Examples of Good Practice in Building Regulation in Europe

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Building regulation following EU Energy Performance of Building's Directive
Since 2005 many countries in Europe strengthened the requirements for buildings and passed measures for more stringent implementation, following the EU Energy Performance of Building's Directive (EPBD, directive . 2002/91/EC).

Calculation of energy demands for heating

To compare heat demand figures for different countries, it is important to note the difference in base that is used in different statistics and standards.

With the EPBD the standard is that the demand is calculated as primary energy, and includes energy for space heating as well as for hot water, ventilation and eventual cooling. The conversion from consumed energy to primary energy is normally done with a factor of 1 for fuels and external (district) heat supply and with a factor of 2.5 for electricity, but some countries use other factors for electricity.

Often in older regulation and statistics are included only energy demand for hot water and space heating, or only space heating.

Another difference is the area. In some countries the practice is to calculate the floor areas inside the rooms of the buildings while in other countries is calculated the total (outer) area of the building multiplied with the number of floors.

Climate differences also counts. In Poland there are 3605 degree days annually, in Germany 3244 (90% of Poland) and in Denmark 3479 (97.5 % of Poland) according to Eurostat

Countries included in this note are Denmark, Germany, and Norway

Denmark
Following EPBD, Denmark introduced a new building code in 2006 requiring total energy requirements for dwellings etc. to be 71 -90 kWh/m2, with the lower values for larger houses (above 2200 m2) and the higher values for a small house (example of 110 m2)[2], including hot water and electricity for pumps, ventilation etc.. The requirements is per m2 of total building area (area of building measured outside the building times number of heated floors) for new houses.
With a net floor area typical 85% of the total building area, the requirements translates to about 85-105 kWh/m2 net floor area.
Solar heating and solar electricity (PV) production is subtracted in the calculations.

The requirements are for dwellings and other buildings where people live, such as hotels, while for offices, schools etc. the building code allows about 20% higher energy demands per m2.
The requirements are also mandatory for larger renovations.

[1] Paper developed by International Network for Sustainable Energy – Europe, a network of 72 NGOs promoting renewable energy and energy efficiency (www.inforse.org/europe), with support from European Climate Foundation and European Commission, DG Environment.

2 Energy Service Denmark, facta-sheet "Bygningsreglement BR08", in Danish, www.energitjenesten.dk

The building code also defines two classes of low-energy buildings:
-class 1 with heat demands below 50% of standard requirements
-class 2 with heat demand 50-72% of standard requirements
This has give substantial interest in construction of low-energy houses.

Local authorities (municipalities) can decide that in specific developments, houses must be low-energy classes. Progressive municipalities have used to require that a certain development (typically 25-250 dwellings) must be build according to a low-energy class.

Local authorities can demand that houses are connected to district heating or natural gas, except low-energy houses.

The energy requirements introduced in 2006 requires 25% lower consumption than the previous building code from 1995. The building code was updated without change of requirements in 2008, but the plan is that requirements will be strengthened 25% in 2010 and again with 25% in 2015.

The aim of the Danish measures to reduce energy demands in houses that the building codes are part of, is to reduce heat demands in dwelling with 2.6 PJ/year (about 1.3% of consumption)[3] of which 0.7 PJ/year of the 2.6 PJ/year is because of the increased requirements in the building code. The social economic potential for reductions of heat demands have been calculated to 23% for dwellings and 25% in commercial sectors (primary, secondary and tertiary) with energy price expectations of 2004 and with possible realisation in 10 years. As the energy prices have increased some 60% since then, the cost-effective potentials are larger, for dwellings somewhere between the previous economic potential of 23% and the much higher technical potential that is evaluated to 58% . If the reductions of 23% are realised, heat demand will be reduced in the average Danish building from about 170 kWh/m2 in 2005 to 132 kWh/m2 total building area, including hot water demand, but excluding electricity for pumps and ventilation. Assuming 15% walls this is equal to about 155 kWh/m2 of net floorspace and if electricity for heating and ventilation is included: about 160 kWh/m2 of net floorspace[4]. Given the increases in energy prices, the economic level of heat demand will be lower than that for existing buildings, following the Danish evaluation. For new buildings the economic level is considerably lower, probably below the requirements for new buildings.

Germany

In Germany the requirements for new buildings are based on total net energy demand and depends on the ratio between surface and volume[5]. For apartment buildings, the requirement is total energy demands around 75 kWh/m2 of useful floor area[6], but for detached house requirements are typical 130 kWh/m2 and up to 148 kWh/m2[7] of useful floor area.

3 Energy Efficiency Action Plan 2005, background report
4 Asuming electricity use for ventilation and pumps of 2 kWh/m2 and a conversion factor of 2.5
5 Information on German Building Regulation from EPBD Buildings Platform - Country Review P73, available from www.buildingsplatform.eu
6 Example of 5-floor building with 10 m wideness, 15 m high, 80 m wide, common hot water supply, energy requirement 74.3 kWh/m2 of useful floor area, surface/volume ration 0.29.
7 With a surface/volume ratio of 0.9-1.0, 180 m2 house with central hot water supply the requirement is total energy demand below 128 kWh/m2, for a surface/volume ratio above 1.05 and electric water heating (combination that gives highest possible allowed energy consumption), the requirement is 147.8 kWh/m2

For existing buildings, energy requirements have to be met when for certain renovations, when more than 20 % of the area of the element in question is renovated. In this case, the owner has the choice to either meet special requirements for the new building elements (from 1/1 2009 the requirements are u-value of 0.24 W/m2K for walls and roofs, 0.20 W/m2K for flat roofs and 1.30 W/m2K for windows) or to prove that the building as a whole does not exceed 140 % of the requirements for a (similar) new building.

Individual states (Länder) in Germany can set additional requirements, and this is done, for instance by Baden-Württemberg that requires that 20% of the heating comes from renewable energy[8].

A new law, in force by January 2009 requires that all new buildings must have a part of their energy demand for heating and hot water covered by renewable energy, unless they are connected to district heating (that are expected to be energy efficient) or they have special low energy demands, at least 15% below normal requirements.[9]. For buildings with solar heating at least 15% must come from solar, for building using biomass, heat pumps and geothermal energy, at least 50% must come from these sources.

The objective of the law is to change heat supply so 14% of heat demand is covered by renewables in 2020, while it is 6.6% today. In addition Germany has an ambition of reducing total heat demand in spite of growing area of heated floorspace.

In Germany there is a growing sector of low-energy houses including the "passive-houses" with space heat demands of only 15 kWh/m2 floor area and 42 kWh/m2 of floor area for total primary energy for heating, hot water and ventilation. These houses have very good windows with U-values below 0.7 kWh/m2, high tightness, and controlled ventilation with air-air heat exchangers.

Norway

Norway is implementing EPBD even though it is not member of EU. Norway has not been among the first countries to implement to EPBD, but its regulation of buildings from '1/2-2007 is setting the highest standards for elements of new buildings in Europe[10]. With the regulation builders can choose between:

a) - energy efficiency performance of building elements or

b) – total net energy consumption, with additional minimum requirements of building elements, total net energy demand of 120 kWh/m2 including electricity for the building (not for activities in the building).

(lower requirements for leasure houses, huts, and for traditional wood-log houses)

While the requirements for individual building elements are among the highest in Europe, total net energy consumption is not, because of the cold weather in Norway.

Norwegian Requirements for Energy Performance of Building Elements for New and Buildings and Major Renovations (method a)

U-value -exterior wall: 0.18 W/sqm K
U-value –roof: 0.13 W/sqm K
U-value -exposed floors: 0.15 W/sqm K
U-value – windows and doors: 1.2 W/sqm K
Standardized value for thermal bridges must not exceed 0.03 W/sqm K for dwellings and 0.06 W/sqm K for other buildings

Air tightness: 1.5 air changes per hour by 50 Pa pressure difference. For dwellings the value of 2.5 air changes per hour by 50 Pa pressure difference applies
Heat recovery of ventilation air in ventilation equipment (year mean heat recovery rate): 70 %
SFP factor (specific fan power):
- Commercial buildings: 2.0/1.0 kWh/m³s (day/night)
- Dwellings: 2.5 kWh/m³s

Total area of glass, windows and doors: a maximum of 20 percent of the heated floor area (sqm)
Automatic equipment for shading or other precautions to avoid the use of local cooling systems

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The requirements for new buildings will also apply to major renovations, more than 50% of the building area, or less if locally required. They will also apply for new or repaired areas when there is a change of use, repair or extension, only to the affected parts.

Control of the regulation is the responsibility of the municipality where the building is located.

Local authorities can set requirements for mandatory district heating. In areas with such requirements, new and renovated buildings must be build to use district heating.