Market Deployment of Solar Housing in Austria

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1. Background

To reduce the heat energy demand and therefore also the fuel demand for space heating as well as the CO_2-emissions is the main goal of the Austrian energy policy. To achieve this goal it is necessary to consider the building envelope and the heating system as an unit. For both new buildings and building renovation high standards for building insulation and for efficiently energy heating systems with the use of locally available renewable energies are important.

Energy-efficient housing have been receiving greater attention in recent years as building constructions and efficient heating systems accelerate. Also new building codes have influenced the market for low energy buildings in the last years remarkable.

Present initiatives on the Austrian housing market are focused on the marketing of *sustainable buildings*, including cost-effectiveness and acceptance by occupants and therefore ready for a faster market penetration. The market deployment of sustainable housing is supported both by research programmes and financial support of the Austrian federal and provincial governments. Besides of the *Housing Promotion Act* for sustainable housing special support for biomass-, solar- and heat pump systems are offered to the consumers by the provincial governments in the order of up to 20% of the investment costs.

The Research Programme *Technologies for Sustainable Development*, initiated and developed by the Austrian Federal Ministry of Transport, Innovation and Technology (BMVIT), support in the framework of the subprogram *"Building of Tomorrow"* the market deployment of sustainable housing. The program's goal is the development and market diffusion of components, prefabricated building parts and building methods, which correspond to the above criteria and to the main principles of sustainable development. The subprogram *"Building of Tomorrow"* makes use of the two most important developments in solar and energy efficient building: the passive house and the low energy solar building approach. For the purposes of the "*Building of Tomorrow*" research program, these energy centred innovations are expanded to take in ecological, economical and social concerns.

"*Building of Tomorrow*" are residential and office buildings, and differ from current construction practice in Austria by fulfilling the following criteria:

- higher energy efficiency throughout the whole life-cycle of the building
- greater use of renewable energy sources, especially solar energy
- greater use of sustainable raw materials and efficient use of materials in general
- increased consideration of user needs and services.

However, the costs should be comparable with conventional building standards.

To support the interest of planners and architects as well as building construction firms for innovative housing, a competition started in 2000. Examples for objects received an award are illustrated in Figure 1a to d.

The *"Building of Tomorrow"* subprogram has a planned duration of five years (2000 – 2005), and a total budget of 120 million Euro. It comprises the following elements:

- technology and component development
- development of innovative building concepts for residential and office buildings
- setting up and evaluating demonstration projects
- market diffusion of the "*Building of tomorrow*".

2. Strategies and measures for marketing of *Sustainable Housing*

Strategies and measures for accelerating the wide-spread market deployment of *Sustainable Housing* are based on the basis of confidence in technologies and markets.

From the experiences in Austria the main indicators for the market penetration of *Sustainable Housing* are:

- nw building standards for energy-efficient housing - in correspondence to the goals of national energy policy - supported with financial measures and
- the acceptance for new building standards and heating systems by consumers.

Main criteria's for *Sustainable Housing* are: Primary energy for building construction and operation (life-cycle-analysis), share of renewable resources, living standard, cost-effectiveness. These criteria's have to be guarantee by planers, architects and building construction firms.

The market penetration of new and innovative technologies require interest and co-operation of all actors in the building sector: building owners and companies, building construction and installation industry, planners and architects. Buyers and tenants are demanding higher performing, more comfortable and healthier buildings. Forward-looking business, communities and energy companies are searching for ways to respond to customer demand. People want houses, offices, apartments and communities in which sound environmental principles are integrated into building architecture and surrounding amenities. An important aspect for economy and industry is, that new technologies and products in the building and heating sector offers new business opportunities. Therefore, the world-wide markets for buildings are changing. The development of new building approaches and products respond to their changing demands.

3. Solar Housing in Austria

The market penetration of low-energy housing show a positive trend in the last five years. Until 1966 the building standards follow the energy codes. Since 1967 the building standards – related to the building envelope insulation – changed remarkable to lower space heat demand. Figure 2a and b 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; Figure 3. For illustration, the share of low-energy housing in new building constructions is shown for the province Carinthia/Austria in Figure 4.

The changing in the building sector was not only the consequence of public funding, but also because of energy-economic solutions in the building sector as well as in more interest and attention from buyers and tenants for environmentally sound, higher performing, more comfortable and healthier buildings. 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. Figure 5 indicates the possibility to realise low-energy building standards to nearly the same investment costs of “standard” housing.

Besides of better building envelope insulation, the use of renewable energy technologies increased in the last years. Favourites are solar combined biomass- (pellets) heating systems.

In the following experimental data and experiences from efficient solar heated buildings with economical and ecological benefits are reported.

Solar hot water preparation

The hot water preparation in new buildings is today standard in Austria. In the area of building renovation, solar systems for hot water preparation are attractive on the market. Especially ineffective heating systems for hot water preparation outside the heating season have been replaced by solar hot water preparation. Thus pollutant emissions through heating (wood-, coal-, oil-boilers) could be reduced and at the same time a high comfort in hot water preparation could be reached.

In solar systems for hot water preparation in residential and commercial buildings flat plate collectors of different designs (non evacuated and evacuated collectors with and without selective coating) are used. For solar hot water systems short-term storages for a few days are generally sufficient. The storage volume is of about 1.5 to 2.0 times of the daily hot water demand. An annual efficiency of the solar system of at least 30% is aimed at. On an annual average the solar share is of about 70% in single-family buildings and of about 40% to 50% - also for reasons of lack of space for the installation of collectors - in multi-family dwellings. The use of solar hot water systems in multi-family buildings has the advantage of lower specific investment costs and thus also the heat preparation costs for solar hot water preparation can be reduced in comparison with small, decentralized systems.

With solar systems for hot water preparation in detached and row houses about 8% to 12% and in apartment housing about 5% to 8% of the total annual heat demand (including space heating) will be covered by solar heat; Figure 6a to c.

Solar supported heating systems

Solar thermal systems with middle-term storage are used to support heating systems during the pre-heating season and for hot water preparation in combination with district heating outside the heating season. Favoured solar supported heating systems are automatically operated biomass boilers (pellets and wood-chips) or ground-coupled heat pump systems.

The solar share of solar supported heating systems – considering energy-economic aspects - depends on the heat demand of the building (space heat and hot water) and the design of the

heat distribution system (design inlet-temperature below 40°C) and is of about 20% to 40% for low-energy dwellings; Figure 7a to c.

The combination of a biomass district heating plant with a solar plant has the advantage that heat outside the heating period can be produced to a large extent through the solar plant and district heat supply is to be made more attractive for the potential consumer through its all year operation. Otherwise the emissions of biomass burners can be reduced remarkably in summer time. In order to cover the heat demand for hot water outside the heating season mainly by solar collectors a thermal storage with a capacity for 3 to 5 days has to be installed. Even if the solar share for space heating and hot water preparation is of about 14% on the annual average, the solar share for hot water preparation outside the heating season is more than 80%.

Solar-supported small district heating for new housing estates are an important new approach for the utilisation of solar energy in the building sector; Figure 8a and b.

Solar heating systems with seasonal storage

The storage capacity of a long-term (seasonal) storage to be used for space heating should last at least for four (passive-house standard) to six months (low-energy-building standard).

This costly possibility of using solar energy for space heating is not favoured at present time for marketing of Sustainable Solar Housing in Austria because there are other possibilities - competitive to conventional heating systems - to use solar energy "indirectly" in form of ambient heat (via heat pumps) or biomass. *Ambient heat* and *bioenergy sources* are attractive alternative "long-term stores" for solar energy. Also heat recovery is an important and economic acceptable instrument to reduce the fuel demand for space heating.

4. Future Prospects

There is a general need for increased public awareness and understanding of *Sustainability*, especially for the main players involved in planning decisions (planning officers, local communities, pressure groups, etc.). Greater consideration needs to be given to the potentially useful role that *energy-efficient buildings* and *renewables* could play in meeting these targets and of ways of encouraging their development and deployment. Encouragement needs to be given also to increase research in this area and to improved sharing of information's on this topic.

In the past decade the demand of fuel 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.

In principle, the criteria's of sustainable housing can be reached by all building constructions: bricks, concrete and wood with sufficient isolation.

The remarkable market development of sustainable housing and renewable energy technologies in Austria has only been possible because Austrian firms have in co-operation with research centres developed cost-effective technologies, both for energy saving building constructions and solar thermal and heating systems based on renewable energy sources. High quality could be achieved in the solar thermal sector and in advanced environmentally-

friendly biomass heating systems with optimised combustion technology. Especially test results led to technical improvements in technologies as well as to common standardisation.

Pilot and demonstration systems have made essential contributions and have apparently contributed to partially overcoming the market barriers for innovative building concepts.

Many examples show, that it is possible, to reduce the fuel supply in buildings by better building insulation standards as well as efficient heating systems with nearly the same investment costs.

Under these circumstances the future prospects for the market deployment of *Sustainable Housing* in Austria are favourable.

More information:

www.hausderzukunft.at

Fig. 1a: Austrian competition 2000 „*Housing for Tomorrow*“

Fig. 1b: Austrian competition 2000 „*Housing for Tomorrow*“

Fig. 1c: Austrian competition 2000 „*Housing for Tomorrow*“

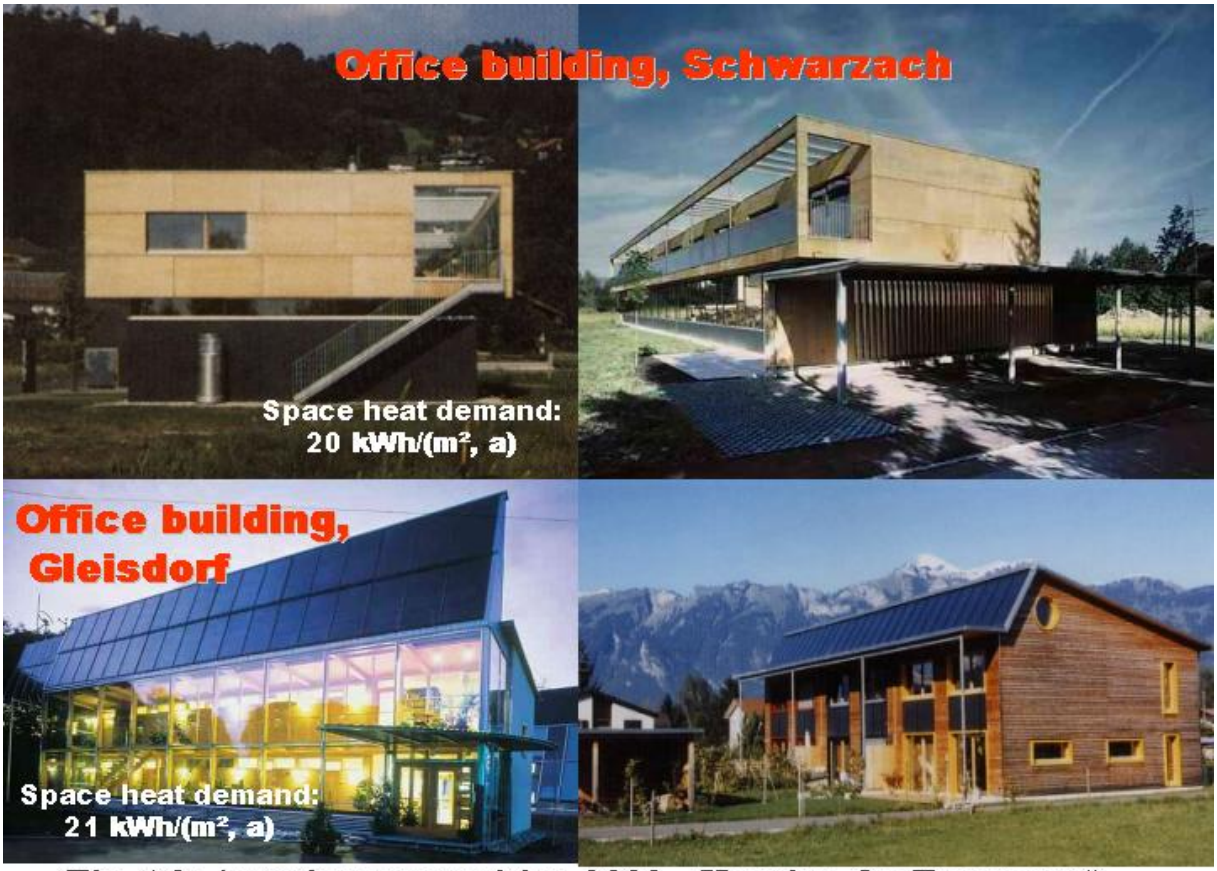

Fig. 1d: Austrian competition 2000 „*Housing for Tomorrow*“

Fig. 1e: Austrian competition 2000 „*Housing for Tomorrow*“

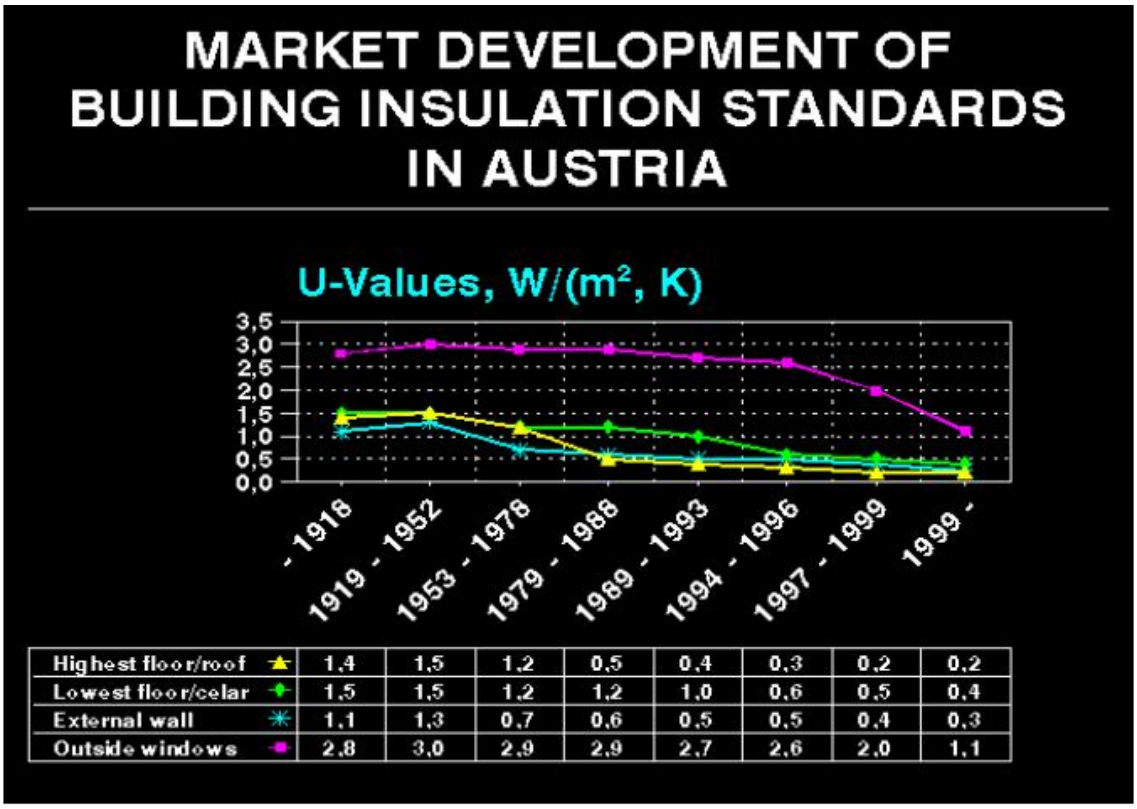

Fig. 2a: Market development of building insulation standards in Austria

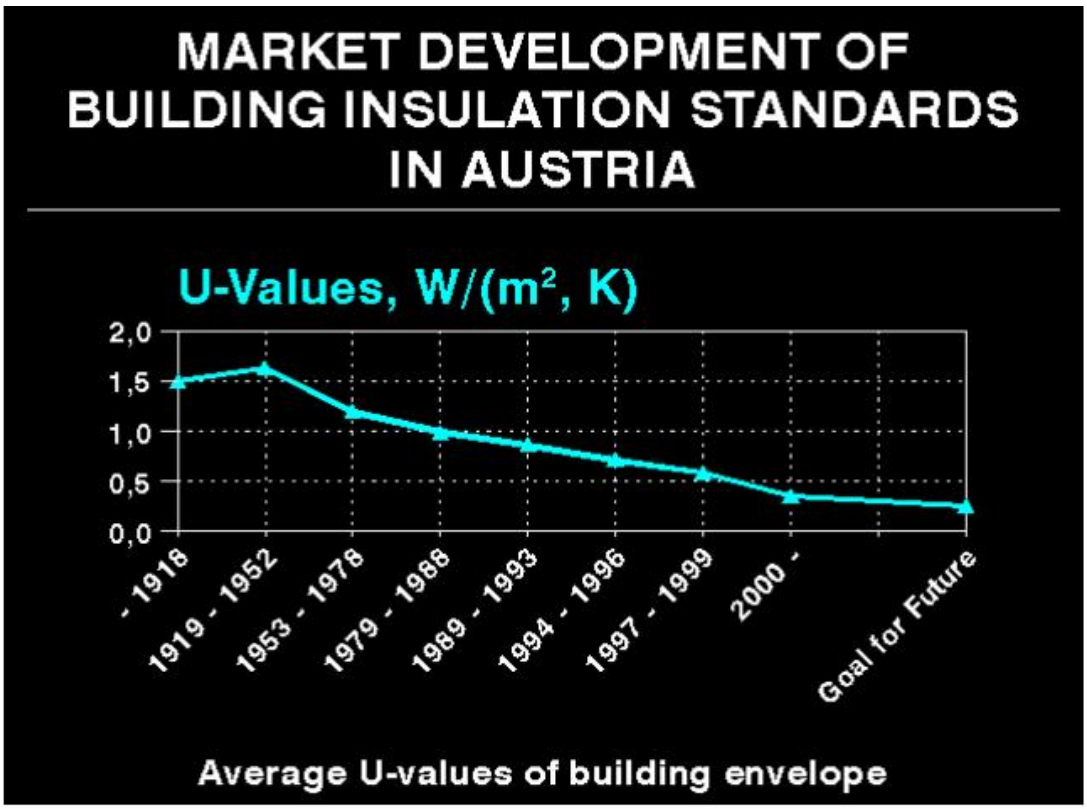

Fig. 2b: Market development of building insulation standards in Austria

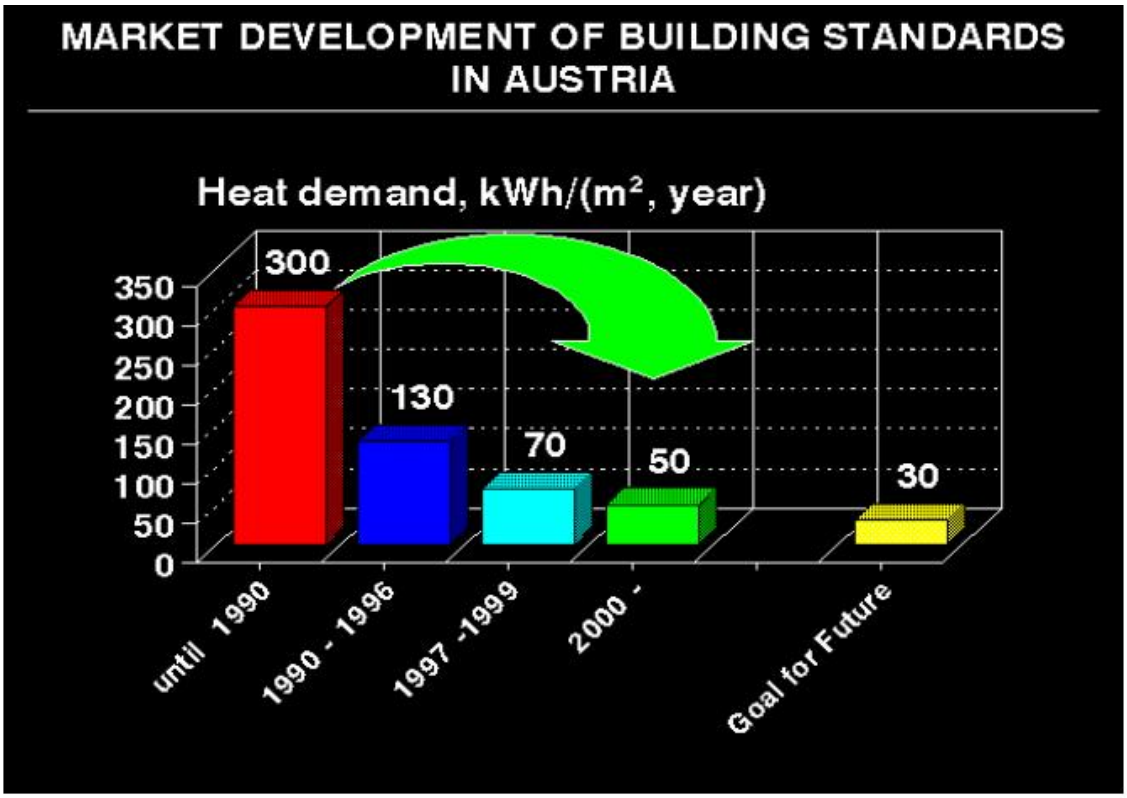

Fig. 3: Market development of space heat demand in buildings in Austria

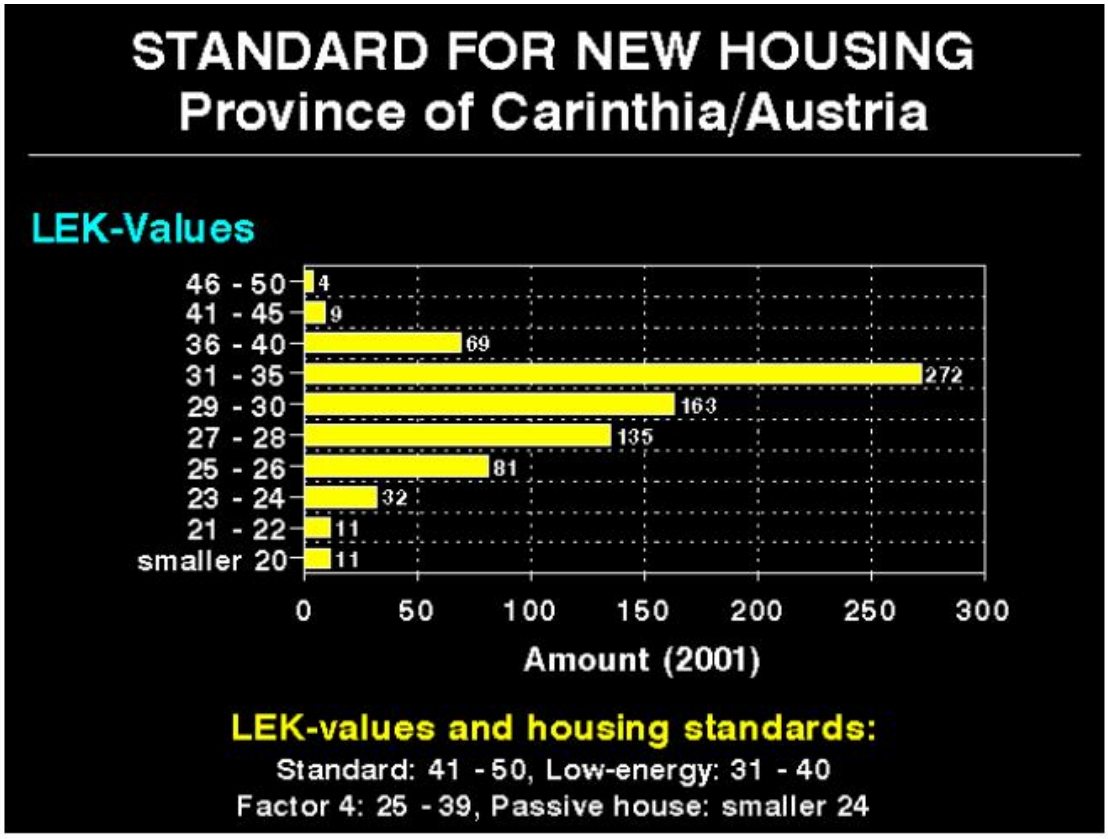

Fig. 4: Standards for new buildings in Carinthia

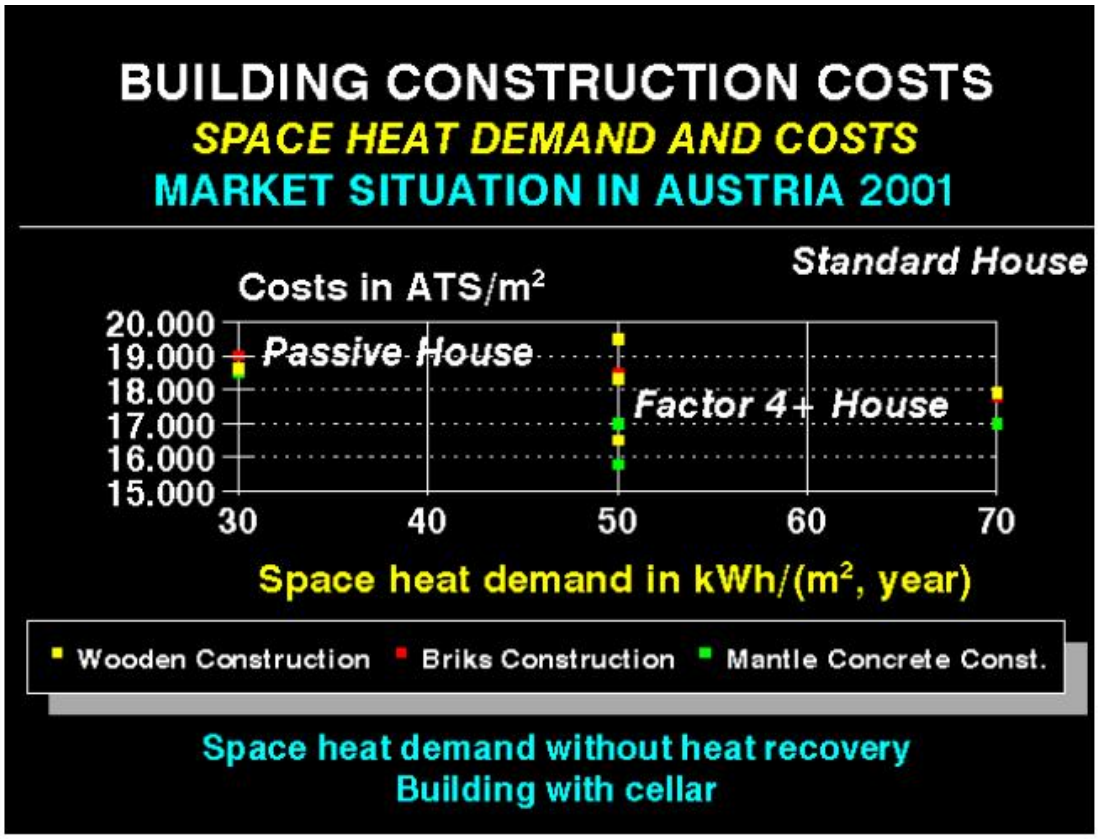

Fig. 5: Building standards and construction costs

Solar share: 8% - 15%
for hot water + space heating

Collector: 6 - 8 m²
Storage: 300 - 500 litre

Fig. 6a: Solar hot water system for single-family housing

Solar share: 5% - 8%
for hot water + space heating

Collector: 3 - 4 m²/flat
Storage: 150 - 200 litre/flat

Fig. 6b: Solar hot water system for multi-family housing

Solar share: 9% - 13%
for hot water + space heating

Fig. 6c: Solar hot water system for biomass district heating

Solar share: 35% - 50%
for hot water + space heating

Collector: 16 m² - 25 m²
Storage: 800 - 2000 litre

Low-energy buildings
and
Low-temperature heat distribution

Fig. 7a: Solar supported heating system for single-family housing

Solar share: 70% - 80%
for hot water + space heating

92 m² collector area, 9 m³ water storage

Fig. 7b: Solar supported heating system for single-family housing

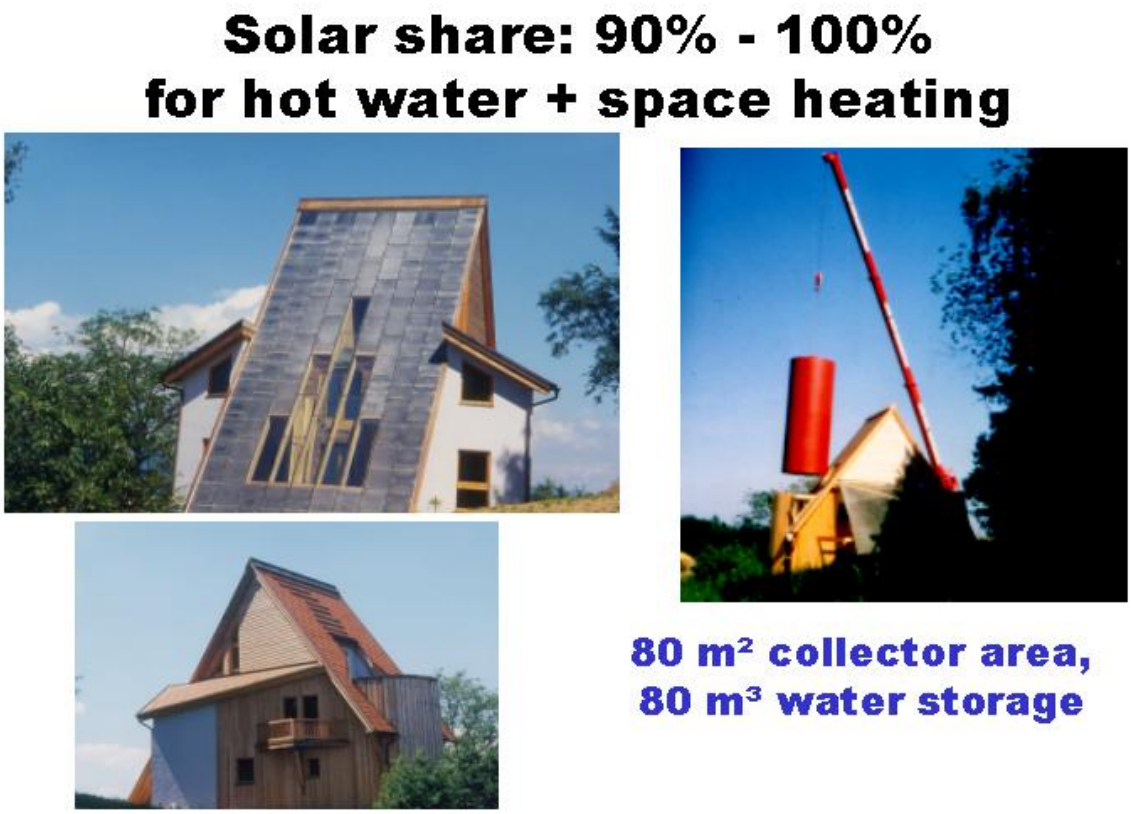

Fig. 7c: Solar supported heating system for single-family housing

Fig. 8a: Solar supported heating system for housing estate

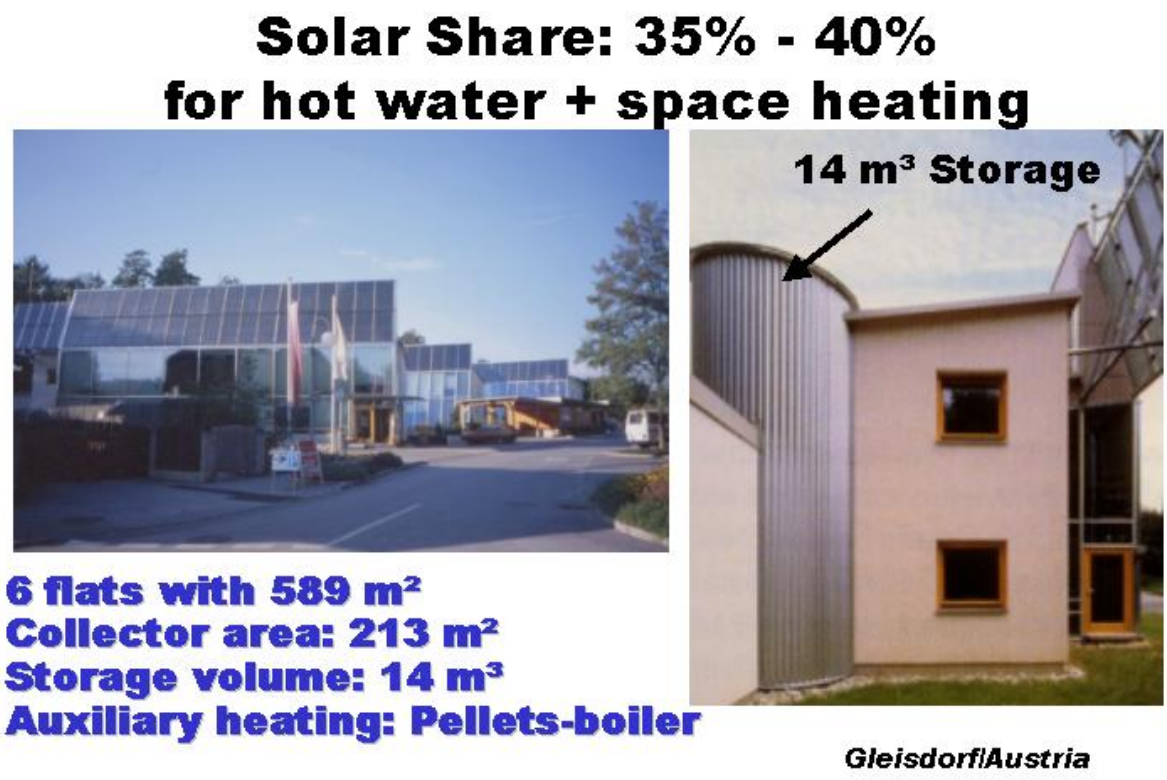

Fig. 8b: Solar supported heating system for housing estate