Experience with building programs State of the art of energy efficiency of new and refurbished buildings

A comparative survey of the present situation in the Czech Republic and Austria

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Executive Summary

The Housing and dwelling stock is about the same size in Austria and the Czech Republic (4,3 Million dwellings in the Czech Republic and 3.8 million dwellings in Austria).

The comparative analysis of the present state of the housing sectors in both countries shows many similarities but also differences in technical state (and energy performance) of the existing as well as new residential buildings, thermal-technical standards, and type and volume of support provided to improve their energy efficiency.

The main conclusions are summoned in the following:

- As for the technical state - Old buildings are generally in a better condition in Austria than in the Czech Republic (CR) with a long history of flats made with precast concrete slabs. The present technical state of the large majority of apartment buildings in the CR which were constructed using prefabricated technology is very bad either due to the low quality of materials, construction works carried out and consequently a long-time neglected maintenance; therefore practically all the Czech state support provided to housing renovations is focused only on this part of the housing stock.

  Regarding new buildings, they have in both countries, due to the improved building material, applied technologies and, subsequently, building codes which set for stricter thermal-technical requirements requiring thus to apply better insulation, far better energy parameters than old ones. But financial incentives, and public awareness in Austria, and especially in some provinces such as Salzburg, have such a strong influence that the average heat consumption level of new housing construction is as much as 50% lower than the average level which is found by new residential buildings constructed in the CR presently (and by current standards also required).

- As for the current standards – Both Austrian and Czech Energy thermal-technical requirements for new as well as renovated buildings are very similar due to the gradual harmonisation of technical standards according to the EU's CEN standardization. The biggest difference is in their scope. While in the CR these technical requirements are defined and applied on a national level, in Austria this is done by provinces individually. Both countries then have also the methodology developed for the evaluation of the energy performance of buildings (in the CR this method has been introduced by a recent energy legislation on energy management, in Austria several provinces developed and applied their proprietary variants, with one common calculation methodology of the space heating energy demand accepted by all provinces developed by the OIB; this methodology has been in 2004 newly extended to cover also the energy efficiency of a heat source and a heating system).

- As for the subsidy schemes – Support provided to improve energy efficiency is both in the volume and extent much more comprehensive in Austria. There, the state respectively provinces provide subsidies not only for thermal renovation of existing buildings but also for (low-energy) new housing construction and in some provinces also for the use of renewable sources of energy. The difference in the amount of support provided in Austria and the CR is also very significant (several billions of Euros in Austria opposed to several tens of millions in the CR). The reason is not only a much more limited financial budget of the Czech public sector but obviously also policy priorities.

These valuable findings set for a good starting point for common future co-operation, namely in these areas:

- In the implementation of the European “Energy Performance of Building Directive” (EPBD) - the implementation of the EPBD on national level has to be finished by January 2006 no matter if CEN Standards are available or not. That gives the opportunity for a common cooperation - a joint project between Austria and the Czech Republic would be useful in this field; in Austria the national calculation algorithms are already under development, thus, the Austrian experience gained so far could be made use of and further jointly developed by the co-operation between respective bodies of the Czech and Austrian state administration responsible for the implementation of this directive into national legislation.
- Renovation of buildings is a key issue to reduce the energy demand for the building sector. In the Czech Republic many buildings have been made with precast concrete slabs using only a few different construction schemes. These buildings could be renovated easily by finding the appropriate and cheap renovation schemes. In Austria the situation is different, because many different constructions exist. A joint project in developiong energy saving and cheap construction schemes which additionally increase the thermal comfort in buildings would be very desirable.
- Another important area of future cooperation can be new housing construction – as it has been identified residential buildings presently constructed in the CR have as much as two times higher energy demand (per unit of floor area) than those being built now in Austria. Such a decrease in energy consumption can be practically achieved without increased investment costs (as it has been proved by the Low-Energy Low-Cost Buildings Project).
- Austria then also supports research and development of so-called “buildings of tomorrow”, which will accomplish the sustainable development in human settlements. Such a research activity has not started in the CR yet. However, the CR has also sufficient knowledge base to launch a similar research project. Strengthening of the Czech research in energy efficient buildings for sustainable future is highly recommended. The cooperation between Czech and Austrian research institutions in this field might accelerate such an approach in the CR as well.

1 Housing Sector in Czech Republic - Basic Characteristics

1.1 Housing and dwelling stock in the Czech Republic

The total housing stock in the Czech Republic (CR) today represents in about 2 million houses[1] in total. A decisive part of which, more than 1.6 million, is used for permanent residence[2]. Over 86% of these houses are family houses[3] (1.4 million), 12% (195 thousand) are multi-family (appartment) houses[4]. The remainder (29 thousand) are other types of houses[5].

Of the total number of the apparment houses more than 62 thousand[6] are prefab buildings (in Czech so-called “panelaks”). The first panel houses in the CR were built at the end of the 1950’s and their construction was undertaken until 1990/91, when the last buildings were completed. Almost 1,2 million of households live in them nowadays.

Table 1: The extent of the housing stock in the Czech Republic in 1991 and 2001

Year	Number of houses	on which permanently occupied				
		Total	being			
			family houses		appartment houses	
			abs.	%	abs.	%
1991	1,868,500	1,597,076	1,352,221	84.7	223 ,700	14.0
2001	1,969,018	1,630,705	1,406,806	86.3	195 ,270	12.0

Source: Czech Statistical Office

As for the dwelling stock it now includes almost 4,4 million flats[7]. From this figure, about 88% flats, or more than 3.8 million, are used for permanent residence, only about an eighth (539 thousand) is at the moment classed as uninhabited. 2,160 thousand premanently inhabited dwellings are situated in apartment buildings, of which nearly 1.2 million being in

[1]) A **house** is here and throughout the whole text understood to mean a construction or part of a construction, which has an independent entrance and own number.

[2]) This is understood to mean that at east one person is registered as having their permanent residence here.

[3]) A **family house** is here and throughout the whole text meant a residential building which has at least three independent flats and two over ground and one underground floors; this category includes family houses, which are detached, terraced, semi-detached and also those houses, which are used for recreation purposes.

[4]) An **appartment house** is here and throughout the whole text meant a property, which has several flats accessible from a communal entrance or stairway that is not a family house (see definition above); the number of floors is not decisive here and also includes villas, which do not fulfil the conditions of a family house.

[5]) **Others** include all other properties, which serve various purposes, meaning administrative buildings, health and social care institutions, accommodation and recreation facilities etc.

[6]) In terms of the Public Census in 1991 a total of 62 456 panel built houses were registered in the Czech Republic with 1 165 thousand permanently inhabited flats (Source: MMR bulletin no. 1, 2000)

[7]) A **flat** is understood to mean a collection of rooms (or as the case may be one room for habitation), which fulfils the technical construction layout of which and fittings fulfil the requirements for permanent residence and are intended for this purpose (§ 3 letter l) edict of the Ministry for local development no. 137/1998 Col., concerning general technical requirements for construction).

panel-built houses, and 1,635 thousand then in family houses, the rest (35 thousand) being in the houses used for other then entirely residential purposes.

According to information by the Ministry for Regional Development, a total of 1,165 millon flats made with precast concrete slabs were built between 1959 and 1990; most being built in the period 1967 – 1975.

Whereas during the period 1960–1990 the increase in the housing and dwelling stock was predominantly realized through the collective housing construction using largely prefabricated panel technology, after 1990 a situation fully changed and a new housing construction was mainly taken over by individuals. [8]

Table 2: The extent of the dwelling stock in the Czech Republic in 1991 and 2001

Year	Number of flats	of which permanently occupied				
		Total	being situated in			
			family houses		appartment houses	
			abs.	%	abs.	%
1991	4,077,193	3,705,681	1,525,389	41.2	2,150,000	58.0
2001	4,369,239	3,827,678	1,632,131	42.6	2,160,730	56.5

Source: Czech Statistical Office

Table 3: Number of flats in panel houses built in the CR during 1959-1990

Numer of flats [thous.]	1959-1960	1961-70	1971-80	1981-90	Total
Total	58.7	344.8	467.1	294.4	1,165

Source: Ministry for Regional Development

[8]) While the total number of permanently inhabited houses compared to the early 1990s increased by about 30,000, the increase in the number of family houses was, however, much higher, of more than 50,000. It was due to the fact that the number of appartment houses decreased. As for the dwellings more than 120,000 were built during the last ten years (110 thous. were built in family houses).

Table 4: Number of completed dwellings in the CR after 1990

Year	Constructions for housing (extensions)	*Of which*			
		in family houses		in multi-dwelling buildings	
		new	*extensions*	*new*	*extensions*
1990	**44 594**	*N/A*			
1991	**41 719**				
1992	**36 397**				
1993	**31 509**				
1994	**18 162**				
1995	**12 662**				
1996	**14 482**	*5 667*	*1 852*	*4 143*	*931*
1997	**16 757**	*6 509*	*2 073*	*4 568*	*2 009*
1998	**22 183**	*8 336*	*2 334*	*6 827*	*2 530*
1999	**23 734**	*9 238*	*2 539*	*6 598*	*2 506*
2000	**25 206**	*10 466*	*2 911*	*5 926*	*2 339*
2001	**24 759**	*10 693*	*2 948*	*5 912*	*1 874*
2002	**22,803**	*8,759*	*2,957*	*4,656*	*1,737*
2003	**27,127**	*8,911*	*2,486*	*6,266*	*1,454*

2 Energy Parameters of Buildings in the Czech Republic

2.1 Present situation in technical state and energy consumption

A substantial part of the existing housing stock in the country is at present in a very morally and technically obsolete state.[9]

Casing constructions of the majority of residential buildings, and especially those built in panel technology, are partially or fully unsatisfactory both in energy terms and in terms of the interior microclimate, thermal cosiness and stability in the summer and winter seasons compared to present requirements.

The reasons behind are longly neglected regular maintenance and defects in the material and bad quality of construction works when the buildings were being constructed. Another reason is then the gradual increase in requirements on thermal-technical parameters of new as well as reconstructed buildings which has been introduced throughout the last 30-40 years.

On the other hand, liberalization of energy prices, which has been carried out during the 1990-ies, initiated the implementation of some (usually the lowest-cost) energy efficiency measures and led to significant decreases in energy consumption especially of heat needed for heating.

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[9]) The technical equipment of the housing stock in the Czech Republic is however at a relatively high level. Sanitary facilities in flats are a matter of course these days (more than 95% of flats have their own water supply, WC and bathroom), nearly 75% have then centrally heated rooms, and 65 % are able to use natural gas.

As a result, the average levels of energy consumption for heating and hot water preparation has decreased compared to the beginning of the 1990s by 20-25% and presently in the flats situated in appartment houses range between 40–50 GJ GJ/ year (75–80% for heating, 20–25% for hot water preparation), that is 45 GJ for an average flat (50–60 m^2 of floor area). For a normal family house (100–150 m^2 habitable floor space) then it is typically 60–80 GJ.

To translate it into the costs, taking into consideration current energy prices for heat (by district heating it is 330-360 CZK per GJ, for heat made from natural gas decentrally, including amortisation and transformation losses, it is 300-330 CZK/GJ), the average annual heating costs range between 13,000 to 18,000 CZK per flat and 18,000 to 26,000 CZK per house (here considered as being heated only by gas).

That represent close to or even more than 50% of the total housing costs households living both in the rental and the owner-occupied housing pay at present.

However, due to the introduction of new energy legislation (so-called the Act on energy management[10]) and stricter requirements for thermal protection of buildings (see below) the decrease in heat consumption is expected to still continue in the near future.

Table 5: Current average energy consumption on heating and hot water preperation in the housing sector in the CR (in GJ a year)

Housing Construction	Heat consumption	of which	
	Total	heating	hot water preperation
Flat in appartment building	40 - 50	30 - 40	8 - 12
Family house	60 - 80	45 - 60	10 - 15

2.2 State regulations on thermal quality

2.2.1 Thermal-technical standards

Thermal-technical requirements for appartment buildings are set by the thermal-technical standard CSN 73 0540. The norm was since its introduction (1964) subject to several amendments (1979, 1992, 1994) the last of which has been carried out in 2002.

The changes to the standard made throughout the time concerned mostly the gradual increase in thermal-technical requirements (esp. evaluated by thermal resistance and thermal transmittance coefficients) for envelope structures (outer walls, roof, windows, and ground floor etc.).

For a example, for outer walls the required minimum heat resistance coefficient for new housing construction has increased from an original value of $R_{N,15}$=0.6 m^2K/W as valid between 1963-1978, over 0.95 m^2K/W applicable between 1979-1992 to $R_{N,15}$=2 m^2K/W required till the end of 2002.

After the last update of the standard, as carried out in 2002, which in line with the EU practice introduced the thermal transmittance coefficient (“U-value“) for the evaluation and setting of minimum/recommended thermal-technical characteristics values, the required limit has been

[10]) Act No. 406/2000 Col.

set still stricter and from 2003 onwards it is $U_{N,15}$=0.38 W/(m^2.K) for heavy-weight walls (of which mass density is over 100 kg/m^3) which corresponds to $R_{N,15}$=2.46 and $U_{N,15}$=0.30 (corresp. to $R_{N,15}$=3.16) for light-weight wall constructions.

The new norm then also includes “recommended“ U-values which construction components of new or renovated buildings should have in order the building could achieve low-energy parameters. These are about 35% stricter then the required “minimum“ values.

Up to the end of 1999 the parameters specified by the Czech standards as “required“ were automatically considered as compulsory. However, as all standards according to the EU-rules has become non-obligatory in the CR since 2000, the eventual obligation to abide them must be set by regulations with higher legislative powers (laws, ordinances).

This has just been applied in case of the requirements for thermal protection of buildings and the required minimum values of thermal-technical characteristics as set by the CSN 73 0540 are made mandatory by one of the executive ordinances[11] to the Construction law[12].

Table 6: Thermal transmittance coefficients (U-values) required/recommended for new and renovated constructions in the CR as set by the CSN 73 0540 Standard [in W/(m^2.K)]

Construction	1994 - 2002	2003 -
Walls	0.46/0.33/0.70*	0.38/0.25 (0.30/0.20)**
Roof	0.32/0.22/0.48*	0.30/0.20 (0.24/0.16) **
Windows	2.9	1.80/1.20 (2.0/1.35)***
Floor	0.32/0.22/0.48*	0.60/0.40

Note: All the values applicable for the lowest outdoor temperature of -15 °C and indoor average temperature of 20 °C
*) Required/Recommended/Permissable for reconstructions
**) For heavy-weight (in brackets for light-weight) constructions
***) For new (in brackets for renovated) windows

The specified limits must be met by both new construction as well as when changes are being made to the existing buildings, however, the conformity with these new minimum levels has not been so far strictly required by planning offices, and in reality, actual thermal-technical parameters has been worse especially in case of renovated buildings.[13]

For a comparison, the following table shows typical U-values for the building envelope as normally applied (but not required) presently in different Eropean countries.

[11]) Decree of the Ministry for Regional Development No. 134/1998 Col.

[12]) Act No. 50/1976 Col. as amended

[13]) The only exception may be windows of which average U-value when new ones are installed is nowadays well below 1.5 W/(m^2.K) including the window frame.

Table 7: Typical U-values for the building envelope as normally applied presently in different Eropean countries

	Roofs						Outer walls						ground floor						windows				
	0.15	0.25	0.35	0.45	0.55	0.65	0.15	0.25	0.35	0.45	0.55	0.65	0.15	0.25	0.35	0.45	0.55	0.65	1,25	1,75	2,25	2,75	3,25
Sweden	■						■						■						■				
Norway	■							■					■						■				
Finland	■							■						■						■			
Denmark	■							■					■						■	■			
Lithuania	■							■						■						■	■		
Ireland	■							■						■						■	■		
Russian Federation	■	■	■				■						■	■	■					■	■	■	■
UK	■								■					■						■	■		
Netherlands		■	■					■	■					■						■	■		
Austria		■							■							■			■				
Germany		■									■					■			■				
Switzerland			■						■									■	■				
France		■								■					■					■	■		
Belgium				■							■							■		■	■		
Italy			■							■						■						■	■
Portugal						■						■						■			■	■	
Spain						■						■						■				■	■

Source: Visier 2002

Table 8: Reference heat consumption limits for heating unsurmountable for certain types of buildings (set by the Decree No. 291/2001 Col.)

A/V* [m^2/m^3]	$e_{V,N}$ [kWh/m^3.rok]	$e_{V,A}$ [kWh/m^2.rok]
0.2	25.8	80.6
0.3	28.4	88.8
0.4	31.0	96.9
0.5	33.6	105.0
0.6	36.2	113.1
0.7	38.9	121.6
0.8	41.5	129.7
0.9	44.0	137.5
1.0	46.7	145.9

Notes:
"A" is the total area of outer constructions, including roof and foundations
"V"heated space of the building
e_{VN} is heat consumption per cubic meter of heated space
e_{VA} heat consumption per square meter of floor area of the heated rooms in a building (with a net height of ≤ 2,6 m).

Additionally to that, the updated standard then moreover newly prescribes for the assessment of energy performance of buildings the application of a new methodology developed in connection with the Act on energy management.

The methodology divides buildings according to their construction characteristics (computed as the ratio of their surface to the volume) and for each type sets forth the reference value of annual (primary) energy consumption on heating ($e_{V,N/A}$). These levels are obligatory for certain kinds/types of constructions (in case they are financed by private entities, then if their energy consumption on heating is 700 or more GJ per year buildings, if financed from public sources then regardless of their consumption).

The ratio between the real and reference heat consumption value then determines the Energy Performance Index (in Czech abbr. as *"SEN"*) and correspondent energy class of the building.

Table 9: Classification of buildings according to the Energy Performance Index in the CR (set by the CSN 73 0540 Standard)

SEN Index [%]	Energy Class	*Note*
≤ 40	A	*Building considered as low-energy*
≤ 60	B	
≤ 80	C	
≤ 100	D	*Satisfactory**
≤ 120	E	*Unsatisfactory*
≤ 150	F	*Significantly unsatisfactory*
> 150	G	*Extremely unsatisfactory*

*) Obligatory for certain types of buildings

2.2.2 Energy consumption limits

In order to protect flat-dwellers, there are maximum consumption limits set both for heat consumption on heating and on hot water preparation which may be charged by the house owner are described in secondary legislation[14].

These are unsurmountable (i.e. the house owner cannot step them over) and are applicable both for flats and non-residential spaces in appartment buildings whether of a tenement, co-op or flat owners association kind. (The exception is, if all the flats and non-residential spaces are used only by the owner of the building; for these cases the decree is then not effective.)

For new buildings or buildings to which a change to their construction has been made after the decree came into force (effective since 1.1.2002) the maximum heat consumption limits are:

on heating:

- **0.7 GJ** per square meter of adjusted floor area of the flat (if heated from a heat source on solid fuels) or

[14]) Decree of the Ministry of Industry and Trade No. 152/2001 Col.

- **0.55 GJ/m^2** (if heated firing gas, heating oil and other fuels or energy).

and

on hot water preparation:

- **0.3 GJ** per cubic meter of consumed water
- **or 0.35 GJ/m^3** if being prepared and delivered outside of the building.

For the other buildings (i.e. old) these limits may be stepped over by the maximum of 50%.

For dividing of measured/invoiced supplies of heat from the DH network or produced in an own heat source among individual flats the house owners then must apply the procedures as set by another state regulation[15].

The allocation procedure calculates the total costs among individual flats dividing the heat consumption measured by both "heat products" into two so-called "basic" and "consumer-dependent" parts. For heating costs this ratio is set as 40 and 50%, for hot water as 30 and 70% resp.

The basic component of the costs for heat is alloted among flats in relation to their floor area. For the costs for hot water preparation it is the total floor area of the flat, for heating costs it is being adjusted for the uniform room space height, and common re-calculation of the size of unheated rooms.

The consumer-dependant part, then, is among individual flats divided in case of heating costs according to the calculation methods which allow to correct the different positions of the flats in the house, with the possibility—but not (!) necessity—to use heating costs allocators installed on each heater as a supplementary instrument. In case of costs for hot water, then, according to the amount of water consumed by each flat (meters for both drinking and hot water consumption are standard).

Such an allocation procedure must be applied for any appartment house which is heated using a common source of heat (a sub-station or a gas-fired HOB) and an internal distribution network for its delivery into individual flats.

Furthermore, as already mentioned, in case of the construction or the reconstruction of buildings financed from public sources and the buildings of which energy consumption on heating is 700 or more GJ per year if financed by private entities, then, there has been introduced by the Act on energy management respectively one of its executive ordinances16 the maximum heat consumption limits for heating.

The table below shows, how big energy savings can be reached based on the current specific heat consumption on heating of various types of appartment buildings in order the building met the required maximum limits after being reconstructed.

[15]) Decree of the Ministry for Region Development No. 372/2001 Col.

[16]) Decree of the Ministry of Industry and Trade No. 291/2001 Col.

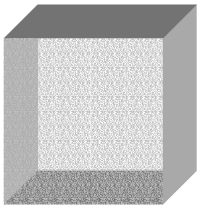
Table 10: Common levels of heat consumption for heating of different types of appartment buildings in relation to the maximum limits

Type of building		Number of flats	Current heat consumption [GJ/year]						
			Total (per house)	Per flat (and in relation to the limit e_{VN} = 100%)					
No.	A/V			30	33	36	39	42	45
1.	0.36	24	≥ 720	99%	109%	119%	129%	139%	149%
2.	0.30	42	≥ 1,260	115%	127%	139%	150%	162%	173%
3.	0.34	64	≥ 1,920	154%	170%	185%	201%	216%	232%
4.	0.27	98	≥ 2940	138%	152%	166%	179%	193%	207%

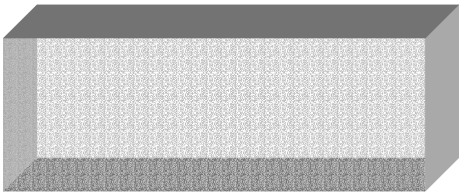
Note: Relative heat consumption of more than 100% corresponds to energy savings needed to be realized when the house being reconstructed in order to comply with present legislation

Legend:

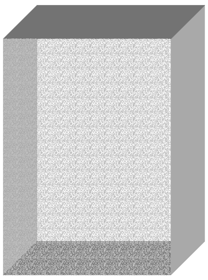
1. Prefab panel building, dimensions (length $_x$ depth $_x$ height): 23 $_x$ 12 $_x$ 27 m, one section, 9 floors (of which 8 with flats), 24 flats, average floor area of heated rooms 60 m^2/flat



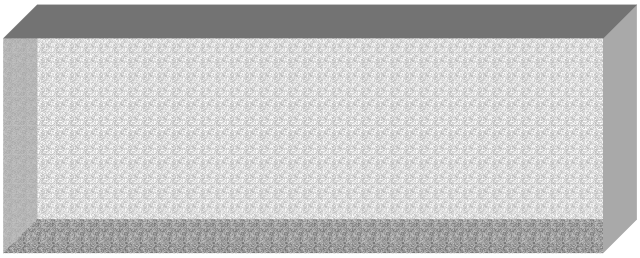
2. Prefab panel building, dimensions (l $_x$ d $_x$ h) : 60 $_x$ 11 $_x$ 18 m, 3 sections, 6 floors (of which 5 with flats), 42 flats, average floor area of heated rooms 55 m^2/flat



3. Prefab panel building, dimensions (l $_x$ d $_x$ h) : 18 $_x$ 18 $_x$ 38 m, 1 section, 13 floors (of which 12 with flats), 64 flats, average floor area of heated rooms 45 m^2/flat



3. Prefab panel building, dimensions ($l \times d \times h$) : 90 x 11 x 24 m, 5 sections, 8 floors, 98 flats, average floor area of heated rooms 50 m^2/flat



2.3 Costliness of housing renovation

According to the expert analysis, average costs connected with the complex renovation of the prefab house ranges between 300 thousand-400 thousand CZK per flat. It constists of basic improvement of wall casing, including claddings and loggias/balconies, roof, and floor (foundation) constructions and their proper thermal insulation, weatherisation or exhange of the windows and other transparent constructions, renovation of the elevator (if it exists there) and of internal electricity, water, and gas distribution common networks.

If the reconstruction of a building concerns mostly/only its thermal rehabilitation, including the exchange of windows and necessary repairs of the wall casing, roof etc., then the average costs amount to 150 thousand-170 thousand CZK per flat, or 2,500-2,900 per a square meter of the floor area.

In order to finance such costs, then, a flat-dweller would have to pay each month (either into Replacement reserves or to repay the loan he took out for it) 40 resp. 50 CZK/m^2 of floor area of the flat for a minimum of 5 years.

If proper thermal instulation is being made to a building, it can bring 15-45% energy savings (30% on average) on heating. As a result, a flat-dweller in an appartment house can save in money 3,000-4,000 CZK on average annually. (Relatively lower energy savings then may be expected by family houses.)

Thus, the paid-back period of thermal insulation measures is very long, at the end of their expected service life (35-50 years). Nevertheless, the energy savings may help to cover 10-12% of the annuity (if the investment costs shall be settled up in 5 years).

Table 11: Costs for basic, optimum, and complex modernisation for 1 typical flat (current price levels)

Measure		**Cost per 1 average flat (CZK)**		
		minimum	**average**	**maximum**
Part A. Statics and building constructions				
A.1	- reparation of elements, eventually bracing of foundation, basement, internal supporting walls, ceilings, stairs	0	0	27,000
A.2	- reparation of elements, event. bracing (or echange) of external walls, under thermal insulation; the measure being done only in connection with measure B.5	17,000	42,000	42,000
A.3	- reparation of loggie/balcony, under thermal insulation; the measure being done only in connection with measure B.5	10,000	28,000	47,000
A.4	- exchange of balcony	0	0	
Part B. Technical equipment of common parts of building				
B.1	- heating source modernisation and installation of central heating system regulation	0	17,000	17,000
B.2	- modernisation of hot water preparation	0	0	10,000
B.3	- gas cooking to electricity cooking exchange	0	0	14,000
B.4	- modernisation of internal electricity, gas, and water distribution infrastructure	0	15,000	30,000
B.5	- thermal insulation of walls	55,000	70,000	70,000
B.6	- thermal insulation of roofs	10,000	18,000	18,000
B.7	- windows and other transparent constructions weathering / exhange	6,000 / 60,000	60.000	60,000
B.8	- loggie glazing	0	0	20,000
B.9	- renovation/exchange of elevator	0	15,000	40,000
B.10	- modernization of lighting on stairways	0	0	5,000
Total		**160,000**	**265,000**	**400,000**

*) A minimal variant equals to the measures related just to the improvement of the thermal characteristics of the building, the average to the “optimal” variant of the reconstruction temporarily removing all the critical defects found nowadays by the panel buildings, and the maximal then to the complex renovation of the external as well as internal communal parts of the appartment house prolonging his service life for next 30-50 years and increasing the standard of living there.

2.4 Some important aspects of heat energy provision and consumption in apartment houses

Basically regardless of the form of housing ownerhip, the indispensible part of living in a flat is the necessity to secure a livable unit for flat-dwellers.

That, therefore, encompasses a number of duties arising (for house owners) and on the other hand rights and benefits (for flat-dwellers).

Beside the proper technical condition of a house which is undoubtedly a pre-requisite, the other, closely related aspect to this are services which are needed for day-to-day operation and comfortable standard of living in the house.

Their provision or their consumption takes place in the common parts of the house, and therefore, it is usually the owner of the house that—upon their supply from the other subjects—finally delivers them to the flat-dwellers, at the right quality and necessary quantity. Their "consumption" is then allocated among individual flats and alltogether as the other part of the rent prescribed for settlement under the common name "service charges".

Among the most usual of these services are: provision of heat for heating of the flats and hot water preparation (if the house is heated centrally), cold running water, water release, lighting of the common spaces, stairways, enterance halls etc.), use of the lift and others depending on the type and the facilities the house is equipped with.

Not included are, however, any consumption which takes place entirely "beyond the door of the flat". That is, therefore, consumption of electricity, gas (both for cooking and heating if the flats are heated locally), and may be also heat, if the heat supplier installs in the house for each flat its own heat exchange sub-station.

However, if the house is heated and/or is hot water being prepared centrally in a common heating source, such as a sub-station connected to a local district heating network or an own in-house boiler (HOB) on e.g. natural gas, then, the delivery of the heating water and hot water into individual flats is the duty of the owner of the house.

Providing of heat supplies for all the flats in an appartment house presumes the securing of a heat source.

2.4.1 Source of heat

Approximately 0.8-1.0 million of flats situated in appartment houses are today heated from district heating systems. That represents about 40% of the Czech households which nowadays have their homes there and then about ¼ of all the households incl. those living in family houses.

By this is meant that they are supplied with the heat produced from heat sources outside of the house based on a contract with the heat supplier which is usually a local DH operator. A great majority of them are in *panel-built* houses.

The most usual way of connection to the DH system is still via a pressure dependant water-blending sub-station installed in the basement of the house (common to one or more of its sections) connecting it to a four-pipe secondary DH circuit.

For each such off-take point, the actual heat consumption for heating is measured by calorimeters installed both on the incoming and outgoing pipe of the heating water circuit. As for the consumption of heat delivered in hot water, it is set according to the total amount of heat delivered by the primary circuit into the district heat exchange station for its preparation which is then allocated among the individual off-take points based on the amount of hot water consumed (measured for the house as a whole and in each flat as well).

However, to minimise distribution losses, there is a trend to decentralise hot water preparation into the places of final consumption by installling compact substations for simultaneous hot water preparation equipped usually with plate heat exchangers in the houses. Then, the consumption of heat is only in connection with heating water delivery.

The other appartment houses representing 1.2-1.4 million flats, i.e. more than 30 % of the total dwelling stock, is heated using own heat source(s).

Most often it is a HOB located in the basement of a building usually firing natural gas and producing heat which is then delivered to individual flats through a centralised heating system. The boiler-room can be common for one or more of building's sections. In this way as much as 2/3 of these multi-family houses may be heated.

In old tenement houses built in the first part of the 20th century or before then there is also quite often that flats are heated locally by gas or electric appliances installed in each room.

This, however, mean that each flat-dweller pays only for the energy he/she really consumed and, as a sesult, there is now allocation of the heating costs among flats except for the heat consumed for heating of the communal parts.
The use of local heat sources (on natural gas) is in the localities where there is no district heating network available or where the heat from the local DH system is significantly more expensive then its alternatives (usually natural gas price being reference level). Either due to the system's bad condition, usage of expensive fuels (i.e. natural gas or heating oil) or poor marketing and service.

And since the availability of gas is very common, with gas networks at present in every village/town above 1,000 inhabitants, its use in the housing sector is gradually on the increase. The option for gas is more often made even in densely populated (metropolitan) areas where DH systems have been so far predominant, especially by small (one-house) residential entities. Even though the investment costs for the installation of an own boiler can be 1.5 or even more higher than in the case of the connection to the DH network as the table below shows.

Table 12: Indicative investment costs of the connection to a DH network and the installation of own heat-only boiler on natural gas

Size of house [number of flats]	Connection to the DH network via sub-station with plate exchangers		HOB on natural gas (incl. heaters for hot water preparation)	
	Thermal output [kW]	Investment costs [thous. CZK]	Thermal output [kW]	Investment costs [thous. CZK]
25	75	250	250 (175*)	400 (350*)
40	150	450	400 (250*)	800 (500*)
70	300	850	800 (500*)	1,200 (900*)

*) If the house is properly thermally inslulated

2.4.2 Contracting, metering, and billing

If the heat is delivered by district heating distribution networks it is required by the Energy law[17] to be metered and billed at each off-take point (i.e. heat exchange station), the heat consumer is connected to the distribution network of the heat supplier.

In case the house owner has more such "places of billing", as is the case of large housing co-ops or the municipal administration, than each off-take point must be namely specified in the

[17]) Act No. 458/2000 Col.

contract with the heat supplier and its account from the others led separately (but settled may be for all the houses alltogether). The house owner then just after the end of the calendar year accounts for each house real (measured) heat consumption, carries out its allocation among individual flats (see below), and based on the sum of the advance payments made by the flat-dwellers during the year send to each tenant his/her balance of accounts for the past year.

An association of owners may also conclude a heat supply contract. For this, however, they may alternatively encharge the caretaker who cares for the common parts of the house. The latter is then a must if the association is not a legal entity (i.e. it will be the duty of the original housing co-op).

The same provisions then apply for the conclusion of contracts on gas supply, and the subsequent metering and billing of gas consumption for each off-take point.

The most problematic is the situation if the appartement building, which is composed of more sections, is connected to the local DH network by only one sub-station installed in one of the sections as it was a common practice in the past.

The reason for that is that sections in appartment houses are now often economically separated and the common source of heat brings about a lot of conflicts and problems, especially when there is no measuring (possible) on the internal distribution network to know what are the precise heat consumption of each section or how to divide the costs for repairs and maintenace of the sub-station among them rightly.

Therefore, today, there is a strong trend both by house owners and DH operators to have for each section an own independent connection (i.e. sub-station) installed.

2.4.3 Ownership and maintenance

As for the ownership, both heat exhange stations and boiler rooms belong to the common parts of the building. In case the house has its own source of heat, then, it is usually in the ownerhip of the house owner.

However, if the house is connected to the district heating network, the heat exhange station may be both in the ownership of the house owner and also the local DH operator.

In the past, if the house was connected to the DH network since the time of its construction, than usually all the costs incurred behind “the foot of the building” were born by the house owner as part of the overall construction costs. And as a result he should become the owner of it (it was usually the case of housing construction realized by “old” housing cooperatives).

The current practice, however, is that it is upon the agreement between the house owner and the DH operator who will finance the installation or reconstruction of the substation (and then become the final owner) and there are both situations that a DH operator buys the existing or finances the new substation and vice versa.

Therefore, for example, *Prazska teplarenska*, the owner and operator of the country‘s most extensive district heating network laid in the capital city of Prague, owns approximately 50% of substations situated in the residential buildings. A similar situation then may be expected by other DH operators.

More common is that a DH operator usually carries out an administration and maintenance of all the sub-stations including those not in his ownership as a contractual service.
Nevertheless, it is the responsibility of the owner of the sub-station installed in the house to secure proper functioning and the efficient operation of the heating source and in-house distribution.

It is not known that any firm on the market of the residential sector would at present provide the modernisation and/or maintenance of the heating source (no matter whether in the form of a sub-station connected to the DH network or an own HOB) as energy performance contracting. Instead, it is usually in the form of a standard contract on the provision of agreed services.
In the end it is necessary to note that according to the Act on energy management the house owners of the buildings which are centrally heated must by the end of this year (2004) equip the heating system of the house with the automatic regulation of the temperature of heating water (according to the outdoor temperature) and also with the individual automatic regulation of heating of rooms by installing thermostatic valves (TRVs) on heaters in each heated room. The eventual installation of heating costs allocators is, however, not compulsory.

Investment costs for the installation of TRVs are between CZK 5,000-7,000 per flat, and since their installation consequently changes pressure ratios in the heating system, it is then usually necessary also to carry out hydronic balancing (both of the internal and external distribution network between individual houses connected to the same heat exchange station), coupled often also with the exchange of circulation pumps (for ones with frequency adjustable rates). Nevertheless, most of the flats today are already equipped with TRVs.

The energy management law also requires for private individuals and legal entities to carry out by the end of 2004 energy audits if the total energy consumption in their real estate and facilities is above 35,000 GJ yearly (but only for those buildings/facilites in which energy consumption is above 700 GJ/year).

3 Czech State Support for Renovation

State support for the undertaking of investment to housing is a product of the state's housing policies. This falls under the jurisdiction of the Ministry for Regional Development (MMR), which is responsible for its own policies and proposals – a concept for housing policies, the definition of concrete benefit mechanisms and other options including legislative changes for the carrying out of such activities. In the framework of the ministry there is a special section, which specifically deals with housing policy and is directly responsible for all activities connected to housing policy.

Among the key priorities of state housing policy are and will continue to be the support of repairs, reconstruction and modernisation of already existing housing funds. Most of the attention is paid to those housing funds, which are situated in apartment buildings, which were constructed using prefabricated panel technology.

Around one-third of all housing funds in the CR are found in *panelaks*. The technical condition of a number of these buildings is not good and requires improvement. These investments for their renovation as shown above, however, are often too high for the tenants themselves to finance (these buildings are inhabited by mostly middle and lower-class groups of the population).

The aid is mostly in direct grants for the reimbursement of costs connected to the carrying out of repairs, as well as subsidies for the partial repayment of interest and the providing of loan guarantees for loans used for these activities.

Some of these activities are financed directly by the state budget through support programs sponsored by the MMR (Ministry for Regional Development), others are sponsored by the State Fund for Housing Development (SFRB), a special fund newly established in 2000 for the carrying out of long-term (multi-year) support, and which is not a direct part of the state budget.

Additional state support for the renovation of housing funds is the subsidy program sponsored by the Ministry of Trade and Industry, which is directed at cutting energy costs of final users of energy products, including those in the housing sector.

Of a total of 1.165 million flats made with precast concrete slabs in the CR, around 150-170,000 have been repaired with the help of state funding so far. Of these, a great majority (more than 80%) just needed to avert possible danger of injury due to a very bad conditions the buildings were in.

3.1 Programs of the Ministry for Regional Development

3.1.1 Program for the repairs of the most serious defects of buildings made with precast concrete slabs ("Accidental program")

The program is run by the MMR and is aimed at fixing the most serious technical and construction problems of apartment buildings constructed using panel technology. The support is provided to owners of buildings and flats made with precast concrete slabs, in the form of direct subsidies which do not have to be paid back up to the level of 40% of the real costs of repair, maximum however 45,000 CZK for one housing unit.

MMR estimates that a total of more than 140,000 flats have been repaired or their buildings stabilised, corresponding to 13% of the total number of flats in all buildings made with precast concrete slabs.

In the last two years, 2002 and 2003, the state budget contributed approximately CZK 285 million per year. The MMR assumes that similar amount will be spent in the years to come. The Program is considered as a long-term one.

Besides this "Accidental program", the MMR ran another support program until the year 2000, an **interest program for providing loans with low interest rates to municipalities for the maintenance of already existing housing funds in their territory.** The financial means provided to municipalities were either used for renovation of their housing funds or for further redistribution in the form of loans to private owners of buildings, which were already written in the real estate record.

This program was begun in 1993 and by 2000, the total volume of state loaned funds reached CZK 2,222, million, which was divided among 111 municipalities. Statuary cities Prague, Brno, Ostrava and Pilsen were provided according to the number of inhabitants CZK 402 million.

In 2001 this program was discontinued by the Ministry of Regional Development, because this form of support was transferred by decision of the acting government to the State Fund of Housing Development, from which it is now financed.

3.2 Programs of the State Fund for Housing Development

The State Fund for Housing Development (further „SFRB" or simply the Fund) was established in 2000 as an independent legal subject established by the state, with the goal of effectively creating, accumulating and expanding state and later private financial means for the support of investment in housing.

One of the main areas for which the Fund was established is the support of repairs, modernisation and reconstruction of housing funds, especially buildings made with precast concrete slabs.

Currently the SFRB is sponsoring two benefits programs with this aim. The first is the already-mentioned program to provide funds to cities and municipalities through the use of low-interest loans for repair and modernisation of housing funds, which was transferred into the Fund's jurisdiction by government edict No. 396/2001. Col.

The second program is called PANEL. It has a grant-guarantee and interest subsidy program exclusively aimed at the repair of apartment buildings built with panel technology.

For the year 2004 the Fund has in its budget the amount of 3.1 billion CZK for individual programs. Of them, CZK 400 million is to go for the loans provision program to cities and municipalities, and a similar amount then to PANEL for grants to (partial) payments of interests from loans.

3.2.1 Program for providing loans for the modernisation of housing

This program, administered by the Ministry of Regional Development until 2000, was transferred to the auspices of the State Fund for Housing Development in 2001. It offers municipalities the possibility of receiving low-interest loans for repair and modernisation of housing funds in their territory.

This means that besides the final use of loans, municipalities can provide additional loans from these funds for the same purpose, to owners of housing funds which are registered in the real estate register (housing coops, associations of owners of units as well as legal entities and physical persons).

Among program conditions are, however, that the municipality must create for these borrowed money a special monetary fund from which:

- repair or modernisation projects will be financed only to the maximum of 50% of their projected investment costs, with the rest having to come from other sources;
- and that at least 20% of the funds will be used for repair or modernisation of flats of other physical persons and legal entities then the municipality itself (under the same condition that the provided loan will cover no more than 50% of the costs).

3.2.2 Program PANEL

Its goal is to simplify the financing of complex repairs to apartment buildings constructed using panel technology including the improvement of their technical heating systems.

The program is being carried out in conjunction with the Českomoravská záruční a rozvojová banka (further in this section as „ČMZRB“ or „guarantee bank“)[18], which was chosen by the Fund as the delegated bank for administration connected with the acceptance and evaluation of applications for support.

[18]) **Českomoravská záruční a rozvojová banka** is a joint-stock company with a bank licence established by the state (more than 70% of shares are owned by ministries and state institutions) for the purpose of developing the infrastructure and economic sectors requiring public support among which is the housing sector.

The above-mentioned government edict allowed SFRB to provide support in the form of **a grant of interest from a loan**, and that in the amount of 3 %, 4 % or 5 % depending on the region from which the applicant for support lives.

One of the basic conditions is that the subject of repairs, modernisation or regeneration of the building made with precast concrete slabs must be always at least a repair of static defect, reconstruction of plumbing or other pipes (health installation, gas, heating, electrical installation) and the improvement of the technical aspects of the heating system. This condition of "complexity" is not valid if one of these repairs is not necessary.

The payback of interest is provided for the whole term of a given loan in bi-annual payments, maximally for a period of 15 years from the date on which the contract is signed for the providing of support.

Since however most of the potential applicants for the payback of interest will not have at their disposal enough funds to secure their own loan, an agreement was made between SFRB and ČMZRB which would in addition allow **bank guarantees** to be offered in the framework of the PANEL ČMZRB program, and this because the legal amendment of the Fund does not allow loan guarantees to be issued.

The above-mentioned bank guarantees can range up to 70% of the unpaid balance of the provided loan, and a decision of its granting is fully in the competence of ČMZRB, which bears the guarantee risk in the case of an unpaid loan by an applicant.

Acceptance of applications to the program has begun in November 2001. By the end of 2003, a total of 199 applications had been accepted for interest payback, according to figures provided by the SFRB, with 127 applications for bank guarantees. The total amount of support in the form of grants for interest payback reached approximately CZK 715 million, of a total volume of loans of nearly CZK 2.3 billion. ČMZRB was the guarantor of a large proportion of these loans, while at the same time providing guarantees of a total amount of nearly CZK 770 million.

If we take into consideration that the average budget costs for the repair of one flat were in the submitted applications CZK 150-160,000, the PANEL program has been so far active in the repair of 15,000-20,000 housing units.

3.3 Other State Support Programs

3.3.1 Program for reducing energy consumption

This is the investment subsidy program of the Ministry of Trade and Industry (MPO) which is provided in the framework of the State Program for the Support of Energy Conservation and Use of Renewable Sources of Energy, more exactly its part A, which is aimed at the initiation of introducing energy saving measures in the areas of production, distribution and consumption of energy and the greater use of renewable and secondary sources of energy in all sectors of the economy.

An organisational component of the ministry, the Czech Energy Agency (ČEA) administers the program for the ministry, and each year one of the supported areas is also given support for measures, which would increase the effectiveness of energy used in the housing sector (in the framework of the program "**Support Measures to Increase the Effectiveness of Energy Used"**).

The program is run from the end of the 1999 and its annual budget allows to help the reconstruction of several hundred or thousand of accommodation units, with the average subsidy between 15,000 – 20,000 CZK per one flat.

Table 13: Number of projects which applied for and recieved the support from the Programme of ČEA between 1999-2003

Year	Number of applicants	Number of supported	Total subsidy [thous. CZK]	Number of flats renovated
1999	150	61	75,826	4,520
2000	157	44	57,698	2,728
2001	144	13	9,905	955
2002	39	9	11,140	1,030
2003	65	17	28,097	1,664

Source: CEA

Table 14: Financial budgets of the programs for the repair and reconstruction of the existing housing stock administered by the state institutions

Program [mil. CZK]	2000	2001	2002	2003	2004	2005	2006
MMR – Accidental program	533	220	285	285	min. 250 – 300 annually		
MMR/SFRB – Loans to municipalities*	300	< 25	350	350	~ 400 annually		
SFRB - Program PANEL	-	*38,7*	592	?	?	?	?
Of which:							
- interest repayments	-	*32*	252	*429*	?	?	?
- bank guarantees	-	*6,7*	*340*	*404*	?	?	?
Subsidy Program of MPO/ČEA	57.7	9.9	11.1	28.1	?	?	?

Note: For the year of 2004 and onwards supposed budgets
Source: MMR, SFRB, ČEA

3.3.2 State support to the system of building savings

In addition to the state support instruments specifically designed for promoting housing renovations, then, there are in the CR two more comprehensive housing subsidy schemes which (in)directly lead to the acceleration of housing renovations and new housing construction.

The first is the **system of building savings (BS)** introduced in the CR already in the early 1990s to replicate the successful German "Bausparen" model (established by the Act No. 96/1993 Coll.).

Due to generous state support (currently in the amount of 15% of the annual amount saved, maximum CZK 3,000; this corresponds to a maximum state supported deposit of CZK 20,000

/year) the BS system, has become the most successful, and also capitally-intensive, state support instrument of the Czech housing policy (see table below).

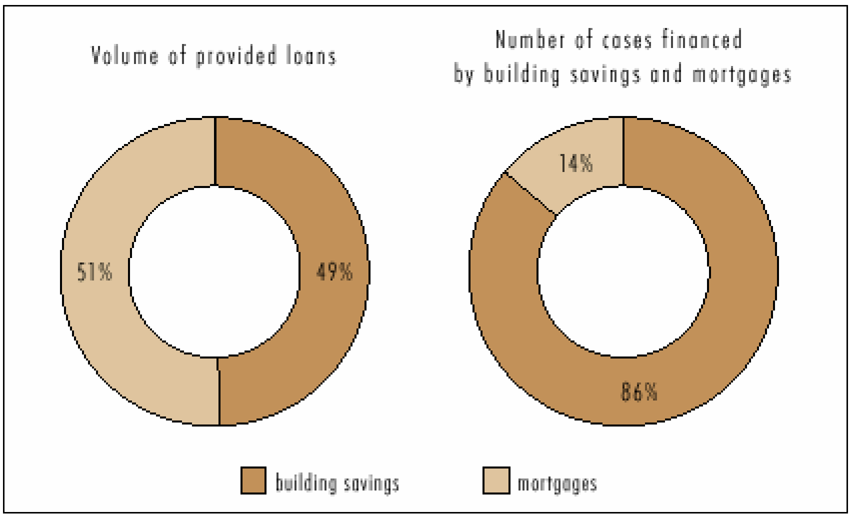
However, so far, only a small part (less than 30%) of the accumulated capital in the BS is being really used for housing needs since the present legislation on the BS system does not prescribe the use of savings made onto the BS account, including the state support awarded, for housing investment after expiry of the contract. This therefore fact raises the question about usefulness of the state subsidies for this purpose and there are discussions about possible conditioning of awarding state support only if the savings in the BS will be used for housing purposes.

In 2002, about 34% of the loans provided in the framework of the building savings system were used for renovations and modernization. The most popuplar use of these loans were in case of the participants living in appartment houses for the modernization of inner parts of the flats (esp. toilet and bathroom facilities), in case of people living in family houses for their extenstions or major reconstructions. However, as the renovation of appartment buildings is on the increase, more and more is the BS system used also for financing of the renovations (and thermal rehabilitation) of the common parts of multi-family residential buildings (e.g. exchange of windows, additional insulation of the roof, outer walls etc).

Table 15: Building savings between 1996-2003 in the Czech Republic

Year	Number of valid agreements [million]	Amount of deposits [billion CZK]	Total target amount [billion CZK]	Balance of valid loans [billion CZK]	Amount of state subsidy awarded [billion CZK]
1996	1.56	34.46	-	1.3	2.3
1997	1.97	59.55	283.3	5.9	3.8
1998	2.37	81.73	345.8	17.6	5.1
1999	2.80	93.63	412.8	26.3	6.4
2000	3.42	110.40	502.9	31	7.7
2001	4.87	133.31	613.8	37	9.3
2002	5.07	180.19	741.4	46.3	~ 11
2003	6.32	236.82	1103.4	63.6	N/A

Figure 1: Number and volume of financed cases (building savings and mortgages, state as of the end of 2002)



3.3.3 State support to mortgage financing of new housing construction

The other state support instrument, which under the present rules promotes new housing construction, is the **support to mortgages**. The support has been introduced by the Czech government in 1995 (by the Decree No. 244/1995 Col.) and included a partial co-financing of interest the applicants have to pay out for the mortgage loan they have taken out.

The level of the interest subsidy (expressed as the percentage) has been annually adjusted depending upon the average market interest rate of mortgages awarded in the previous year.

Due to the constant decrease in interest rates in the last years, the interest support was also lowered (in 2001 to 2%, in 2002 to 1%), and presently is stopped at all.

The promotion of mortgages is anyway preserved by the possibility for private individuals to deduct all the interest expense paid out in the calendar year from his or her income tax base.

4 List of Key Legislation and Standards related to Energy and Housing Sector in the Czech Republic

4.1 Energy legislation and technical standards related to housing

- Act No. 406/2000 Col. (the “Act on energy management”)

  The list of applicable executive ordinances published to the Act:

  - Ministry of Trade and Industry (MIT) Decree No. 151/2001 Coll. laying down details of efficiency of energy use during heat energy distribution and internal heat energy distribution
  - MIT Decree No. 152/2001 Coll. laying down rules for heating and hot water supply, specific indicators of heat consumption for heating and hot water preparation, and requirements for equipping internal heat installations of buildings with instruments controlling delivery of heat energy to the final consumers
  - MIT Decree No. 213/2001 Coll. issuing details of energy audit requisites
  - MIT Decree No. 291/2001 Coll. determining the details of the effectivenes of energy application during heat consumption in buildings

- Ministry for Regional Development (MMR) Decree No. 372/2001 laying down rules for the allocation of the costs for heat consumption on heating and hot water supply among final consumers
- CSN 73 0540 Thermal Protection of Buildings

  The Standard then prescribes (or makes use of) the calculation methods and requirements as set in the following EN/ISO standards also transposed into the Czech national standardization:

  - CSN EN ISO 10211-1:1995/Cor 1:2002 Thermal bridges in building construction -- Heat flows and surface temperatures -- Part 1: General calculation methods
  - CSN EN ISO 10211-2:2001 Thermal bridges in building construction -- Calculation of heat flows and surface temperatures -- Part 2: Linear thermal bridges
  - CSN EN ISO 7345:1987 Thermal insulation -- Physical quantities and definitions
  - CSN EN ISO 6946:1996 Building components and building elements -- Thermal resistance and thermal transmittance -- Calculation method
  - CSN EN ISO 13370:1998, Thermal performance of buildings -- Heat transfer via the ground -- Calculation methods.
  - CSN EN ISO 10456:1999 Building materials and products -- Procedures for determining declared and design thermal values
  - CSN EN ISO 13793:2001 Thermal performamce of buildings - Thermal design of foundations to avoid frost heave

4.2 General key legislation related to housing

- Act No. 50/1976 Col. (the "Construction law")

  The relevant executive ordinances published to the Act:

- MMR Decree No. 134/1998 Col., on general technical requirements on construction
- Decree No. 137/1998 Coll. on general technical construction requirements (applies to the territory of the Czech Republic, with the exception of the city of Prague) and
- Decree No. 26/1999 Coll. of the city of Prague on general technical requirements for construction in the city of Prague, as amended (applies to the territory of the city of Prague)

4.3 Legislation to state support instruments in housing

- Govenmental decree No. 299/2001 Coll., on the use of proceeds of the State Housing Development Fund for partial financing of interests from loans provided by banks to legal and private entities for repairs, modernization or regeneration of panel buildings (the legislation on the “PANEL Program”);
- Govenmental decree No. 480/1998 Coll., announcing the concept of the perennial “Government Program for the Support of Energy Savings and the Utilisation of Renewable and Secondary Sources of Energy”;
- Act No. 96/1993 Coll., on building savings and state support to building savings, in present wording;
- Government Decree No. 244/1995 Coll., as amended by Decree No. 78/1998 Coll., stipulating conditions for the provision of state support to financing of new housing construction via mortgages.

5 Examples of Best Practice in the Czech Republic

5.1 District Development Plans - An Approach to Structure the Local Development Process City of Brno Municipality of Utrecht

The project ”Housing, an integral approach” was carried out within the framework of co-operation between the Municipalities of Utrecht (the Netherlands) and Brno (Czech Republic). The project was the result of the activities carried out in the field of housing and monument care since the official start of the co-operation in 1993. The project included a combination of transfer of knowledge and transfer of skills. At the same time the newly obtained skills were put directly into practice.

The primary aim of the project was to develop a consistent housing policy in the city of Brno, within the framework of the national policy, based on the local circumstances and the outcomes of two development plans at the city district level. The housing policy was formulated not only to direct city developments but also as input for the integral Brno strategy. The overall objective of the project was to support the city of Brno and its inhabitants to cope with new responsibilities in the field of housing, due to the transition from a centrally planned economy toward a market economy. Furthermore, the project aimed to improve the transparency in the relation between the municipal government, the city-districts, the local people and other partners in the field of housing and district development.

One of the major goals of the project was to find a basic methodology, which can be used by any district or city, to improve the quality of life in these districts for its inhabitants, not form the point of view of one specific sector, but through an integral approach.

The elaboration of District Development Plans has proven to be an appropriate instrument for translating the long-term city strategies into lower district plans and concrete projects in neighborhoods. Similarly, the efforts to elaborate a development plan can support the cyclical development of the long-term strategy, its results serving as input for redefinition of long-term goals. By means of public participation and linking together of currently experienced problems in the districts, quick and apt responses to the situation can be ensured.

The project received 1st prize award in the project contest at Eurocities 2000 and the knowledge that have been obtained from the project is being spread amongst other cities and countries by means of reports, articles and presentations.

5.2 Low Cost/Low Energy Buildings in the Czech Republic

The project supported by the UNDP and co-ordinated by SEVEn, The Energy Efficiency Center, has been initiated with the aim to prove that it is possible to design and build much more energy efficient residential buildings then is nowadays common in the Czech Republic at minimum or even no increased investment costs and at no expense of the comfort level of living for their residents.

The project was started in June 1999 and the last project activities shall continue nearly till the end of 2004. It is focused on creating local capacity and state-or-art expertise in developing, designing and construction of low-cost low-energy multi-apartment buildings.

The major goal challenged by the project is to design and construct such a residential multi-dwelling building of which investment costs would be comparable with, ie. not higher, than standard newly constructed buildings, and in the same time which would have significantly reduced energy consumption by at least one third or more.

Therefore, the project has included the collection of up-to-date international experience, dissemination of this expertise among local professional groups, creating concrete local has-on experience with developing low-cost low-energy building, construction of such a building in a partnership with a local investor who covers full investment costs, disseminating the gained experience among other stakeholders and investors, developing new standards for low-cost low-energy (LC- LE) buildings, and strengthening capacity in developing and financing further LC- LE constructions.

In the framework of the project, three towns have decided to construct such residential houses (towns Susice, Humpolec, and Zelezny Brod), using their own financial sources and with the same state support as provided to the standard new residential multi-dwelling construction. Early this year, the first of the planned LC-LE houses in Susice has been finally finished and households could move in. At present, there are measurements carried out to verify the planned parameters.

The LC-LE buildings to be constructed should meet the following parameters:

- energy consumption on heating of 45 - 50 kWh/m^2 a year,
- 38% reduction of CO_2 emission,
- 43% reduction of operational costs in comparison with same large residential building according to national standards, investment costs comparable with reference level in CR (approximately 15 000 CZK/m2 (to the utilized area) = ca 500 EURO.

5.3 Renovation of panelaks in Svitavy Town

Svitavy is the first and so far probably the only town in the Czech Republic that will have shortly finished the renovation of all of their dwelling stock situated in panel-built houses.

With the financial help of the state support programme "PANEL" nearly 1800 renovated flats in 32 panelaks - partly owned by the muncipality and a local housing cooperative - are to be renovated in the town in the near future.

Such a scale of the project thus makes it by far the biggest renovation programme carried out in one municipality in the Czech Republic so far. The total costs will amount to approx. 320 million CZK and all the buildings should be renovated by the end of 2006.

The reasons for their rehabilitaion were several. The town, which owns about 600 of these flats, decided to renovate them before their privatization to avoid the risk that some tenants (new-owners) would not be then able to finance their renovation in future only themselves and on the other hand to avoid the risk that tenants which would become more well-off would start leaving their rented dwellings in these houses if they do not provide them with sufficient comfortable living. A financial model "from the flat in panel-built house to the flat in panel-built house", when the income from flats sale reimburse renovation costs, has proved very successful.
In case of the housing cooperative which owns in the town 20 buildings made with precast concrete slabs with more than 1000 flats, the great motivation has been the state support as offered by the PANEL Programme (state banker's guarantee up to 70% to get a bank loan and interest grant 3-5%), and also the fact that by the simultaneous renovation of more buildings allow to considerably decrease the unit costs for renovation (for example the tendering

procedure for the replacement of approx. 5,500 windows led to the decrease in price about 30%).

The housing cooperative financed the renovation mostly (90%) from the bank loan and the rest from own resources. The average cost per one flat unit has been approx. 164,000 CZK, which is about 2,500 CZK per one m^2 of the living floor space (considering the average flat space is 65 m^2).

6 Housing Sector in Austria - Basic Characteristics

6.1 Housing and dwelling stock in Austria (Statistik Austria, 2004, Hüttler et al., 2003)

In 1991 in Austria (A) about 1.8 million buildings containing altogether almost 3,4 million homes for 7.8 million inhabitants were counted (2.3 persons per home). Since then, approximately 40.000 to 60.000 new homes have been complemented every year, while at the same time a loss of 15.000 homes per year has been registered due to demolition or re-dedication.

About two thirds of the dwellings in multi-family buildings are situated in buildings which were built after World War II.

The total housing stock in 2001 represents about 2 million houses[19] and about 3.9 million dwellings in total (of which about 3.3 million are main residences[20]). 1.2 million of the permanent residences are single family houses (30%), and 0.2 million are two family houses (5%) (see Table 15 and 16).

Table 15: The extent of the housing stock Austria from 1961 and 2001

Year	Number of houses	Number of dwellings	
		total	Main residences
1961	1 049 953	2 249 678	
1971	1 259 533	2 665 942	
1981	1 586 841	3 052 037	2 642 000[1)]
1991	1 809 060	3 393 271	2 972 222
2001	2 047 071	3 866 483	3 313 000

1) 1980

Table 16: Increase in buildings and dwellings; results of the yearly survey on residential construction, buildings and dwellings completed 1975 to 2002

Year	Increase in buildings	Increase in dwellings				
		Total	In 1 and 2 family houses [%]	In multi family buildings [%]	Other buildings with dwellings [%]	Private ownership [%]
1975	19 645	48 570	43	54	3	50
1980[1)]	37 653	78 457	54	43	4	60
1985	19 349	41 153	53	46	1	56
1990	18 542	36 553	59	40	1	62
2000	21 056	53 760	44	52	3	49
2002	17 957	41 914	50	46	2	55

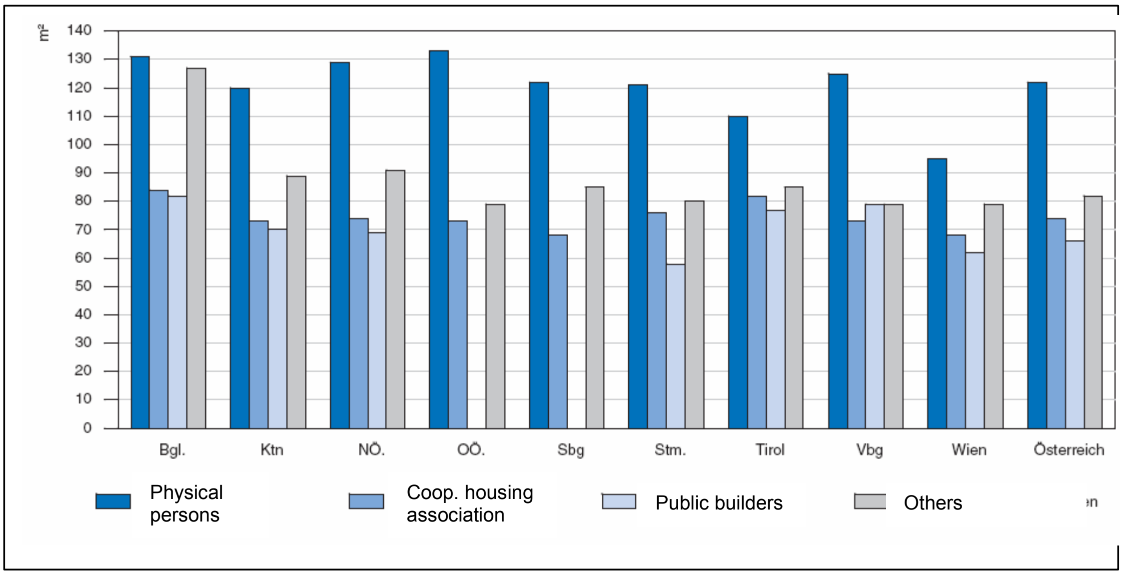
Due to numerous nominations from years before too high

[19]) A **house** is here and throughout the whole text understood to mean a construction or part of a construction, which has an independent entrance and own number.

[20]) This is understood to mean that at least one person is registered as having their permanent residence here.

A total of 1.62 millon flats were built between 1961 and 2001, nearly equally distributed over the time. There are slightly more single- and double family houses than multi family buildings. More than 50 % of the buildings are privately owned. More than 50 % of the dwellings have more than 90 m² living area. Private homes tend to be larger (125 m²) than others (about 70 m²).

Figure 2: Average Size of dwellings completed in 2002 by building contractor



6.2 Legal framework (Hüttler et al., 2003)

The Austrian legal framework for residential buildings distinguishes three different laws according to the different forms of ownership:

- rent law („Mietrechtsgesetz", MRG)
- co-operative housing law („Wohnungsgemeinnützigkeitsgesetz", WGG)
- condominium law („Wohnungseigentumsgesetz", WEG)

The **rent law** refers to about 30 % of all households. It is applied mainly for the multi-family building stock, which has been constructed before the second world war and to multi-family buildings rented out by municipalities or by companies.

The landlord is responsible for the maintenance of public parts of the building (facade, roof, stair-well, etc.), in specific cases for maintenance of flats (but only for strong damages), maintenance of common appliances, renovation measures based on decisions of public authorities, installation of technical feasible measures that reduce the energy demand of the building (payback period of ten years), useful improvements of the building, if there is enough rent reserve available. To finance these kind of measures the landlord has to use at first the rent reserves from the last ten years (i.e. the reserves that remain from rent revenues after subtracting all expenses for maintenance in the given time-span). If these reserves are not sufficient he has to use the expected rent reserves over the coming ten years. Finally – if both financing resources are not enough – the landlord is allowed to apply for an increase of the rent (§ 18 MRG). This application has to be approved by the so-called „Schlichtungsstelle", which is an administration for the settlement of disputes outside the court system.

The **co-operative housing law** is quite comparable to the tenants law. However there is one main issue that distinguishes these two laws with respect to building renovation activities. Additionally to the ordinary rent, the housing co-operative is allowed to charge a so-called maintenance and improvement fee. The level of this fee has an upper limit which is defined by law and which depends mainly to the construction period. For buildings that have been built more than 20 year ago the upper limit is € 1,32 per m² and month, of which € 0,33 are reserved for ordinary running maintenance. The rest can be used for improvements resp. comprehensive building renovation measures.

The **condominium law** refers to multi-family buildings in which the dwellings are owner occupied. This law regulates how public parts of the building have to be administered by the association of the owners. The following issues concerning building renovation have to be approved by the majority of owners: the monthly payments to the maintenance reserve and the raising of a loan for renovation activities in the case that the reserves are not sufficient to cover investment costs. For any kind of improvement measures (i.e. investment that goes beyond the pure maintenance of building) an unanimous decision of the owner is necessary.

Table 17: Ownership Structure of Austrian Homes, 1991

		Dwellings	
		Number	**Share**
Private owners			
	House owners	1 175 328	39.6%
	Freehold flats	308 672	10.4%
Private total		**1 484 000**	**50.0%**
Rented			
	Rented under rent law	836 976	28.2%
	Rented under cooperative housing law	314 608	10.6%
	Flat provided by employer	86 072	2.9%
Rental total		**1 237 656**	**41.7%**
Other legal situations		246 344	8.3%
Total		**2 968 000**	**100.0%**

Source: Statistics Austria, HWZ 1991

According to nearly 30 % of the dwellings are rented out under the rent law, about 11 % are rented under the co-operative housing law and also approximately 11 % are owner occupied dwellings.

7 Energy Parameters of Buildings in Austria

7.1 Present situation in technical state and energy consumption

7.1.1 Austria

Between 1981 and 1990 thermal insulation measures were carried out for altogether 9,4 % of the buildings, which results in an average renovation rate of 1 % per year. Most renovation activities are initiated by co-operative housing associations (about 13,4 % of these buildings). The higher renovation rate within this sector corresponds partly with the beneficial legal framework, given with the co-operative housing law (Hüttler et al., 2003).

The energy costs for heating in Austrian homes amount to an average of 7,9 € per m² useful floor area and year. Including water heating and electricity demand, an average energy demand of 280 kWh/m².a and 13.9 € per m².a useful floor area results for Austria (ref. Table 19). This is about 25 % of total costs for average housing. In general, it can be assumed that about 30 kWh/m².a are used for water heating (assuming a demand of about 180 l/d and dwelling) and about 50 kWh/m².a are used to cover (other) electricity demands.

Table 18 shows the type of heating system and the fuel type from 1980 to 2002. The main fuels for space heating are oil and natural gas with a share of about 30% each, followed by district heat and wood with about 15% each. Cole, which had a share of 30% in 1980 was nearly not used any more (2%) in 2002; electric heating had a stable share from 1980 to 2002 with about 8% (Figure 18). Single stoves are continuously replaced by central heating systems (Figure 18).

Table 18: Austrian Dwellings (main residence) by type of heating and fuel used for heating 1980 to 2002

Year	1980	1985	1990	1995	2002 2)
Factor	1 000				
Type of heating system					
Single stove	1 480	1 306	1 100	996	712
Heating system covering one floor	271	336	478	451	460
there under:					
In buildings with 3 and	159	200	283	334	363
more flats	878	1 131	1 322	1 676	2 141
Central heating, district heating					
there under:	83	175	226	347	549
District heating	13	-	-	-	-
Unknown					
Fuel					
Wood	410	545	616	571	491
Cole, coke, briquettes	743	622	418	216	79
Natural gas	352	431	579	777	900
Oil	827	667	771	843	981
Electricity	196	251	261	314	257
District heat, other , unknown	114	256	254	402	605
Total	2 642	2 772	2 900	3 123	3 313

Source: STATISTIK AUSTRIA. - 1) 1980 - 1990: March; 1995: December; 2002: September. - 2) Preliminary results

Table 19: Energy consumption of households in 1999/00 - basic data by energy sources

Fuel	Dwellings 1)	Energy			Costs			
		per dwelling	per m² living area	Share of total	total	per dwelling	per m² living area	Share of total
	1 000	GJ		%	1000 EUR	EUR		%
Hard coal	45 007	51.8	0.6	0.8	17 918	399.70	4.29	0.4
Lignite	19 634	22.6	0.3	0.2	7 468	377.90	4.43	0.2
Lignite Briquettes	68 758	23.5	0.3	0.6	20 148	290.69	3.82	0.5
Coke	81 240	72.6	0.7	2.1	45 667	559.58	5.41	1.1
Oil (oven)	468 515	87.2	0.8	14.3	356 955	763.06	7.41	8.7
Oil (light)	325 330	105.7	0.9	12.0	269 728	828.47	7.41	6.6
LPG	36 247	60.1	0.6	0.8	27 788	763.06	7.49	0.7
Natural Gas	1 152 963	56.0	0.7	22.5	655 038	566.85	6.79	16.0
Wood logs	880 379	67.0	0.6	20.6	323 704	370.63	3.37	7.9
Wood chips	43 527	85.0	0.7	1.3	22 395	515.98	4.32	0.5
Ambient heat	13 738	5.4	0.0	0.0				
Solar	31 795							
District heat	477 416	45.1	0.6	7.5	271 740	566.85	7.81	6.6
Electricity	3 258 870	15.3	0.2	17.4	1 802 176	552.31	6.11	44.0
night tariff	357 063	10.9	0.1	1.4	81 533	225.29	2.48	2.0
Central Heating 2)	428 189				270 794	632.25	7.87	6.6
Total	3 258 871	88.0	1.0	100.0	4 091 520	1 257.24	13.88	100.0

Source: STATISTIK AUSTRIA, 1) Every dwelling is counted for each fuel listed, therefore double counting occur: In the Total line each dwelling is counted only once. 2) Three and more dwellings per building

Figure 3: Heating fuel for Austrian dwellings (main residences)

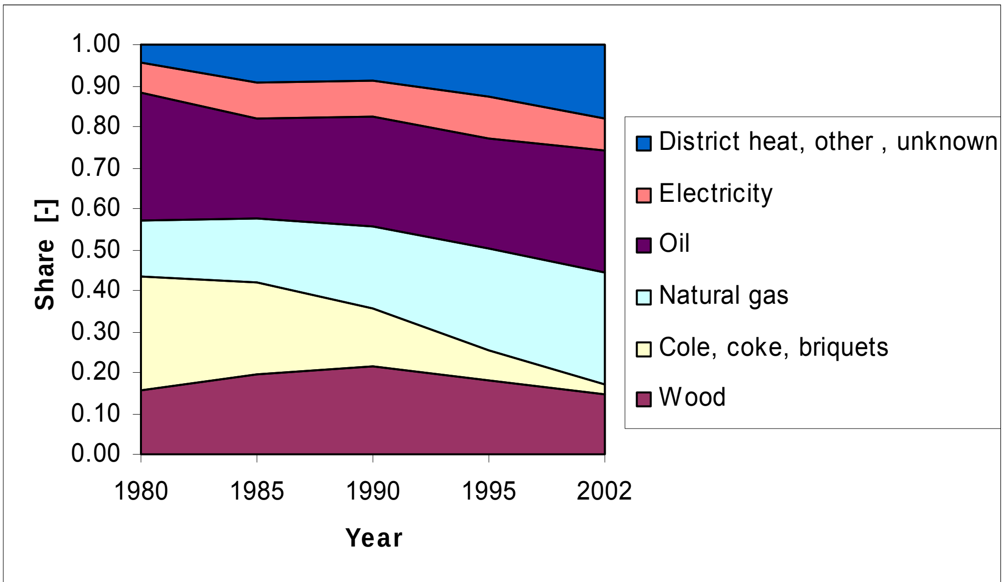
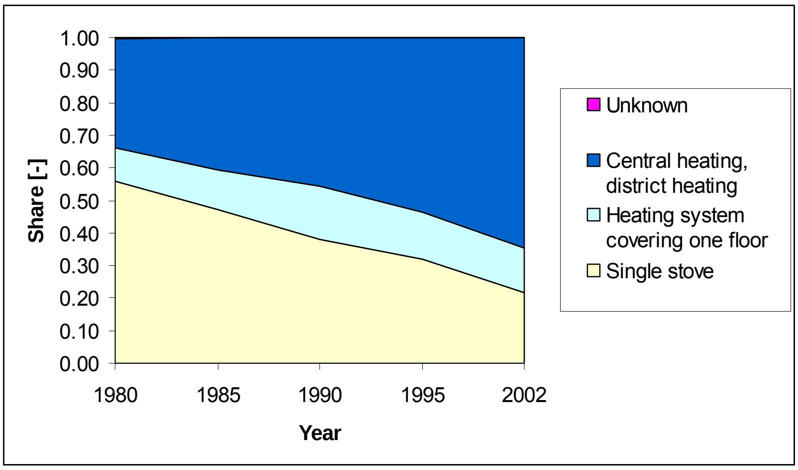


Figure 4: Type of heating system for Austrian dwellings (main residences)



7.2 State regulations on thermal quality in Austria

7.2.1 Authorities and measures of thermal quality regulations of buildings

7.2.1.1 Building regulations (Hüttler et al., 2003)

The building regulations lie within the nine Austrian provinces authority. The nine building codes ("Bauordnungen") differ in general and in detail particularly referring to regulations for new buildings or new parts of existing buildings.

- **Energy related regulations for new buildings**

There is a general convention to harmonize U-values (the so called „§ 15a agreement"). This agreement fixes the upper level of the U-values but leaves it up to the provinces to set up their own U-value with stricter limits. All provinces have defined lower limitations of the U-values for themselves ("Wärmeschutzverordnungen").

Additionally some provinces have implemented energy performance requirements for buildings within the building codes in the form of the heating energy demand (in kWh/m²a) or the so called LEK-values (non-dimensional value for heat insulation of a building in relation to the geometry of the building). At the moment two provinces have exactly specified in which cases the energy performance has to been calculated for reconstructed or extended buildings.

In general the conditions of civil engineering are defined in the Austrian standards („ÖNORMEN"), in the case that building laws refer to these standards they have binding character.

Austrian Building codes can be found i.e. in http://www.bauordnung.at.

Regarding the heating systems there are partially regulations concerning the efficiency of boilers and the emission limits of some air pollutants (e.g. CO, NO_x, total suspended particles).

- **Energy related regulations for existing buildings**

Energy related regulations for existing buildings within the building codes are existing with respect to the renewing of construction units (e.g. the replacement of windows), to building extensions (e.g. roof extensions) and to the modernizations or replacement of the heating system.

7.2.1.2 Energetically relevant subsidy schemes (from Cerveny et al., 2003 and Hüttler et al., 2003)

The advantage of subsidy schemes is the relative freedom of the defined requirements. The so called "Wohnbauförderung" is the main energetically relevant subsidy scheme in Austria (EnergieSparFörderungen). The subsidy schemes are very different for each Austrian province. In all provinces there are subsidy schemes for new buildings and for renovation of buildings

In 1999 € 2.2 billion were spent on this subsidy schemes for residential buildings in Austria, almost 75.2 % of which were used for the construction of new residential buildings. All over Austria, increased efforts have been made, more recently, to re-direct funds towards the renovation of existing buildings in particular.

Due to the fact that subsidy schemes are regulated by the nine Austrian provinces there are enormous differences. While in Styria, the corresponding figure for renovation of buildings amounts to 35 % of the entire funds available for subsidization, in some of the provinces that figure is less than 5 % (see

Table *20*)

Table 20: Regional distribution of subsidies for residential buildings in Austria, 1995

Area	Funds for new buildings	Funds for renovation of buildings	Total subsidy funds	Funds for renovation per inhabitant	Funds for renovation share of total
	million €	million €	million €	€/inh.	%
Burgenland	62.1	8.8	70.9	32	12.4%
Carynthia	150.8	5.8	156.6	11	3.7%
Lower Austria	279.9	100.3	380.2	68	26.4%
Salzburg	176.2	8.8	185.0	18	4.8%
Styria	182.7	100.2	282.9	85	35.4%
Tyrol	166.9	28.1	195.0	45	14.4%
Upper Austria	322.9	48.5	371.4	36	13.1%
Vienna	477.3	201.2	678.5	131	29.7%
Vorarlberg	124.4	19.8	144.2	60	13.7%
Austria	**1 943.2**	**521.5**	**2 464.7**	**67**	**21.2%**

Source: Federal Ministry for Financial Affairs, data provided by the provinces, calculation by E.V.A.

The amount of the provinces for renovation subsidies can be assessed by the expenses per inhabitant of the province. In this context the largest amounts per inhabitant are spent in Vienna (131 €/inh.), followed by Styria (85 €/inh.). The lowest renovation subsidy level exists in Carinthia with 11 €/inh.

While the average amount spent on subsidies for the construction of new buildings is about 36500 € per home, the comparable amount for old buildings is only about 3 650 € per renovated home. In 1999 75% of subsidies were spend for new buildings and 25% for renovation. The share for renovation has been steadily increasing in the last years.

New buildings

Among others, measures to decrease the space heating energy demand below certain values and to improve the environmental performance of buildings are subsidized. In particular these are

- Measures to decrease heat losses, emissions and improve the humidity and noise behaviour of the building envelope
- Measures in the space heating system to improve the efficiency, reduce emissions or to use renewable energy sources (biomass, solar thermal plants, heat pumps) or district heating systems
- Use of environmental friendly building materials (non HF(C)KW materials, materials from renewable energies or waste)
- Dense building structure (e.g. reduction of land use traffic and infrastructure cost)

All measures for all provinces can be found in detail in e.g. Hüttler et al. (2003)

Renovation of old buildings

In most Austrian provinces there is a distinction of the subsidy schemes depending on the building type (apartments, single family house, multi family buildings) and kind of renovation („small“ or „total“ renovation).

Mainly measures to improve the energetical behaviour, heating system or materials used in buildings are subsidized. The subsidy is given either to the persons applying (and is then mostly depended also on their economic situation) other to communes or building associations. The kind of subsidy can be either annuity grants or investment grants.

The following approaches are used for subsidies

- Definition of minimum heat insulation standards
  In many Autrian provinces a specific heat insulation standard has to be achieved to get the subsidy. This can be either the values from Table 21 (Burgenland, Lower Austria, Styria) or separately defined values for Space heating demand (Vorarlberg) or minimum insulation thickness (Tyrol).
- Subsidy depending on achieved U-values
  The lower the U-values, the higher is the subsidy. With this approach also „small“ renovations are driven towards energy efficiency. These subsidy schemes are used in Salzburg and Styria.
- Subsidy scheme depending on total space heating energy demand
  This model is useful for total renovations of buildings but not very successful for single assures (like changing the windows). Examples for this subsidy schema can be found in Vienna (Thewosan), Vorarlberg (subsidy scheme „Ökologische Sanierung“) and other provinces.

All measures for all provinces can be found in detail in e.g. Hüttler et al. (2003).

7.2.2 Thermal-technical standards

7.2.2.1 Building insulation (U-Values) (building codes)

Table 21 shows the upper limits of U-values (W/m²K) for new buildings or new parts of buildings according the building codes of the Austrian provinces

Table 21: Upper limits of U-values (W/m²K) according the building codes of the Austrian provinces

Status: 9/2003	B	K	N	O1	S2	St	T	V	W3
Valid since	'02	'97	'96	'99	'02	'97	'98	'96	'01
Wall to ambient	0.38	0.40	0.40	0.50	0.35	MFH: 0.50 SFH/TFH: 0.40	0.35	0.35	0.50
Wall to unheated space and fire walls	0.50	0.70	0.70	0.70	0.50	0.70	0.50	0.50	0.50
Wall to separate dwelling or office	0.90	1.60	1.60	1.60	0.90	1.60	0.90	1.60	0.90
Ceiling to ambient, unheated roof	0.20	0.25	0.22	0.25	0.20	0.20	0.20	0.25	0.25
Ceiling to unheated spaces	0.35	0.40	0.40	0.45	0.40	0.40	0.40	0.40	0.45
Ceiling to separate dwelling or office	0.70	0.90	0.90	0.90	0.90	0.90	0.70	0.90	0.90
Windows	1.70	1.80	1.80	1.90	1.70	1.90	1.70	1.80	1.90
Doors to ambient	1.70	1.80	1.80	1.90	1.70	1.70 / 1.90 (GD)	1.70	1.90	1.90
Walls to ground	0.35	0.50	0.50	0.50	0.40	0.50	0.40	0.50	0.50
Floor to ground	0.35	0.50	0.50	0.50	0.285	0.50	0.40	0.50	0.45
Abbr.: MFH Multi family building EFH/TFH One and two family building GD Glasdoor									

7.2.2.2 Other energy relevant regulations in the building codes

In **Upper Austria** additionally the space heat demand is defined for the whole building in dependency of the ratio of surface (AB) to volume (VB) of a building (Oö. Bautechnikver-ordnung)

- AB/VB < als 0.2 m-1: 40 kWh/(m².a)
- AB/VB > als 0.8 m-1: 90 kWh/(m².a)
- AB/VB between 0.2 and 0.8 m-1: linear increase from 40 to 90 kWh/(m².a).

In **Salzburg** the maximum LEK value of heated space is defined in the building code (Table 22).

The LEK value is defined as

$$LEK = 300 * \frac{U_m}{(2 + I_C)} \quad with$$

$$U_m = \frac{total\ specific\ transmission\ [W/K]}{total\ surface\ of\ heated\ space\ to\ ambient\ [m^2]} \quad and$$

$$I_C = \frac{gross\ Volume\ of\ heated\ space\ [m^3]}{total\ surface\ of\ heated\ space\ to\ ambient\ [m^2]}$$

Table 22: Salzburg: Maximum LEK values for heated space for different building types

Building type		
1	Residential multi family buildings	38
2	Residential single family buildings	44
3	Schools, kindergarden, offices, shopping centers, halls for events, and other buildings that are used only temporarily	50
4	Buildings with indoor air temperature lower than 12°C	54

In Vienna the building code defines, additionally to the U-values mentioned above, maximum specific heat transfer losses depending of the heated volume of the building in 9 classes (§97a, Table 23).

Table 23: Vienna: Maximum specific transmission losses heated space for different heated building volumes

Building class:	**heated Volume [m³]:**	**Max. spec. transmissions-losses [W/m³K]:**
A	up to 500	0.36
B	up to 1000	0.34
C	up to 1500	0.32
D	up to 2200	0.30
E	up to 3000	0.28
F	up to 4500	0.26
G	up to 6000	0.24
H	up to 8000	0.22
I	> 8000	0.20

7.2.2.3 Calculation method of space heating energy demand

There is one methodology to calculate the space heating energy demand of buildings that is accepted in all Austrian provinces. It was developed by the Austrian Institute of Buildings

Technology (Österreichisches Institut für Bautechnik, OIB), which is a coordination platform of the Austrian provinces in the whole building sector. It is responsible mainly for the certification of building material and is an EU-accredited laboratory.

The methodology is based on the European EN832 and the Austrian ÖNORM B 8110-1 Standard. The result is an ENRGIEAUSWEIS that classifies the building space heat energy demand in the categories A: SH Energy demand ≤ 30 kWh/m²a to G: SH Energy demand ≥ 160 kWh/m²a. The calculation procedure is available for free at http://www.oib.or.at/ „Leitfaden und Programm für die Berechnung von Energiekennzahlen".

In 2004 the method is expanded to the efficiency of the heating device and the heat distribution system in order to go into the direction of the EU energy performance of buildings directive.

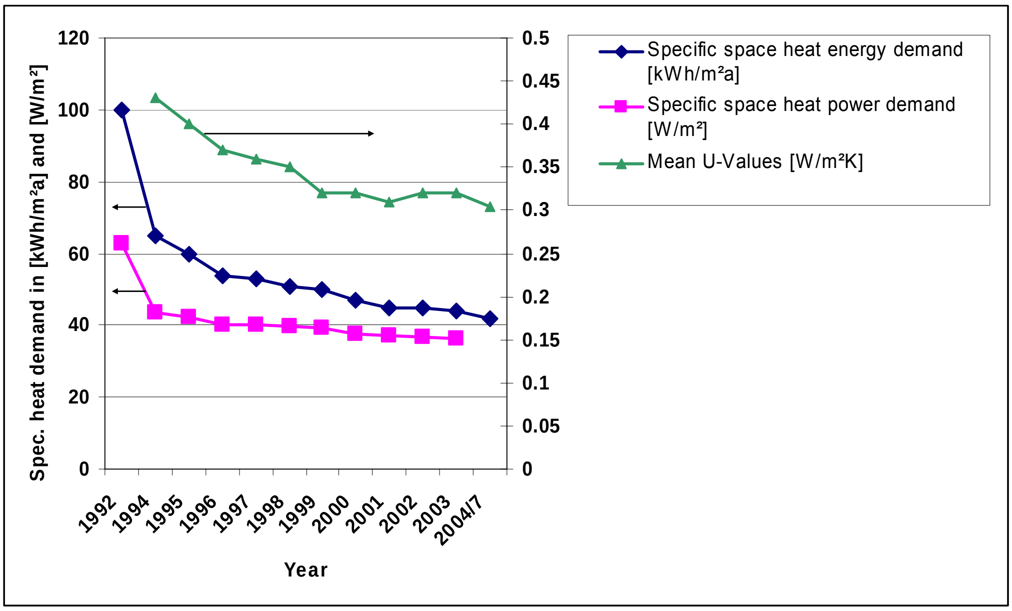
7.3 Improvements of buildings due to building codes, subsidy schemes and other regulations

There have been some statistics of the change of the building quality due to regulations, buildings codes and other measures in Austria in the past. In the following results from Salzburg and Vienna are presented.

7.3.1 Example Salzburg

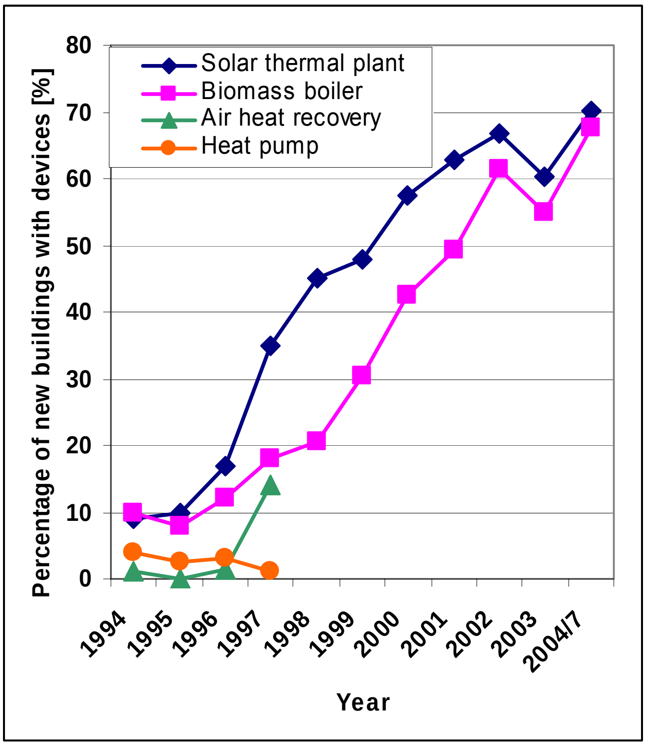
Figure 5 shows the increasing thermal quality of new buildings in Salzburg from 1992 to the year 2000. The specific heat load has decreased by 40 % and the mean U-values by about 25%. There is still room for further improvement.

Figure 5: Development of specific heat load [W/m²], specific heat energy demand [kWh/m²a] and mean U-values [W/m²K] of new buildings in Salzburg, (Energieberatungsstelle des Landes Salzburg, 2004)



In Figure 6 the development of the percentage of the use of renewable (biomass boilers, solar thermal plants) and energy efficient heating devices (heat pump and exhaust air heat recovery system) in Salzburg is shown. Biomass and solar thermal plants have a very high increase so that today about 70 % of all new buildings are equipped with a combined biomass solar thermal system. Heat pumps are decreasing in this time period.

Figure 6 Percentage of buildings with subsidized solar thermal plants, biomass, mechanical ventilation and heat pumps in Salzburg (Energieberatungsstelle des Landes Salzburg, 2004)



7.3.2 Example Vienna

Since 1995 in Vienna there are two instruments available to increase the quality of new buildings:[21]

- Competitions of building companies for new buildings built by the city of Vienna (Bauträgerwettbwerb)
  The jury decides by using criteria like city planning, economy and ecology which project will be built. The building companies have to deliver detailed plans including specific energy losses (W/m³K) and the U-values.
- The "Grundstücksbeirat" evaluates all other projects with a similar approach

The Austrian Energy Agency (Energieverwertungsagentur) stimulated a study performed by Österreichisches Ökologieinstitut that evaluated the realized (plus second prize) objects and the objects that were recommended by the "Grundstücksbeirat". In total 150 new buildings with over 16.000 flats were analyzed.

Despite the fact, that no limits for the energetical performance were given, there was a decrease of the calculated energy demand between ba 35% (Grundstücksbeirat) and 42 %.

[21] http://www.iswb.at/index.htm?room=wienerwohnbau&page=..%2Fwienerwohnbau%2Fqualitaet.htm&mm=wienerwohnbau&sm=qualitaet

(Bauträgerwettbewerb). Figure 7 shows the impact on the U-values and Figure 8 on the specific space heat loss from 1995 to 1997. Additionally the costs of the buildings decreased by 15 to 20 % in the same time.

Figure 7: Development of U-Values of buildings in Vienna (Energieverwertungsagentur, 1997)

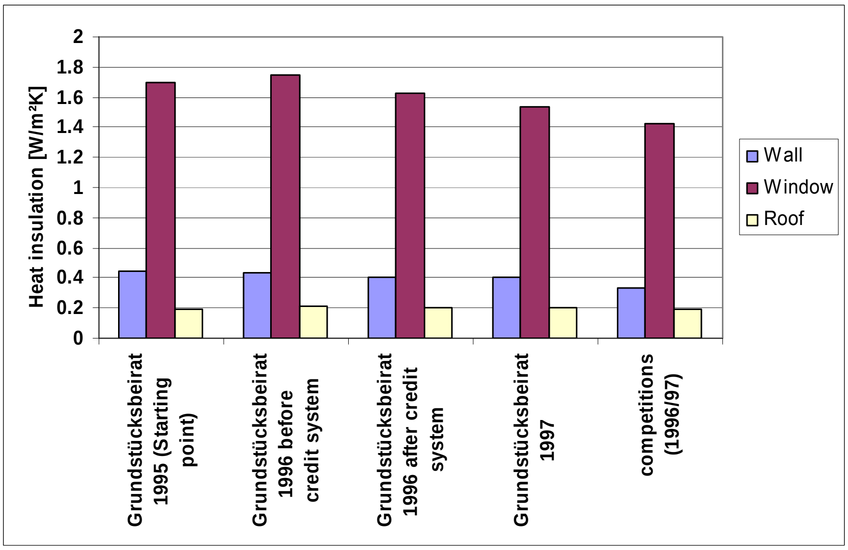
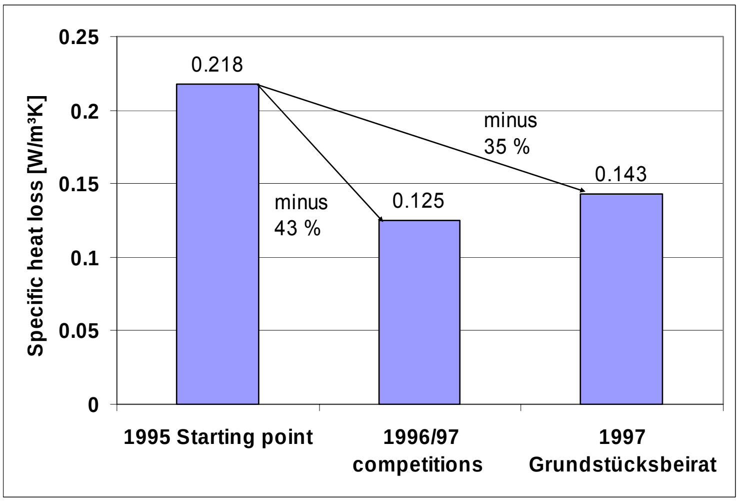


Figure 8: Development of volume specific heat loss of buildings in Vienna (Energieverwertungsagentur, 1997)



7.4 Austrian activities related to the European “Energy Performance of Buildings Directive” (EPBD)

The work related to the EPBD is happening on different levels in Austria:

On the one hand the OIB (Austrian Institute for Building Technology) is expanding the calculation method for the space heating energy demand to the efficiency of heating devices and heat distribution systems in order to nationally fulfil the EPBD.

On the other hand the national standardization bodies are acting within the European standardization network CEN in order to adapt or develop new standards for the implementation on the EPBD. Many CEN Standards have to be improved or newly built (like cooling energy demand of buildings). The national Austrian standardization groups related to buildings are testing the current approaches of the new or revised standards for their Austrian applicability and evaluate specific national figures that are left open by CEN.

8 Building Related Research Programs in Austria

Starting in the 1970[ies] building related research was performed in a program of the Federal Austrian Ministry of Economic Affairs. This program supported building related research without specified focus. In 1988 this program stopped and the building research money was shifted to the Austrian provinces. This nearly stopped the activities on building related research except in Vienna and Lower Austria (Amann, 1998). Fortunately after 1988 research related to energy efficient buildings was supported in research framework programmes of the European Union.

In 1999 a new Austrian research program "Nachhaltig Wirtschaften" ("Technologies for Sustainable Development", http://www.nachhaltigwirtschaften.at/programme/index.html) was launched by the Austrian Ministry of Transportation, Innovation, and Technology. It is a 5 year research and development program and initiates and supports trendsetting research and development projects and the implementation of exemplary pilot projects.

The program pursues clearly defined emphases, selects projects by means of tendering procedures and is characterized by networking between individual research projects and by accompanying project management. The Ministry invites tenders in three subprograms.

- Building of Tomorrow (http://www.hausderzukunft.at/)
- Energy Systems of Tomorrow (http://energiesystemederzukunft.at/english.htm)
- Factory of Tomorrow (http://fabrikderzukunft.at/english.htm)

The "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 method. For the purposes of the "Building of Tomorrow" subprogram, these energy centred innovations are expanded to take in ecological, economical and social concerns (see graphic).

The "Buildings of Tomorrow" are residential and office buildings, and differ from current building 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
- increased consideration of user needs and services.
- However, the costs are comparable with conventional building methods

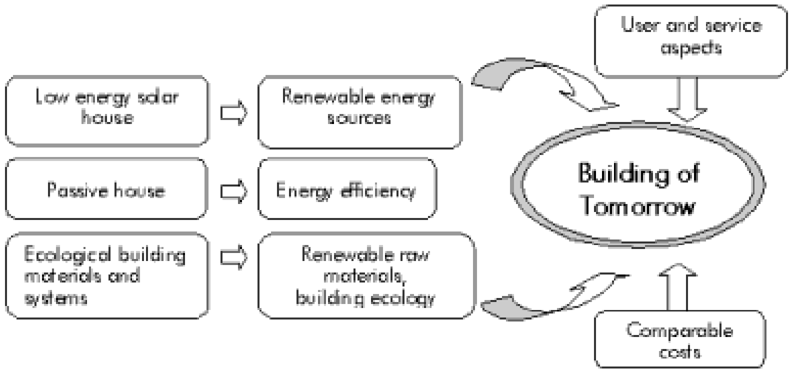
The subprogram's goal is the development and market diffusion of components, prefabricated building parts and building methods which correspond to the above criteria and to the main principles of sustainable development.

Combining all of these demands is very challenging. Conflicts of aims can arise which need somehow to be reconciled. On the other hand, when social, economic and ecological aims can be integrated, the chances of success for the concept are vast. The key to realising this goal lies in innovation - not only technological but social, technological and institutional innovation.

It is precisely in the combination of all these criteria that the chance arises to make technological leaps which actually have a high market potential (see Figure 9).

After careful consideration of over-development of the countryside, land use and mobility demands, priority has been given to multiple dwellings, rather than single family homes.

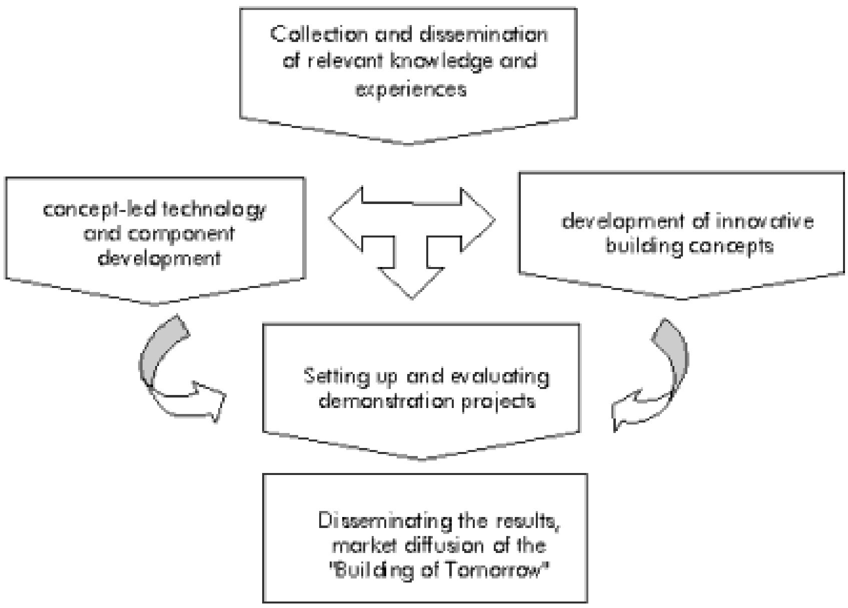
Figure 9 Elements of the research program “Building of Tomorrow” (http://www.hausderzukunft.at/)



The "Building of Tomorrow" subprogram has a planned duration of five years. It comprises the following elements, which build on each other logically (see also Figure 10).

- Generation, preparation and dissemination of know-how in order to support the technology development process in a way that focuses on the project's aims
- Concept-led technology and component development
- Development of innovative building concepts for residential and office buildings
- Setting up and evaluating demonstration projects
- Market diffusion of the "Buildings of tomorrow"

Figure 10: Logical structure of the research program “Building of Tomorrow” (http://www.hausderzukunft.at/)



Different types of research projects were defined:

- Basic research like social or technical studies, build up of ecological evaluation procedures and tools, knowledge dissemination structures (100 % funding)
- Company related basic research (max 75 % funding, rest industry partner)
- Product related research (max. 50 % funding, rest industry partners)
- Additional planning costs for innovative new low energy buildings or energetical renovation (100 % funding)
- Additional investment costs for innovative low energy demonstration buildings (max 50 % funding)

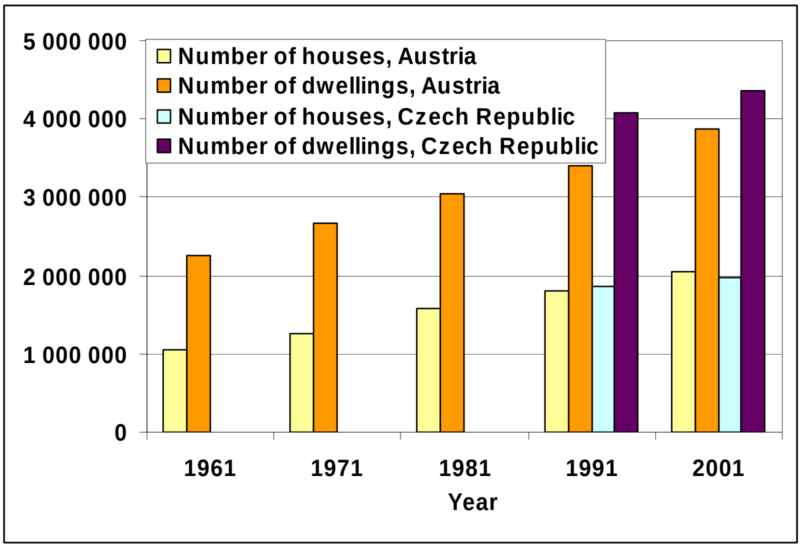
Within this frame 487 proposals have been submitted so far and 150 of them were financed. All reports can be downloaded at http://www.hausderzukunft.at/.

This programs ends 2005. Currently there is a discussion in Austria about a follow up research program.

9 Conclusions and Recommendations

Housing and dwelling stock is about the same size in Austria and the Czech Republic (4,3 Million dwellings in the Czech Republic and 3.8 million dwellings in Austria).

Figure 11: Comparison of housing and dwelling stock in Austria and the Czech Republic"



The comparative analysis of the present state of the housing sectors in both countries shows shown many similarities but also differences in technical state (and energy performance) of the existing as well as new residential buildings, thermal-technical standards, and type and volume of support provided to improve their energy efficiency.

The main conclusions are summoned in the following:

- As for the technical state - Old buildings are generally in a better condition in Austria than in the Czech Republic (CR) with a long history of flats made with precast concrete slabs. The present technical state of the large majority of apartment buildings in the CR which were constructed using prefabricated technology is either due to the low quality of materials, construction works carried out and consequently a long-time neglected maintenance very bad; therefore practically all the Czech state support provided to housing renovations is focused only on this part of the housing stock.

  Regarding new buildings, they have in both countries, due to the improved building material, applied technologies and, subsequently, building codes which set for stricter thermal-technical requirements requiring thus to apply better insulation, far better energy parameters than old ones. But financial incentives, and public awareness in Austria, and especially in some provinces such as Salzburg, have such a strong influence that the average heat consumption level of new housing construction is as much as 50% lower than the average level which is found by new residential buildings constructed in the CR presently (and by current standards also required).

- As for the current standards – Both Austrian and Czech Energy thermal-technical requirements for new as well as renovated buildings are being very similar due to the gradual harmonisation of technical standards according to the EU's CEN standarddization. The biggest difference is in their scope. While in the CR these technical requirements are defined and applied on a national level, in Austria this is done by provinces individually. Both countries then have also the methodology developed for the evaluation of the energy performance of buildings (in the CR this method has been introduced by a recent energy legislation on energy management, in Austria several provinces developed and applied their proprietary variants, with one common calculation methodology of the space heating energy demand accepted by all provinces developed by the OIB; this methodology has been in 2004 newly extended to cover also the energy efficiency of a heat source and a heating system).

- As for the subsidy schemes – Support provided to improve energy efficiency is both in the volume and extent much more comprehensive in Austria. There, the state respectively provinces provide subsidies not only for thermal renovation of existing buildings but also for (low-energy) new housing construction and in some provinces also for the use of renewable sources of energy. The difference in the amount of support provided in Austria and the CR is also very significant (several billions of Euros in Austria opposed to several tens of millions in the CR). The reason is not only a much more limited financial budget of the Czech public sector but obviously also policy priorities.

These valuable findings set for a good starting point for common future co-operation, namely in these areas:

- In the implementation of the European "Energy Performance of Building Directive" (EPBD) - the implementation of the EPBD on national level has to be finished by January 2006 no matter if CEN Standards are available or not. That gives the opportunity for a common cooperation - a joint project between Austria and the Czech Republic would be useful in this field; in Austria the national calculation algorithms are already under development (in close contact to the work being performed in CEN), thus, the Austrian experience gained so far could be made use of and further jointly developed by the co-operation between respective bodies of the Czech and Austrian state administration responsible for the implementation of this directive into national legislation.

- Renovation of buildings is a key issue to reduce the energy demand for the building sector. In the Czech Republic many buildings have been made with precast concrete slabs using only a few different construction schemes. These buildings could be renovated easily by finding th appropriate and cheap renovation schemes. In Austria the situation is different, because many different constructions exist. A joint project in developiong energy saving and cheap construction schemes which additionally increase the thermal comfort in buildings would be very desirable.

- Another important area of future cooperation can be new housing construction – as it has been identified residential buildings presently constructed in the CR have as much as two times higher energy demand (per unit of floor area) than those being built now in Austria. Such a decrease in energy consumption can be practically achieved without increased investment costs (as it has been proved by the Low-Energy Low-Cost Buildings Project).

- Austria then also supports research and development of so-called "buildings of tomorrow", which will accomplish the sustainable development in human settlements. Such a research activity has not started in the CR yet. However, the CR has also sufficient knowledge base to launch a similar research project. Strengthening of the Czech research in energy efficient buildings for sustainable future is highly recommended . The cooperation between Czech and Austrian research institutions in this field might accelerate such an approach in the CR as well.

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