

# EU and German Requirements on Energy Efficiency of Residential Buildings

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Looking back on the turbulent price market for oil and gas in 2008, reaching highs not expected that soon, energy efficiency is today more focused than ever before. Climate protection, still an honorable goal, but someone may ask if it can be combined with a profitable investment too.

## EU Requirements on Energy Efficiency of buildings

The requirements are based on the EU Directive 2002/91/EG (Energy Performance of Buildings Directive) of the European Parliament and Council from the December 2002 about the general energy efficiency of buildings. The basics of it are to increase the energy efficiency of new or existing buildings in the European Union, therefore reducing CO<sub>2</sub>-emissions too; also creating an instrument, an “energy certificate”, to compare the energy efficiency of buildings. For example the directive demanded an energy certificate requirement for most of the buildings in the EU until 2006; today this is still an ongoing progress, almost completed in every country within the EU. Additional to this directive, the European Council decided in 2007 to increase the percentage of renewable energies used for heating in buildings to twenty percent, within the EU.

## German Requirements on Energy Efficiency of residential buildings

To implement the EU requirements, Germany passed the Energy Conservation Act (“Energieeinsparungsgesetz” short EnEG) and with regard to it the Energy Regulation (“Energieverordnung”, short EnEV). Currently in effect are the EnEG 2005 and the EnEV 2007. These two are expected to be replaced by a new EnEG and EnEV in 2009, this is currently being discussed in Parliament. About 35 percent of the primary energy is used for heating of living spaces and hot water in Germany. Heating

produces about 20 percent of the annual CO<sub>2</sub>-Emissions in Germany.

### **Definition of low-energy houses**

These three definitions, passive house, KfW Energy-Saving House 40 and 60 are commonly used terms, and accepted in Germany and they are essential for subsidization requests.

KfW Energy-Saving House 60:

The annual primary energy demand  $Q_p$  may not exceed 60 kWh per square meter per energy reference area  $A_n$ . Furthermore, the specific heat transmission losses shall fall 30 percent below the upper limiting value, required according to the EnEV 2007.

KfW Energy-Saving House 40:

The annual primary energy demand may not exceed 40 kWh per square meter per energy reference area. Furthermore, the specific heat transmission losses shall fall 45 percent below the upper limiting value, required according to the EnEV 2007.

Passive House:

Fulfilling all the requirements of a KfW Energy-Saving House 40, and additionally, the annual heating demand shall not exceed 15 kWh per square meter of leasable area.

### **Energy Certificate in Germany**

Since January 2009, whoever sells a residential building or flat, or even rent a flat to someone in Germany, is not only legally obligated to have an energy certificate for it; the owner must also ensure that the interested person can easily view the complete energy certificate. An example of this is when renting a flat the energy certificate for the building maybe pinned on the wall in the staircase. (EnEV 2007) There are a few exceptions, for example heritage listed buildings, which do not require an energy certificate. In Germany there are two different kinds of energy passes. One is the so called “Verbrauchsausweis”, which is just based on the consumption of energy during the last three years, and some basic facts about the building. To receive this energy certificate, no site visit of the building by an energy expert is required; therefore it is much cheaper then the other certificate, called “Bedarfsausweis”. For this second certificate, a site visit is required, providing more detailed information about the facade, windows, heating systems and so on. Based on these, together with basic facts about the building, the energy demands of the house are calculated, due to standard numbers for each of the house components and their current condition, additional to this certificate, there is always a direct proposals included about measures for increasing the energy efficiency of the building.

Both of them comply with the current regulations, with the exception, a “Verbrauchsausweis” is insufficient, if it is a small house up to 4 flats, which does not fulfil an older requirement of the heat insulation ordinance from 1977 (WSVO 1977). None of these two can guarantee the exact amount of energy needed in the future, because every person has their own individual consumption. In comparison, the second energy certificate is even better, while it does not depend on individual energy demands of the people, and not on the climate of the last three years.

### **EnEV Requirements on Energy Efficiency for new residential buildings**

The annual primary energy demand is limited depending on the specific heat transmission losses in comparison to the heat transferring outer skin of the building. On average the annually required primary energy demand is about 100 kWh per year and per square meter of energy reference area; this is for a new building due to the EnEV 2007. Furthermore, there are minimum requirements concerning thermal insulation, air ventilating, and air ventilating heat losses.

Furthermore, there are minimum requirements on new heating systems, such as low-temperature boilers with time control and controllable outside temperature. An additional law for heat energy efficiency, the EEWärmeG, demands renewable energies are to be used for heating in new buildings to a small percentage. The Goal is to increase the use of renewable energies in heating to 14% in 2020. At the moment there is no requirement for renewable energies in existing buildings or refurbishments.

### **Retrofit Responsibilities of Owners of existing multi-residential houses**

Owners of existing buildings have to replace all boilers with an actual power output of between four and up to 400 Kilowatt until 2009 when they are:

Using fluid or gas as the fuel and were built up in or before October 1978; they have been improved to run below the exhaust emission limit, or if the burner was changed after October 1996.

Exceptions are boilers that are not using common market fuel, only heating water or ranges, and heating appliances also delivering hot water.

Uninsulated, accessible hot water pipes, as well as fittings in unheated rooms, still have to be insulated; the thermal transmission coefficient shall not be above 0.3 Watts per square meter and Kelvin degree.

Furthermore, all refurbishment and modernizations measures in or on the building must conform to the EnEV 2007.

## **Basic Elements of the EnEV 2009**

These are the planned changes due to EnEV 2009.

Primary energy demands shall be lowered by thirty percent.

Night thermal storage heating installations shall be successively decommissioned by 2020. The current system of the energy certificates shall not be changed.

## **Costs, Subsidizations and Apportion on Tenants in Germany**

As a rule of the thumb you will get subsidizations for energy efficiency when you mainly increase the energy efficiency of a house, you will get more subsidization if you beat the current energy efficiency standard of new houses by thirty percent.

Further, a private person living in a single or double house often can choose between a credit institute and direct funds for the subsidization, and they have more programs to choose between than others. The others normally receive a credit as subsidization and only direct funds if they reach the standard energy efficiency required for a new building. There are a lot of subsidization programs, sometimes combinable, and since 2009 you can also split these programs into smaller refurbishment measures. We will therefore put our focus on refurbishment measures of existing multi-residential houses only. We will only talk about single-owned houses, this means unsold flats to another person or party are excluded.

## **Measures for increasing Energy Efficiency in Buildings**

In general all measures can be put into four categories:

1. Thermal insulation of the roof and cellar
2. Renewal of windows and doors
3. Façade insulation (incl. heating and ventilating system)
4. Heating system and current distribution board

Each category itself has a lot of options, and therefore should be decided individually, and on the situation and the building itself. From a technical point of view, a concept following these categories step by step is excellent for an effective modernisation of a building, assuming that all categories are required to be refurbished, and not already being modernized before.

For our next calculations, we are assuming that annual heating costs are around 15 €per square meter in non-energy efficient houses in Germany today.

The following costs are net costs and are dependent on experienced data from an engineering firm. They may differ a lot depending on the buildings and their condition. Generally speaking, façade insulation is the most effective measure for reducing heating costs, 30-40% or 5-6 € followed by replacement windows and doors, 25% or 3,75 €, and in shared third place, the other measurement categories with about 10-20% or 1.50-3 €

Looking at it from a cost perspective, replacing heating systems is the cheapest, 25-50 €(per square meter leasable area), followed by thermal insulation of the roof and cellar, 50-75 €, windows and doors, 100-150 € and finally the façade insulation (including costs for heating and ventilation system, 60-80 €), 175-240 €. Assuming that without doing special measures for energy efficiency, we have costs of about 50 per cent of these measures for required maintenance. This is excluding windows where we need to assume costs of about 80 percent, the most cost-effective measure for reducing heating costs, if there is no possibility of avoiding this measure, this is renewing or replacing the heating system. This is followed by windows and doors, thermal insulation of the roof and the cellar and façade insulation.

### **Apportion on Tenants**

Apportion on tenants is regulated in the German BGB §559. Therefore, the annual rent of a building can be increased by 11 percent of the expenses arising as a result of the measures which in the long term improve the quality, or effectively decrease in energy and water costs of an apartment in the future,. If these measures affect more than one apartment, the costs have to be adequately split amongst them.

Regarding our four categories, around 40 percent of the costs are creditable for this paragraph. For each category; windows and doors only 10-15 percent, therefore 4.4 per cent, respectively about 1.5 percent of the costs is the amount of the annual rent of the building that can be increased as the result of such a measure. Again, assuming that 50, respectively 80 percent are needed for maintenance, the investment part for energy efficiency would have an initial yield of around 8-9 percent after finishing the modernization. Why not go for it? The main reason why this may not be profitable at all is due to the rental system of Germany. You are allowed to increase the rent, yes, but first, are tenants willing to pay more if they already paid a top rent for this location? A second problem may be that the achievable market rent equals the average rent in this location and the current rent of your tenants equals this average rent, or is a bit lower. Then you increase the rents after a modernization, well, having the previously mentioned yield for around 3 years. Assuming an increase in the average rent by only 4 percent in

this area in three years, all the other owners can also increase their rents to nearly the same level as yours, and therefore your bonus income by modernization has vanished because you are not allowed to raise the rents above the average. There are a lot more scenarios which are not suitable for such an investment, for example higher (or less) fluctuation. The main argument for convincing tenants is that they have to pay less operational costs.

## **Subsidizations**

Subsidies are almost entirely measures for modernization of a building, not only for energy efficiency. Maybe regional programs exist where a housing association might receive some subsidies given as direct funds, but in general the subsidies are credits with a lower interest rate. As a housing association, the most important program for energy efficiency in existing buildings is the so called KfW-CO<sub>2</sub> Credit for house refurbishments measures.

Last year this program included five packages of measures which were subsidized. This year the possibility to split them into smaller measures shall be or has already been expanded. The subsidization is given as a credit up to 100 percent of the creditable investment costs (excluding maintenance measures) plus additional expenses like architects or energy consulting.

The minimum requirements for this subsidy are to increase the energy efficiency of the building to new building standard due to the EnEV 2007, or if this has already been achieved 30 per cent below it. Unfortunately, the benefits of a subsidy decrease at the same rate as the possible tenant apportion (BGB §559a) for example, if a credit is giving you a interest rate benefit of 2.000 Euro per year, the creditable investment for tenant apportion is decreased by 2.000 Euro. The benefit therefore of taking a subsidy credit is a lower rent increase for current tenants, remember the problems discussed in the last paragraph, and according to this a probable higher yield for this investment.

The interest rate for this credit was about 1.41 percent over a 20 year duration, 3 years no repayment of principal and a 10 year fixed interest period or about 1.71 over 30 year duration, 5 years no repayment of principal and a 10 year fixed interest period.

## **Calculation Example**

Example building:

Multi-residential house with 8 units built in 1975, currently in bad condition, without or having low insulation and conventional oil or gas burner as the heating source. All four

categories of measures are essential for maintenance. We further assume that the annual benefit of using a subsidy credit is about 2 percent compared to using another credit.

We are comparing a minimum essential maintenance to a higher quality measurement with the goal of increasing the energy efficiency to that of new building standard defined in EnEv 2007. We assume that the annual average heating costs per square meter are about 15 €. The used costs for the measures and cost reduction in heating costs are averages based on a database from an architectural firm, and may differ for most buildings. All costs are shown in Euros per square meter leasable area.

	Roof / Cellar	Windows / Doors	Facade	Heating	All
Total Costs (incl. 19% tax)	83,30	154,70	238,00	41,65	517,65
Maintenance Costs	41,65	123,76	119,00	24,99	309,40
Investment in energy efficiency measures	41,65	30,94	119,00	16,66	208,25
Reduce of heating costs					
current costs: 15€ per year	2,25	3,75	5,25	2,25	13,50
example future: 20€ per year	3,00	5,00	7,00	3,00	18,00
Subsidizations					
Creditable costs	33,32	15,47	95,20	16,66	160,65
credit benefit (yearly 2% lower interest rate)	0,67	0,31	1,90	0,33	3,21
Tenant apportion					
yearly tenant apportion (11%)	3,67	1,70	10,47	1,83	17,67
apportion using subsidization	3,00	1,39	8,57	1,50	14,46
tenant costs reduce without subsidization	-1,42	2,05	-5,22	0,42	-4,17
tenant costs reduce using subsidization	-0,75	2,36	-3,32	0,75	-0,96
Initially yield on the investment					
with subsidization	8,8%	5,5%	8,8%	11,0%	8,5%
depending on operational costs reduce (current)	5,4%	12,1%	4,4%	13,5%	6,5%
depending on operational costs reduce (example)	7,2%	16,2%	5,9%	18,0%	8,6%
Initially yield on complete measurement					
depending on tenant apportion	4,4%	1,1%	4,4%	4,4%	3,4%
depending on operational costs reduce (current)	2,7%	2,4%	2,2%	5,4%	2,6%
depending on operational costs reduce (example)	3,0%	3,2%	2,9%	7,2%	3,5%

*Example for a calculation of a energy efficiency modernization concept of a residential building*

The calculation shows that we achieve an initial yield of 8.8 percent on our investment into the energy efficiency measures, and already a reduction of 6.5 percent of the heating costs. Unfortunately, the benefit of the cost reduction for the current tenants is not as high as the possible apportion and therefore we might correct our yield expectation. In addition, the problematic rent system might reduce it, too. Otherwise, in the long term we will achieve the current heating cost reduction through additional rent. Therefore, a minimum yield of 4 percent is realistic and we have made an investment for the future, because heating costs are supposed to increase and we lowered the primary energy needs of this building immensely. Therefore, we shall go for this investment. To comment, if we are not in the position of doing the refurbishments right away, we should not be willing to go for these measures today.

## **Conclusions**

The energy efficiency of buildings will increase, but it is directly linked to the energy prices. As long as an investment into energy efficiency is not profitable enough, it will only be done according to essential maintenance. The requirements on a new building today, due to the EnEV 2007, are also relative low. The EnEV 2009 might slightly increase the efficiency of new buildings in the future, but the main part, the existing multi-residential buildings, have not been considered to change that fast.