Renewable Energy in the Heating and Cooling sector in Austria
(including regional aspects of Styria)

D3 of WP2 from the RES-H Policy project

A report prepared as part of the IEE project
"Policy development for improving RES-H/C penetration in European Member States
(RES-H Policy)"

March 2009

Written by
Gerald Kalt (kalt@eeg.tuwien.ac.at), Energy Economics Group
Lukas Kranzl (kranzl@eeg.tuwien.ac.at)

With contributions from
Reinhard Haas (haas@eeg.tuwien.ac.at)
Andreas Müller (mueller@eeg.tuwien.ac.at)
Peter Biermayr (biermayr@eeg.tuwien.ac.at)

Supported by

The project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)" is supported by the European Commission through the IEE programme (contract no. IEE/07/692/SI2.499579).

Content

List of figures

List of tables

The RES-H Policy project

The project "Policy development for improving RES-H/C penetration in European Member States (RES-H Policy)" aims at assisting Member State governments in preparing for the implementation of the forthcoming Directive on Renewables as far as aspects related to renewable heating and cooling (RES-H/C) are concerned. Member States are supported in setting up national sector specific 2020/2030 RES-H/C targets. Moreover the project initiates participatory National Policy Processes in which selected policy options to support RES-H/C are qualitatively and quantitatively assessed. Based on this assessment the project develops tailor made policy options and recommendations as to how to best design a support framework for increased RES-H/C penetration in national heating and cooling markets.

The target countries/regions of the project comprise Austria, Greece, Lithuania, The Netherlands, Poland and UK – countries that represent a variety in regard of the framework conditions for RES-H/C. On the European level the projects assesses options for coordinating and harmonising national policy approaches. This results in common design criteria for a general EU framework for RES-H/C policies and an overview of costs and benefits of different harmonised strategies.

This report

This report provides an overview of the current situation in one of the target countries, specifically Austria (including regional aspects of Styria). It describes the structure and current state of the market for heating and cooling in Austria and the levels of penetration of renewable heating and cooling technologies. Furthermore, policy and regulatory efforts adopted in support of RES-H/C are described and the associated levels of success are assessed.

Since in Austria a major part of RES-H policies are in the responsibility of the regional governments, a special focus of this report is on the Austrian province of Styria.

Similar reports have also been prepared relating to the other countries/regions targeted within this project (Greece, Lithuania, Netherlands, Upper Austria, Poland, UK).

Executive summary

Heat generation accounts for about 50% of the total final energy consumption in Austria and about 40% of Austria's total greenhouse gas emissions are related to heat generation. Hence, increasing the share of renewable energy systems in the heat sector is of central importance for achieving climate and energy policy targets.

Compared to most other (Central) European countries the proportion of renewable energy in the Austrian heat sector is relatively high. This is mainly due to the high share of bioenergy in residential heating and the high importance of industrial wood residues which are partly used to cover the wood-processing industries' heat – and to some extent also power – demand. Chapter 1 and 2 give an overview of the structure of the current energy and heat consumption.

Compared to heat generation the energy demand for cooling is almost negligible in Austria. In Chapter 3 an assessment of the status quo is presented.

Chapter 4 provides insight into the current structure of residential and high-temperature heat generation as well as the historic development of the use of biomass and other renewable technologies in the heat sector. In recent years especially pellet boilers became increasingly important in the residential heating sector. Compared to other technologies the contribution of heat pumps and solar thermal heat generation is still quite moderate, but the growth rates were notable in recent years. In the 80ies heat pumps for water heating had already become quite popular but sales figures in Austria declined significantly during the 90ies. However, since 2000 the number of annually installed heat pumps has more than tripled, and especially heat pumps for auxiliary space heating are becoming increasingly important. During the same period, the annually installed area of solar thermal collectors has almost doubled. Apart from detailed descriptions of these developments, Chapter 4 also includes a scenario for the heat sector until 2030 and cost data for renewable heating systems.

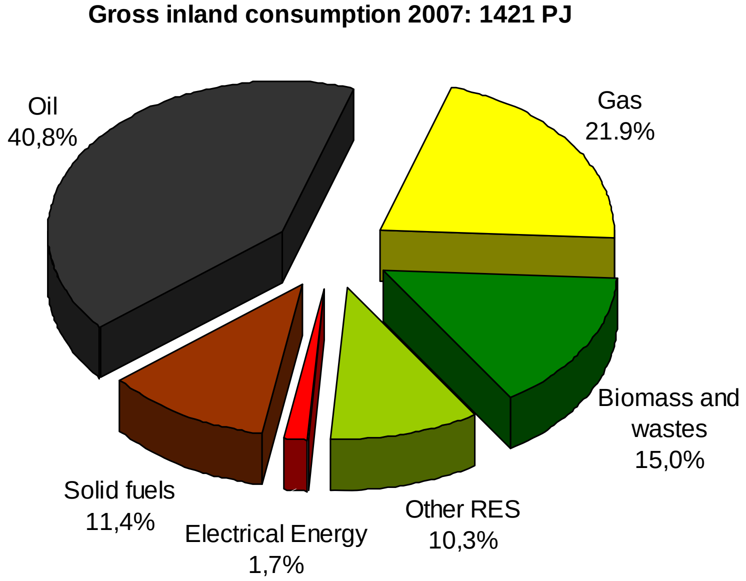
Investment subsidies definitely played a central part in the deployment of renewable technologies in the heat sector. Subsidies for small-scale systems are in the competence of provinces and differ significantly, both with regard to amount and preconditions (e.g. efficiencies and emissions of biomass heating systems). Chapter 5 gives an overview of the currently implemented investment subsidies, fiscal incentivisation and other regulations and actions for promoting renewable heating systems.

In Chapter 6 an overview of subsidies and pilot projects in the field of renewable cooling systems in Austrian as well as scenarios of the cooling demand up to 2030 are presented. In Chapter 7 ongoing legislative, regulatory and market changes are described.

1 Introduction

This chapter is to give a short overview of the Austrian energy supply and the share of heat generation and cooling in the total energy consumption. Figure 1 shows the structure of the gross inland consumption in 2007. The highest contribution to the Austrian energy supply comes from the fossil fuels oil and gas (more than 40% and 20%, respectively). Due to the traditionally high shares of hydropower and biomass, the contribution of renewable energy sources is also relatively high (more than 25%).

Figure 1: Gross inland energy consumption in Austria in 2007

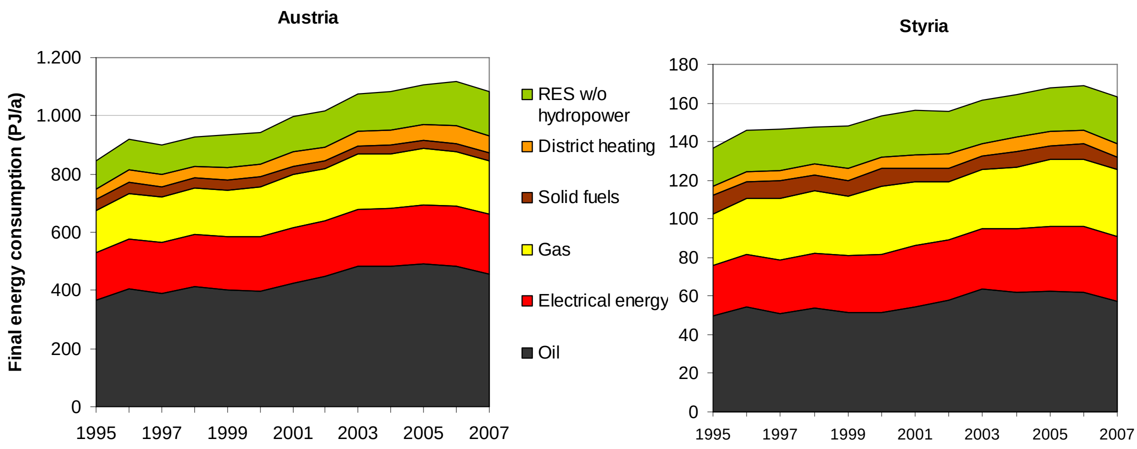


Source: Statistik Austria 2008

Figure 2 shows the development of the final energy consumption in Austria and the Province of Styria. During this period, the final energy consumption in Austria increased from 845 to 1.083 PJ/a (increase of about 30%). For the first time since 1997 the annual consumption decreased from 2006 to 2007 (by about 3%). This can be attributed to the exceptionally warm winter on the one hand and to the rapid increase in fuel prices on the other. With regard to the structure of the final energy consumption, only a slight shift towards district heating (+1,2%) and RES (+2,5%) occurred from 1995 to 2007.

In Styria, the final energy consumption increased by about 20% during the period 1995 to 2007. The structure of the Styrian final energy consumption only shows slight differences to the Austrian. These differences include slightly higher contributions of biomass and gas.

Figure 2 Development of the final energy consumption in Austria and Styria from 1995 to 2007

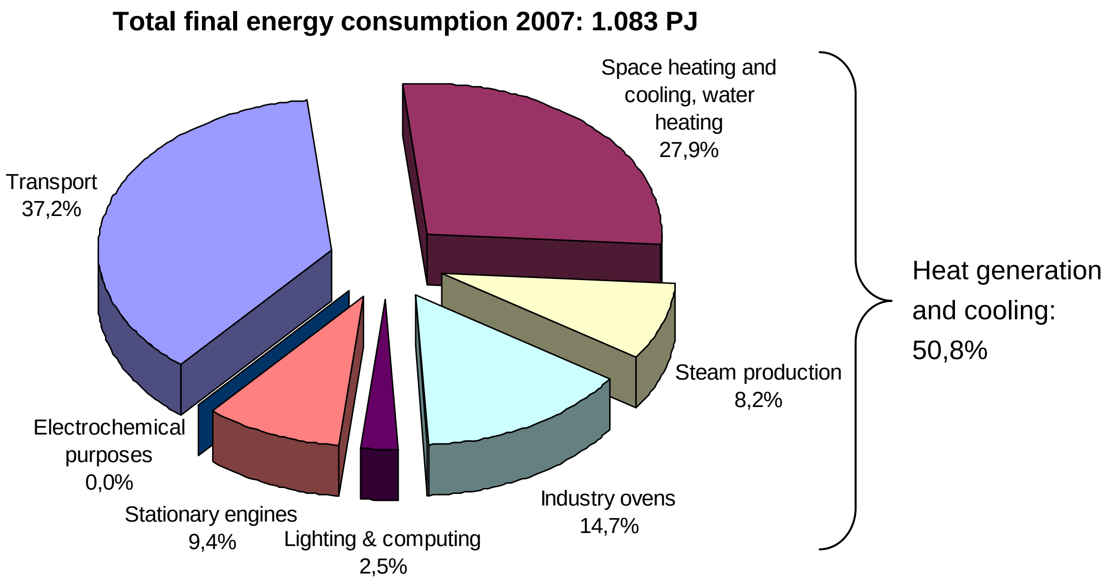


Source: Statistik Austria 2008

Figure 3 gives an overview of the structure of the final energy consumption in 2007. Transport (including off-road traction) accounts for the biggest share in the final energy consumption, followed by the category “space heating, cooling and water heating”. The share of cooling in this category is estimated less than 1%. According to the official energy statistics by Statistik Austria, high-temperature heat generation is subdivided into “steam production” (including process heat) and “industrial ovens”. In total, low- and high-temperature heat generation and cooling account for more than 50% of the total energy consumption in Austria.

Statistical data on the energy demand for cooling in Austria are sparse. In literature there are only a few estimates on the total electricity demand for cooling. In Haas et al. 2007, the energy demand for air conditioning in the year 2005 is estimated about 365 GWh, on the basis of a bottom-up approach. Hence, it is about 0,4% of the category “space heating, cooling and water heating” (and less than 5% of the total electrical energy used for these purposes).

Figure 3 Structure of final energy consumption in Austria in the year 2007



Source: Statistik Austria 2008

The final energy consumption in Styria was 15% of the total consumption in Austria in 2007 (163 PJ).

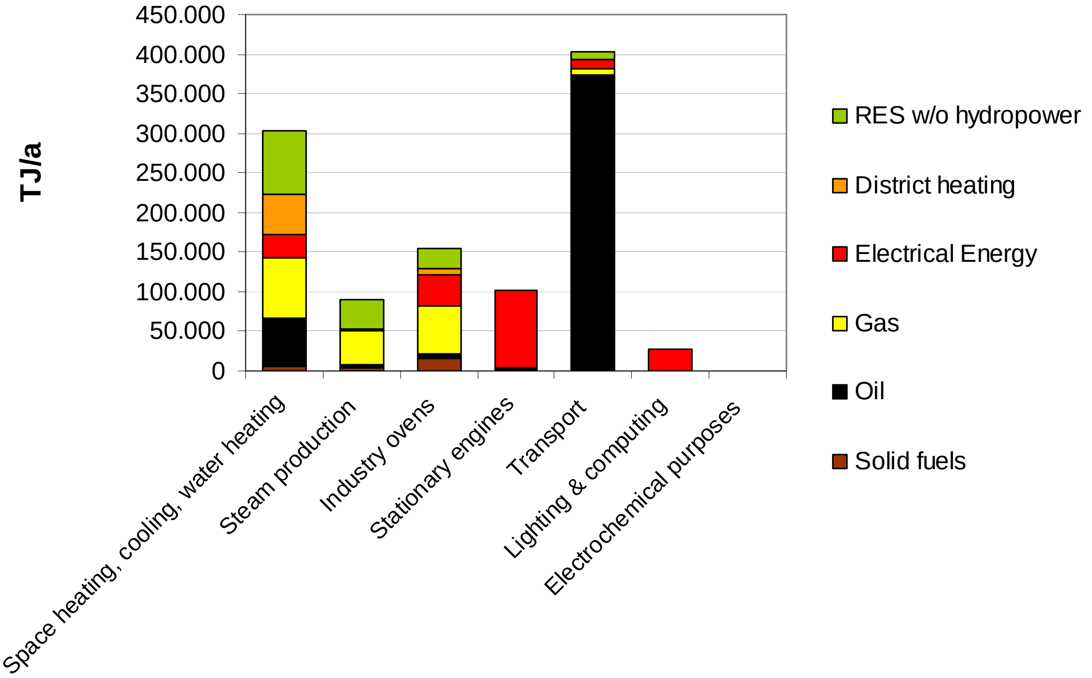
The greenhouse gas emissions related to heat generation and cooling were about 36,2 million tons (mt) in 2005, according to Haas et al. 2007. This is approximately 40% of the total national greenhouse gas emissions. Thereof, 22,4 mt were related to space and water heating, 0,1 mt to cooling, 4,6 mt to steam production and 9,1 mt to industry ovens.

2 Architecture of the market for heat

2.1 Final energy consumption

The structure of the final energy consumption broken down by energy source and sectors is shown in Figure 4. “Space heating, cooling and water heating” comprises low-temperature heat generation and air conditioning in buildings, “Steam production” industrial and commercial heat generation and process heat and “industrial ovens” industrial and commercial facilities, reaching from small bakery ovens to large blast furnaces. The fraction “stationary engines” includes the final energy consumption of all kinds of engines which are not used for mobility, reaching from small engines in household appliances to large engines in industrial production processes. Transport comprises road transport as well as rail, air and marine traffic. Further categories are “lighting and computing” and “electrochemical purposes”.

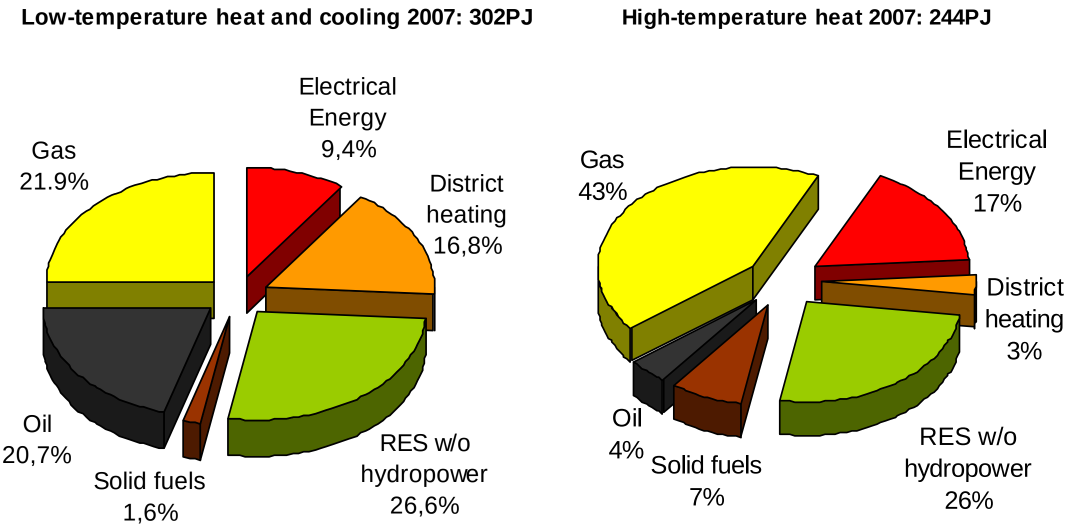
Figure 4 Final energy consumption in Austria in the year 2007 broken down by energy sources and applications



Source: Statistik Austria 2008

With regard to the architecture of the energy sources, it is obvious that both in low- and high-temperature heat applications, a wider variety of energy sources is used than in the other categories, where electrical energy and oil, respectively, account for almost 100%. Furthermore, the share of renewable energy sources in heat generation is already relatively high. They account for more than one fourth of the total energy consumption for low- as well as for high-temperature heat generation, as Figure 5 illustrates (with the share of district heating and electrical energy from renewable sources – especially hydropower – not included)[1]. The main contribution comes from solid biomass in its different forms (fuelwood, wood chips, pellets, wood residues etc.).

Figure 5 Final energy consumption for low- and high-temperature heat (steam production and industry ovens) broken down by energy sources in the year 2007



Source: Statistik Austria 2008

2.2 Residential heating

Table 1 and Figure 6 provide insight into the current structure of the current stock of principal residences in Austria and the installed heating systems. About 50% of the total stock has central heating systems installed and about one fifth is equipped with access to district heating systems. Concerning the age-structure, it is clear to see that in residences in older buildings the share of single stoves, gas and self-contained central heating systems is significantly higher than in newer buildings. Among residential buildings which were constructed after 1970, about 60% have central heating systems installed and 22% have access to district heating.

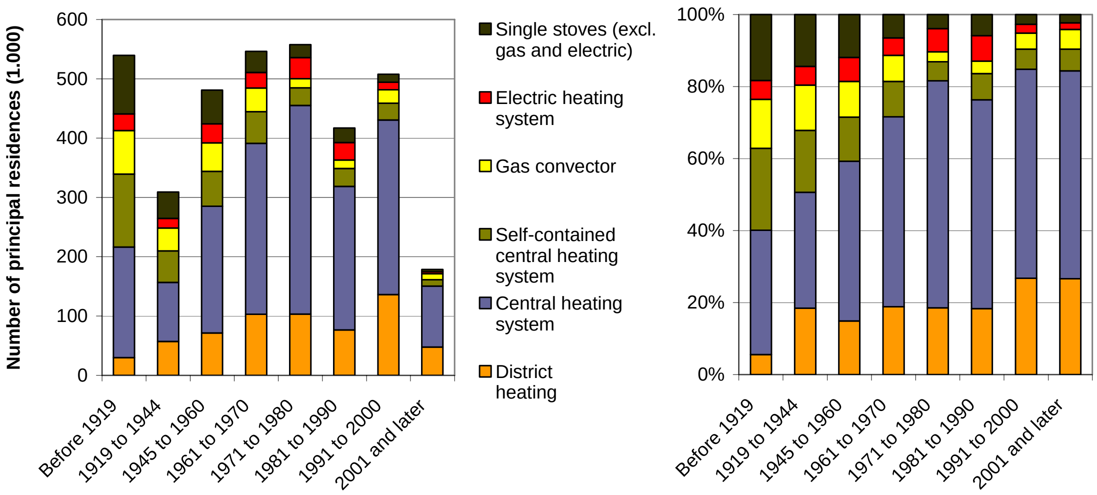
[1] Power generation in Austria in 2007: hydropower: 38.196 GWh (59,4%), thermal power: 23.353 GWh (36,3%), „new" renewables: 2.059 GWh (3,2%), others: 675 GWh (1,05%), Total: 64.283 GWh (100%); Share of hydropower and "new" renewables: 40.255 GWh (62,6%); Source: E-Control (2008)

Table 1 Structure of principal residences in Austria broken down by age-structure of the building and heating systems (2007)

Stock of principal residences	Total principal residences	District heating	Central heating system	Self-contained central heating system	Gas convector	Electric heating system	Single stoves (excl. gas and electric)
	1.000						
Total	**3.536,9**	**624,5**	**1.779,5**	**387,0**	**262,5**	**183,0**	**300,5**
Before 1919	539,6	29,9	186,6	122,6	73,5	28,1	99,0
1919 to 1944	309,1	56,9	99,6	53,1	38,9	16,0	44,5
1945 to 1960	481,1	71,6	213,6	58,8	47,8	32,1	57,3
1961 to 1970	546,2	102,9	288,3	53,4	39,8	26,2	35,6
1971 to 1980	557,5	103,2	351,9	29,5	15,4	35,6	21,8
1981 to 1990	417,1	76,5	241,9	30,3	14,5	29,3	24,5
1991 to 2000	507,8	136,0	294,5	28,5	22,7	12,3	13,8
2001 and later	178,6	47,5	103,1	10,7	9,8	3,3	4,0

Source: Statistik Austria 2008

Figure 6 Structure of principal residences in Austria broken down by age-structure of the building and heating systems (2007)



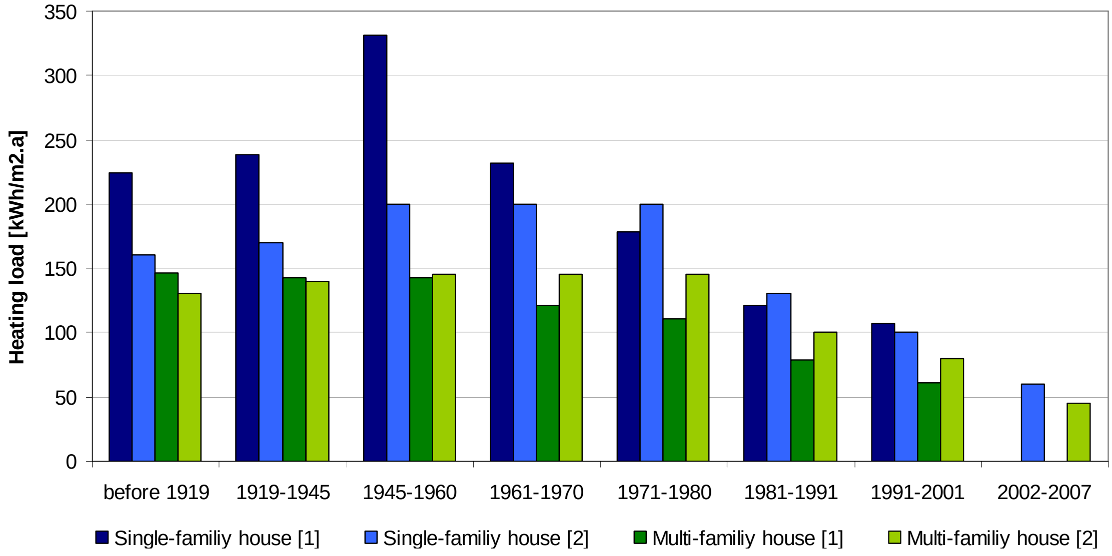
Source: Statistik Austria 2008

In the last 30 years or so, the quality of thermal insulation of residences in Austria has improved significantly. In Figure 7, data on the heating load of single- and multi-family houses in Austria broken down by age structure according to two different studies are illustrated. According to these data, the annual heating loads of single-family houses which were built before 1981 range from about 160 to more than 300 kWh per m^2 and those of multi-family houses from about 110 to 150 kWh per m^2. By contrast, the annual heating loads of houses from the period 2002 to 2007 are about 50 kWh/m^2.

According to Amann 2008, the following annual rates of thermal renovation were achieved in the 1990ies: Less than 1% in the field of privately owned houses and homestead apartments and about 2% in the field of municipal tenements. On average, the rates of thermal renovation were 1%. Current rates are estimated to be slightly higher (1% and between 2 and 3%, respectively).

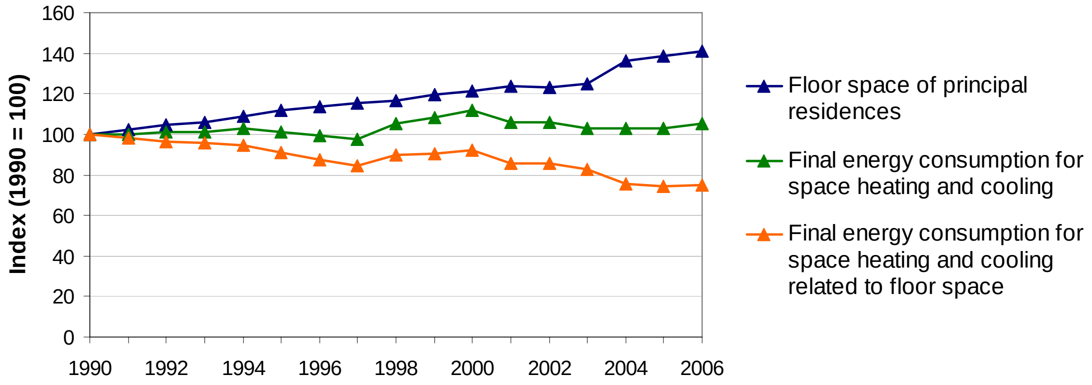
However, from 1990 to 2006, the effect of decreasing average heating loads was compensated by an increase of the average floor space, as Figure 8 illustrates. In total, the final energy consumption for space heating and cooling has stayed relatively constant throughout this period.

Figure 7 Heating load of single- and multi-family houses in Austria broken down by age-structure



Sources: Biermayr 1999 [1], Lang et al. 2007 [2]

Figure 8 Indices of final energy consumption for space heating and cooling in Austria from 1990 to 2006



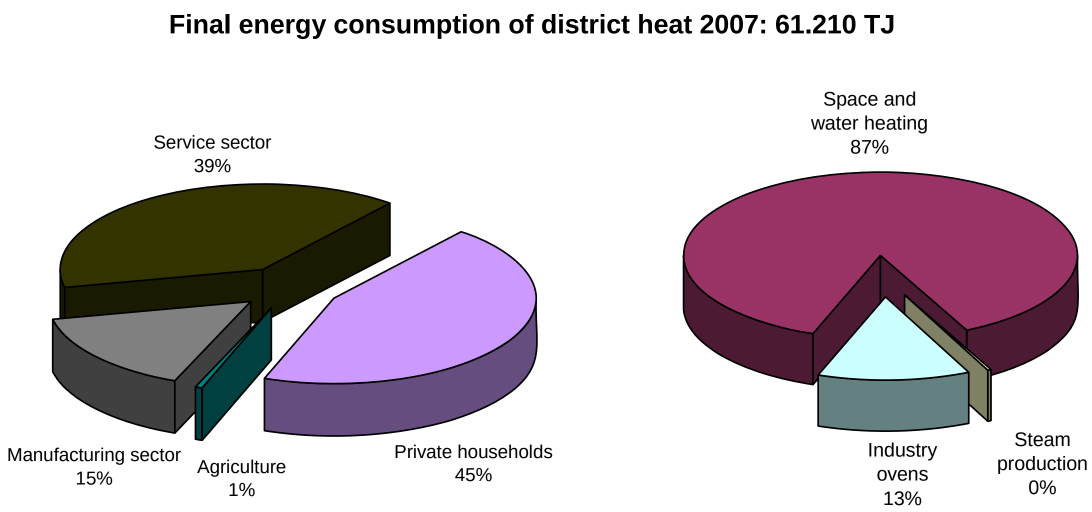
Sources: Statistik Austria

2.3 District heat

In Figure 9 the structure of the use of district heat in Austria is illustrated. 45% of the final energy of district heating systems is used in private households, 39% in the service sector and the rest primarily in the manufacturing sector. The main purpose of district heat is for space and water heating (87%) and 13% are used in industry ovens.

Since 1980 the share of dwellings which are supplied with district heat has increased from approximately 83.000 to 625.000 (2007), which corresponds to 18% of all dwellings in Austria. Among dwellings which were constructed after 2001, the share is even clearly higher (27%). The shares in Austria's biggest cities are: 36% in Vienna, 60% in Linz, 30% in Klagenfurt, 26% in Graz and 23% in Salzburg. In total, the length of district heating grids in Austria is approximately 4.000 kilometres (2007), which is about twice as much than in 1995 (source: FGW 2009).

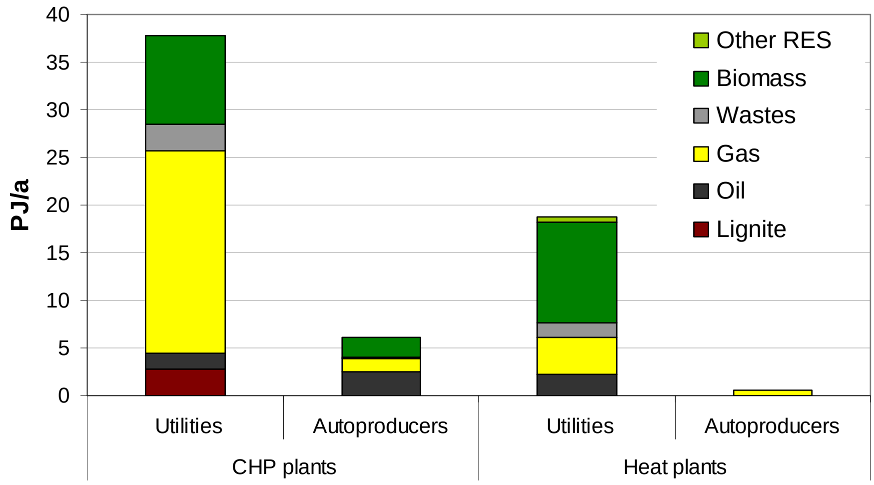
Figure 9 Structure of final energy consumption of district heat in Austria 2007



Source: Statistik Austria 2008

Figure 10 shows the structure of district heat supply in Austria, broken down by energy sources, plant types (CHP and heat plants) and operators (utilities and autoproducers). The biggest contribution is made up by utility-owned, gas-fired CHP plants, followed by utility-owned biomass heat plants. In total, biomass accounts for approximately 35%, other RES for 1%, wastes for 7% and fossil fuels for 57% of the total district heat production.

Figure 10 Structure of district heat supply in Austria in 2007



Source: Statistik Austria 2008

Institutional players in the Austrian heating sector include the following:

The Austrian gas and district heat suppliers are organized in the “Fachverband der Gas- und Wärmeversorgungsunternehmungen (FGW)” (Association of gas and district heat supply companies). Apart from gas and district heat suppliers, the FGW also represents the interests of district cold supplying companies.

The regulatory authority for the Austrian electricity and gas markets is the E-Control GmbH. It was set up by the legislator on the basis of the new Energy Liberalisation Act and is entrusted with monitoring, supporting and, where necessary, regulating the implementation of the liberalisation of the Austrian electricity and natural gas markets. (E-control 2009)

3 Architecture of the cooling sector

As already mentioned in section 1, there are no statistical data available on the energy consumption for cooling and the structure of the cooling sector in Austria. The following estimates and assessments could be found in literature: In the project “COOLSAN – Kältetechnische Sanierungskonzepte für Büro- und Verwaltungsgebäude“ (Blümel et al. 2005) the consumption of electrical energy for cooling in the year 2004 is estimated 103 GWh/a and the reference value for the year 2010 is 208 GWh/a.

In Haas et al. (2007), the total energy demand for air conditioning is assessed on the basis of a bottom-up approach. This approach basically consisted of the following steps: First, an educated guess of the number of buildings which are equipped with air conditioning was made, and second, the energy demand was calculated on the basis of average specific energy demands for cooling retrieved from literature. The values stated in the study „Der Energieverbrauch der Dienstleistungen und der Landwirtschaft 1990-2035“ (CEPE 2007) account for 6,3 kWh/m^{2}a for partial and 26,7 kWh/m^{2}a for full air conditioning. According to Haas et al. 2007, the total electricity consumption for air conditioning in Austria is 365 GWh/a (reference year 2005). The main data and assumptions which were used for this assessment are summarized in Table 2.

Table 2 Assessment of the electricity demand for cooling in Austria, according to Haas et al. (2007)

Categories of builings	Number	No air conditioning	Partial air conditioning	Full air conditioning	Electricity cons.
	[1]	[%]	[%]	[%]	[GWh]
Single family house	1.196.770	97,5	2,0	0,5	68
Semi-detached house	211.403	97,5	2,0	0,5	16
Apartment buildings, small	120.813	98,0	2,0	0,0	8
Apartment buildings, large	55.039	98,0	2,0	0,0	7
Schools etc.	17.771	99,0	1,0	0,0	1
Hospitals etc.	427	70,0	20,0	10,0	6
Sports and recreational facilities	2.016	98,5	1,0	0,5	0
Hotels, large	2.204	50,0	30,0	20,0	38
Hotels, small	34.257	80,0	15,0	5,0	65
Office buildings, large	8.295	50,0	30,0	20,0	119
Office buildings, small	26.342	88,0	10,0	2,0	10
Offices in apartment buildings	10.404	96,0	3,0	1,0	5
Commercial buildings, large	10.140	85,0	10,0	5,0	11
Commercial buildings, small	23.543	88,0	10,0	2,0	10
Total					365

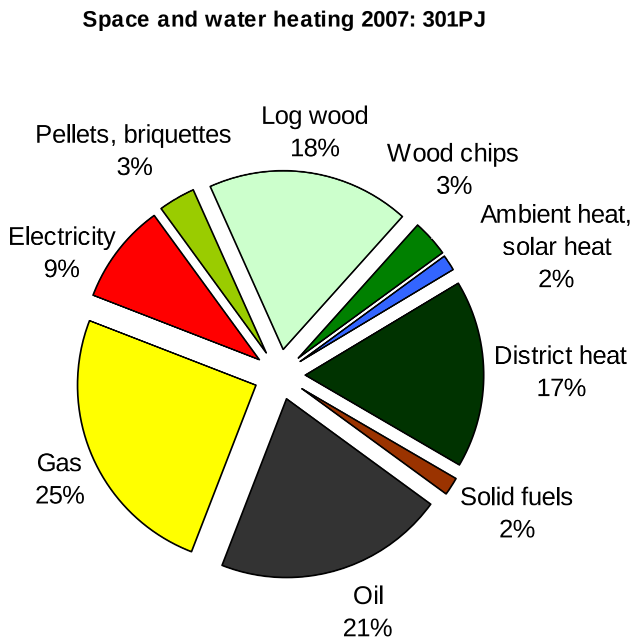
Source: Haas et al. 2007

4 Current Status of Renewable Energy Sources of Heat

4.1 Low-temperature heat

Figure 11 shows the structure of final energy consumption for space and water heating broken down by energy sources. Fossil fuels (oil and gas) account for the biggest fractions in this sector (21 and 24%, respectively). The total share of renewable energy sources is close to 30%. In recent years, the number of modern wood pellets and wood chip heating systems has been growing significantly, whereas the use of log wood has been decreasing. Still, the high share of renewables in the final energy consumption for space and water heating is mainly due to the traditionally high share of log wood in Austria. It still accounts for about two thirds of the total renewables in this sector. The share of ambient heat and solar thermal systems was only 1,53% in 2007.

Figure 11 Final energy consumption for space and water heating broken down by energy sources (2007)



Sources: Statistik Austria 2008, Haas et al. 2007, own calculations

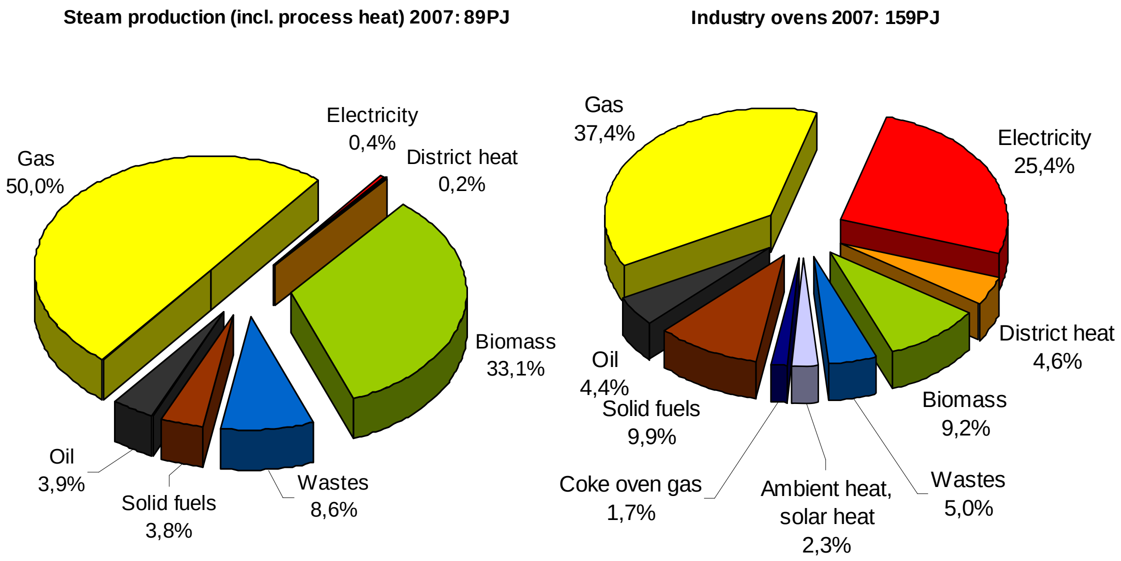
4.2 High-temperature heat

High-temperature heat comprises the categories “steam production” and “industrial ovens”. In 2007 these sectors accounted for 8,2 and 14,7% of the total final energy consumption in Austria (see Figure 3).

Steam production (including process heat) is primarily based on gas (50%) and biomass (33,1%), as can be seen in Figure 12. The main reason for the high share of biomass is that in the wood processing industries vast amounts of wood wastes like bark, wood chips and black liquor (biogenous waste liquor from the paper and pulp production) are used for energy recovery.

In the category “industry ovens” the share of biomass is only 9,2% and of all renewables 11,5%.

Figure 12 Final energy consumption for steam production and industry ovens broken down by energy source (2007)



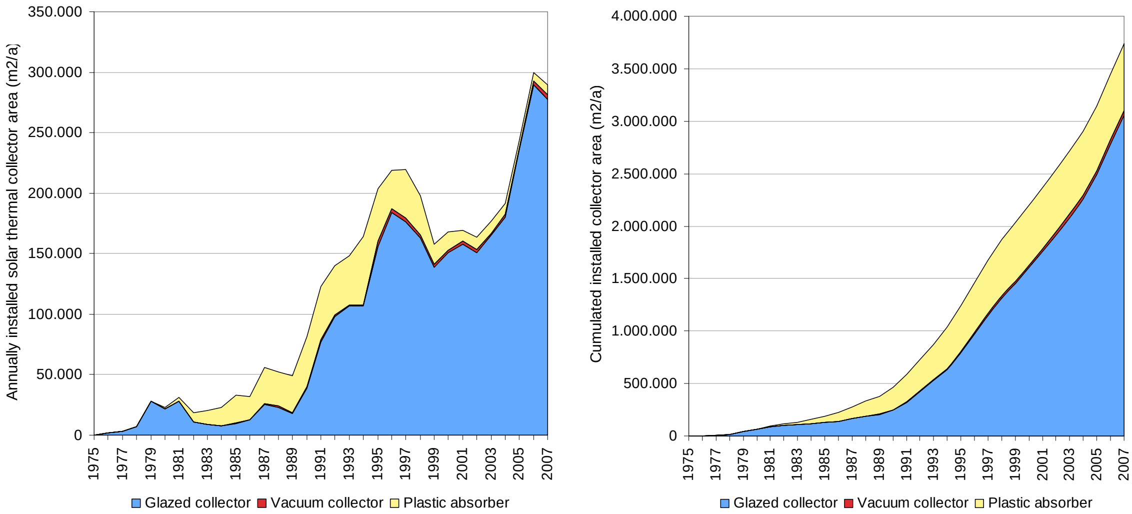
Source: Statistik Austria 2008

4.3 Market development

4.3.1 Solar thermal

The Austrian market for solar thermal collectors developed strongly within the past two decades and became a very mature market with current market growth rates above 20%. With respect to the stock of cumulated installed collector area the growth rates (new installed collector area) amount to about 10%. The following figures show the development of the first systems in the 1980’s with a dynamic progression by self-construction-groups. In the 1990’s the commercial phase of market introduction took place.

Figure 13 Development of installed solar thermal collector area in Austria



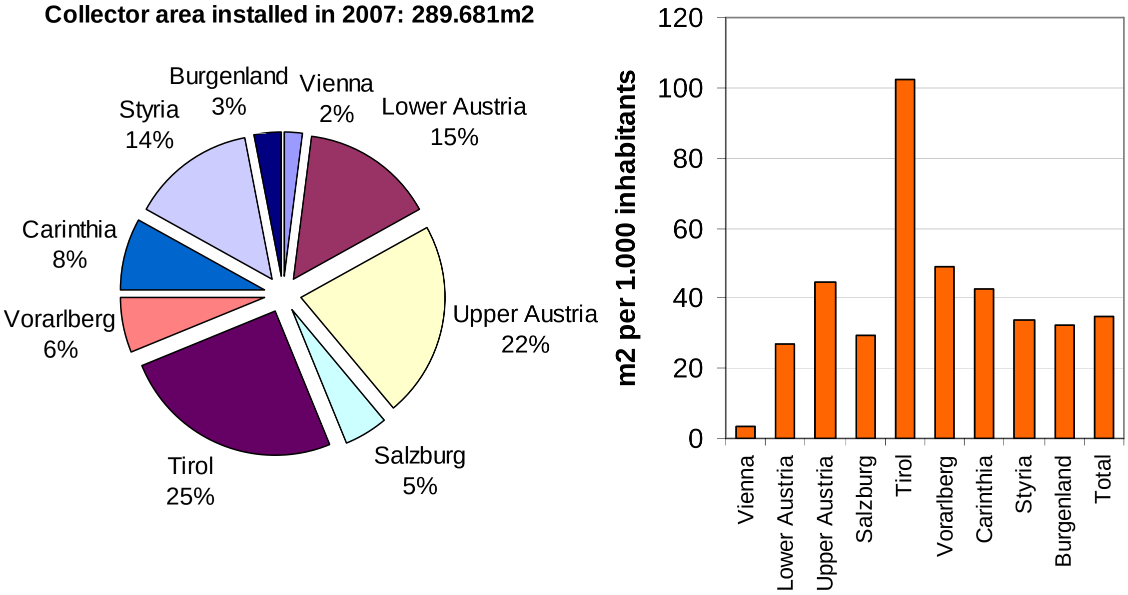
Source: Faninger et al. 2007, AEE Intec, Biermayr et al. 2008

In the year 2006, the number of dwellings equipped with solar thermal systems was close to 280.000. Regarding the collector area installed in 2007, it can be assumed that the number has risen to more than 300.000 in 2007. About every third of the newly installed systems is designed as auxiliary heating system and two thirds are installed in new buildings.

Figure 14 shows the collector area (additionally) installed in 2007 broken down by provinces. Tirol accounted for the highest contribution (25%), followed by Upper Austria (22%) and Lower Austria (15%). Related to the number of inhabitants, the deployment was clearly highest in Tirol (102,5 m^2 per 1.000 inhabitants compared to the Austrian average of 34,8 m^2 per 1.000 inhabitants).

In **Styria** 40.800 m^2 of collector area were installed in 2007 (39.800 m^2 glazed collectors and 1.000 m^2 plastic absorbers). This is 14% of the total collector area installed in Austria in 2007.

Figure 14 Solar thermal collector area installed in Austria in 2007 broken down by provinces

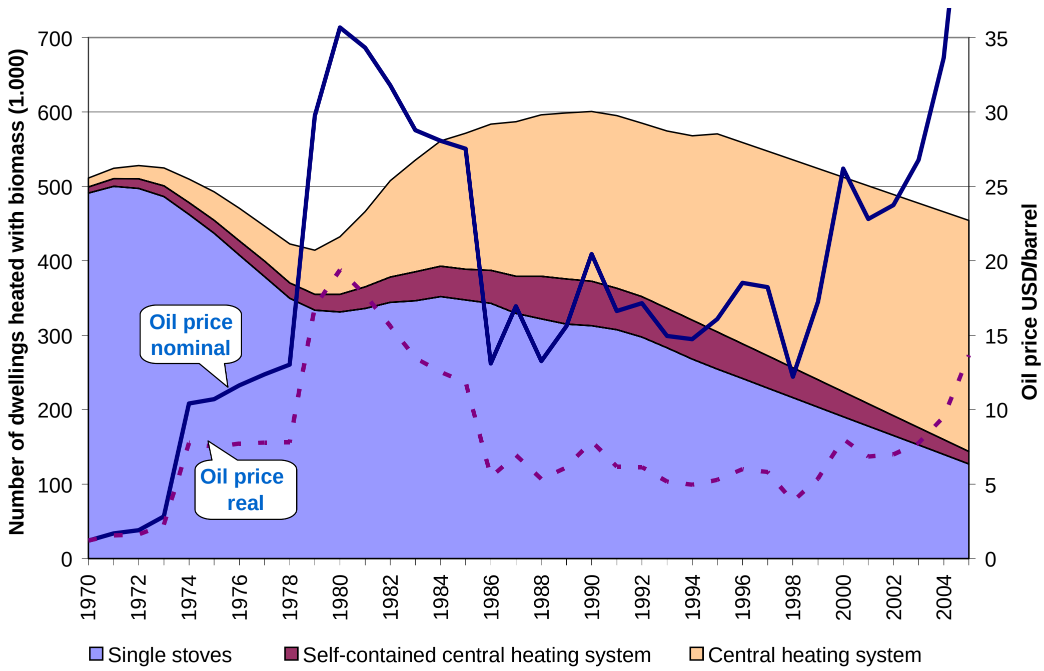


Source: AEE Intec, Biermayr et al. 2008, Statistik Austria 2008

4.3.2 Biomass

The following figures show the development of biomass heating systems in Austria. Figure 15 illustrates that the oil price had a significant impact on the development. Moreover, a change in the type of biomass heating can be observed: In the 1970's single stoves represented the dominant domestic biomass heating system. This changed in the 1980's, when central heating boilers boomed.

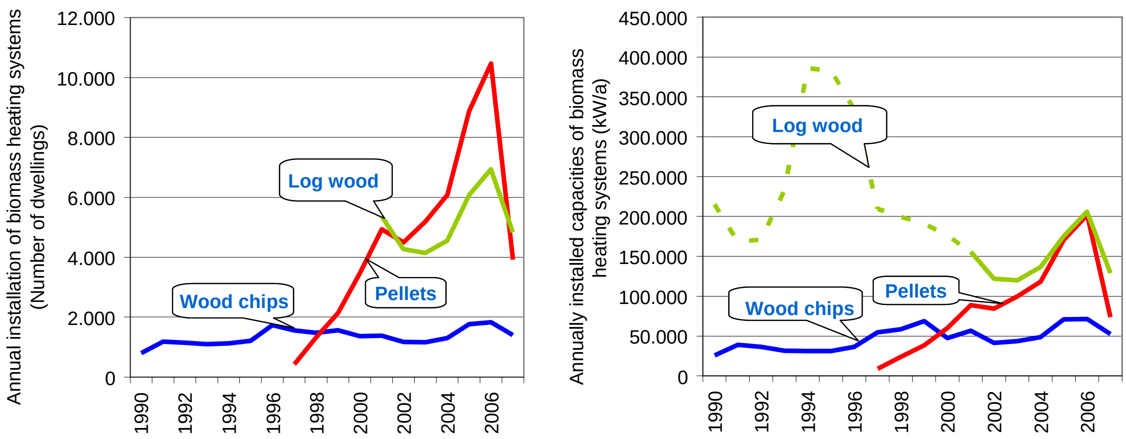
Figure 15 Historic development of the number of dwellings heated with biomass in Austria from 1970 to 2005



Source: Statistik Austria, EEG/TU Wien

In the late 1990's a new development started with the market introduction of pellet boilers. Within less than ten years of market introduction the annually installed capacity of pellet boilers increased significantly. From 2002 to 2006 the annual installation of pellet boilers even exceeded the annual installation of the currently most important renewable heating systems in Austria, wood log boilers (Figure 15).

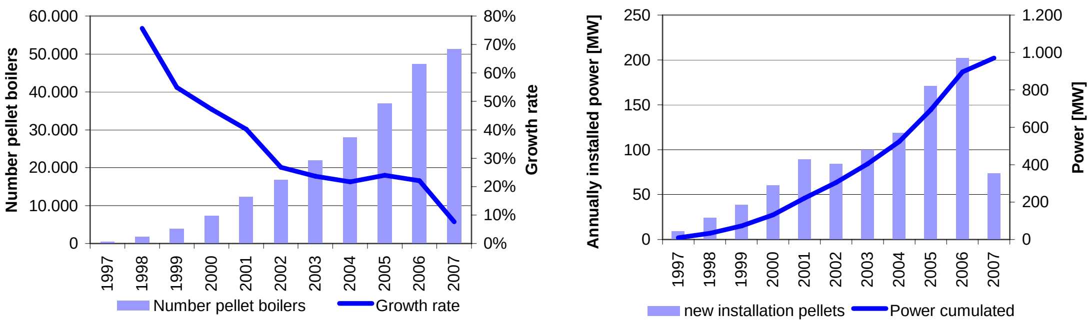
Figure 16 Annual installation of small-scale biomass boilers in Austria (number and total capacity)



Source: Haneder et al. 2008, Statistik Austria, EEG/TU Wien

Figure 17 gives a more detailed insight into the rapid market development of pellet boilers. From 1997 to 2007 the number of boilers installed in Austria increased from less than 500 to more than 50.000. Due to a high increase in pellet prices, sales figures declined sharply. However, current date indicate that the market already recovered in 2008 due to the succeeding decline and stabilization of the pellet price.

Figure 17 Development of pellet boilers in Austria

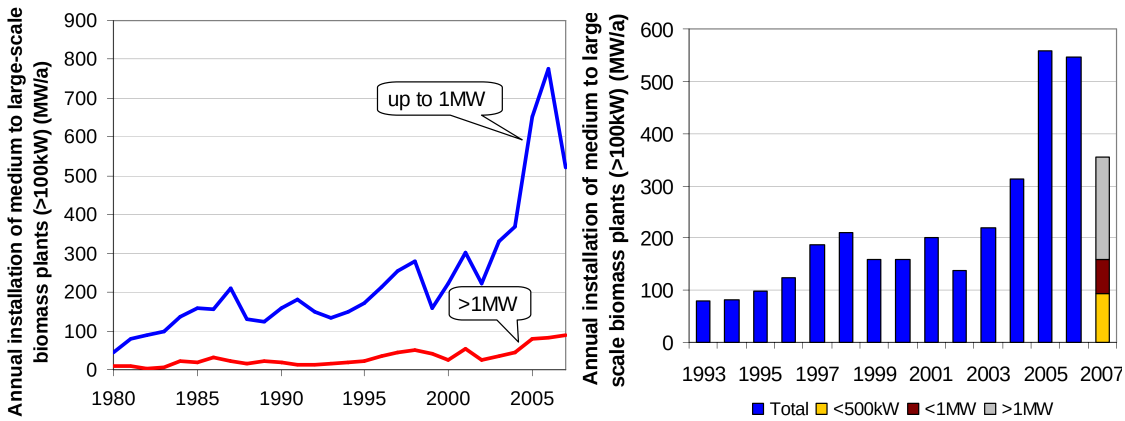


Source: Haneder 2007

Figure 18 shows the development of the number of annually installed biomass plants with a capacity of more than 100 kW. In this figure both heating plants and combined heat and power (CHP) plants included. Especially in the years 2005 and 2006 a very rapid deployment occurred, primarily due to a boom in the field of CHP, which was triggered by the Renewable Energy Act of 2002. However, after the amendment of 2006 the deployment of CHP plants declined rapidly.

Figure 18 shows that the annual installation in the years 2005 and 2006 was more than 500 MW. More than 50% of the capacity installed in 2007 were plants with a rated thermal power of more than 1 MW, about 20% were plants between 0,5 and 1 MW and about 25% plants with less than 0,5 MW.

Figure 18 Annual installation of medium to large-scale biomass plants in Austria (number of plants and total capacity)

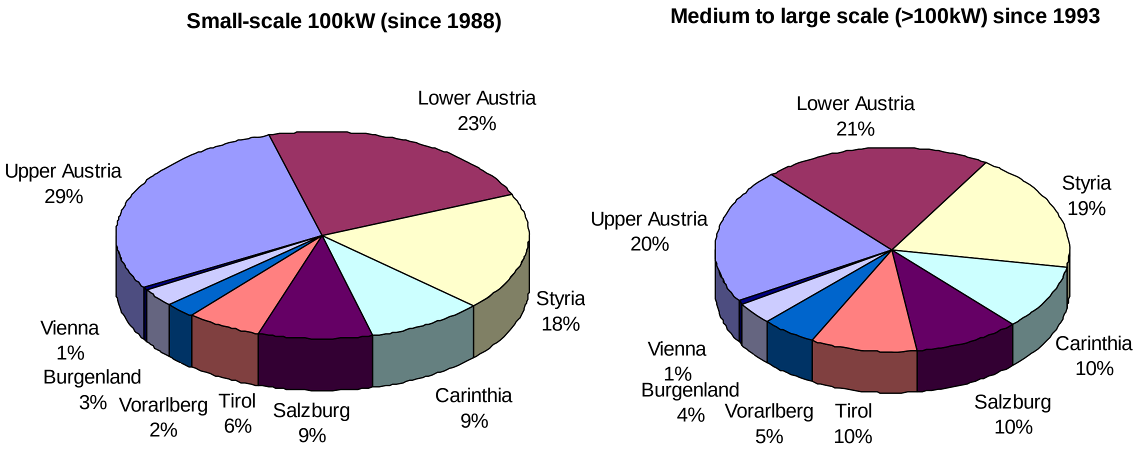


Source: Haneder 2007

Figure 19 shows the distribution of small and large-scale biomass plants broken down by provinces (number of plants installed since 1988 and 1993, respectively). Basically, most plants were installed in Upper and Lower Austria and Styria. However, relative to the population, the leading province with regard to small-scale boilers is Upper Austria, followed by Carinthia, Salzburg and Styria. In Vorarlberg, Tirol and Vienna, the numbers per capita are clearly lower. The number of large-scale plants per capita is more equally distributed (apart from Vienna). The leading provinces are Salzburg, Carinthia and Styria.

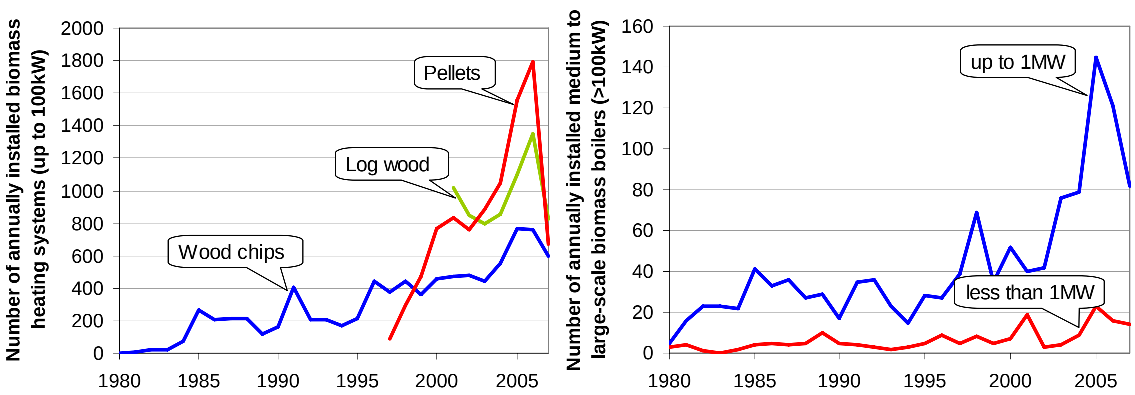
Figure 20 shows the development of annually installed biomass (pellet, log wood and wood chip) boilers and large-scale plants in **Styria**. Again, the highest increase was achieved with pellet boilers (cp. Figure 16) but also the annual installation of wood chip boilers increased steadily since the 1980ies.

Figure 19 Installation of small and medium to large-scale biomass boilers since 1988 and 1993, respectively, broken down by provinces



Source: Haneder 2007

Figure 20 Annually installed capacity of biomass boilers in Styria



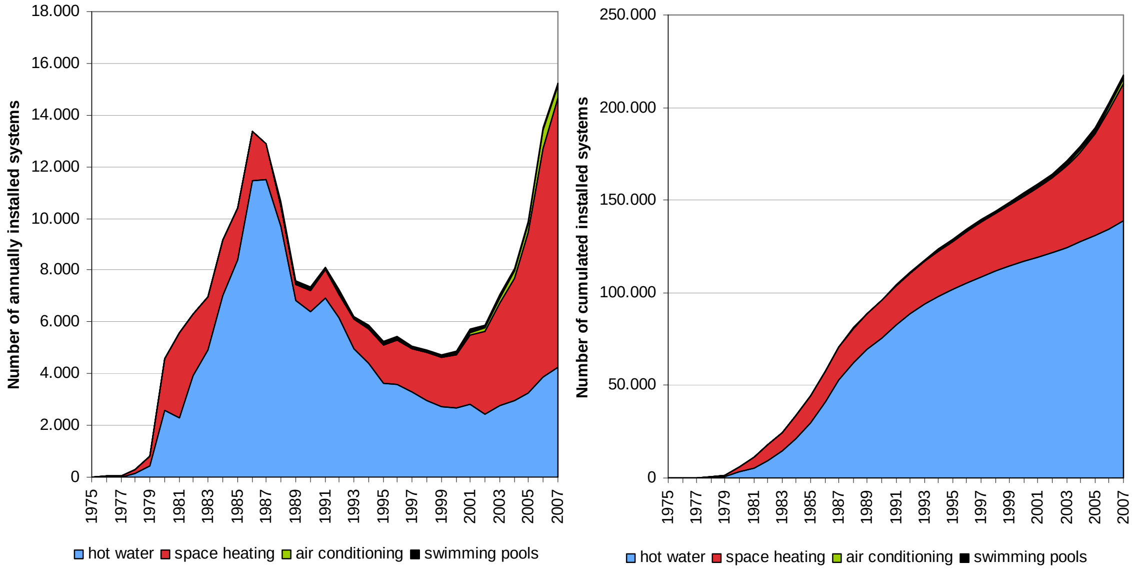
Source: Haneder 2007

4.3.3 Heat pumps

The following figures show the development of heat pumps. Whereas in the 1980's there was clear dominance of hot water systems, in recent years the main market growth occurred in the field of space heating systems. Air conditioning systems are only a small market niche.

Comparing the development of heat pumps in Austria with the oil price development we can see a correlation with a time lag of a few years: The oil price peak in the 1970ies and beginning of 1980ies resulted in a quite strong growth of hot water heat pumps. However, in the late 1980ies and 1990ies, the number of annually installed heat pumps decreased significantly due to constantly low oil prices during this period. Within the last few years, again a rapid increase in the number of annual installations could be observed. Apart from oil recent oil price developments, the last year's growth was accompanied by policy instruments (investment subsidies and incentives by electricity suppliers).

Figure 21 Development of installed heat pumps in Austria



Source: Faninger et al. 2007

4.4 Scenarios of the heat sector up to 2030

Despite the high importance of the heat sector with regard to climate and energy policy issues, no official targets concerning renewable energy in the heat sector have been defined yet. However, some provinces (e.g. Upper Austria), cities and municipalities have already specified ambitious aims.

In the following sections, scenarios of the Austrian heat sector up to 2030 according to Haas et al. 2007 are presented. In Chapter 4.4.1 three different scenarios for space and water heating are illustrated. In the Chapters 4.4.2 and 4.4.3 scenarios for the categories "steam production" respectively "industry ovens" are presented.

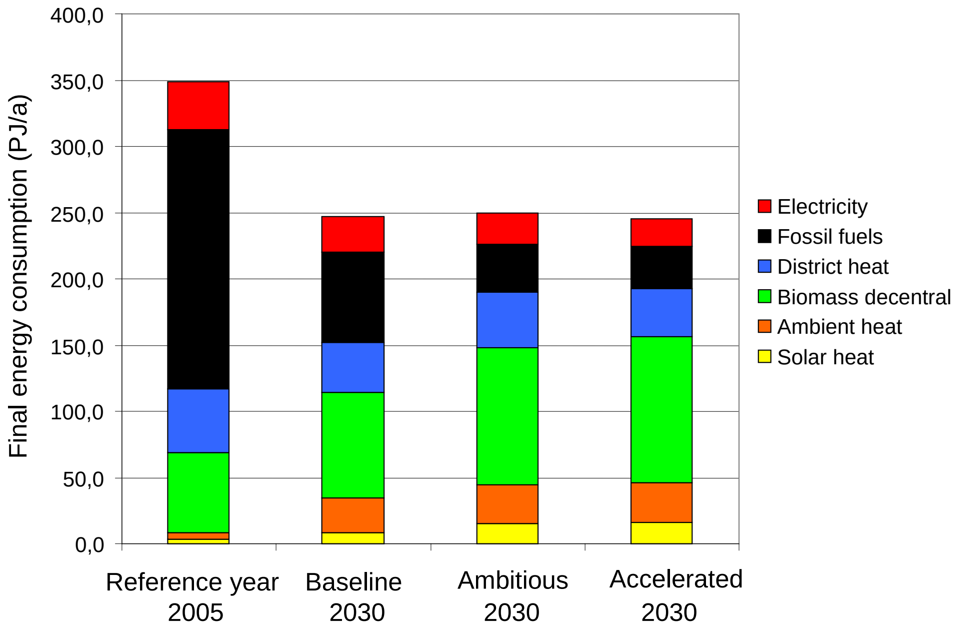
4.4.1 Space and water heating

For the category space and water heating three different scenarios were prepared, which basically differ with regard to the assumptions concerning fossil fuel price developments until 2030 and CO_2 prices as well as with regard to the energy policy instruments assumed. In the *baseline scenario* it is assumed that there is a moderate increase in fossil fuel prices until 2030 and that current policy instruments are maintained. CO_2 prices are not internalized in this scenario. In the *ambitious scenario* a higher increase in fossil fuel prices and moderate CO_2 prices are assumed. The energy policy instruments for promoting renewable energy sources assumed in this scenario are more ambitious than in the *baseline scenario*. In the *accelerated scenario*, the highest increase in fossil fuel prices and CO_2 prices are assumed. The energy policy instruments are identical to those in the *ambitious scenario*.

The following figures show the aggregated results of these scenarios. Figure 22 shows the final energy consumption for space and water heating in the reference year 2005 and the year 2030 in the scenarios. A – to some extent – surprising result is a significant and for all three scenarios almost identical reduction of the total final energy consumption for space and water heating. In all scenarios, the present framework of normative energy policy instruments (e.g. thermal insulation standards for buildings) is installed in the model. Furthermore the scenarios are based on the assumption that in both new buildings and building renovation the current technological efficiency standard (active and passive components) is applied. Moreover, it should be noted that in the scenarios with higher fossil energy prices some efficiency improvements are compensated by a higher share of biomass heating systems with somewhat lower efficiencies than fossil boilers. These mechanisms result in a steady increase of energy efficiency of buildings and heating systems where energy prices only play a subordinate role.

The scenarios show a reduction of final energy consumption from about 350 PJ in the year 2005 (reference value) to about 250 PJ in the year 2030. This is equivalent to a reduction of 29%. With regard to the structure of energy carriers there are clear differences between the three scenarios. The *ambitious scenario* as well as the *accelerated scenario* shows a much higher share of renewable energy than the *baseline scenario*. In the *baseline scenario* the share of renewables is 61%, in case of the *ambitious scenario* it is 76% and in the *accelerated scenario* it is about 79%. The share of renewables in electricity generation (especially hydro power) is not considered in these figures. There are some differences between the *ambitious* and the *accelerated scenario* at the end of the investigated period. However, the major difference between these scenarios is the development over time – in case of the *accelerated scenario* the deployment of renewable energy systems occurs somewhat faster. The difference between *ambitious* and *accelerated scenario* is highest in the year 2025 (Haas et al. 2005).

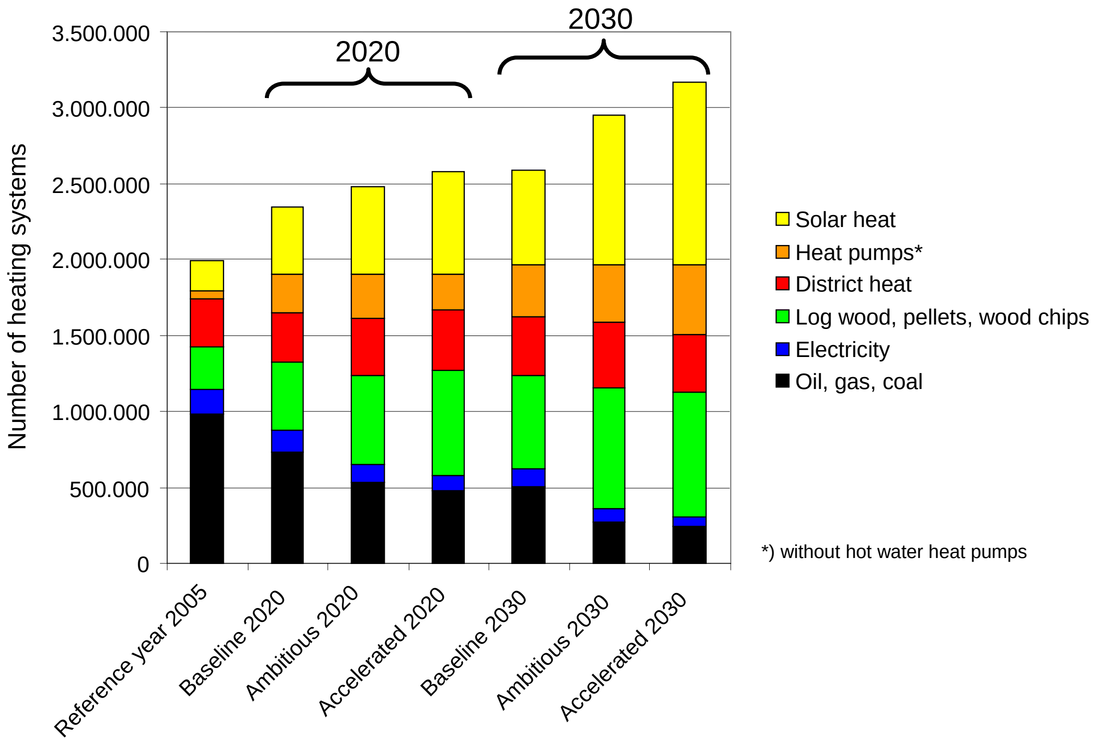
Figure 22 Final energy consumption for space and water heating in the three scenarios in 2030 and in reference year 2005, broken down by energy source



Source: Haas et al. 2007

Figure 23 shows the technology diffusion in the three scenarios. The figure illustrates the clearly higher diffusion of solar and biomass heating systems in the *ambitious* and the *accelerated scenario*, compared to the *baseline* scenario. The decreasing final energy consumption in Figure 22 on the one hand and the increasing number of heating systems installed on the other, are due to a slight increase in the number of dwellings and the significant reduction of average heat loads. Furthermore, solar systems are primarily used as additional heating systems or for water heating only.

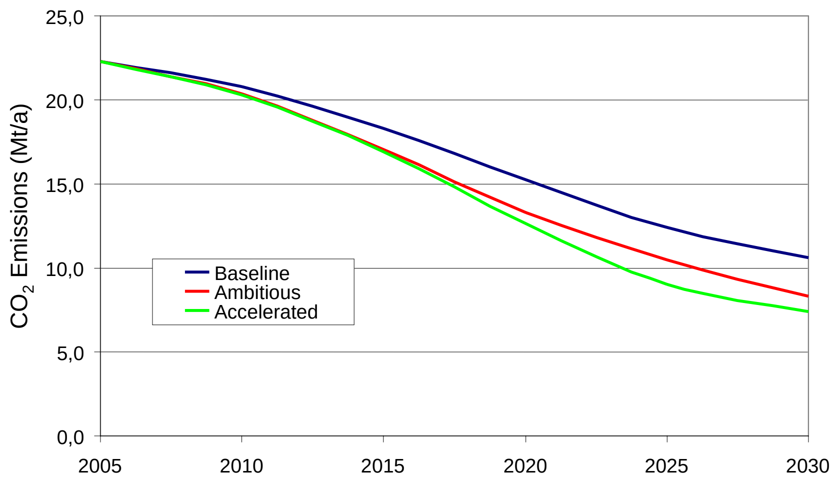
Figure 23 Number of primary heating systems and solar systems installed in the three scenarios



Source: Haas et al. 2007

Figure 24 shows the development of CO_2 emissions related to space and water heating in the three scenarios. Even in the *baseline scenario* there is a significant reduction of greenhouse gas emissions from 22,4 Mt in 2005 to 10,6 Mt in 2030 due to the reduced energy demand and the enhanced use of renewable energy sources. In the *ambitious* and the *accelerated scenario*, the annual emissions are reduced to approximately 8,3 and 7,4 Mt, respectively. Hence, the scenarios illustrate that the CO_2 emissions related to space and water heating could be reduced by more than 50% until 2030, if both energy efficiency and renewable energy sources are promoted.

Figure 24 Development of CO_2 emissions related to space and water heating in the three scenarios



Source: Haas et al. 2007

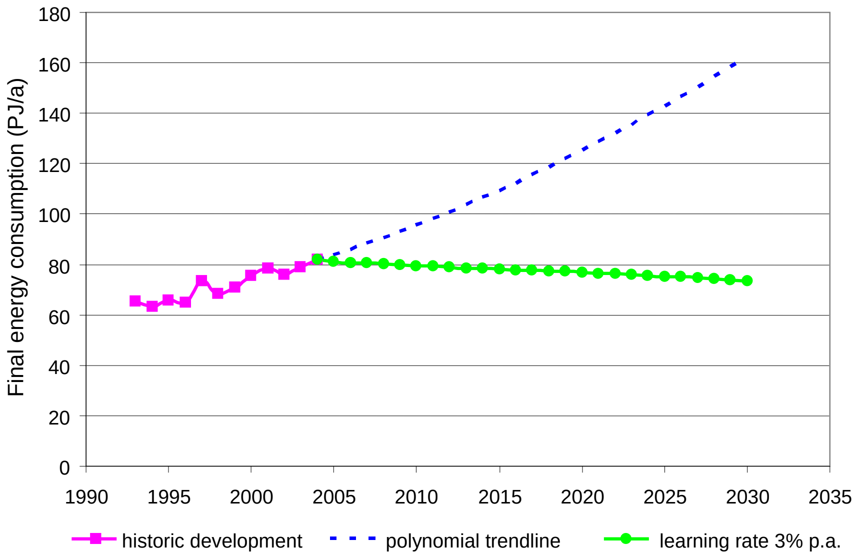
4.4.2 Steam production and process heat

If the future development of the final energy consumption for steam production and process heat is estimated by means of a trend analysis based on historic data since 1993, this sector shows a significant increase until 2030 (Figure 25). However, in Haas et al. (2007) an estimated annual learning potential of 3% per annum is assumed to be feasible. This learning potential is expected to be achievable with increased technological efficiency within the processes, but also due to structural changes in this sector (reduction of energy-intensive processes). The resulting scenario is also shown in Figure 25.

Concerning the energy sources used for steam production and process heat, the following assumptions were made by Haas et al. (2007): First, it was assumed that until 2030 10% of the energy demand for processes with a temperature less than 200°C is met with solar systems. These processes account for approximately 30% of the total demand in this sector. Second, for coal a significant reduction and for oil a moderate reduction until 2030 was assumed. Electricity and district heat were assumed so remain constant.

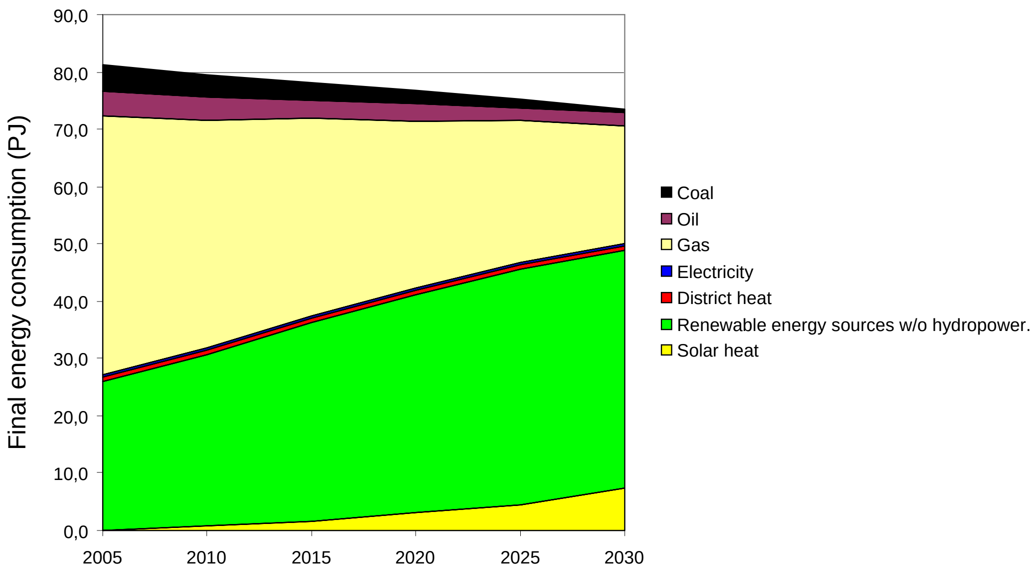
The resulting scenario for the sector “steam generation and process heat” are illustrated in Figure 26. In this scenario the share of renewable energy sources increases from 33% in 2005 to 68% in 2030. The CO_2 emissions of this sector decrease from 4,6 Mt/a to 2,3 Mt/a.

Figure 25 Historic development, polynomial trendline up to 2030 and scenario assuming a learning rate of 3% p.a. of the energy demand for steam production and process heat



Source: Haas et al. 2007

Figure 26 Scenario of the final energy consumption for steam production and process heat

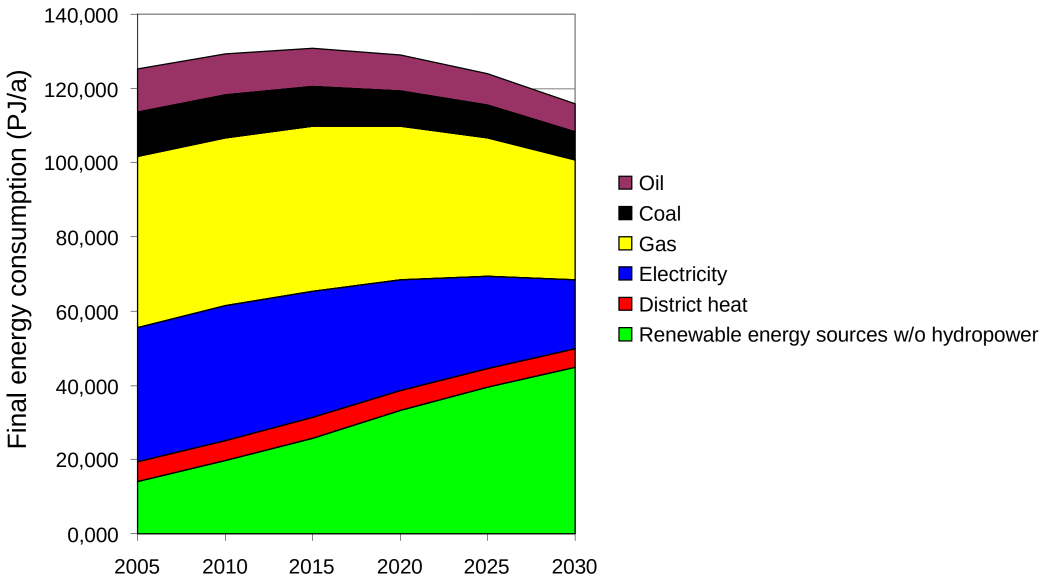


Source: Haas et al. 2007

4.4.3 Industrial ovens

The scenario for the sector "industrial ovens" according to Haas et al. (2007) is shown in Figure 27. Similar to the sector "steam production", an annual increase of energy efficiency of 2% per annum is assumed. For applications where it is technological possible, a fuel switch programme, mainly from fossil energy carriers to biomass is assumed to occur. In this scenario, the CO_2 emissions decrease from 9,1 Mt/a in 2005 to 6,1 Mt/a in 2030.

Figure 27 Scenario of the final energy consumption for industrial ovens

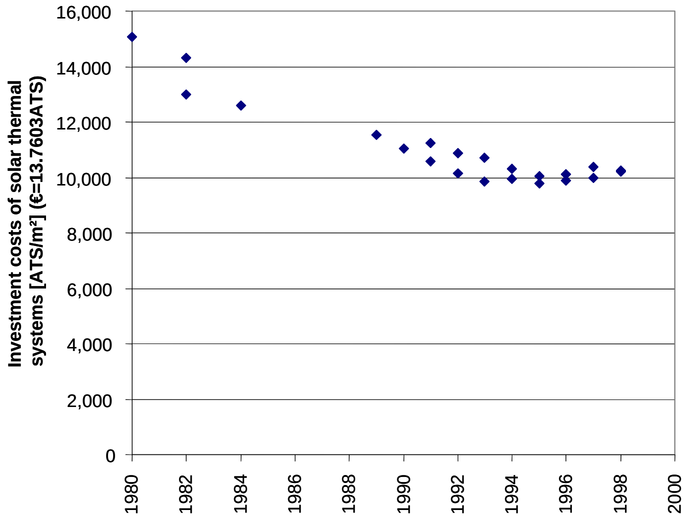


Source: Haas et al. 2007

4.5 Technology costs

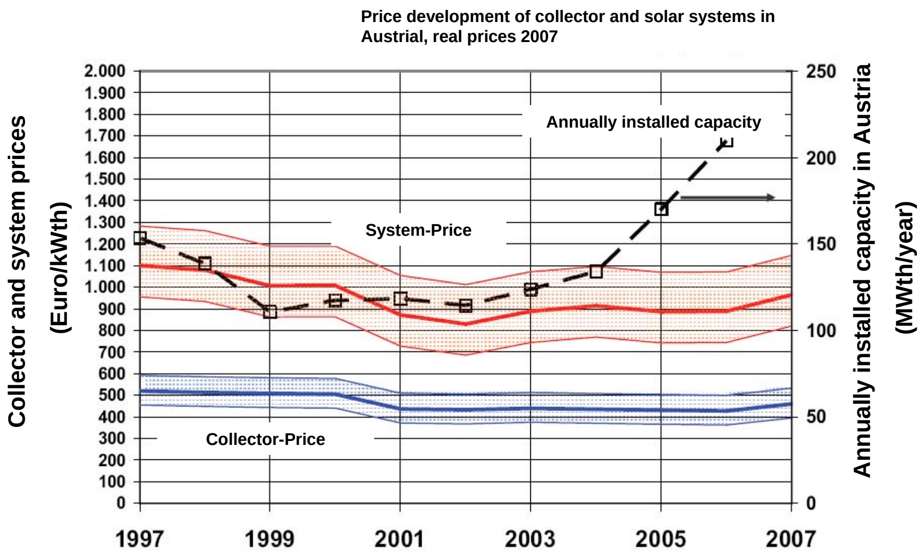
The following figures show the development of investment costs of solar thermal systems in Austria from 1980 to 1998 (Figure 28) and 1997 to 2007 (Figure 29). It is clear to see that a decrease in investment costs took place from 1980 to the mid of the 1990ies. However in the period from 1997 to 2007, system costs remained quite stable.

Figure 28 Development of investment costs of solar thermal systems in Austria from 1980 to 1998



Source: Haas et al 2001

Figure 29 Development of investment costs of solar thermal collectors and systems in Austria from 1997 to 2007



Source: AEE-Intec 2007

For heat pumps, according to Haas (1988), Haas et al (2001) and Schriefl (2006) no significant cost reduction could be observed within the last decades.

Concerning biomass heating systems, the development of inflation-adjusted investment costs seems to be quite stable. Moreover, the comparison of investment costs is quite problematic. Due to technological progress the characteristics of boilers changed fundamentally. For example, significant progress could be made with respect to emissions and efficiency and also the quality of control devices improved significantly (Kranzl 2008) (see also Chapter 5.4).

5 Support schemes for RES-H

This Chapter is structured according to the different types of support schemes:

- Fiscal incentivisation
    - Grants
    - Tax relief
        - Value added tax
        - Value added tax
        - Income tax
- Compulsion based instruments
- Promotional activity

In Chapter 5.4 the effectiveness of the different support schemes is analyzed briefly.

5.1 Fiscal incentivisation

5.1.1 Grants

Fiscal incentivisation of solar thermal systems, heat pumps and biomass heating systems for residential heating is primarily based on investment subsidies in Austria. Since they are within the authority of the province governments, the support schemes vary from province to province. A direct comparison of the amounts of subsidies between the provinces is not possible due to diverse conditions, methods of calculation etc.

National policies are primarily focused on subsidies for large scale plants (e.g. biomass district heating, commercial plants). These programs are handled by the Austrian Kommunalkredit (Kommunalkredit 2009).

5.1.1.1 Subsidies for solar thermal systems

Subsidies were first introduced by provinces during the 1980ies and developed strongly during the 1990ies. Roughly speaking, the level of investment subsidies for solar thermal systems vary from 20% to 50% of investment costs (depending on the size of the installation, the type of collector and of the system etc.). Typical subsidies are in the range of 600 € to 1.700 € for sole water heating systems and 1.100 € to 3.500 € for combined water and space heating systems.

In Vienna, Lower Austria, Burgenland, Upper Austria, Carinthia and Tirol the subsidies are defined as a share of the investment costs. Upper limits are usually calculated on the basis of a fixed amount plus an amount per m^2 collector area. For solar thermal heating systems the upper limits are usually clearly higher than for water heating systems.

In Salzburg an investment subsidy per m^2 collector area is granted (100 €/m^2 for systems with 1 to 6 m^2 and 50 €/m^2 for systems with 7 to 25 m^2).

In **Styria** the amount of subsidy is calculated on the basis of a fixed amount (300 € for water heating systems and 500 € for combined water and space heating systems with at least 25 m^2) and a variable amount (50 € per m^2). Furthermore, the installation of renewable heating systems can also be subsidized within the “Eigenheimförderung” (subsidy for house building) with up to 7.000 € or within the “Wohnhaussanierung“ (residential building refurbishment). (Land Steiermark 2009)

In Vorarlberg the subsidy for single family homes is also calculated on the basis of a fixed and a variable amount, and for multi-family houses on the basis of the investment costs (25 or 30%, depending on the type of system).

5.1.1.2 Subsidies for biomass systems

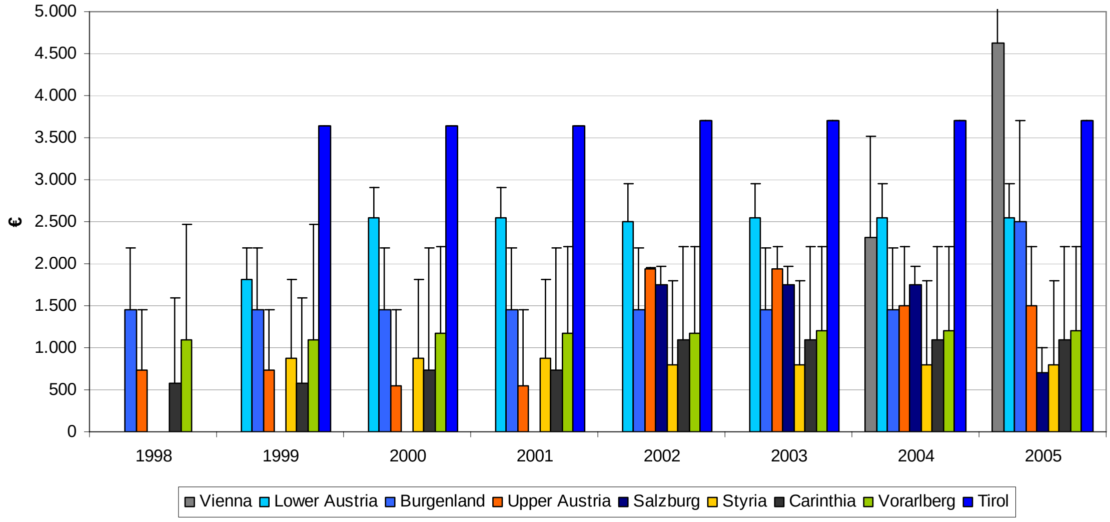
Investment subsidies for biomass heating systems are granted in every province but their amounts and conditions are very diverse. In Lower and Upper Austria, Carinthia, Styria and Burgenland the subsidies account for 25 to 30% of the investment costs. In the other provinces the amounts partly depend on parameters like the type of the heating system, emissions and other parameters. In Vienna, for example, the amount is calculated on the basis of the Investment costs, a factor which is based on the CO, NO_x and other emissions according to the test report of the boiler plus a credit for maintenance costs. Furthermore a minimum efficiency (the value depends on the rated power of the boiler) is a precondition for the subsidy.

In **Styria**, since January 1st 2009 the following regulations concerning direct subsidies for biomass heating systems apply: The investment subsidy accounts for up to 25% of the total investment costs. The upper limits for pellet stoves and log wood gasifiers are 1.100 € and 1.400 € for pellet and wood chip central heating systems. Additionally, the installation of a circulation pump of the efficiency class A as well as hydraulic calibration are subsidized with 50 €. Additional building refurbishment is subsidized with 100 € and the installation of electrostatic particle precipitators with 500 €. For multi-family houses, the upper limits mentioned above are multiplied with the number of apartments. The Styrian subsidy for renewable heating systems within the “Eigenheimförderung” (subsidy for house building) and the “Wohnhaussanierung“ (residential building refurbishment) also applies to biomass heating systems (see previous chapter).

In some regions in Austria, municipalities also grant subsidies for residential biomass heating systems.

The following figure illustrates the historic development of typical (for some provinces maximum) subsidies for biomass heating systems. Due to the different conditions a comparison between of the amounts of subsidies between the provinces is not possible, but still, the figure illustrates that from 1998 to 2005 subsidies were introduced, respectively raised significantly in all provinces. As already described in section 4, a very successful market introduction of pellet boilers took place in these years. It is assumed that subsidies played an important part in this development.

Figure 30 Development of investment subsidies for domestic biomass heating systems[2]



Source Haas, Havlickova, Kalt, Knapek, Kranzl, Weger 2005

5.1.1.3 Subsidies for heat pumps

Investment subsidies for heat pumps in Lower and Upper Austria, Burgenland and Tirol are in the range of 15% to 30% of the investment costs. In some provinces, the amount of subsidies depends on whether the heat pump is used solely for water heating or also for space heating. For example, in Lower Austria the maximum amount is 1.100 € for the former, 2.200 € for the latter and 2.950 € in the case of a coefficient of performance of 4 or higher. In Carinthia the amount of subsidy is 1.500 € for houses with a maximum specific heating load of 60 kWh/m²a and 2.000 € in the case of 50 kWh/m²a.

In **Styria** there are no direct subsidies for heat pumps. However, the regulation for renewable heating systems within the "Eigenheimförderung" (subsidy for house building) and the "Wohnhaussanierung" (residential building refurbishment) also applies to heat pumps (see chapter 5.1.1.1).

According to an agreement between the federal and the provincial governments about building regulations for the reduction of greenhouse gas emissions, a minimum coefficient of performance of 4 is requested.

Moreover, for heat pumps several electricity utilities provide additional incentives like investment subsidies or/and reduced electricity tariffs.

[2] Due to the diversity of support schemes among the provinces a direct comparison is not possible and actual amounts can vary widely. The figure shows either representative or maximum amounts.

5.1.2 Tax relief

5.1.2.1 Value added tax

For agricultural and silvicultural products the reduced value added tax of 10% is applied in Austria. Hence, the value added tax on biogenous fuels (log wood, wood chips, pellets etc.) is only 10%, whereas the VAT on fossil fuels is 20%.

5.1.2.2 Taxes on fossil fuels

Apart from the reduced VAT for biomass, the use of renewable technologies is favoured by additional taxes on fossil fuels.

According to the Austrian mineral oil tax, the additional tax on domestic heating oil is 98 € per 1.000 l (about 9,8 €/MWh) and the tax on other heating oils 60 € per 1.000 kg (about 5,07 €/MWh). Until January 1, 2004 the taxes were 69 € per 1.000 l and 36 € per 1.000 kg.

The additional tax on natural gas is 6,6 Eurocent per cubic meter (about 5,96 €/MWh). Until January 1, 2004 it was 4,36 € per cubic meter.

5.1.2.3 Income tax

Since the year 1979 the Austrian Income Tax Act defines energy savings measures as special expenses for which tax allowances may be reclaimed. These measures include among other things expenses for heat pumps, solar thermal systems and bioenergy systems.

Special expenses can be deducted from the net taxable income (tax base). Examples for such special expenses are expenses for voluntary insurance, convertible bonds, donations and also for building construction and renovation. This last section also includes renewable heating and DHW systems and energy efficiency measures (listed above).

There is no restriction regarding the combination of tax allowance schemes and investment subsidies. Thus, a cumulation of these schemes is possible. The tax allowance applies to the total investment costs (i.e. material cost and installation cost of the appliance). All types of residences are eligible to the scheme.

Several parameters (e.g. taxable annual income, number of children) have an impact on the level of actual financial incentives that the tax allowance scheme induces for different types of tax-payers under various conditions. Depending on these parameters, typical tax reductions due to RES-H investment vary widely. Assuming investment costs for individual RES-H systems in the range of about 4.000 € and 18.000 €, the share of the tax reduction on the investment costs can reach a maximum range of 4,2% and 15,4%. The estimated average is about 1% and 5%. Hence, the impact of this instrument is rather limited compared to the investment subsidies described in the previous chapters.

5.2 Compulsion based instruments

Within all provinces, traditionally quite substantial support schemes for residential building construction (and more recently also for renovation) exist. Since the 1950ies, these schemes represented the main promotion system for supporting the construction of new residential dwellings. Originally, no energy specific standards were required for receiving these subsidies. However, within the last years these support schemes have been adapted in several provinces, insofar as they are now only eligible if thermal quality standards for the buildings are considered or renewable energy sources are used for heating (e.g. in Upper Austria support is only granted for houses with solar thermal or biomass heating systems).

In **Styria** the following criteria apply since June 1, 2006: To be eligible for subsidies, new buildings have to be equipped with solar thermal water heating systems. For multi-family houses, the heat load may not exceed 45 kWh/m² per year. Furthermore, since May 2, 2007 that heating systems of both multi- and single-family houses have to be based on renewable energy sources to be eligible for subsidies.

Due to the high importance of these requirements for residential building subsidies can be considered as compulsion based instruments.

Following the Directive on the energy performance of buildings (2002/91/EC) the energy pass for buildings is obligatory in Austria since January 1, 2009. It has to be presented for every house which is sold, rent, or leased and provides information on the thermal quality of the building. The actual methods of calculation, regulations concerning the issuance of the energy pass etc. are primarily in the competence of the provinces in Austria. Despite efforts to harmonize the building regulations of the provinces there are no uniform regulations for Austria. There is no relevance whatsoever to renewable heating systems within the energy pass.

All biomass boilers which are placed on the market have to be certified according to the conventions Art. 15a B-VG „Schutzmassnahmen betreffend Kleinfeuerungen" (concerning protective measures for small-scale heating systems” and "Einsparung von Energie" (concerning measures for energy saving). Specifically, it has to be certified that boilers fulfil emission and efficiency standards.

As already mentioned in Chapter 5.1, according to regulations in some provinces renewable heating systems are only eligible for direct subsidies if they comply with certain reference values concerning emission standards or minimum efficiencies, which go beyond compulsory values.

5.3 Promotional activity

Apart from the instruments mentioned above, a number of awareness campaigns and training programmes haven been/are carried out by regional energy agencies as well as the federal government (e.g. the program “holz:wärme” for biomass and “solar:wärme” for solar heat within the framework program “klima:aktiv”). For example, within the campaign “Spar mit Solar” free information events about solar heating systems were carried out in **Styria** in 2008.

The project “qm Heizwerke” (“qm heat plants”), which is also carried out within the program klima:aktiv, aims at increasing the efficiency of district heating systems in Styria by assisting and supporting planners, constructors and operators of district heating systems.

Since 2000 the Austrian Biomass Association has been organising regular job training courses for plumbers and chimney sweepers. These courses are partly financed by the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Attending these courses qualifies professionals as “„Biowärme-Installateur“ (“bio-heat plumber”) respectively „Biowärme-Rauchfangkehrer“.(“bio-heat chimney sweepers”), which are legally protected terms.

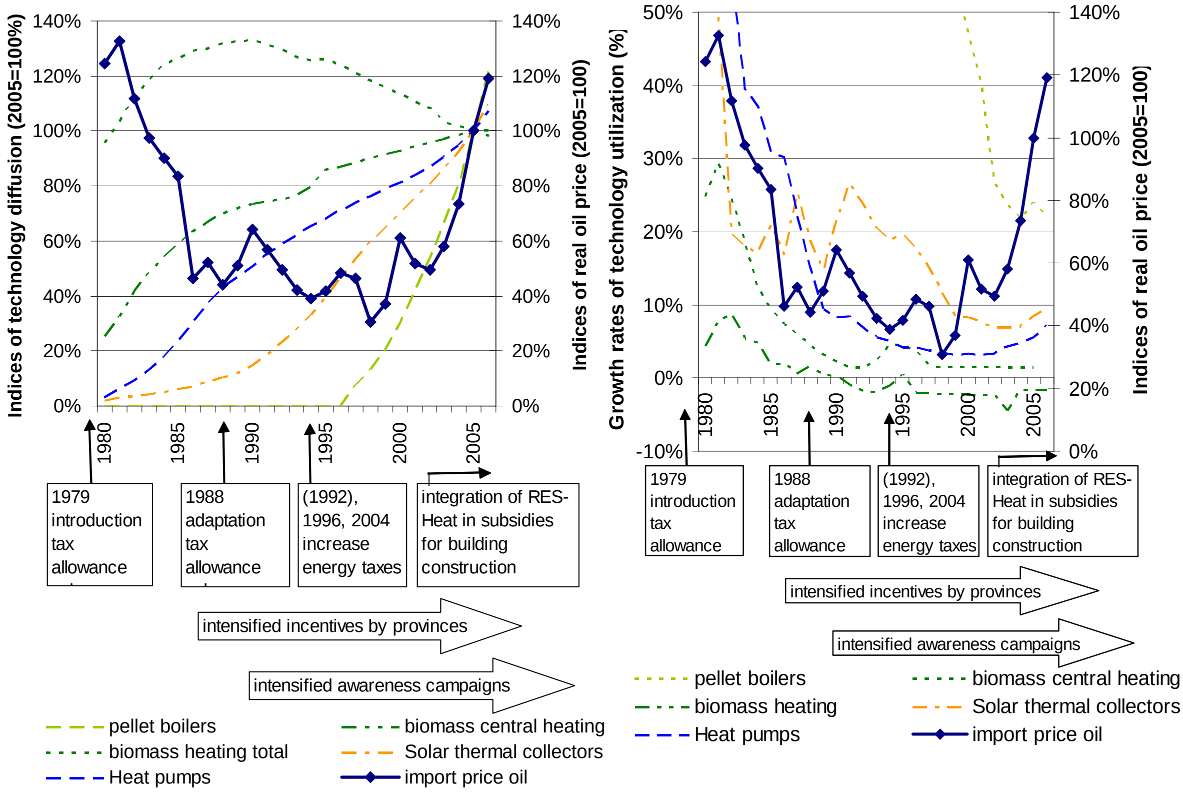
5.4 Effectiveness of support schemes

The historical development of renewable energy systems in the heat sector which was shown in section 4 was enforced by a number of policy instruments, stakeholder engagement as well as energy economic side conditions. One of the most important drivers was the development of the oil price. The introduction of the different policy instruments itself again was driven by the oil price.

The following figures show that the oil price strongly triggered the growth of renewable heating systems (especially biomass heating systems and heat pumps) in the early 1980ies. The oil price decline in the late 1980ies and 1990ies correspondingly led to a reduced growth or even decrease of these technologies. Then, the new oil price increase since the late 1990ies again pushed the development, especially of new technologies like pellet boilers, heat pumps for space heating and solar thermal space heating systems.

The promotion schemes, especially from the provincial governments had a significant impact both on the diffusion of these technologies as well as on the technical quality (efficiency, COP, emissions).

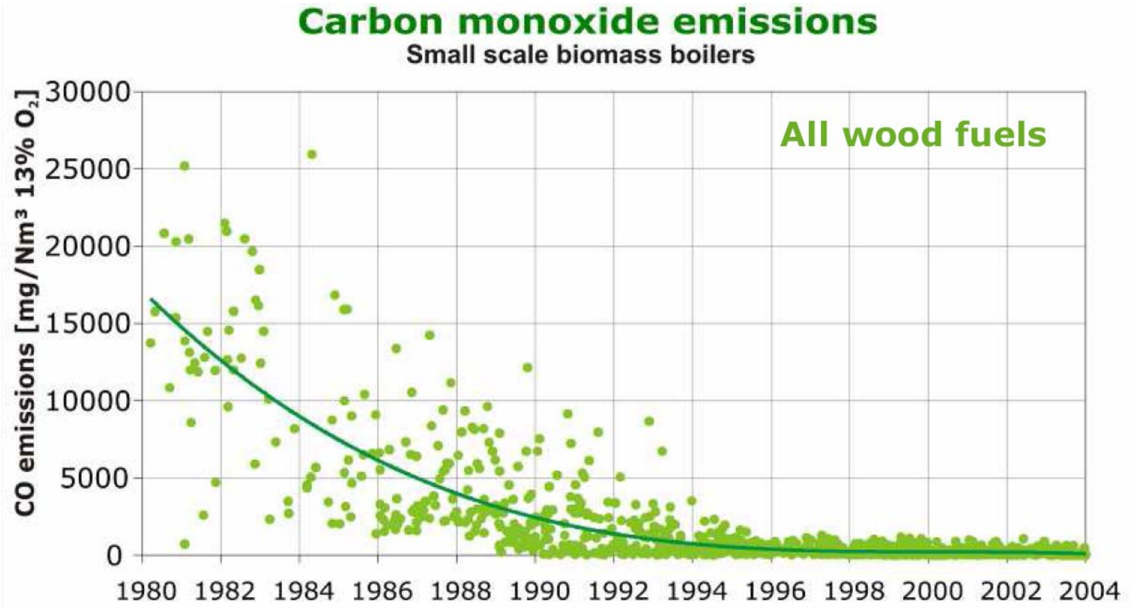
Figure 31 Oil price development and other energy economic side conditions and the development of biomass heating systems, solar thermal collectors and heat pumps in Austria



Source: Kranzl 2008

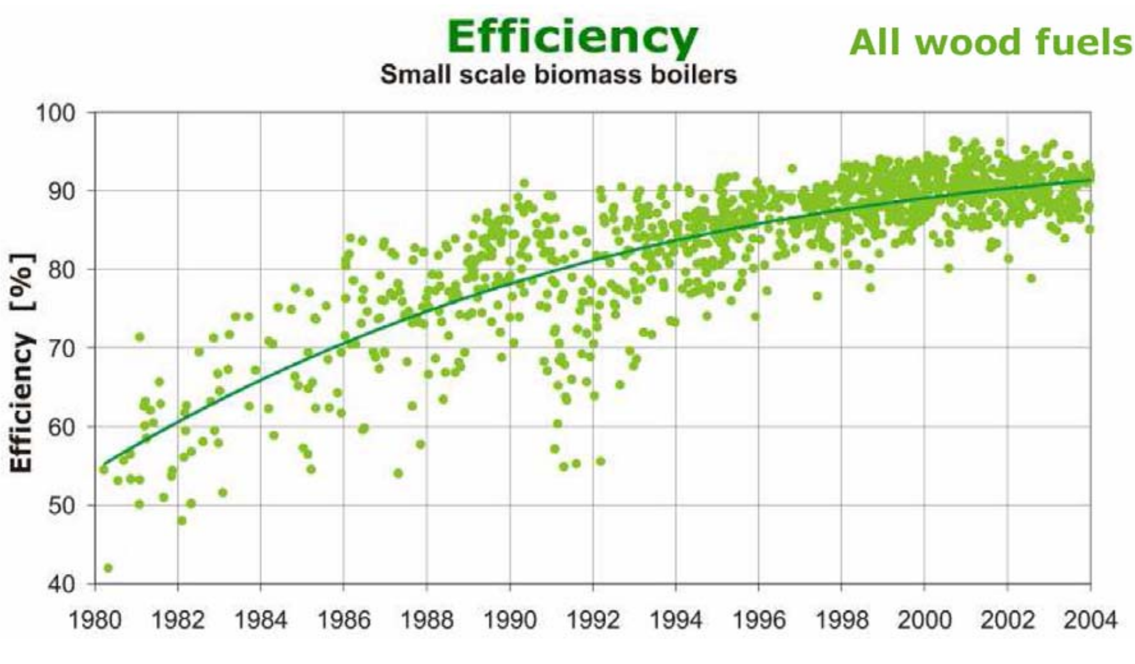
The following figures show the results of biomass boiler tests from 1980 to 2004. Figure 32 shows the CO emissions and Figure 33 the efficiencies of the tested boilers. It is clear to see that within this period, substantial improvements could be achieved. To some extent, this can be attributed to the regulations concerning emissions and efficiencies and obligatory type tests.

Figure 32 Results of biomass boiler type tests from 1980 to 2004: Carbon monoxide emissions



Source: Haslinger et al. 2008, FJ BLT Wieselburg

Figure 33 Results of biomass boiler type tests from 1980 to 2004: efficiency



Source: Haslinger et al. 2008, FJ BLT Wieselburg

6 Current Status of Renewable Energy Sources of Cooling

6.1 Support schemes

Besides R&TD the following promotion schemes for RES-C systems exist in Austria: In Lower Austria air conditioning systems which are powered by photovoltaic systems are subsidized with up to 30% of the investment costs (up to 1.500 €) and in Vienna, there is a subsidy of up to 30% of the investment costs for solar cooling systems. As far as it is known, there are no subsidies for renewable cooling systems in the other provinces.

However, there is also a subsidy for solar cooling systems on a national level (managed by the Kommunalkredit). This subsidy can be claimed by companies, non-profit organizations, public institutions and utilities and accounts for up to 30% of the investment costs.

6.2 Pilot projects

There are some solar/biomass cooling systems installed in Austria, for example in a winery in Southern Styria, in the "Ökopark Hartberg" (Styria) as well as cooling systems for office and public buildings in Sattledt (Upper Austria), Gröbming (Styria), Graz (Styria) und Gleisdorf (Styria). The total power of solar cooling systems in Austria is more than 8.000 kW and the collector area more than 20.000 m^2. They are primarily used for cooling office buildings, laboratories, hotels and industrial buildings, but also hospitals, sports centers and a winery (Hackstock 2008).

Some information about several of these pilot projects is available at Solarwärme (2009) and Solid (2009).

6.3 Scenario until 2030

In Haas et al. (2007), a scenario for cooling in Austria until 2030, based on the estimate of the current demand which was shown in Chapter 3, is presented. In Table 3 some data and assumptions of this assessment are summarized. According to this scenario, the final energy demand for cooling increased from 365 GWh/a in 2005 to 1.875 GWh/a in 2030. The future diffusion of air conditioning systems is of course an open question. Due to the climate change the diffusion could occur clearly faster than in this scenario, which does not take into account the possible effects of climate change.

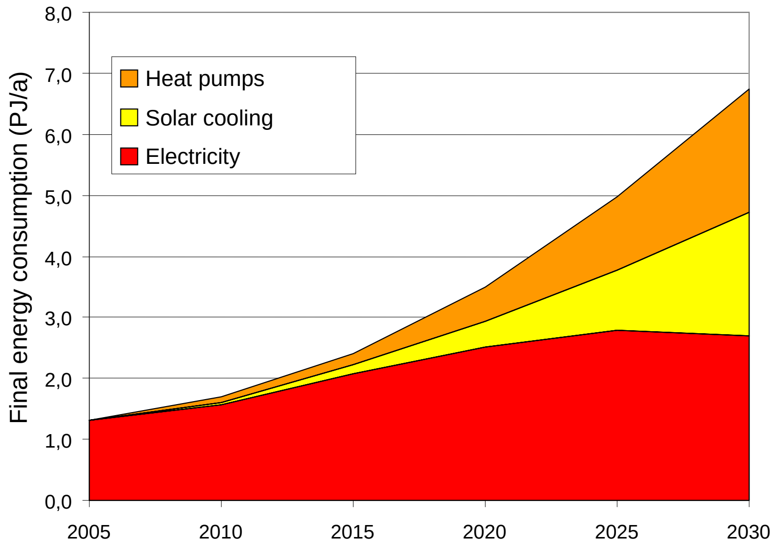
Table 3 Scenario of the electricity consumption for cooling in Austria in 2030

			2005			2030			Electricity consumption	
Categories of buildings.	Number of buildings 2005	Number of buildings 2030	No air conditioning	Partial air conditioning	Full air conditioning	No air conditioning	Partial air conditioning	Full air conditioning	2005	2030
	[1]	Stk	[%]	[%]	[%]	[%]	[%]	[%]	[GWh]	[GWh]
Single family house	1.196.770	1.332.543	97,5	2,0	0,5	75,0	20,0	5,0	68	754
Semi-detached house	211.403	215.249	97,5	2,0	0,5	75,0	20,0	5,0	16	158
Apartment buildings, small	120.813	131.825	98,0	2,0	0,0	83,0	15,0	2,0	8	97
Apartment buildings, large	55.039	60.073	98,0	2,0	0,0	83,0	15,0	2,0	7	93
Schools etc.	17.771	19.070	99,0	1,0	0,0	94,0	5,0	1,0	1	12
Hospitals etc.	427	428	70,0	20,0	10,0	30,0	40,0	30,0	6	15
Sports and recreational facilities	2.016	2.348	98,5	1,0	0,5	85,0	10,0	5,0	0	3
Hotels, large	2.204	2.379	50,0	30,0	20,0	10,0	60,0	30,0	38	68
Hotels, small	34.257	37.096	80,0	15,0	5,0	40,0	40,0	20,0	65	244
Office buildings, large	8.295	9.826	50,0	30,0	20,0	20,0	40,0	40,0	119	258
Office buildings, small	26.342	30.704	88,0	10,0	2,0	65,0	25,0	10,0	10	44
Offices in apartment buildings	10.404	12.416	96,0	3,0	1,0	80,0	10,0	10,0	5	44
Commercial buildings, large	10.140	10.857	85,0	10,0	5,0	40,0	40,0	20,0	11	45
Commercial buildings, small	23.543	25.346	88,0	10,0	2,0	65,0	25,0	10,0	10	41
Total									365	1875

Quellen: EEG (2007)

In this scenario, it is further assumed that a significant market diffusion of solar cooling systems and cooling with heat pumps will occur. Figure 34 shows the final energy consumption for cooling, broken down by technology. It was assumed that 30% of the above mentioned values for the year 2030 can be substituted with heat pumps and further 30% can be substituted with solar cooling.

Figure 34 Scenario for the final energy consumption for cooling in Austria until 2030



Source: Haas et al. 2007

7 Ongoing Legislative, Regulatory and Market Changes

The annual installation of solar thermal systems and heat pumps in Austria has increased significantly in recent years. The highest annual increment of solar thermal collector area was observed in 2006 (300.000 m^2). (In 2007 it was slightly lower and for 2008 no data are available yet.) Concerning heat pumps, for the first time since 1986 a new all-time high of annually installed systems was achieved in 2006 (13.600 systems). In 2007, this value was again surpassed by 10%. The annual installation of pellet boilers, which developed very dynamically since the end of the 1990ies, declined sharply in 2007 due to the pellet price surge late in the year 2006. The annual installation dropped to about 40% of the previous year's value and also the sales figures of log wood and wood chip boilers decreased by about 30%.

With regard to large-scale biomass boilers (> 100 kW), especially in the years 2005 and 2006 significant increases could be observed. This was primarily due to the rapid deployment of biomass CHP plants which was triggered by the commencement of the Austrian Renewable Energy Act of 2002. After an amendment was passed in 2006 the deployment came to a halt. This is evident from the installed capacities of large scale boilers in 2007 (despite the time lag between approval and commissioning of renewable electricity plants).

The support schemes for renewable heating systems have been revised several times in most provinces in recent years. In addition to these support schemes, a federal support scheme for biomass heating systems ("Förderaktion Holzheizungen") was initiated within the program "Klima- und Energiefonds" in 2008. The core objective of this support scheme was to stimulate the declining market for biomass boilers and facilitate a steady increase of biomass in the residential heating sector. Within this action, the installation of biomass heating systems was incentivized with an additional investment subsidy of 800 € for pellet boilers and 400 € for log wood and wood chip boilers with a rated power of up to 50 kW. The budget of this support program was 9 million € in 2008 (Klimafonds 2009).

Following the EU Directive 2002/91/EG (Energy Performance of Buildings Directive) the "energy pass" was introduced in Austria. Since January 1, 2009 sellers and renters of houses, apartments or other buildings have to submit the energy pass of the property to the buyer or user, respectively. The idea of the energy pass is to provide profound and comparable information about the thermal quality of buildings. The practical implementation of the directive is primarily within the authority of provinces in Austria. This includes setting up the methodology of calculating key figures of the thermal quality of buildings, contents and regulations about the issuance of the energy pass.

In order to introduce common regulations throughout Austria, efforts to harmonize provincial legislation are in progress. To some extent this is also true for the different support schemes for renewable energy systems (e.g. the requirement of a minimal coefficient of performance for heat pumps).

In order to tackle the current economic crisis the Austrian government plans to provide funding for thermal building renovation. This could also lead to an enhanced switch to renewable energy systems.

8 Conclusions

Due to the high importance of the heating sector within the Austrian energy system, the enhanced use of renewable heating systems is a core issue in order to fulfil energy and climate policy targets. The share of low-temperature heat in the final energy consumption of Austria was as high as 28% in 2007, the share of steam generation (including process heat) was 8% and industrial ovens accounted for about 15%.

Currently, measures to increase the share of renewable energy sources in the heat sector vary from province to province and are rather inhomogeneous. These measures include tax relieves, financial incentives, compulsion-based instruments (e.g. in the field of house building or approval processes for heating boilers), promotional activities and other initiatives. In the field of renewable cooling support schemes are scarce.

The results of analyses about the historic development of renewable heating systems (heat pumps, solar thermal and biomass heating systems) indicate that both oil prices and support schemes had a significant impact. For example a very successful market introduction of pellet boilers was achieved in the last 10 years or so. Furthermore, the introduction of emission and efficiency standards for biomass heating systems contributed to significant technological progress, as results of obligatory boiler test suggest. Another positive trend which could be observed in recent years is that solar thermal systems and heat pumps are increasingly used as auxiliary heating systems, rather than solely for water heating. With the introduction of a minimum coefficient of performance the share of ambient heat of these systems will further increase and can be expected to lead to a concentration on building types which are most suitable for this technology (high thermal quality, low-temperature heating systems). Together with increasing thermal quality of buildings, the remaining heat demand which has to be covered with biomass and fossil-fuelled heating systems can be reduced significantly.

Air conditioning only plays a subordinate role in today's energy system in Austria. However, it can be assumed that there will be a notable increase in the energy demand for cooling throughout the next decades. The use of renewable energy-based cooling systems should therefore also be promoted. There are already several biomass and solar cooling systems installed in Austria.

With regard to the further development of policy instruments for promoting renewable heating systems in Austria, the following questions and challenges have to be considered:

- Will support schemes be rather implemented on provincial or federal level?
- What importance can be attributed to regulatory measures?
- What measures are necessary for significantly increasing the thermal quality of the existing building stock? How can thermal renovation and increasing the use of renewable heating systems be coordinated in an efficient way?

- What will be the future role of subsidies for house building with regard to renewable heating systems?

9 References

Amann, W., 2008: Presentation „Steuerliches Förderungsmodell für die thermische Gebäudesanierung", Institut für Immobilien, Bauen und Wohnen GmbH, April 2008

Biermayr, P., 1999: „Einflussparamerter auf den Energieverbrauch der Haushalte", Dissertation

Blümel, E. et al., 2005, "COOLSAN – Kältetechnische Sanierungskonzepte für Büro- und Verwaltungsgebäude"; Endbericht des gleichnamigen Forschungsprojektes im Auftrag des BMVIT;

CEPE, 2007, "Der Energieverbrauch der Dienstleistungen und der Landwirtschaft, 1990 – 2035", Eidgenössisches Departement für Umwelt, Verkehr, Energie und Kommunikation UVEK; März 2007

E-control 2009: Website http://www.e-control.at/ (last access March 2009)

Faninger, G., Weiss, W., Bergmann, I., Biermayr, P., Kranzl, L., 2007: „Erneuerbare Energie in Österreich. Marktentwicklung 2006. Thermische Solarenergie, Photovoltaik und Wärmepumpen." BMVIT, Berichte aus Energie- und Umweltforschung 11/2007.

FGW 2009: Fachverband der Gas- und Wämeversorgungsunternehmungen ; http://www.gaswaerme.at (last access in March 2009)

Haas, R., Havlickova, K., Kalt, G., Knapek, J., Kranzl, L., Weger, J., 2005: „Final Report for the CZ-AT Research Project: Biomass – Implementation and Support Schemes", November 2005

Haas, R., Biermayr, P., Kranzl, L., Müller, A., Schriefl, E., 2007: „Wärme und Kälte aus Erneuerbaren 2030", Wien.

Hackstock, R., 2008: „Detail-Infos zum Solarmarkt Österreich", Verband Austria Solar, http://www.solarwaerme.at (last access March 2009)

Haslinger, W., Carvalho, L., Eder G., Emhofer, W., Friedl, G., Griesmayr, S., Kohl, G., Lasselsberger, L., Musil-Schläffer, B., Ohnmacht, R., Schwarz, M., Wopienka, E., Wörgetter, M.: „Small-scale Biomass Combustion Technology – A Technology Review", 16th European Biomass Conference, 2-6 June 2008, Valencia

Jerome, A. et al., 2003, "Energy Efficiency and Certification of Central Air Conditioners (EECCAC)"; final report april 2003, study for the D.G. Transportation-Energy (DGTREN) of the Commission of the E.U.

Klimafonds 2009: Website http://www.klimafonds.gv.at/ (last access in March 2009)

Kommunalkredit 2009: Website http://www.kommunalkredit.at/ (last access in March 2009)

Kranzl, L., 2008: „REFUND+, Quantitative and economic assessment of the direct fiscal measures, Study of the Austrian case", January 2008

Land Steiermark 2009: Website http://www.verwaltung.steiermark.at (last access in March 2009)

Lang, G., 2007: „Erhebung CO2 Emissionen und Energieverbrauch für Wohngebäude im Bestand und Neubau in Österreich für den Berichtszeitraum 2008 – 2020 zur Zielerreichung der EU-Klimastrategie“, March 2007

Lasselsberger, L. 2002: „Typenprüfung von Holzfeuerungen“, BLT Wieselburg

qm Heizwerke 2009: Website http://www.qm-heizwerke.at/, (last access in March 2009)

Solarwärme 2009: „A programm of the Lebensministerium und Austria Solar within the action klima:aktiv“, http://www.solarwaerme.at/ – Marktstatistik (last access in March 2009)

Solid 2009: Website http://www.solid.at/ (last access in March 2009)

Statistik Austria, 2008: Website of Statistik Austria, http://www.statistik.at/ (last access in March 2009)

AEE Intec, 2007, AEE – Institute for sustainable technologies (solar thermal systems): Werner Weiss, 17 December 2007

Berger, M., Haas, R., Kranzl, L., 2001: Strategien zur weiteren Forcierung erneuerbarerer Energieträger in Österreich unter besonderer Berücksichtigung des EU-Weißbuches für erneuerbare Energien und der Campaign for take-off. Im Auftrag von BMwA und BMLFUW. – Wien 2001.