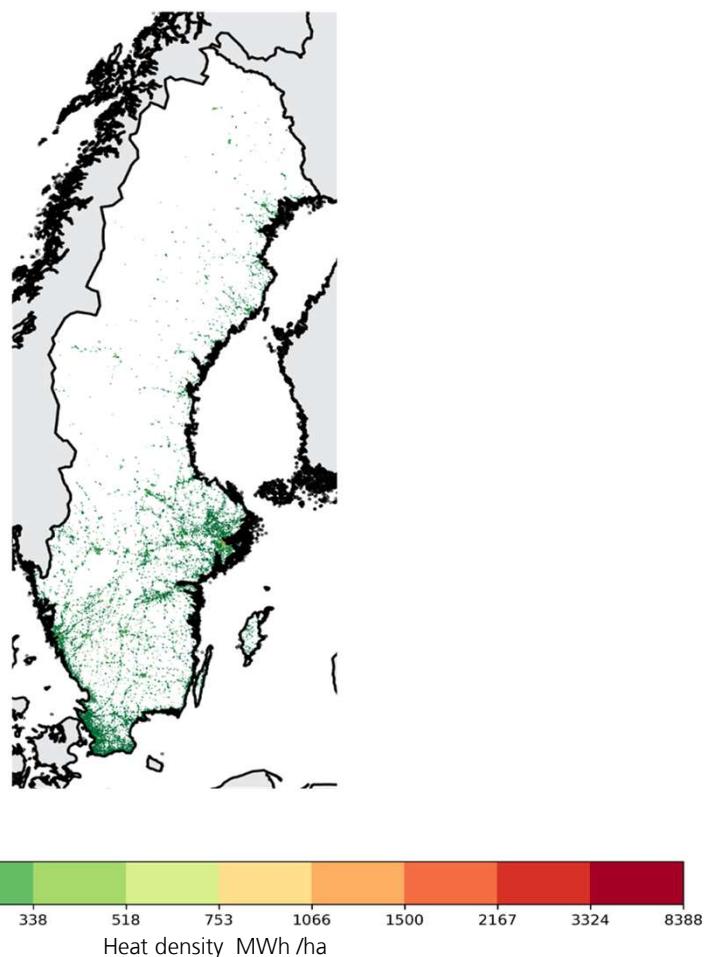
Final energy consumption in residential sector



Space heating market summary

2017

Sweden



Source: <https://www.hotmaps.eu/map>



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2. Task 1: Establish energy consumption for space and water heating for EU

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- COP is found from studies for different forward temperatures in an average climate zone (Strasbourg) for an air-to-water heat pump and scaled to the other climate zones.

3. Methodology: Calculation of heating energy balances

4. Task 2: Comparative overview of renewable space and water heating technologies

- Ground-source heat pumps have lower scaling coefficients due to less variance in ground temperature compared to air temperature.
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Part 3: Policies and historical trends

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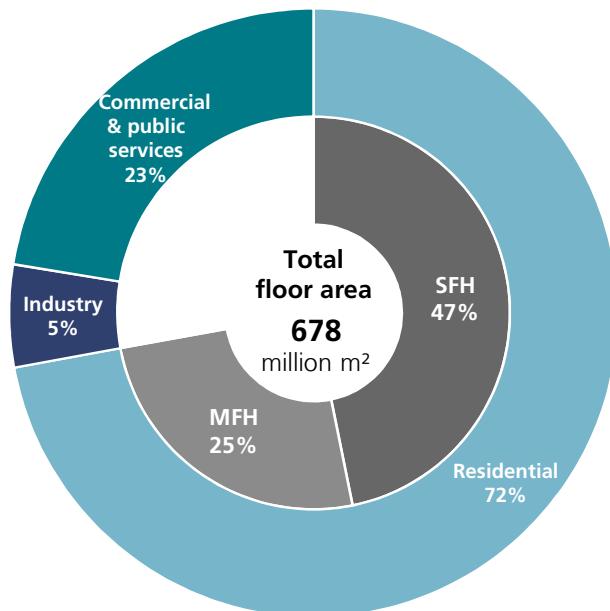
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- **Energy carrier shares in gross heat production of district heating 2000-2017:** As district heating is mainly used for space heating, this indicator provides a good overview of structural changes in the upstream heat supply, ultimately affecting primary energy and embodied CO₂ emissions in space heating. Data source for this part is Eurostat [nrg_bal_peh].

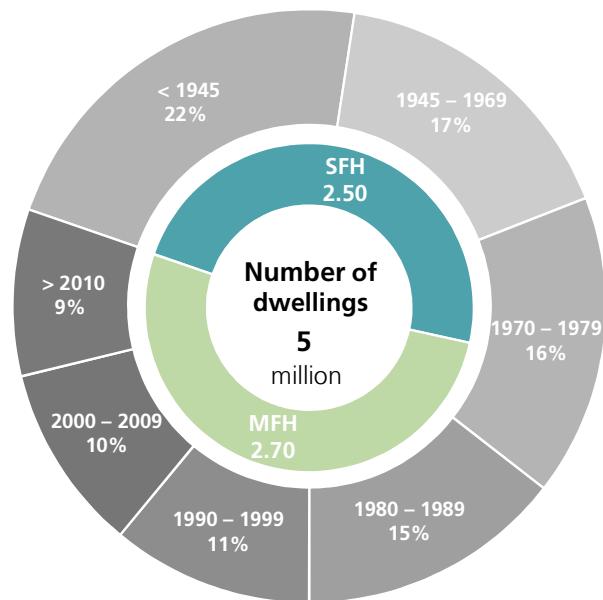
Building Stock Data

SFH: Single family house
MFH: Multi-family house



Sweden 2017

5



Number of dwellings
5 million

SFH 2.50
MFH 2.70

Climate Data

Heating degree days

Sweden

EU-27

Average value 2000-2017

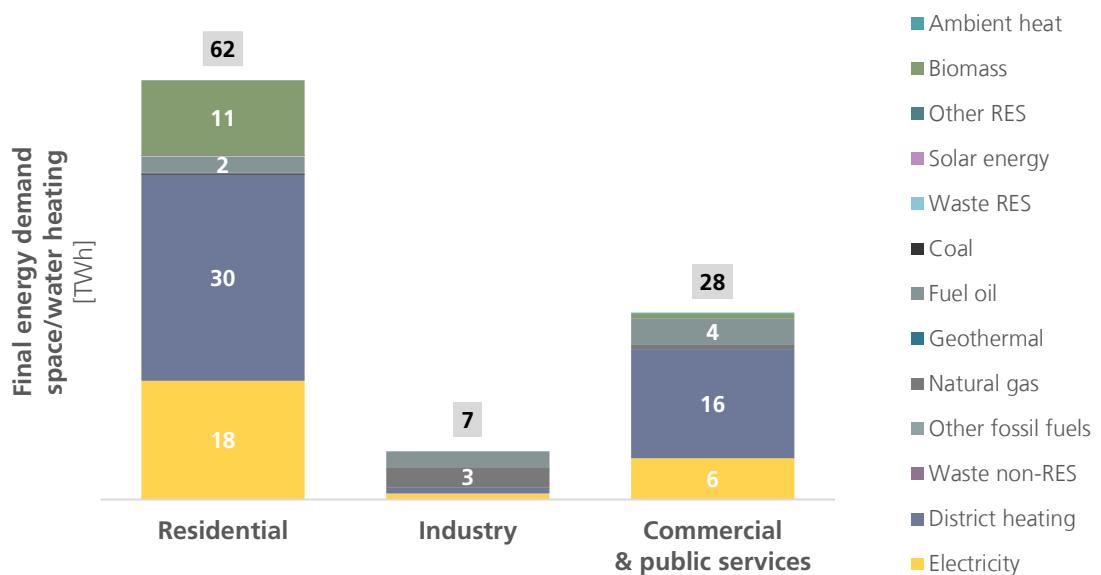
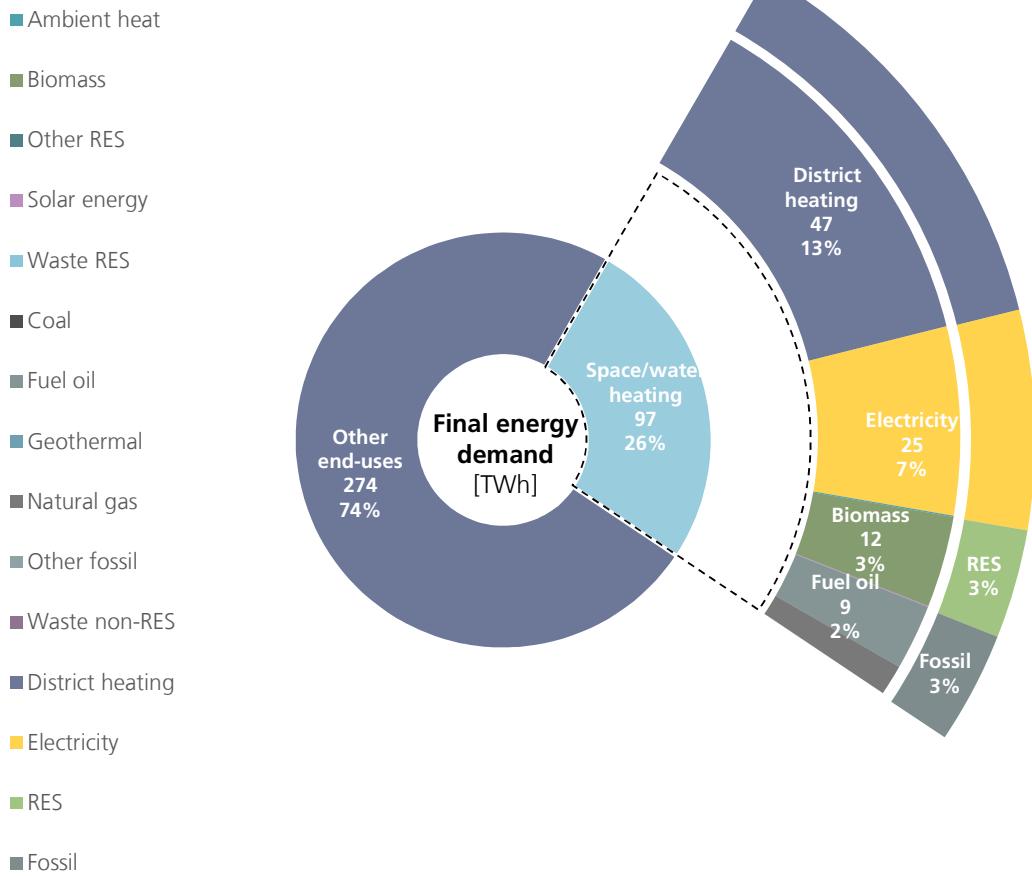
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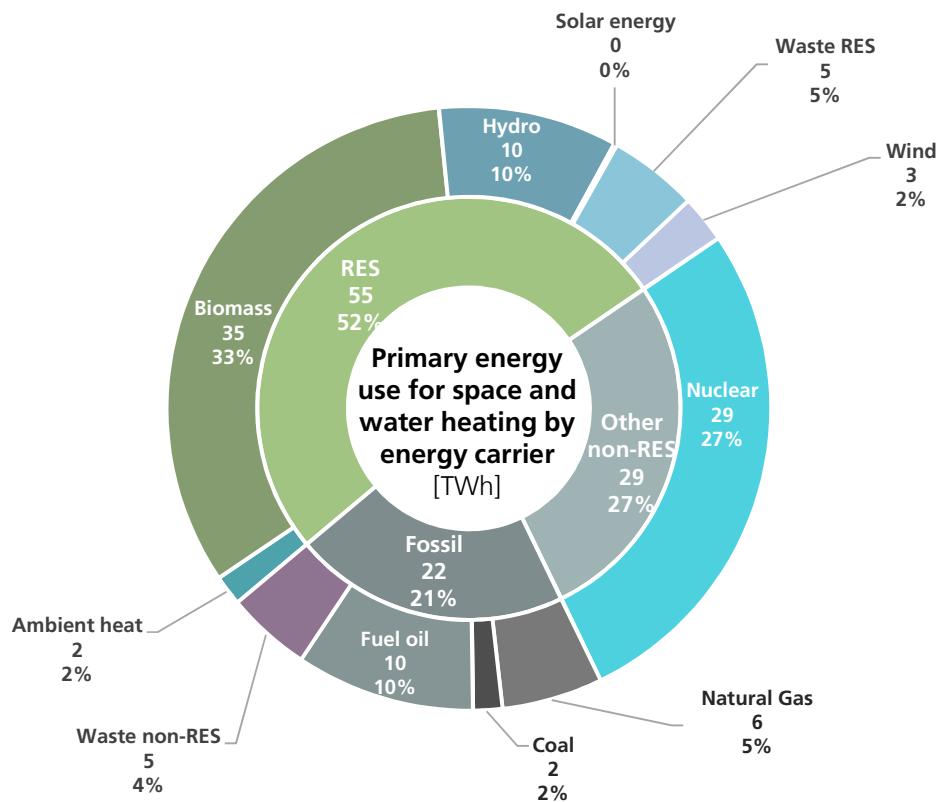
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Overview of energy demand

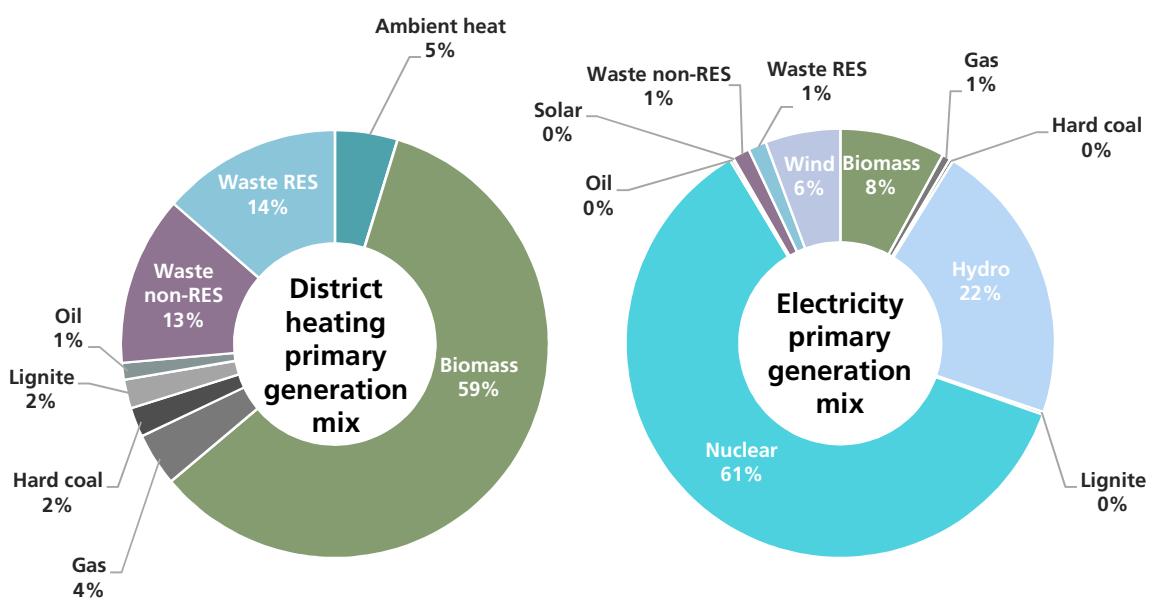
Sweden 2017

6





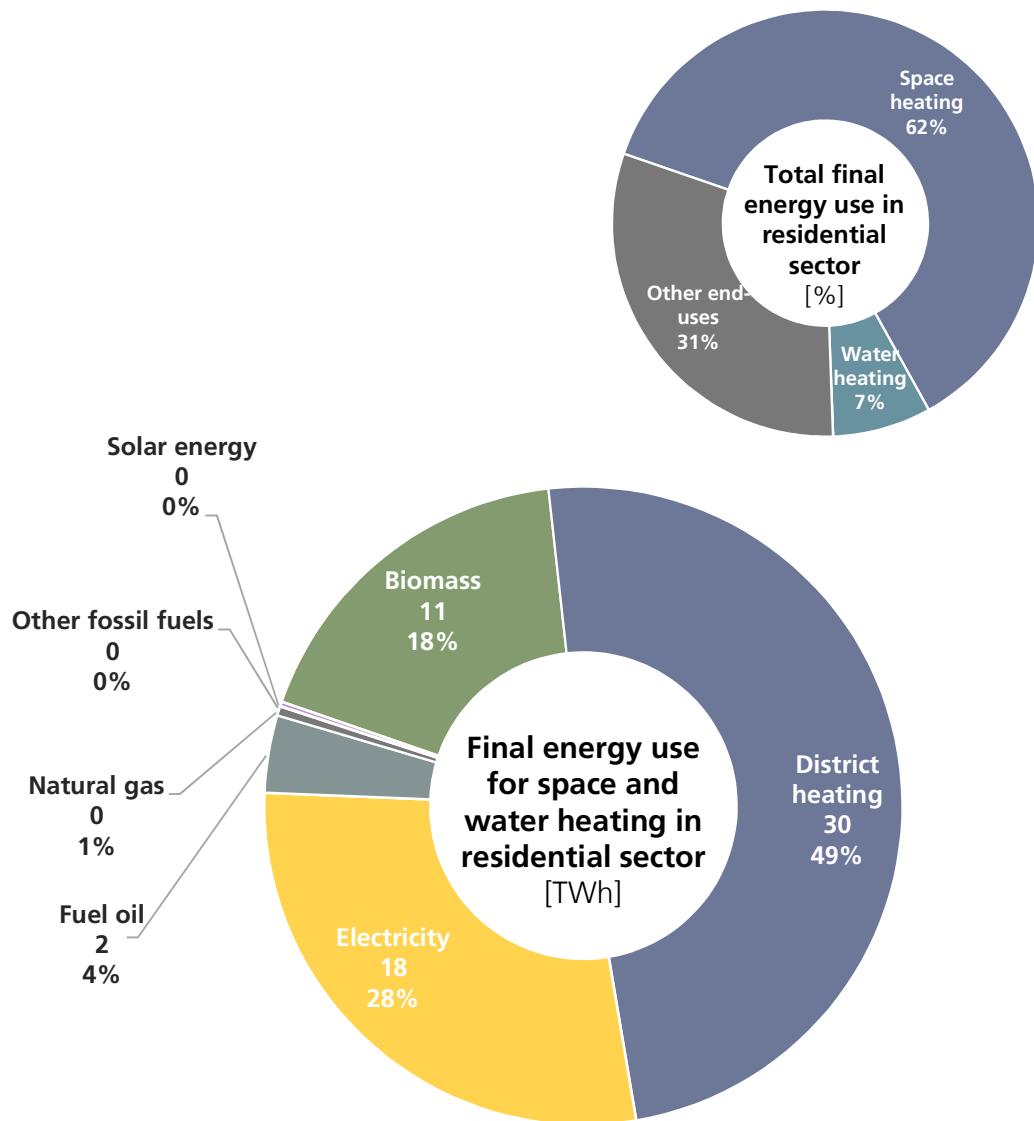
Generation mix



Space & water heating in residential sector

Sweden 2017

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Specific energy demand

127

kWh/m²yr

Final energy demand

142

kWh/m²yr

Primary energy demand

151

kWh/m²yr

Single-family dwellings

167

kWh/m²yr

Single-family dwellings

82

kWh/m²yr

Multi-family dwellings

95

kWh/m²yr

Multi-family dwellings

Technology mix

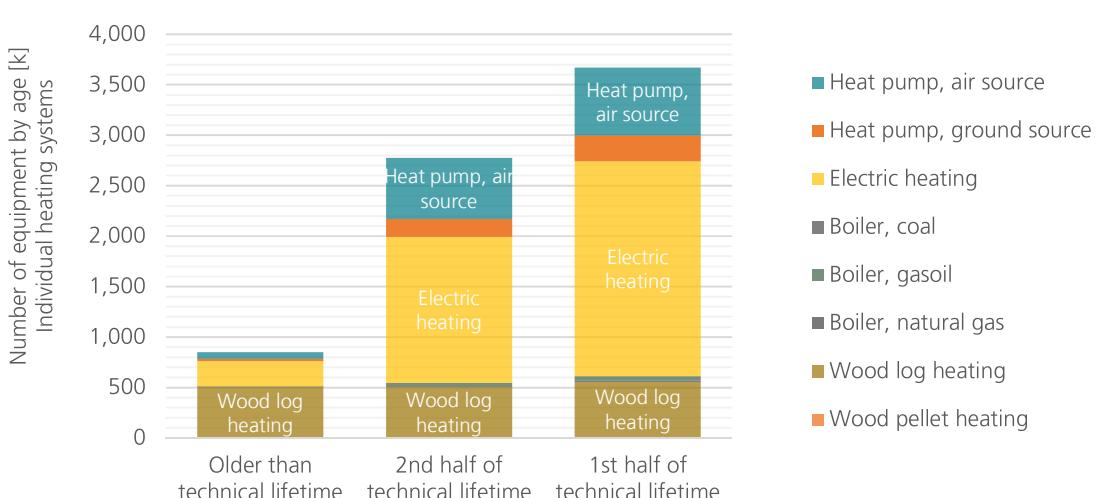
Sweden 2017

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Technology	Total number of equipment [k]	Older than technical lifetime (%)	2nd half of technical lifetime (%)	1st half of technical lifetime (%)	Technology efficiency [%]	Installed capacity [GWth]
Heat pump air source	1,346	5%	45%	50%	3.3	7.5
Heat pump ground source	454	4%	39%	57%	3.5	4.5
Solar thermal	429*	3%	27%	70%	0.5	0.3
Electric heating	3,826	7%	38%	56%	1.0	3.8
Boiler, coal	-	-	-	-	0.8	-
Boiler, gasoil	81	6%	38%	55%	0.9	2.5
Boiler, natural gas	24	10%	45%	45%	1.0	1.7
Wood log heating	1,550	32%	32%	35%	0.7	18.5
Wood pellet heating	14	8%	41%	51%	0.8	0.5

* unit 1000 m²

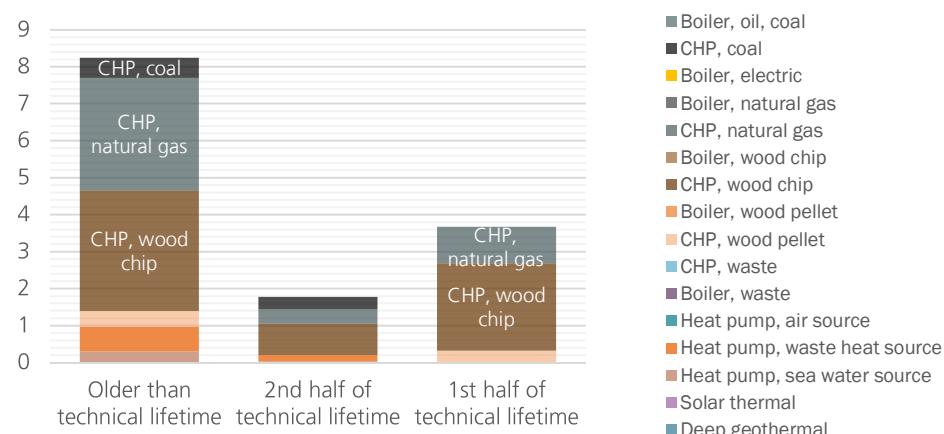
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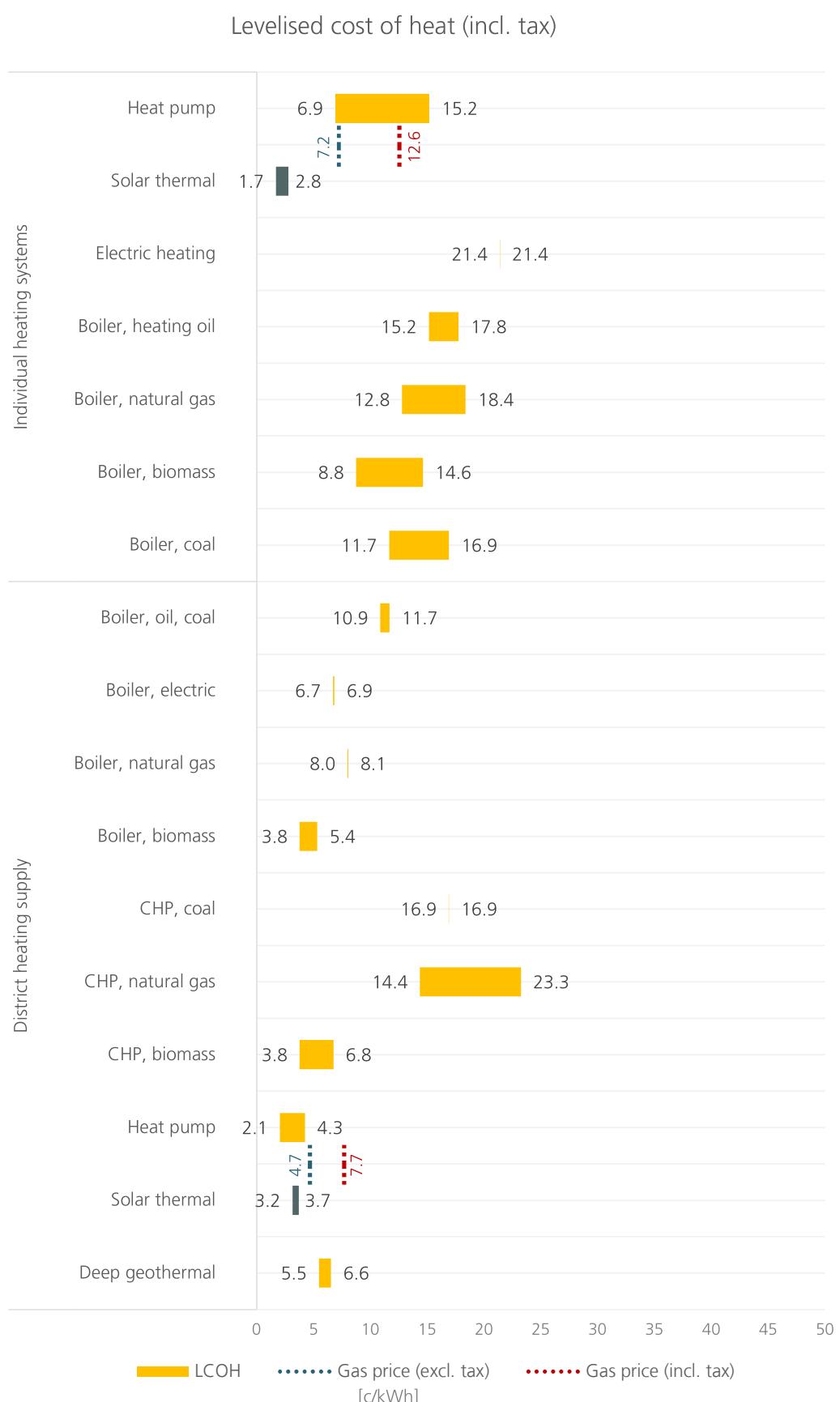


Technology	Total number of equipment	Older than technical lifetime	2nd half of technical lifetime	1st half of technical lifetime	Technology efficiency [%]	Installed capacity [GWth]
Boiler, oil, coal	-	-	-	-	0.9	-
CHP, coal	4	75%	25%	0%	0.5	0.9
Boiler, electric	-	-	-	-	1.0	-
Boiler, natural gas	-	-	-	-	1.1	-
CHP, natural gas	100	33%	35%	32%	0.4	4.4
Boiler, wood chip	-	-	-	-	1.1	-
CHP, wood chip	80	35%	20%	45%	0.9	6.5
Boiler, wood pellet	-	-	-	-	1.0	-
CHP, wood pellet	19	37%	0%	63%	0.7	0.7
CHP, waste	-	-	-	-	0.8	-
Boiler, waste	-	-	-	-	1.1	-
Heat pump air source	-	-	-	-	2.7	-
Heat pump waste heat source	35	74%	23%	3%	5.0	0.8
Heat pump sea water source	7	86%	14%	0%	2.6	0.3
Solar thermal	13	31%	46%	23%	0.4	0.0
Deep geothermal	-	-	-	-	6.5	-

- no data

District heating supply





Financial support schemes	
Financial support for RES-H investments	Measures in place
Financial support specifically addressing low-income households	No measure
Financial support specifically addressing public buildings	No measure
Scrapping schemes for heating equipment based on fossil fuels	Measures in place
Financial support for energy efficiency investments	
Financial support specifically addressing low-income households	Measures in development
Financial support specifically addressing public buildings	Measures in place
Financial support for RES-H infrastructure investments	
Price-based mechanisms (renewable heat incentives)	
Heat incentives for central heating systems	No measure
Heat incentives for decentral heating systems	No measure
Energy- and CO2 pricing	
CO2 pricing	Measures in place
Tax exemptions for electricity for heat pumps	No measure
Regulatory measures	
RES-H obligations	
RES-H obligation for new buildings	No measure
RES-H obligation for existing buildings	No measure
Trigger point: Major renovation	No measure
Trigger point: Exchange of heating system	No measure
RES-quota for district heating	
Priority access for RES and/or waste heat in district heating	
Energy efficiency requirements for new buildings	
Energy efficiency requirements for existing buildings	
Trigger point: Major renovation	Measures in place
Trigger point: Transfer of ownership or new tenancy	No measure
Trigger point: Efficiency class below certain level	No measure
Ban on fossil fuel heating technologies (oil and/or gas)	
New installations in new buildings	No measure
New installations in existing buildings	No measure
Use of fossil fuel heating technologies	No measure
Phase-out for certain building segments (e.g. public buildings)	No measure
Energy efficiency obligations (including buildings)	
Zoning regulations for DH and/or Gas	
Information and planning	
National Database for EPC	Measures in place
National requirements for urban heat planning	No measure

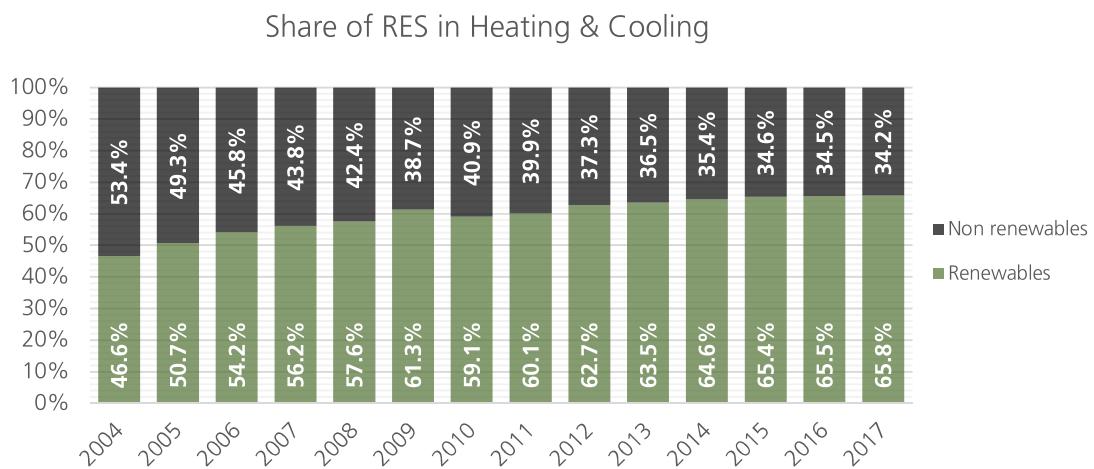
 No measure

 Measures in development

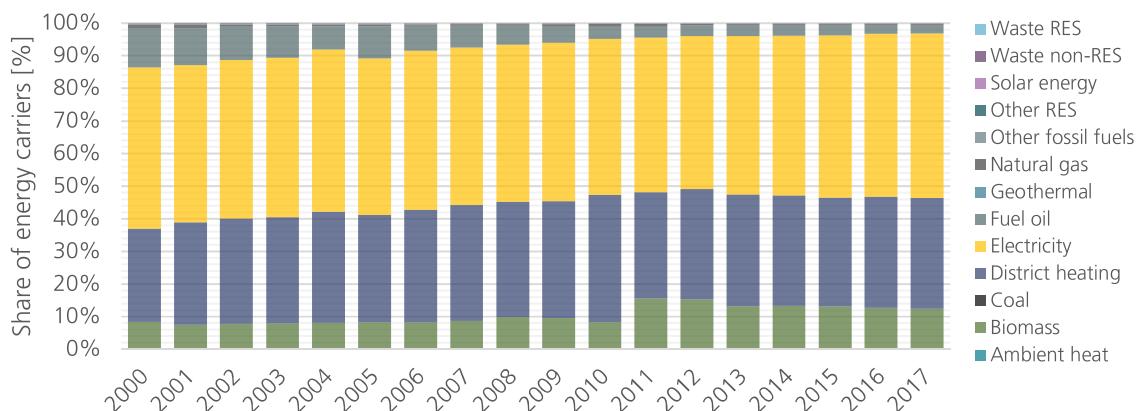
 Measures in place

Historical trends

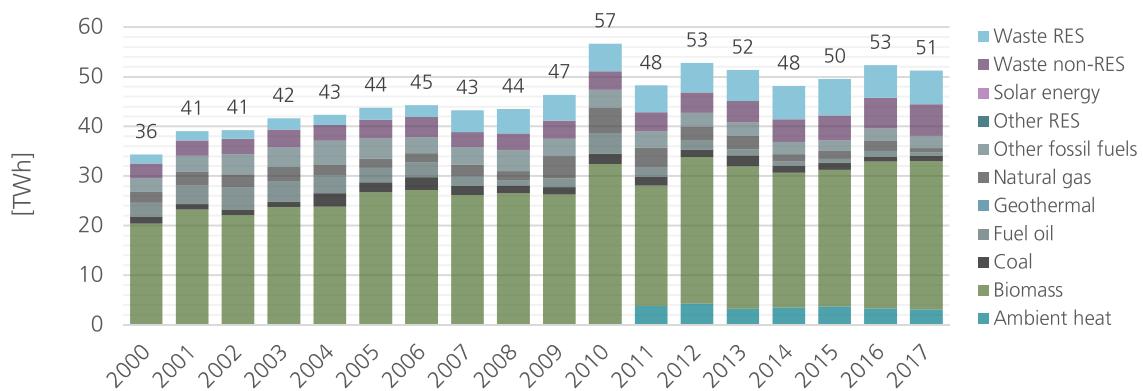
Sweden 2017



Final energy consumption in residential sector



Gross heat production in district heating grids by energy carrier



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