Austria: Social housing providers at the forefront of energy efficiency

Wolfgang Amann, Alexis Mundt and Walter Hüttler[1]

1 OVERVIEW OF NATIONAL ENERGY POLICY AND NATIONAL CLIMATE CONDITIONS

1.1 *Climate conditions*

The Austrian climate is continental. Cold winters alternate with moderate and rainy summers, but there are large differences between the western regions, mainly dominated by the Alps, and the flatter eastern part of the country, with Vienna at 210m above the sea level. The average temperature lies slightly below 0°C in January and reaches 20°C in July. In the Western parts snow is frequent during the winter months; in Vienna snow is less common. Summer months in Vienna and other low-lying cities can get hot with around 10 days per year above 30°C. Yet, air conditioning in the residential building stock is not very common. The climate in Vienna is influenced by the Pannonian Plains and often windy. The average yearly rainfall in Vienna and other Eastern regions clearly lies below the national average of 660mm.

1.2 National energy policy

Austria's official Energy Strategy is influenced by EU-wide goals (e.g. the 20-20-20 targets). The security of the energy supply and crisis provision is to be enhanced by focusing on renewable energy (hydro power including pump storage, wind power, biomass and photovoltaic) and by aiming at cost effectiveness (e.g. district heating and cooling, diversification of supply sources and routes, gas storage, smart metering etc.). Furthermore energy efficiency is to be improved at all stages of the provision and energy use. The share of renewable energy in gross final energy consumption is to increase from 29% (2008) to 35% in 2020 (Energiestrategie Österreich, 2010). These long-term goals seem very ambitious, as Austria is lagging behind in reaching the Kyoto goals.

The national goal lies on the stabilization of final energy consumption until 2020 at the 2005 level of 1,100 PJ. Some 28% of final energy consumption go to space heating and cooling as well as water heating, mostly in private households. Space heating, the single most important factor in energy consumption by households, is mainly done by natural gas (27% of households), oil (23%), wood and wood chips, pellets, etc. (21%), district heat (21%) and electricity (7%) (data from Statistics Austria, 2008). In recent years there is a clear trend away from coal and gas and towards renewable energy sources, automated heating systems and district heating. Final energy consumption in the buildings sector ought to decrease until 2020 to 10% below the 2005 level, i.e. to 303 PJ.

1.3 National energy policy regarding housing

In the sector of residential buildings, energy goals are to be reached by stipulations on the energy efficiency of new construction, by the introduction of the Energy Performance Certificate according to

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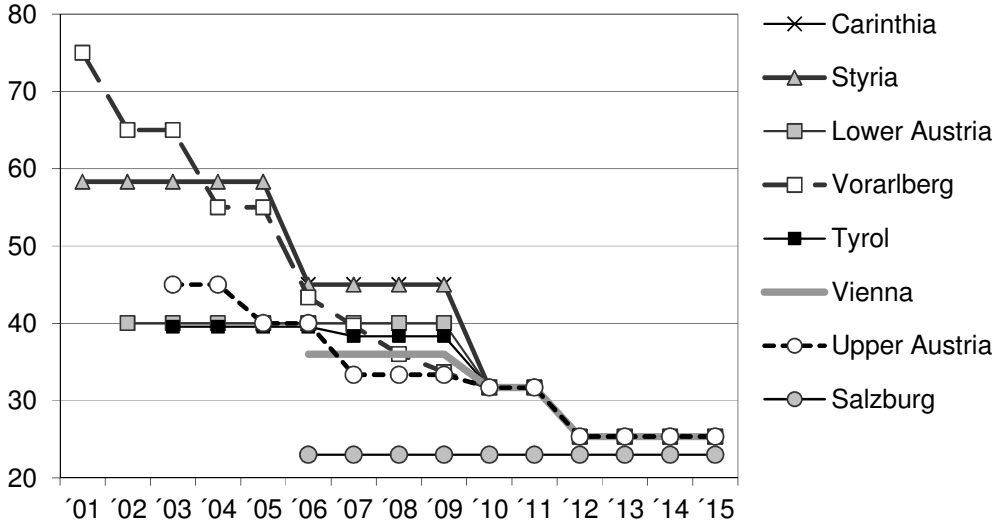
EU law (and its transformation into Austrian law by the Guideline 6 (dated April 6, 2007) of the Austrian Institute of Construction Engineering (*Österreichisches Institut für Bautechnik* - OIB), the increase in comprehensive thermal refurbishments, passive house standards in new construction and the enforcement of new heating systems (including photovoltaic energy).

In order to reach the 2020 goal of a reduction of final energy consumption in the buildings sector, the refurbishment rate of current 1% of the existing stock is bound to increase to 3%. This goal is to be achieved by a restructuring of the regional housing subsidies (see below).

Good energy performance in new construction is guaranteed by the maximally permissible annual thermal heat demand per square meter in the building codes of the regions, and, more ambitiously, by the stipulations on energy performance within the regional housing subsidy laws. Since a large part of new constructions makes use of these regional subsidies (see below) the limits on thermal heat demand function as a strong incentive. The minimum standards for new construction have been tightened severely in the last decade (see Figure X.1) and are designed to converge at the limit of 25 kWh/m²/year heating demand from 2012.

Figure 1 Heating demand minimal standards in new construction according to subsidy laws



Source: Amann *et al.*, 2011

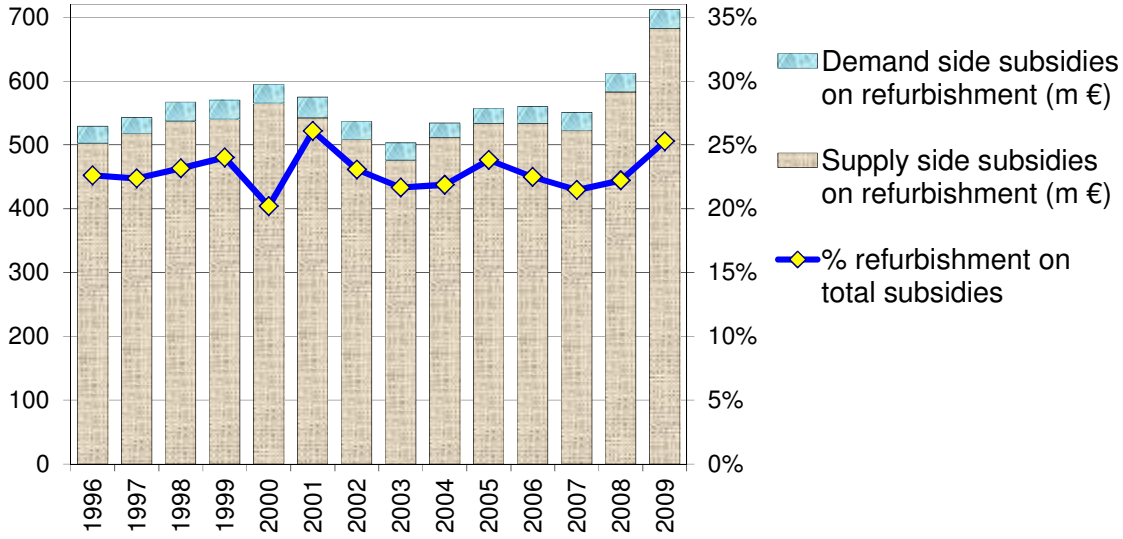
In addition to these minimum requirements, subsidy laws are designed according to a point-system providing additional finance for single measures that increase the energy efficiency above the minimum requirements. In all regions the maximum subsidies are granted for passive-house projects (below 15 or 10 kWh/m²/year according to regional laws).

Direct housing policy expenses in Austria lie within the responsibility of the nine regions. Until recently, founding was provided through the federal budget with earmarking of funds for housing policy measures. Since 2009, when the earmarking of funds was lifted, the regions themselves may decide on the funds allocated to housing policy out of their own budgets. All of the nine regions dedicate a large part of their funds to housing policy measures and, nowadays in contrast to most European countries, with a strong focus on direct supply-side subsidies to new construction in the form of loans or annuity subsidies. Yet, the share each region devotes to new construction, refurbishment subsidies and demand-side subsidies

varies considerably. Recently, the share of demand-side subsidies (mostly in the form of housing benefits) within the housing policy expenses has increased strongly in some regions. Supply-side housing subsidies have traditionally been used as a stimulant to aggregate demand and, as such, as a decided instrument of fiscal policy (Czerny & Weingärtler, 2005 and 2007; Amann, 2010).

Altogether, the nine Austrian regions spent € 2.82 billion on direct housing policy in 2009. This is around 1% of GDP. Some 49% of these expenses are directed to new multi-storey construction in the form of "social housing" (see below), some 13% are direct subsidies of individuals constructing single-family houses for themselves, some 14% are demand-side subsidies in the form of housing benefits, and some 24% are direct refurbishment subsidies (figure 2).

Figure 2 Expenses for refurbishment subsidies within Austrian direct housing policy expenses



Source: Amann *et al.*, 2011

After years of stagnation, refurbishment subsidies soared strongly between 2008 and 2009 with expenses rising by € 100 million (+16%) to in sum € 712 million. The fraction of refurbishment subsidies (supply-side and some demand-side) rose to 25% of all housing policy expenses, an increase by 3 percent points in just one year. The strong increase in refurbishment subsidies within the regional budgets in 2009 can be attributed to the federal initiative of the refurbishment voucher. Out of the federal budget a special voucher for refurbishment measures was granted in addition to regional refurbishment subsidies. The subsidy was granted in form of a non-repayable grant of 20% of eligible refurbishment expenses up to a limit of € 5,000 and was used mainly in the private single-family housing stock. There were approximately 14,000 cases with a total subsidy volume of € 61 million, motivating a total investment of € 485 million or around € 33,000 per refurbishment (Schleicher & Karner, 2010). Thus, by making use of comparatively moderate subsidies, the refurbishment quota within the single-family housing stock could be leveraged above the long-term mean of 1%. The federal refurbishment voucher has been relaunched in a similar manner from 2011 to 2013, after it was cancelled in 2010 due to budgetary considerations.

Even if the details of the subsidy laws differ considerably among the nine regions, all of them provide subsidies to small-scale refurbishment measures as well as to comprehensive thermal refurbishments of buildings (Lugger & Amann, 2007; FGW, 2009; Amann, 2010). The latter are defined as concomitant renovation works of the building shell and/or the building technologies (HVAC, lighting, electrical

applications, control systems) provided that at least three of the following outer building surfaces and building technologies are renewed or thoroughly refurbished: windows, roof or up-most ceilings, façades, basement ceiling, energetically relevant building technologies (mostly energy efficient heating systems). In short: at least three thermally relevant renovation measures have to be conducted.

Very recently, the stipulations on comprehensive thermal refurbishments were tightened, but at the same time subsidies were increased (Amann, 2009; Amann *et al.*, 2006; Köppl *et al.*, 2008). The impetus behind this development was an agreement in fall 2008 between the federal state and the regional governments to enhance the incentives to energy efficiency within the residential housing stock and to reduce CO_2 emissions (Art. 15a B-VG-Vereinbarung, 2008).

Even though this agreement has led to some unification of the regional subsidy requirements on refurbishment measures, the regions still apply very different instruments (long-term loans, annuity subsidies to capital market loans, grants, demand-side housing benefit in case of increased user costs due to renovation works) (Amann, 2009; Köppl *et al.*, 2010). Mostly these subsidies are object-based and, in comparison to new construction subsidies, do not stipulate income limits of beneficiaries. In order to activate household capital reserves in the area of single-family houses, refurbishment subsidies are often designed as non-refundable grants rather than re-payable long-term loans. Only a small part of refurbishment subsidies are income-dependent and classified as demand-side, usually in the form of increased housing benefits after eligible renovation works.

Generous refurbishment subsidies are available at the regional level for renovation works that yield an energy efficiency of passive houses (below 15 or 10 kWh/m²/year according to regional laws). In practice these high-tech refurbishments are still only carried out in some prestigious pilot projects.

2 ENERGY EFFICIENCY IN THE SOCIAL HOUSING SECTOR

2.1 Sector characteristics

In Austria as a whole, the number of dwellings (main residences) in 2009 according to micro census data was 3.6 million. Out of these some 45% are single-family houses, the rest are dwellings in apartment buildings.: approx. 11% are owner-occupied apartments, approx. 40% are rental apartments, the remaining are other tenures. The Austrian social housing stock is managed by municipalities and Limited-Profit Housing Associations (LPHA). This sector includes 22% of all dwellings in Austria. This is approximately 10 percent points above EU-15 average. According to tenure in a European context, Austria is very close to Sweden and Denmark.

When applying the traditional definition of social housing according to cost-basing of rent levels (and therefore below-market rents) and of restricted accessibility according to need (income limits) and therefore focussing on LPHA and municipal rental stock as social housing, it is important to bear in mind that a much larger part of the housing stock was co-financed by the public and may be considered subsidized housing. Unlike many other European countries, Austria still co-finances a large part of new construction partly out of housing subsidies, which are, for most builders, an indispensable part of financing. This is the case for private individuals who build their own homes, as well as for LPHAs, commercial developers and municipalities. This explains the very high 80% of housing starts that receive some kind of subsidy. Especially owner-occupied houses and LPHA-built owner-occupied

apartments received large amounts of subsidies. In some regions (e.g. Vienna) there are also subsidized rental apartments by commercial builders.

There are strong regional and local differences in this division of the Austrian housing stock: The nationally high percentage of social rental dwellings is due to the importance of Vienna, where 40% of the stock may be classified as such. In other regions, especially where single-family houses are predominant, social rental dwellings represent a much lower share of the overall housing stock. Nevertheless, social rental housing represents a predominant share of all dwellings in multi-storey buildings and in the rental stock in all regions (Mundt & Amann, 2010).

For the question of energy efficiency in the housing stock, it should be considered that LPHAs manage a larger stock than their own social rental apartments (owner-occupied subsidised apartments and terraced houses built by LPHA, some of the municipal housing stock). Altogether LPHAs manage some 815.000 dwellings. The municipal housing stock in Austria mainly belongs to the municipality of Vienna, i.e. some 220.000 dwellings.

In 2009 there were 191 active LPHAs in Austria, differing in their legal status and owner constellation. There were 99 co-operatives and 92 limited-profit companies, set-up either as private limited or as joint-stock companies. Co-operatives are owned jointly by their members while the limited-profit companies are owned by local or regional public bodies, charity or religious organisations, trade unions, political parties, the financial sector or private persons. Apart from the ownership structures, there are only minor differences in legal status, since all LPHAs are regulated by the same law, the 'Limited-profit Housing Act' (*Wohnungsgemeinnützigkeitsgesetz*) of 1979, are embedded in the same supervisory structure and are represented by the same umbrella organisation GBV. To international standards, Austrian LPHAs are rather large, with on average over 4,000 managed dwellings per provider.

There is an obvious trend towards owner-occupation in many European countries with an increased promotion of this type of tenure also to households of limited income. This development goes hand in hand with the rental sector losing importance and accounting for a constantly decreasing share in new construction. In Austria, on the other hand, social rental housing construction gained importance over the last decades and the supply of social housing has increased, especially because LPHA are predominant in new construction in the multi-storey stock (Deutsch 2009, p. 292). While in the 1970s LPHA housing only represented around 20% of housing output, with more than 30% it now forms a high proportion of total new construction. That is more than half of all multi-storey housing construction. During the economic crisis, LPHA housing construction clearly functioned as a stabiliser against rapidly dropping private and commercial housing starts. In 2009 the number of new dwellings by LPHA was 15.600.

All LPHA activity is governed by the Limited-Profit Housing Act and supplementary by-laws which are a federal state responsibility. By international comparison it is a very tight and detailed law: it determines very clearly what LPHA can do, and what they cannot do. LPHA have to focus on housing construction, refurbishment and housing management. In fact, it is a strong incentive for high construction quality and social balance that housing associations also function as long-term managers of their stocks.

There is a very tight system of control over LPHA activities and expenses: a supervisory board is mandatory for every LPHA. Additionally, all LPHA have to join the umbrella organisation (GBV), which incorporates the Audit Association (*Revisionsverband*) responsible for the annual auditing. In addition to the general auditing procedures, the Audit Association examines whether the provisions of the Limited-Profit Housing Act are observed, in particular, the calculation of rents and the principle of tie-up of property, which stipulates that all surpluses from LPHAs' activities have to be reinvested in new housing construction or refurbishment measures. The auditor's report has to be made public also to the general assembly of housing co-operatives and must be presented to the supervisory authority, i.e. the regional governments. These have a number of possible sanctions, such as the withdrawal of public subsidies or the withdrawal of the LPHA status.

FINANCING

In addition to the Limited-Profit Housing Act of the federal state level, since the devolution of responsibility for housing promotion from the federal state to the nine regions in the late 1980s, subsidies and requirements to LPHAs (quality and ecological standards, income-limits of future residents) are determined by nine different regional housing subsidy laws.

These laws set up special social housing financing arrangements, mainly focussing on supply-side loans or annuity grants. Land purchases in some regions have to be financed out of the LPHAs' own equity. Capital contributions by future tenants play an increasingly important role in financing. These funds are used for the purchase of building land or for construction costs and, through the principle of cost rents, help to keep future monthly costs of tenants low. These capital contributions can be rather high in some regions, especially in Vienna, and therefore are sometimes supported by individual household loans in order not to hamper accessibility to the social housing stock.

Other financing sources of LPHA activities are the funds made available by special housing banks (Amann, Lawson & Mundt, 2010; Lawson & Milligan 2007), which themselves accrue finance by saving incentives to households in the form of housing construction convertible bonds that are partly exempted from capital gains tax. Via the housing banks, capital market funding plays a major role in social housing finance in Austria. LPHA also receive funds from the "Bausparkassen", which are mainly a loan-savings collective for retail housing loans, but also fund LPHA housing projects. LPHAs enjoy a very favourable rating on the capital market due to ownership structures, the tight system of audit and control and the implicit public guarantees out of the importance of public funds within the financing structure.

Any profits made by the LPHA have to be reinvested either in the purchase of land, or in refurbishment and new construction (tie-up of assets principle). Interests paid on own equity to the owners and shareholders is limited (2011: 3.5%). Therefore most of their own equity is bound in the housing stock.

SALES

Since the mid-1990's, new subsidized rental construction carried out by LPHAs is endowed with a right-to-buy. After a period of 10 years, tenants of these new-built apartments have a 5 year time-frame to exercise their right-to-buy. Until now only relatively few households used this possibility. It is estimated that only 20% of the eligible rental stock (i.e. part of new construction since mid-1990's) will be bought by tenants (Mundt *et al.*, 2009). Prices for these dwellings do not have to be strictly cost-

based but may get close to market prices. For some LPHA this is an opportunity to increase their equity, which, according to the Limited-Profit Housing Act, has to be reinvested in new construction. There is a tendency that the right-to-buy will be exercised mainly by better-off tenants and for very high-quality apartments, contributing to a residualisation of the remaining housing stock.

ALLOCATION

Income-limits are dependent on household composition and vary according to the nine regional housing subsidy laws. For a two-person household they range from € 43,500 net income per year (Salzburg) to € 58,000 (Vienna). The limits are very high in an international comparison and are only checked when moving in. Future income developments are not taken into account. In some municipalities, income limits to the municipal housing stock are slightly lower than to the LPHA housing stock. The allocation of apartments is carried out according to waiting lists. Certain types of households or housing situations (single-parents, disabilities, overcrowded, etc.) receive preferential treatment, but this varies across municipalities. The allocation is usually done by the LPHA. Municipal administrations however have allocation rights to some shares of the LPHA housing stock. In Vienna, for example, half of new-built social apartments and one third of re-let social apartments are allocated by a special municipal housing agency. Foreigners not from EU countries were not granted access to the social housing stock for a long time, but after the implementation of EU anti-discrimination directives, nowadays, long-term (5 years and more) residents receive equal treatment. To our knowledge there is no broad documentation of allocation practices varying across LPHA and municipalities.

RENT SETTING

Rents in the LPHA housing stock are basically determined by historic costs on a strictly estate based level. There is no rent-pooling at LPHA level. Due to long term regional subsidies, financing costs and therefore cost-rents are low. A special mark-up for periodic renovation and maintenance works is considered (see below), maintenance fees cover the running costs.

Once regional subsidies are paid back (average 35 years) for certain buildings, LPHA are allowed to collect rents that are subject to a maximum limit (2011: 3.13 €/m²). There are income-dependent housing benefits available to social renters in all regions if the cost-rents surpass the reasonable housing expenses varying with household income (Mundt & Amann, 2009).

2.2 Portfolio and asset management

The Limited-Profit Housing Act is considered amongst experts to be very favourable towards refurbishments (Weiler, 2008, p. 363). This is due to the fact that expenses for refurbishment measures are collected within the cost-rent scheme as a mark-up on cost-rents on a long-term basis: in addition to the cost-rents and maintenance fees for running expenses, social housing renters are charged the so-called *Erhaltungs- und Verbesserungsbeitrag* (EVB), which is a fee for periodic renovations or improvement works. The EVB is an estate-based fund and varies according to the building's age. The complex methods of calculation are specified in the Limited-Profit Housing Act (§14 par. 2) and the concomitant ordinances. The base-rate stands at 0.39 €/m² per month at the moment, but increases to 1.54 €/m² per month for buildings older than 20 years.

In addition, if the collected funds do not suffice for comprehensive refurbishment measures and if the need for these measures is confirmed by a court decision, the legal framework opens the possibility to collect an increased EVB (called EVB II) for a limited period of time. LPHAs also have the option to apply an out-of-house contracting scheme for refurbishment measures. The energy costs saved due to these measures may then be included in the running maintenance fees charged to the renters for a limited period of 10 years.

These self-sustained funds are supplemented by subsidies as described above. Up to now, refurbishment measures have however been largely financed out of the base-rate EVB and additional regional refurbishment subsidies (see above). The EVB II and the contracting scheme have hardly been applied (Weiler, 2008, p. 366). For the future, the tightened stipulations on energy efficiency in the building codes that were motivated by the EU buildings directive and the implementing Austrian laws (OIB guidelines) are supposed to overburden the current EVB-scheme and make the collection of additional funds inevitable (Amann *et al.*, 2010, p. 58).

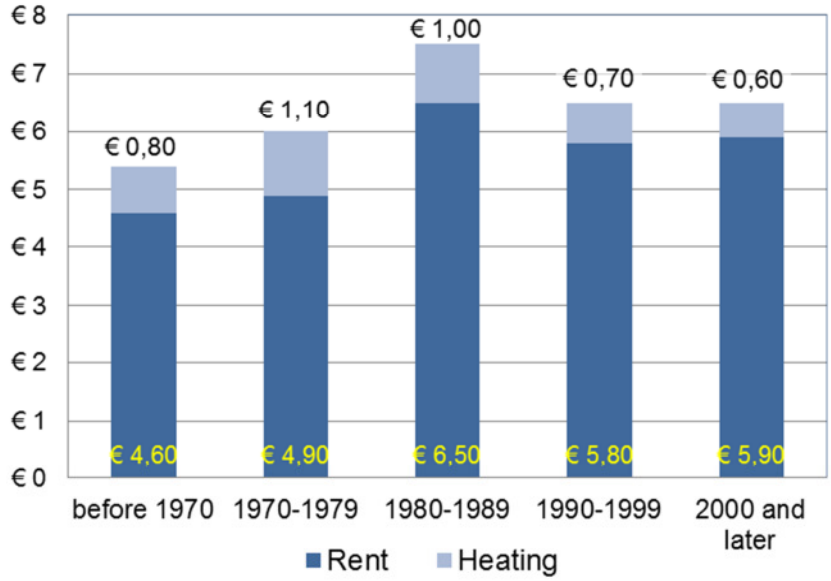
The LPHA sector is strongly committed on high standards in refurbishment for several reasons. It has access to a comprehensive financing scheme that allows for regular and quite ambitious refurbishment measures. Legal regulations fit well to practical needs of refurbishment, both in terms of asset management, funding and enforcement. Within the legal framework LPHA are fully autonomous in management of their assets. The LPHA sector acts similarly as investor, developer and housing manager. For this reason a long term perspective in asset management takes place. Investment decisions in new construction and refurbishment are taken not only for reasons of return on investment, but primarily considering retention of property value, smooth maintenance and – as a matter of course for social landlords – social sustainability.

2.3 Energy efficiency in housing management in the sector

Energy efficiency has for several reasons a high significance in everyday practice of LPHA rental housing management and maintenance. Due to the mechanisms described above, LPHA housing maintenance is better funded than all other sectors of the housing stock. Neither the private rental nor the owner-occupied sector have similar financial and legal tools to enforce energy efficiency measures (Komendantova & Amann, 2007; Amann & Weiler, 2009). Additionally, the LPHA sector has a specific relation to the regional governments as their ultimate controlling authority and because of their dependency on housing subsidies. These are strong incentives to implement housing policy goals quite immediately.

Emphasis on energy efficiency in housing construction goes back to the 1970's when the government started incentives to the LPHA sector to improve the thermal quality of construction. As seen in Figure X.3, this had immediate consequences for the heating costs of tenants. Tenants in the LPHA housing stock of the 1970s have to pay around 1.10 €/m² per month for heating and warm water, tenants in new buildings only half the amount.

Figure 3 Rents* and heating costs in the LPHA stock according to building's age



* Rents = gross rents (incl. maintenance, management, reserve funds, taxes etc.) without energy
Source: IIBW survey 2009, n = 3,500 dwellings.

Political significance of energy efficiency in the housing sector rose considerably in the early 2000s when the Kyoto treaty started to become effective (the Kyoto Protocol from 1997 was ratified by the Austrian Parliament in 2002). Besides financial incentives and obligatory regulations, awareness was effectively raised by several research, technology and dissemination programmes, launched by the federal government, such as ´Building of Tomorrow´ (*Haus der Zukunft*) or ´Climate active´ (*Klima:aktiv*). The paradigm shift from conventional construction over low energy standard to passive house standard was driven by financial tools, awareness building, proof of feasibility with several pilot projects. Legal obligations played only a minor role. Today already close to 10,000 dwellings in passive house standard have been built, most of which by the LPHA sector. With this number, Austria is an international front-runner in this new technology. One region (Vorarlberg) has made passive house standard even obligatory for social housing construction. Federal documents, particularly Austria's Energy Strategy (2010), have defined a short transition period for nationwide application of passive house standard in social housing construction.

In this way, the LPHA sector could gain extensive experience on consumers' reaction on passive house techniques. As a matter of fact, there was quite some reluctance against the new technology only a few years ago. There were doubts, whether tenants would accept apartments without heating, whether heat-recovery ventilation would be sufficiently consumer friendly, whether it would be possible to change consumer behaviour. Current projects show that the new technology may be implemented with a low profile and simple operating controls. All technological innovations work in the background; tenants hardly feel a difference to conventional buildings. Today, all bigger LPHA and a growing number of commercial developers have realised projects in passive house standard with altogether positive results in customer relations (Belazzi *et al.*, 2011).

It is currently debated whether the EU discourse of "nearly zero energy standard" (recast of the Energy Performance of Buildings Directive from 2009), which is regarded less ambitious than passive house standard, should be applied instead of passive house standard. It is still not entirely clear in which way "nearly zero energy" should be implemented into national legislation.

Low energy and even nearly zero energy standard is emerging even in rehabilitation ("factor 10-refurbishment", see below). In many cases, however, the old stock lags behind not only in thermal standards, but also regarding accessibility for disabled, sound insulation and planning typology. Taking costs for such refurbishments to be close to half the costs of new construction, the rationale seems debatable.

But there is no real alternative to rehabilitation in Austrian housing legislation, since reconstruction is almost impossible to enforce (Hüttler, 2008a and b): condominiums would require unanimous consent for demolition and new construction, which is practically impossible to obtain. But also in private rental housing and social housing tenancy rights prohibit reconstruction.

3 CASE STUDIES

The following case studies represent innovative approaches of high quality refurbishment based on different models of housing management:

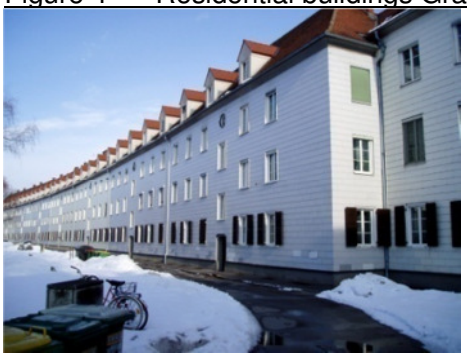
The first project was carried out by the limited profit housing association GIWOG which is one of the leading innovative companies within this sector. As one of the big LPHA's in Austria, GIWOG is currently managing about 33.000 dwellings located in five of the nine Austrian provinces. Already in the late 1980s GIWOG launched a comprehensive refurbishment program aiming at energetic improvement and and up to date standard for the large stock of buildings from the 1950s and 1960s. The company was among the first LPHA's in Austria applying passive house standard in a newly built multi-apartment building (Solar City in Linz in 2004) and was definitely the first company applying passive house standard within a comprehensive refurbishment project (Makartstraße in Linz in 2006).

The second project represents a typical business model in the private real estate sector applied in historical buildings from the late 19th and early 20th century. It is presented in the context of social housing as a showcase for the policy strategy to rely not only to the LPHA sector and the public housing sector for achieving social targeting and ecological sustainability in housing provision, but also to the commercial housing sector. The extension of the attic serves as the major financing source, whereas subsidies from the provincial government play a minor role. Ulreich Bauträger is one of the most ambitious private real estate developers within this sector, carrying out high quality and innovative refurbishment projects year after year, mainly focussing on buildings from the so called "Gründerzeit". Ulreich is not only property developer but is also providing property managemt in order to secure a high quality facility management including energy efficient management of HVAC-equipment. As a comparatively small company Ulreich Bauträger together with and Gassner & Partner as general planner is carrying out about two refurbishment projects per year.

3.1 Refurbishment of Residential Area Dieselweg, Graz

The comprehensive refurbishment in the residential area Dieselweg in the 7th district (Liebenau) of Graz, the 2nd biggest city in Austria, is considered to be a showcase project of successful renovation of aged social housing stock to passive house standard. It comprises five buildings (numbers 4, 6, 8, 12 and 14) and one long building row (numbers 3-19). The residential houses were built between 1950 and 1968 in order to provide accommodation for workers of the at that time Austrian manufacturing company Puch (cars, motor-bikes, bicycles).

Figure 4 Residential buildings Graz, Dieselweg, situation in 2008 before renovation


Dieselweg 3-19 (year of construction 1950)


Dieselweg 4,6,8 (year of construction 1958)


Dieselweg 12, 14 (year of construction 1968)

Photos: GIWOG

Currently, the buildings are owned by GIWOG, a limited-profit housing association founded in 1947. In cooperation with the 'Building of Tomorrow' initiative (mentioned in the previous section) the buildings were refurbished by using precast façade devices. Refurbishment subsidies and additional funding was provided by the regional government of Styria. The main objectives of this renovation project were:

- reduction of the heating demand and CO_2-emissions by about 90%;
- essential reduction of costs for heating and hot water;
- significant improvement of indoor air quality and comfort for tenants;
- improvement of outdoor environment quality by reduction of particulate matter emissions.

The refurbishment project was implemented in 2008 and completed in 2009, comprising a total useable floor space of about 10,000 m². The whole estate was in more or less original state until 2008, which means: no insulation of exterior walls, floor and roof, urgent need for renovation of the windows, heat supply for the apartments based on solid fuels, oil or electricity and consequently, low comfort and high operating costs.

Figure 5 Basic data and characteristics of the refurbishment project Graz, Dieselweg

	4, 6, 8	12, 14	3-19
Year of construction	1958	1968	1950
Number of apartments	204		
Floor area	appr. 10.000m²		
Start of renovation	2008		
Completion of renovation	2009		
Heating demand before renovation [kWh/ m²/year]	184	225	142
Heating demand after renovation [kWh/ m²/year]	9,6	9,6	13,6

Source: GIWOG

Basically, reducing energy demand, running costs and emissions are the most important aspects when refurbishing a building. Having accomplished these general principles, the introduction of a solar thermal energy system and consequently the use of solar thermal energy is the next logical step. Further improvements were applied, like single-room ventilation devices with heat recovery and a centralized heating system.

Figure 6 Refurbishment project Graz, Dieselweg 3-19 partly completed (October 2009)

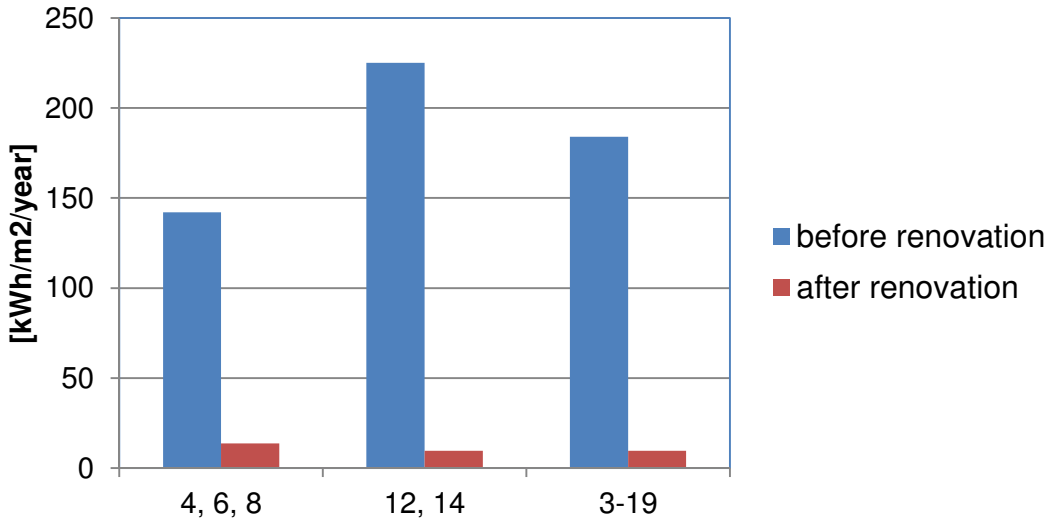
Photo: Hüttler, e7

Figure 7 Refurbishment project Graz, Dieselweg 12 and 14 with solar thermal collectors already installed (October 2009)

Photo: Hüttler, e7

One of the main features of this refurbishment project was the façade solution consisting of the existing wall (300mm), the compensation and equalization plane (100mm rock wool) and the pre-fabricated façade model consisting of 18mm OSB board, 120mm rock wool, 15mm MDF board, 30mm solar comb, 29mm rear ventilation and 6mm safety glass. Due to the dynamic effect of the solar comb the U-value of the whole construction is between 0,02 and 0,12 W/m²K. As a consequence the energy performance of the buildings is now on passive house standard resulting in energy heat demands between 10 and 14 kWh/m²/year. The initial energy heat demand could be reduced by a factor of 10 to 20.

Figure 8 Heating demand Dieselweg before and after renovation



Source: GIWOG

As further key element the apartments were re-equipped with decentralized mechanical ventilation, i.e. single room fans with heat recovery. The air ducts for supply and exhausted air are integrated into the new prefabricated façade modules.

Finally, the heating and hot water system was complemented with 3 m² solar thermal collector area per apartment, one central heat storage per house and groundwater to water heat pumps.

The use of pre-fabricated façade modules simplifies the renovation due to the fast construction progress and thus minimizes disturbances for the inhabitants, which do not need to move. The façade modules are made in fabrication halls which results in high quality due to weather independent fabrication conditions and quality assurance during the whole production process.

The first results show that the costs for heating and hot water could be reduced to 0.21 €/m² per month (compared to cost for hot water *only* before renovation with 0.40 €/m² per month). The total costs for the whole project (including renovation of the building shell, heating and hot water installation including solar thermal collectors and heat pumps and new elevators) make up app. € 8.8 million (excl. VAT) which results in total costs of € 816 per m² usable floor area.

The realization of this highly innovative project was enabled through financial support from the following public authorities:

- Loan from the regional government for 'Comprehensive renovation' (*Landesförderungsdarlehen*): € 7.0 million
- Grant from the federal program ´Building of Tomorrow´ for solar and ecological measures (non-repayable): € 0.2 million
- Grant from the federal Climate and Energy Fund (non-repayable): € 1.0 million.
- Grant from the regional government ´Promoting the environment´ (non-repayable): € 0.5 million
- Accrued reserves: € 0.1 million

The payback of the loan is secured by monthly contributions from the tenants over the next 25 years according to the EVB regulation.

Meanwhile a follow-up pilot project was launched within the ´Building of Tomorrow´ program, aiming at refurbishment of large residential blocks built in the 1950s to ´Plus Energy Standard´. However, the considerable share of public financing in this pilot project raises legitimate questions with regard to broader replication. Taking into account the recent restrictions in public budgets as a consequence of the financial crisis in 2009 and the following years, the predominant challenge of future pilot projects will be the development of technically robust and cost-effective solutions to improve not only the quality of the building shell but resulting in an overall up to date standard of the whole building. As a consequence of comprehensive cost-benefit analysis, the issue of "re-constructing" i.e. demolition of old buildings and new construction of residential buildings fulfilling up to date requirements may become more important during the next years (Hüttler 2008b).

3.2 Refurbishment Wissgrillgasse: commercial developer with subsidies

The innovative refurbishment project 'Roofjet Wissgrillgasse' was realized within a flagship project focusing on buildings from the late 19th and early 20th century (the so-called *Gründerzeit*) with typically decorated façades. The aim of this flagship project is to modernise historical buildings in a

systematic and holistic way using innovative technical and organisational solutions. The substantial improvement of the thermal-energetic quality of historical buildings provides significant better comfort for the users and contributes to attaining a CO_2 neutral building sector (Gassner *et al.*, 2009).

The main objective of the project 'Roofjet Wissgrillgasse' was to demonstrate in practice that even historical buildings can be modernized to lowest energy standard. The project is based on a holistic and sustainable refurbishment concept for the special type of Viennese *Gründerzeit* buildings with innovative technical and organisational solutions.

Figure X.8 Residential building Vienna, Wissgrillgasse, before and after major renovation

Photos: Ulreich, Gassner & Partner

This residential building in Penzing, the 14th district of Vienna, was built around 1900 and is located near the main railway-track in the western part of the city. The building has a comparable high amount of detached fire-proof walls and a typical decorated façade on the frontage. The refurbishment concept focused on three issues:

- Reduction of the energy demand through high quality improvement of the building envelope,
- Application of different systems of mechanical ventilation (decentralized and semi-central) with heat recovery in order to reduce noise exposure from the railway and improve indoor air quality

- Energy supply based on renewable energy sources (biomass heating system and facade integrated thermal solar panels).

Figure 9 Basic data and characteristics of the refurbishment project Vienna, Wissgrillgasse

Year of construction	around 1900
Number of apartments	20
Floor area before/after renovation	1100/1900 m²
Start of renovation	2009
Completion of renovation	2010
Heating demand before renovation [kWh/m²/year]	186
Heating demand after renovation [kWh/m²/year]	23

Source: Ulreich, Gassner&Partner, e7

In order to improve the thermal quality of the building envelope, all parts were insulated. The whole façade was insulated with high performance insulation (λ=0.025 W/m²K), which means that the 12 cm insulation realized in this project corresponds with 20cm conventional insulation. In order to conserve the historic character of the building, the decoration on the frontage façade was replicated with EPS elements. Existing windows were replaced by new high performance windows with triple glazing featuring a thermal loss coefficient U_w of 0.92 W/m²K.

Figure 10 Residential building Vienna, Wissgrillgasse, after major renovation in 2010

Photo: Hüttler, e7

Heat losses resulting from unregulated air exchange through leaks in the building envelope were eliminated by an air-tight connection of the construction components. The installation of mechanical air-ventilation systems with heat recovery guarantees the necessary air exchange along with minimized thermal losses.

A resource efficient and sustainable supply of energy for heating and hot water is guaranteed by the installation of a central biomass heating system with a pellet boiler and 50m² façade integrated thermal solar panels. The solar panels provide up to 9 % of the annual energy demand for heating and hot water.

Through the measures applied in this project the energy heating demand could be reduced from 186 before to 23 kWh/m²a after renovation, i.e. by a factor 8. The project demonstrates that even historical buildings from the *"Gründerzeit"* can be refurbished to lowest energy standard.

A main feature of the whole project was the conversion and extension of the attic, so that the usable floor space could be increased from initially some 1100 m² to about 1900 m². In general, the possibility of conversion and extension of the attic is a key question of renovation projects in *Gründerzeit* buildings in Vienna, particularly in terms of refinancing the renovation costs.

The project was partly financed by subsidies from the City of Vienna and from the Austrian R&D program 'Building of Tomorrow PLUS' (*Haus der Zukunft PLUS*).

One of the questions still remaining unsolved is the conflict between owner rights of the neighbors and energy performance requirements when it comes to the insulation of fire-walls. The owners of the two adjacent estates would have to conclude a private contract which at least temporarily allows the application of fire-wall insulation and thus the "use" of some 10 or 20 cm of the neighbor's estate. This was also a critical point in the project Wissgrillgasse which could be solved by a kind of gentlemen's agreement. It is obvious that there is an urgent need for legal regulation, particularly in view of the new Energy Performance of Buildings Directive (EPBD 2010), which requires minimum standards for the energy performance when they undergo a major renovation.

The project was partly financed by subsidies from the City of Vienna (app. € 0.1 million non repayable grant for the elevator, biomass-heating and ventilation systems from the Austrian federal R&D program ´Building of Tomorrow PLUS´ (*Haus der Zukunft PLUS*). Together with annuity subsidies, also from the City of Vienna, the capital value of all subsidies accumulates to around € 0.4 million. The major financing source – as in most other comprehensive *Gründerzeit* refurbishment projects – are highly attractive apartments in the attic which were sold already during the construction phase. As long as the market is able to afford the relatively high prices for top floor apartments with terrace and high quality standard, this business model for comprehensive refurbishment will be applied to a considerable share of historical buildings, promising a 'second life' of another 60-100 years.

4 CONCLUSIONS

Energy efficiency is a vital issue in the Austrian social housing sector. The strong engagement of Limited Profit Housing Associations (LPHA) goes beyond national ambitions of energy efficiency and reduced emissions. Despite of the considerable volume of the sector with some 20% of the total housing stock, its share of energy consumption is far lower compared to the large stock of private single family houses. More than 95% of the LPHA stock is in multi-storey buildings. LPHA have additional interests for their engagement. Following their social mandate, reduced energy costs make housing more affordable and secure for their tenants. Additionally, energy efficiency is an important field of

innovation. The sector uses its performance in energy efficient construction and refurbishment as a proof of effectiveness and as a USP in a competitive market.

Energy efficiency in Austrian social housing has improved considerably over the past decade. New construction is generally in low energy standard, a growing share of buildings even in passive house standard. This new technology has meanwhile become mainstream in the sector. Almost all bigger LPHA have gained experience with construction and marketing of passive houses. In addition to high energy efficiency in new construction, social housing has a higher thermal refurbishment rate than all other housing sectors.

Today, the Austrian social housing sector seems to be a best practice example of the implementation of low energy and even passive house standard in Europe. The positive performance was achieved with a comprehensive set of tools. The Limited-Profit-Housing scheme has created high organisational capacities in implementing new technologies at moderate costs. A strict system of audit and control not only assures efficiency, but also promotes dissemination of experience. The sector-specific legal framework stimulates the associations in this respect, as it comprises sound mechanisms of financing, including sufficient maintenance fees and the possibility to balance expenditures for energy efficiency measures with future savings from heating costs. The Austrian provinces provide a range of subsidies for energy efficient new construction and refurbishments. Federal research and dissemination programmes have proved feasibility of passive houses with a number of pilot projects and created awareness. Finally, the financing sector has developed several tools to provide cheap money for social housing, namely the housing construction convertible bonds of the housing banks and the *Bausparkassen* scheme.

Of course, also some weaknesses and threats are detectable. Different to the LPHA sector, thermal refurbishment is rather poorly implemented in all other housing sectors. Without the institutional and financial provisions of the LPHA sector and with a weak housing legislation, both the condominium sector and the big stock of single family houses show only low refurbishment rates. Taking the ongoing stagnation in legal reform, no change is in sight. The LPHA sector itself suffers from rising construction costs and budgetary constraints, which makes it doubtful whether the hitherto achievements may continue.

The achievements of the LPHA sector in energy efficiency are a result of an integrated housing policy approach. Austrian social housing not only targets social policy issues, but also economic, environmental and regional development policy issues. Despite of the strong commitment of the public in social housing, total public costs are with approx. 1.0% of GDP moderate, compared to other western and northern EU countries.

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