

THE BUILDING SECTOR IN AUSTRIA

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Energy Consumption and Energy Policy

About 40% of the energy consumption in Austria is used for the heat supply in buildings. Half of this is allotted to flats; fig. 1. Reduction of the energy consumption as well as the increase of efficiency of heating systems have priority in the Austrian energy policy. In Austria, the CO₂-emissions in the sector of dwellings are of about 21% (fig. 2) and therefore an interesting sector for the goal to reduce CO₂-emissions through the energy supply.

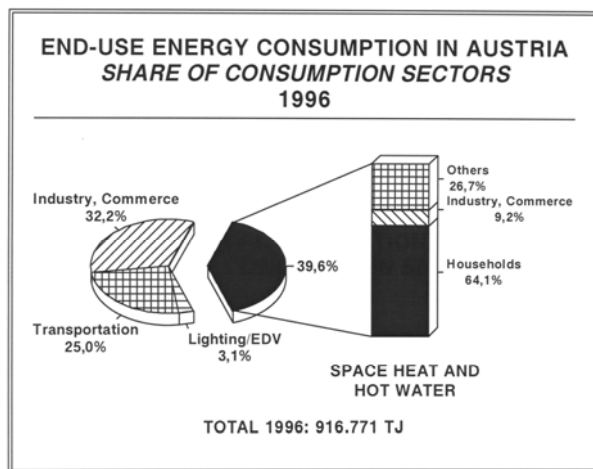


Fig. 1: Energy consumption in buildings

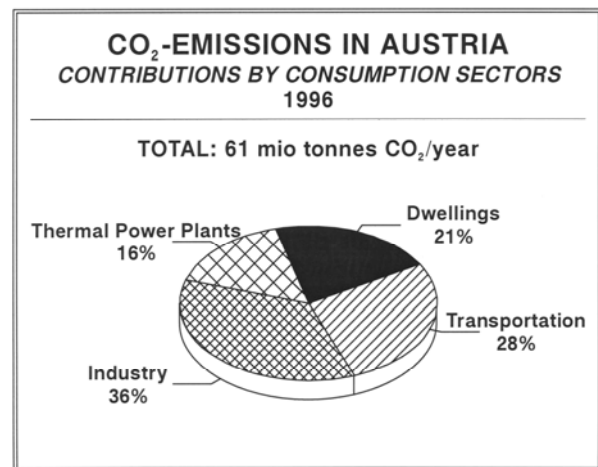


Fig. 2: CO₂-emissions by consumption sectors

Considering the goals of the Austrian energy policy to save primary energy and to reduce the CO₂-emissions the requirements for building constructions and heating systems are:

- Energy conservation,
- substitution of fossil energy carriers and
- the use of renewable energy sources.

To achieve the goals for *Sustainable Housing* the heating system also requires the utilization of locally available renewable energy sources, such as biomass and solar energy in the form of radiation (direct use) or ambient heat (indirect use).

For new buildings the technologies are available to achieve these figures - space heat demand smaller than 30 kWh/(m², year), utilization of renewable energy sources (bio energy, solar energy) for heat supply with an annual share of more than 30% - by different measures. Of importance is also the renovation of old buildings with the conditions for new buildings; fig.3.

The present energy consumption in dwellings/flats is illustrated in fig. 4. The share of applications in dwellings is in old buildings about 80% for space heating, about 10% for hot water preparation, about 7% for appliances and about 3% for lighting. The energy demand for space heating of new buildings is of about 60% of old buildings. Therefore the share energy

consumption in new buildings has changed to about 62% for space heating, about 20% for hot water preparation, about 14% for appliances and about 4% for lighting.

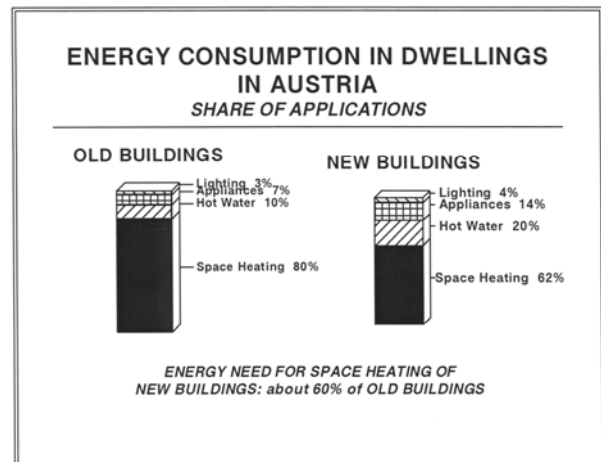
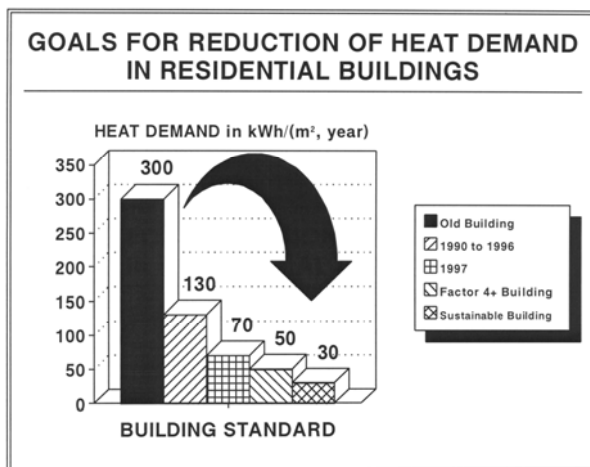


Fig. 3: Goals for reduction of space heat demand Fig. 4: Energy consumption in dwellings

Technologies for Sustainable Solar Housing

In the past decade the energy and fuel demand for space heating as well as for hot water preparation could be reduced remarkably by energy-saving building constructions and by energy-efficient heating systems. Practical research in and demonstration of low-energy buildings as well as new technologies for the heating of buildings have resulted in a number of economical and marketable solutions in the building sector.

The following technical possibilities offer the reduction of energy consumption in buildings (fig. 5):

- (1) Reduction of heat demand for space heating through energy saving building constructions: *low-energy building*.
- (2) (1) and the application of elements and systems for the "passive" use of solar energy in buildings: *solar building*.
- (3) (1), (2) and the application of energy-efficient heating systems: *low energy building in combination with energy-efficient heating systems*.
- (4) (3) and the use of solar energy via "active" (solar collectors) and "passive" (solar architecture) ways as well as via "indirect" use of solar energy through ambient heat (thermal stored solar energy in the environment): *low-energy building in combination with solar and heat pump systems*.
- (5) Reduction of fuels for *hot water preparation* through solar and heat pump systems.
- (6) reduction of electricity for lighting via *day lighting systems* especially in commercial and institutional buildings.

The main influence factor for the *space heat demand* of dwellings is the insulation of the building envelope. With new energy codes for dwellings in Austria since 1996, space heat demand and fuel demand for space heating as well as the CO₂-emissions through heating systems have been reduced by more than 30% in new buildings .

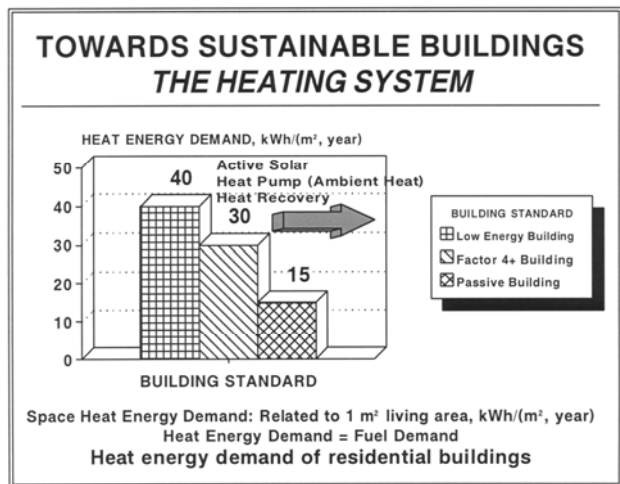
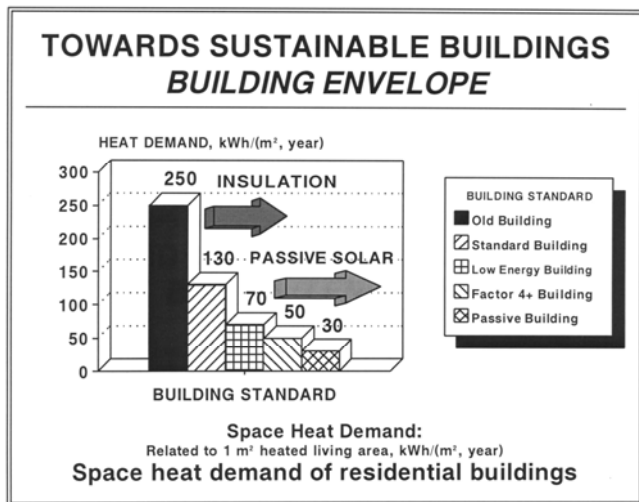


Fig. 5: Ways to realize *Sustainable Houses*

Table 1: Building Codes in Austria: Regulations in Austrian Provinces
U-Values in W/(m², K)

Province	Burgenland	Carinthia	Lower Austria	Upper Austria	Salzburg	Styria	Tirol	Vorarl-berg	Vienna
Validity since	1998	1997	1996	1995	1983/1991	1997	1998	1996	1993
outer walls	0.45	0.40	0.40	0.50	0.47-0.56	MD: 0.5 1&2D: 0.40	0.35	0.35	0.50
walls to unheated building-parts and walls of fire	0.70	0.70	0.70	0.70	0.70-0.83	0.70	0.50	0.50	-----
walls to separate operating units	1.20	1.60	1.60	1.60	1.56	1.60	0.90	1.60	0.90
outside ceilings, lofts, passages, etc.	0.25	0.25	0.22	0.25	0.26-0.30	0.20	0.20	0.25	0.20
ceilings to unheated building units	0.40	0.40	0.40	0.45	0.37-0.45	0.40	0.40	0.40	0.40
ceilings to separate residential- and other operating units	0.90	0.90	0.90	0.90	1.03	0.90	0.70	0.90	0.90
windows	1.70	1.80	1.80	1.90	2.50	1.90	1.70	1.80	1.90
external doors	1.70	1.80	1.80	1.90	2.50	1.70/1.90	1.70	1.90	1.70
walls to ground	0.40	0.50	0.50	0.50	0.55-0.67	0.50	0.40	0.50	0.50
floors to ground	0.40	0.50	0.50	0.50	0.39-0.47	0.50	0.40	0.50	0.40

Table 1 illustrates the actual building codes in Austria. Responsible are the regional governments (*provinces*).

In the last years the building insulation standards have been increased in Austria. Fig. 6 illustrates the development of the U-values of the building envelope (average figures) in Austria from 1918 to 2000. With higher standards for the insulation of the building envelope also the LEK-values - defining the transmission-heat losses of a building - could be reduced remarkably. Within the better insulation of the building envelope it has been possible to reduce *heat load* from 150 W/m² to 40 W/m² and *the space heat demand* from more than 300 to 60 kWh/(m², year) in the last decades.

Realized projects show, that it is possible, to reduce the fuel supply up to 30% compared to „standard“ buildings by better building insulation with nearly the same investment costs.

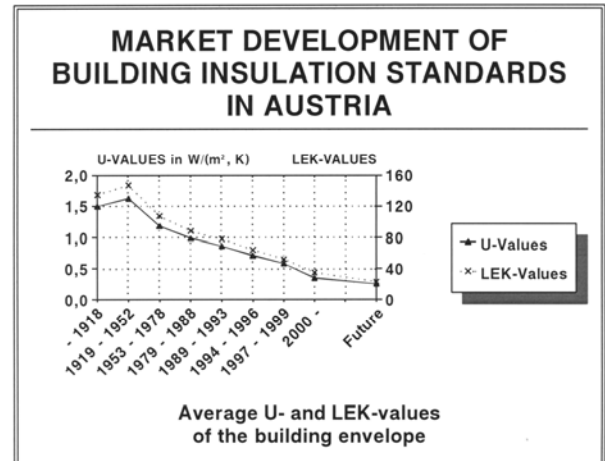
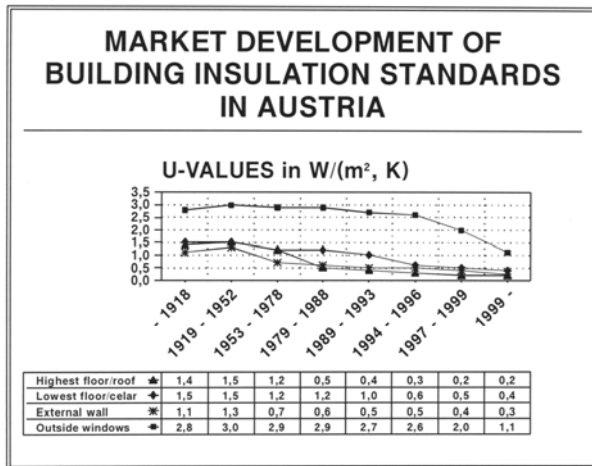


Fig. 6: Market development of U-values and building transmission losses

The Present State of Housing Types in Austria

The heated area in both residential and other buildings has increased rapidly in the last decades. The growth in the total area of detached housing stock in particular during the 1970s is the result of a high building rate and insignificant demolition as well as renovation. At present apartment buildings are dominating. Under the *Housing Promotion Act* of the Austrian government detached dwellings get more financial support from the regional governments, which has influenced the further market deployment of apartment and detached houses. Today the scale of dwelling types is presented by 57% apartment houses, 19% farm-houses, 10% detached houses, 3% weekend houses and 11% other buildings; fig. 7. About 21% of the inhabitants are living in their own flats/houses and 79% in rented flats.

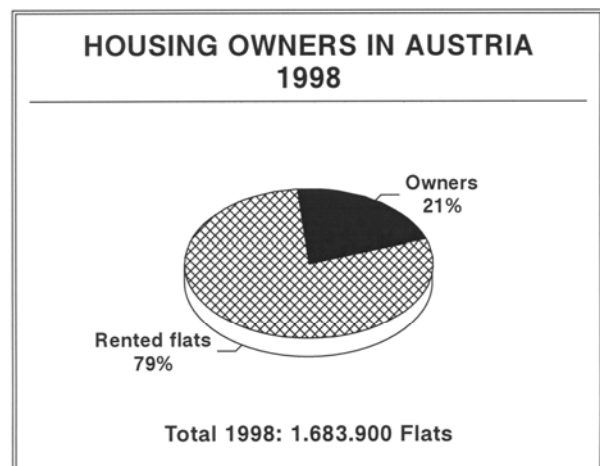
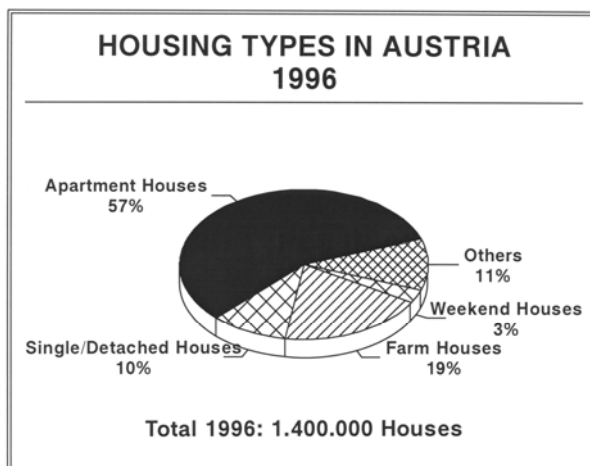


Fig. 7: The situation of housing in Austria

The Present State of Heating Systems

For the heating of dwellings the following heating systems are in operation: single furnace, apartment heating, central heating and district heating. In the last years the heating through single furnace has been replaced by apartment heating, central heating and district heating, as shown in fig. 8.

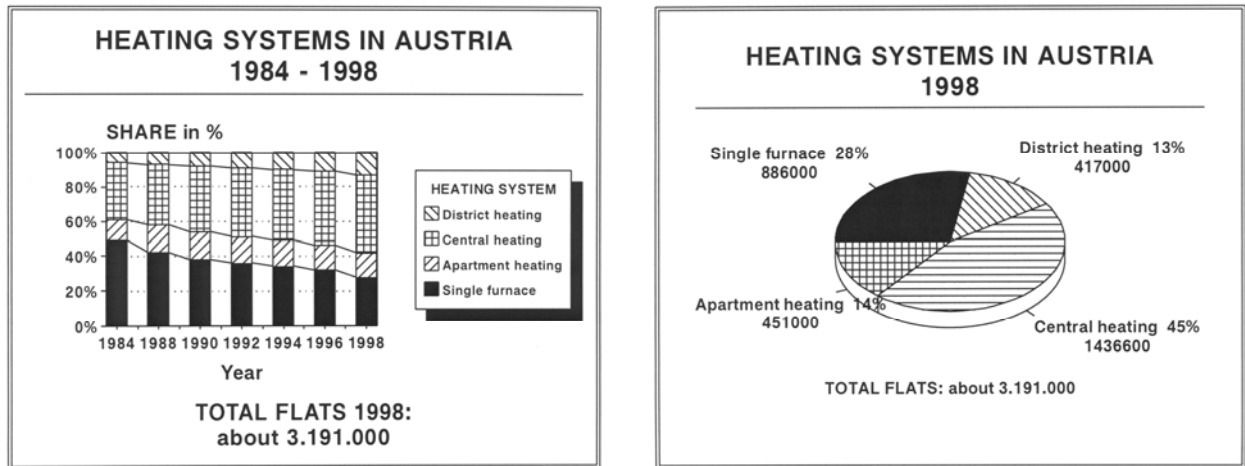


Fig. 8: Heating systems in Austria

Also the fuels for dwellings and flats have been changed in the last years; fig. 9.

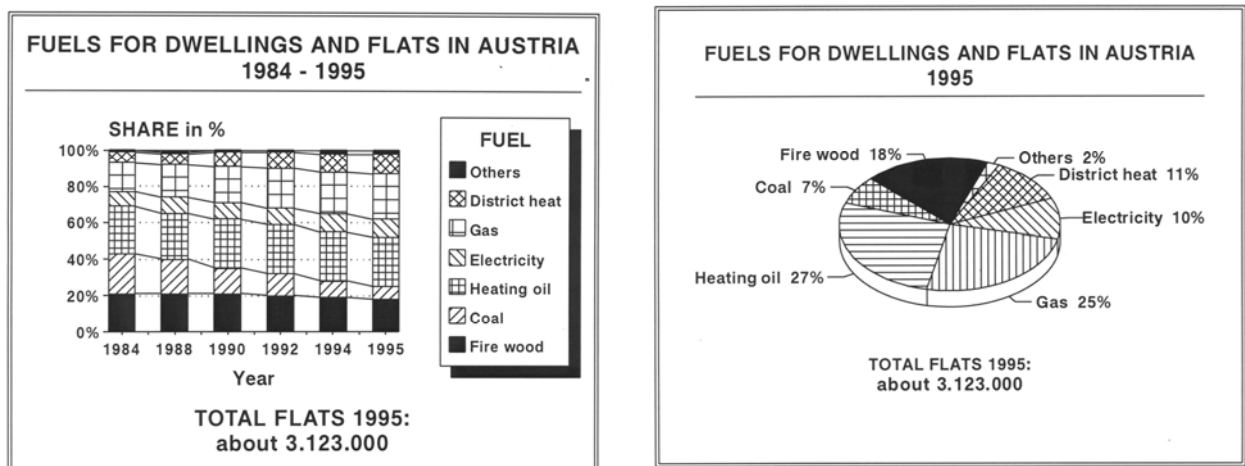


Fig. 9: Energy sources for space heating in Austria

There are many possibilities to reduce the *fuel supply* for space heating. Today there exist energy-efficient oil- and gas-boilers as well as modern boilers for firewood and biomass (pellets and wood chips), also in smaller units. The meteorological conditions in Austria allow the use of solar radiation via solar thermal systems to produce hot water with an annual share of more than 40% in multifamily buildings and more than 80% in single-family buildings. There are also possibilities to reduce the fuel supply for space heating in countries with a moderate solar radiation through solar assisted heating systems (*SolarCombi-Systems*). The indirect use of solar energy in heating systems via ambient heat by heat pump technologies is today a proved energy-efficient heating technology in Austria. Ground-coupled heat pump systems are dominating the market in single-family houses, combined with low-temperature floor heating systems. Direct evaporation and secondary fluid systems are both being used. Heat pumps are mainly installed in new buildings. Retrofitting of existing buildings with high-temperature radiators happens relatively seldom because of the low oil price and the small seasonal performance factor involved.

Heat recovery can be accomplished by heat exchangers, by air-to-air heat pumps or by a combination of the two. The heat pump provides not only heat recovery, but also heating if the heat pump outlet temperature is higher than the room air temperature. In such a system the additional heat demand becomes very small, and conventional heating systems would not be cost-effective.

Small heat pump systems in combination with air-ventilation and heat recovery are very promising heating technologies for *Passive House* standards.

Governmental Measures for Market Deployment of Sustainable Housing

The market deployment of *Sustainable Housing* is supported by both the federal government and the local governments (provinces) in different ways: direct financial support, tax incentives, financial support under the *Dwelling Improvement Act* and the *Housing Promotion Act*.

New standards for thermal efficiency of new buildings - with the goal to reduce the space heat demand within reducing the thermal transmittance co-efficient (U-values) for new buildings by about 20% compared to actual values - have influenced the market for energy-efficient building constructions and new heating systems with utilisation of renewable energy sources.

In Austria, energy research, development and demonstration was focused in the last 20 years to the building sector with the goal to find ways for the realization of sustainable buildings:

“Based upon a life cycle analysis sustainable buildings are designed to minimize both direct and indirect adverse impacts on the indoor, local, regional and global environment.”

Sustainable buildings incorporate sustainable materials and components and use of a minimum amount of energy, which should be covered to a high percentage by renewable energy carriers. The core element for sustainable buildings are high heat insulation of the building envelope as well as active and passive use of solar energy: *Sustainable Solar Housing*.

The Federal Ministry for Transport, Innovation and Technology (BMVIT) initiated in the year 2000 a five years programme, the „*Austrian Programme on Technologies for Sustainable Development*“, where the structural change towards an eco-efficient economy is supported

through research, technological development and dissemination activities. Seven guiding principles were formulated as a basis for the programme:

- Service-orientation.
- Resource-efficiency.
- Utilisation of renewable resources.
- Multiple use.
- Flexibility and ability for adaptation.
- Failure-tolerance, learning ability and risk anticipation and –prevention.
- Ensuring work, income and quality of life.

The Austrian Programme on Technologies for Sustainable Development has a budget of 45 – 50 Mio ATS per year (3.27 – 3.63 Mio EURO). Public calls are carried out regularly. Two programme lines exist so far, the „*Building of Tomorrow*“ and the „*Factory of Tomorrow*“.

The aim of the „*Building of Tomorrow*“ programme line is to conceive, plan and realise advanced buildings for living and working that fulfil the following criteria:

- Increased energy efficiency over the whole life cycle.
- Enhanced utilisation of renewable energies (in particular solar energy).
- Increased use of renewable materials and efficient use of materials.
- Services and user aspects.
- Comparable costs in relation to conventional buildings.

The topics of the first call included the analysis of user behaviour and experiences of inhabitants of innovative buildings, the adaptation of criteria for the assessment of buildings, efficient solar technologies, innovative components (e.g. storage, windows, PV, solar cooling, and others) as well as innovative methods, components and elements on the basis of renewable materials. For the first call, 242 proposals were submitted. Out of these were 102 studies and technology projects, 90 innovative building concepts and 50 „pioneers“. The total project sum amounted to 231 Mio ATS (16.79 Mio EURO) requesting 169 Mio ATS (12.28 Mio EURO) of public money. As a whole, 35 proposals were funded (29 RTD projects and 6 innovative building concepts). The total project amount is 58 Mio ATS (4.21 Mio EURO) with a public funding part of 32 Mio ATS (2.33 Mio EURO). Moreover, 14 „pioneers“ received an award.

User Motivation

The annual budget of an average Austrian household is of about 24370 EURO (1999/2000), from which are used 1185 EURO (4.9%) for energy supply in housing (heating, hot water, appliances, lighting) and 1757 EURO (7.2%) for individual transportation (fuel, maintenance). Therefore, the energy supply of housing has not an economic priority up to now. Nevertheless there are other reasons for energy saving in housing: a better understanding of the energy and environment situation, more independence from the development of the energy market (availability and price) and an expected higher living comfort. Under these circumstances an important motivation factor for housing owners and occupants are certifications, e.g. Energy Pass, Energy Star, Emissions, Life-Cycle Analysis, Total Building Quality Assessment, and its guarantee by planners, architects and building construction firms.