CONCERTED ACTION
ENERGY PERFORMANCE
OF BUILDINGS

EPBD implementation in Sweden

STATUS AT THE END OF 2012

1. Introduction

The work of implementing the Energy Performance of Buildings Directive (EPBD) is fulfilled partly by the National Board of Housing, Building and Planning and, regarding the information part within the articles 14 and 15, by the Swedish Energy Agency, on behalf of the Ministry of Health and Social Affairs, and by the Ministry of Enterprise, Energy and Communications, respectively.

Swedish regulations of energy management in new and renovated houses have existed on national level since 1948. Regulations on the Energy Performance (EP) certification, known in Sweden as 'energy declaration', came into force in October 2006. The first energy experts were certified in the summer of 2007, and the first accredited company registered the first Energy Performance Certificate (EPC) in the national register in September 2007. Since then, about 420,000 EPCs have been registered, as shown in Figure 1.

2. Energy performance requirements

Swedish building regulations refer to both residential and non-residential buildings. Also, they cover both new buildings and buildings under renovation. Public buildings are included in non-residential buildings. Furthermore, the Swedish building code on energy is divided into three different climatic zones and has different requirements for electrically heated buildings including heat pumps, and buildings heated with other heating sources.

2.1 Progress and current status

Since 2006, the Swedish building regulations have been based on measured energy consumption. The measured values for heating, cooling, hot water and auxiliary energy are summed up to an energy usage figure. This figure, divided by the heated area (10 °C), as well as the maximum overall U-value, must not exceed the values listed in Table 1 for residential buildings in the different climatic zones. The maximum permissible installed power in electrically heated residential buildings is listed in Table 2.

For non-residential buildings, the maximum energy use and the maximum overall U-values are listed in Table 3. There is also a limit for the maximum installed power in non-residential buildings (Table 4). Since 2006, the regulations have been updated twice: first in 2009, when demands on all buildings heated with electricity were

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Figure 1: Accumulated amount of energy certificates.

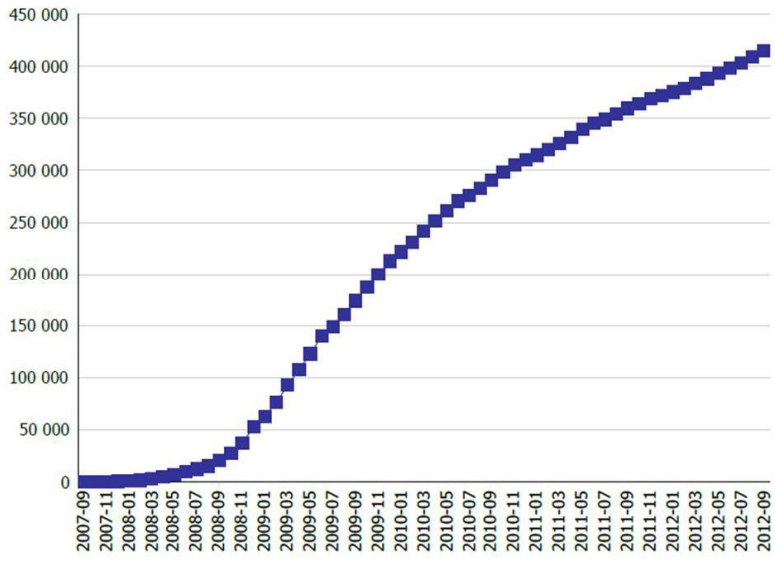
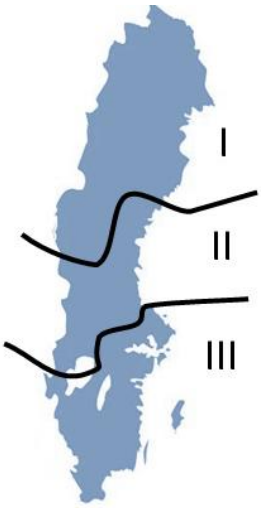


Figure 2: The three climatic zones in Sweden.



increased; and for the second time in 2012, when demands on buildings with other heating sources were increased. The 2006 changes resulted in an increase of the degree of compliance; thus, more buildings are now fulfilling the maximum stipulated energy use. In the southern part of each climatic zone, the EP of the buildings is about 30-40% higher than that required by the code, because the construction companies want to build only one type of building in each zone to avoid introducing changes in their production sites. The new detailed renovation rules which came into force in 2012 allowed a transition period until the 1st of January 2013. Before these regulations, renovation requirements were not so detailed: prior to 2012, the law simply stipulated that every change in a building should aim to comply with the requirements for new buildings, taking into consideration the size of the alteration and the possibilities of the building. The 2012 regulations specified more details to make the interpretation and implementation of the regulations easier.

2.2 Format of national transposition and implementation of existing regulations

In order to allow the building board of the municipalities to follow the development of the building project, the compliance check system in Sweden is divided into two parts: first, there is an asset rating during the construction of the building. This is then followed by the second, final verification under use, with measurements during the second heating season of the building, to see how the building fulfills the requirements. As this second part of the compliance check is the reference method, it does not matter which type of calculation programme was used or what air tightness value the building really has, as long as the measured energy consumption does not exceed the limit of the requirements.

In mixed use buildings, the energy use allowed is calculated according to the percentage of heated area in the respective part.

For all buildings, the building boards of the municipalities stipulate compliance checks to be carried out by a certified control responsible representative of the 'Byggherre'. If there is no compliance, the 'Byggherre' can be fined, or the further use of the building can be prohibited.

2.3 Cost-optimal procedure for setting EP requirements

Whenever the National Board of Housing, Building and Planning changes the regulations, it makes an analysis of the economical, technical and environmental consequences, as well as of the consequences on the children, the elderly and the persons with disabilities. The Board also asks itself, "is this regulation needed?" At the latest revision of the energy regulations, the Board concluded that Sweden has reached the limit for what is economically reasonable with the techniques available today. Calculations according to the cost-optimal regulation so far show that the current Swedish requirements comply with the cost-optimal levels. The plan for the future is to monitor the low-energy buildings built in Sweden during the last few years, as well as in the next years to come, to see if the demands can be tightened at the Control station (see 2.4, below) of the action plan for Nearly Zero-Energy Buildings (NZEB), 2015. Requirements towards buildings with very high EP could then continue to develop based on the results. Presently, in Sweden, the buildings with an EP by 25% higher than that stated in the building regulations are referred to as low-energy buildings and those with an energy performance by 50% higher are classified as having very low energy use.

2.4 Action plan for progression to NZEB

The Swedish action plan for NZEBs consists of four parts:

'Part 1 The Swedish implementation of the concept of nearly zero-energy buildings'. The consequence analysis that was carried out the last time Sweden altered the energy requirements showed that, with the available technologies, the requirements had reached as far as they could towards NZEB, and still have economic viability.

Table 1: Maximum allowed bought energy use per area heated to 10°C, and maximum overall U-value in residential buildings.

Requirements for residential buildings Bought energy[kWh/m²]								
	Other heating source				Electrical heating [>10W/m², installed heating]			
Climatic Zone / Year	North	Middle	South	U-Value [W/m².K]	North	Middle	South	U-value [W/m².K]
2006	130		110	0.5	95[1]		75[1]	0.5
2009	150	130	110	0.5	95	75	55	0.4
2012	130	110	90	0.4	95	75	55	0.4

1 Electrical panes in one or two-family houses

'Part 2 Promotion measures for knowledge and an efficient implementation'.
The second part is the starting point for the evaluation of low-energy buildings. 120 million SEK are dedicated to promote and follow up projects concerning low-energy buildings.

'Part 3 Control station and milestone 2015'.
The third part consists of an evaluation of the promoted projects and, based on the results, an estimation of the right moment to decide on the future steps and policies.

'Part 4 The role of renewable energy in nearly zero-energy buildings'.
The last part concerns Renewable Energy Sources (RES) in Swedish buildings and the Swedish energy supply system as such. Sweden must also find out a way to show the renewable energy produced on-site or nearby the buildings which are not showed today. The document 'Vägen till Nära nollenergibyggnader' ('On the road to NZEB'), describing the role of renewables, is available on the government website.

3. Energy performance certificates

The changes in the EPBD that came into force in December 2010 were implemented in Sweden by new regulations, through changes in the Law (2006:985) on Energy declaration of Buildings, the Ordinance 2006:1592 and the regulations enacted by the National Board of Housing, Building and Planning. The changes came into force in July 2012. The major change is that the certificate ('declaration') has to be presented at an earlier stage in the process, when a sale or renting of the building or part of the building takes place. The certificate shall be presented to the presumed renter or buyer.

Sweden has a central register for certificates since 2007. This register will also be used for future validation checks. The Swedish Parliament also decided that the National Board of Housing, Building and Planning takes over the compliance checks of the certificate, when the certificate is issued, displayed or handed over, as well as when the EP is displayed in commercial advertisements. Before that, the local authorities have had the role of compliance checkers.

Table 2: Maximum installed electrical power for heating in residential buildings.

Maximum installed electrical power for heating in residential buildings			
Climate zone	North	Middle	South
Maximum installed Power [kW]	5.5	5.0	4.5
Addendum when A_{temp}> 130 m^2	0.035*(A_{temp}-130)	0.030*(A_{temp}-130)	0.025*(A_{temp}-130)

Table 4: Maximum installed electrical power for heating in non-residential buildings.

Maximum installed power for heating in non-residential buildings			
Climate zone	North	Middle	South
Maximum installed Power [kW]	5.5	5.0	4.5
Addendum when q_{DVUT}[1]>0.35l/s	0.030*(<q>-0.35)	0.026*(<q>-0.35)	0.022*(<q>-0.35)
Addendum when A_{temp}> 130 m^2	0.035*(A_{temp}-130)	0.030*(A_{temp}-130)	0.025*(A_{temp}-130)

1) q maximum specific outdoor airflow at dimensioning winter air temperature

Table 3: Maximum allowed bought energy use per area heated to 10°C, and maximum overall U-value in non-residential buildings.

Requirements for non-residential buildings Bought energy[kWh/m^2] Area heated to more than 10°C								
	Other heating source				Electrical heating [>10W/m^2, installed heating]			
Climatic Zone / Year	North	Middle	South	Overall U-Value [W/m^2.K]	North	Middle	South	Overall U-value [W/m^2.K]
2006	120		100	0.7	<-See other heat source		<-	<-
Addendum if $q^1_{hygiene}$>0,35 l/s	90*(q-0.35)		70*(q-0.35)	-				
2009	140	120	100	0.7	95	75	55	0.6
Addendum if $q^1_{hygiene}$>0,35 l/s q_{max}[2]=1.0 l/s	110*(<q>-0.35)	90*(<q>-0.35)	70*(<q>-0.35)	-	65*(<q>-0,35)	55*(<q>-0.35)	45*(<q>-0.35)	-
2012	120	100	80	0.6	95	75	55	0.6
Addendum if $q^1_{hygiene}$>0,35 l/s q_{max}[2]=1.0 l/s	110*(<q>-0.35)	90*(<q>-0.35)	70*(<q>-0.35)	-	65*(<q>-0,35)	55*(<q>-0.35)	45*(<q>-0.35)	-

1) Average specific outdoor air flow during heating season, 2) maximum airflow counted for addendum

The content of the certificates also includes recommendations. If these recommendations were realised, the energy savings would be about 25% in single-family houses, between 15 – 20% in multifamily houses and 10-15% in non-residential buildings.

3.1 Progress and current status on sale or rental of buildings

A certificate shall be presented at the latest at the time when a building is sold. This is the most common situation for sales of single-family houses. In this case, the compliance is very high: when comparing the numbers of certificates with buildings sold, a certificate is available in 90 to 95% of the cases. In some cases, this depends on the exemptions from the obligation, for example, when a single-family house is sold within the same family. In other words, non-compliance is limited to only a few cases. So far, no authority has performed any compliance checks in these cases. Compliance checks have been activated by consumer complaints, because the buyers had the opportunity to demand an energy certificate at the cost of the seller within 6 months from the date of the transaction. To increase the overall compliance rate, the checks are now the responsibility of the National Board. BOVERKET has sent letters to property owners of buildings not having an energy certificate registered at the official database. Until now, owners of several thousands of buildings have been contacted; some of them are ordered to have a certificate issued and others are advised on the actions necessary to 'declare' their buildings.

BOVERKET also started with reactive compliance checks in 2013, acting after complaints from tenants and others stating that the building owner/seller failed to deliver a certificate. BOVERKET will also increase its cooperation with other authorities, such as the Energy Agency and the Consumers Agency.

Random quality checks are also to be conducted as a validation of the incoming certificates. All certificates are so far validated only for the declared values but, starting in 2013, more thorough quality checks will be developed on a random basis. So far, the validations make it impossible to overlook cases in which the figures are out of range, as the programme asks the expert to verify the unreasonable figures when filling in the form. If errors are found, BOVERKET gives the building owner the chance to contact their assessor in order to have the certificate corrected.

Rented buildings should have had a certificate since the 1st of January 2009. The degree of compliance in these cases has been lower so far. About 35% of the rented buildings do not have a certificate. This is the main reason for the transfer of compliance checks from the Municipalities to the National Board.

The National Board has chosen to change the display of the certificates during 2013, to increase the interest of consumers. Certificates will become more similar to those in the rest of Europe, with classes from A to G, with colors from green to red, as shown in Figure 3. The intervals have also been changed to obtain a bigger spread of the declared classes of the buildings. So far, most of the buildings fall in three out of the seven possible categories or classes, between 50 and 200 kWh/m^2.

The cost of a certificate is at least 1,000 €. The price has been rather stable since the start.

The assessors are divided into two different levels: the lower level refers to assessors for simple buildings, single-family houses and smaller multi-family houses with low or non-integration among the technical systems, or with a simple system for monitoring and adjusting. The higher level refers to assessors for complicated buildings (for example buildings with air-conditioning), public buildings, as well as all buildings with cultural value. So far, Sweden also has had a system according to which the companies issuing certificates had to be accredited. Experts acknowledged in other EU countries were excluded from accreditation; they only had to fulfill the regulations for being an expert in their own country. Within the standards for accreditation, the handling of complaints, Quality Assurance (QA) systems and all other requirements that companies must meet are controlled by the accreditation authority once a year. The consumers can also turn to the accreditation authority, Swedac, if their complaints are not followed upon by the assessors.

So far, only three accreditations have been withdrawn.

From the beginning of 2014, the Swedish system of accreditation will be replaced

by the personal responsibility of a certified expert, in order to increase the quality of the certificates, but also to lower the price of the certificate for smaller building owners in regions where there are long distances and huge areas to be covered (Sweden is a long country with not so many persons living in the north, so the distance between them and their closest neighbors can be 100 km). By giving the assessor personal responsibility, it will be cheaper for smaller businesses to act on the market.

Sweden believes that the quality of the certificates has already been improved. The new law increased the demand on audits to buildings when issuing the certificate, if the EP is lower than that required of a new building.

The number of assessors has decreased from 1,100 to 800, as the market has gone smaller since the beginning. This was an expected development, since the buildings that needed a certificate already have one; now, new certification is only needed for new and sold buildings. Rented and public buildings shall have a certificate all the time since the 1st of January 2012. The certificates are valid for 10 years.

A new private association of assessors called VETIC has appeared; it has been a source of experience in the field for the National Board. They inform BOVERKET when assessors are doing a bad job, or when they see a potential for improvements, like the Toyota example.

3.2 Progress and current status on public and large buildings visited by the public

The original regulation (2006:985) for public buildings included all buildings with an area bigger than 1,000 m^2. It has been altered in 2012 to include all buildings with an area bigger than 500 m^2, either public or visited by the public. As the regulations on certification in Sweden covered all kinds of buildings from the beginning, the development as described above for sold and rented buildings also applies to public and large buildings.

3.3 Implementation of mandatory advertising requirement – status

EP indicators in advertisements are mandatory since the 9th of July 2012, but are so far rare. Until now, the EP has been indicated by a number, but Sweden is working on changing it to a symbol with a letter showing the EP class. This will come into force before the end of 2013. Swedish authorities believe that this will increase the use of EP indicators in advertisements, as the symbols will be easier to be communicated, and ordinary people will recognise them from the ones on their refrigerators and washing machines; therefore, they will ask for information more often. At the same time, the compliance checks will increase, partly through the National Board, but also through reactive compliance checks due to information from the Consumers Agency that has the task to inform consumers about their rights and interest.

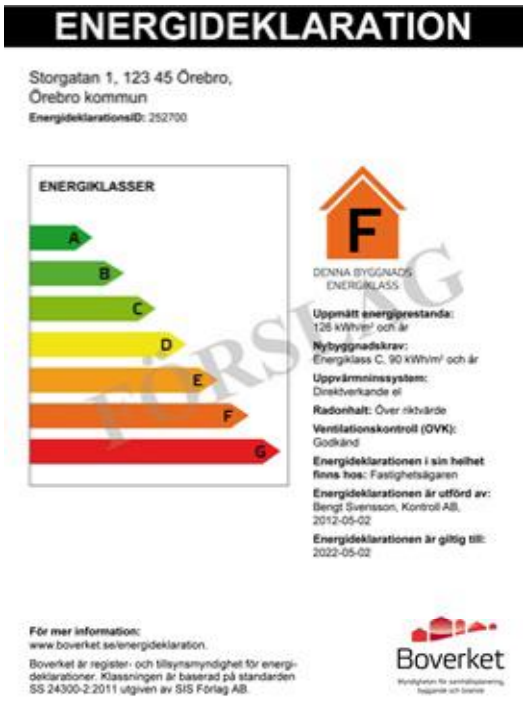


Figure 3: Suggested new certificate and symbol for energy performance indicator or advertisement.

Table 5: Different levels in the proposed labeling system.

Class A	< 51% of the requirements for new buildings
Class B	Between 51 and 75% of the requirements
Class C	Between 76 and 100% of the requirements
Class D	Between 101 and 125% of the requirements
Class E	Between 126 and 150% of the requirements
Class F	Between 151 and 175% of the requirements
Class G	> 175% of the requirements

3.4 Information campaigns

To begin with, the first information campaign was directed to the real estate brokers, as they are closely connected to the transaction of buildings, they cover a great part of the advertisements and are most of the time those doing the paper work for the transactions and the displaying of facts when selling a house or a condominium. BOVERKET has direct

communication with the association of real estate brokers. The certificates were made available to real estate brokers through electronic channels. This has been a success, since the brokers are collecting, on average, 300 certificates a day from the official register.

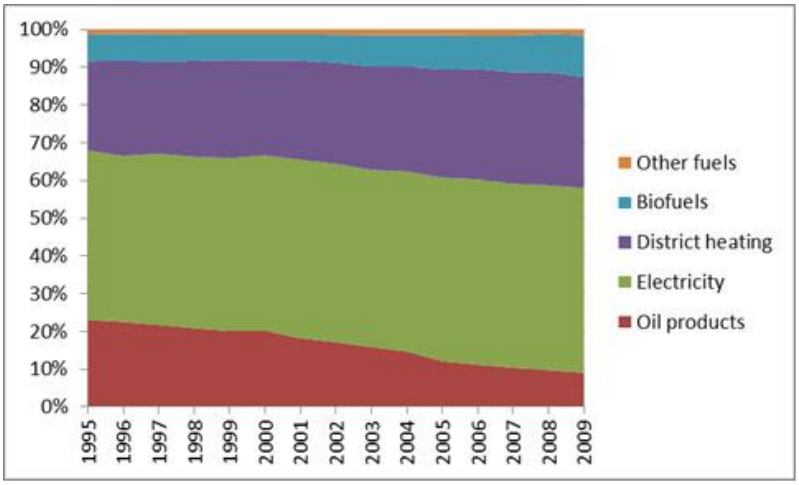
A broader information campaign will be launched, directed towards the building owners and users, as soon as the new classification is in place.

4. Inspection requirements - heating systems, air-conditioning

Sweden started off with option B (information campaigns) for boilers, as well with an inspection scheme for air-conditioning (AC) systems with an output above 12 kW. There is also an inspection scheme for mandatory ventilation checks. One of the problems has been that there is no control of the location of the few cooling systems that are not attached to ventilation systems. Therefore, Sweden decided that a broad information campaign would have bigger effect regarding those systems.

Figure 4: Example of information given by real estate brokers, describing the energy certificate system.

Figure 5: The energy mix in Swedish heating.



4.1 Progress and current status on heating systems

Since the end of the 1990s, Sweden had an environmental target to become free from fossil-fueled boilers for heating and hot water production by 2020. The prognosis on this target is quite positive.

Since 1992, Sweden also has a mandatory ventilation check regarding ventilation in multifamily houses, schools and offices. These shall be carried out every two or three years, depending on the type of ventilation system. The assessors certified for performing ventilation checks must also give advice on energy efficiency measures; if a cooling system is attached to the ventilation system, information about how to make the system more efficient will be given to the building owner. This way, this ventilation control system will be part of the information system to fulfill the alternative on information included in the directive for AC installations integrated with the ventilation system. To cover the comfort cooling systems not installed as attached to the ventilation system, the national Energy Agency is preparing information to be spread via their regional Energy Agencies and the local energy and climate advisors of the municipalities. Each one of the 290 municipalities of Sweden has either an energy advisor or an energy and climate advisor in their staff, in order to inform private and public players about energy efficiency and climate issues. These advisors are financed by the Energy Agency.

4.2 Progress and current status on AC systems

The regional and local energy offices will continue to spread the information, and the experts conducting the mandatory ventilation system checks will continue to provide energy efficiency advice.

5. Conclusions and future plans

Sweden has had a history in the field of energy efficiency since the 1970s and the oil-crisis. However, some of the energy saving initiatives back then ended in personal disaster in certain cases. Some people tightened their houses too much and got mold problems, while some energy saving measures made the ventilation systems get out of balance due to poor implementation. Although Sweden now continues to work hard towards an energy efficient society, taking the example of the past into account, the Swedish authorities this time have to scrutinise the measures from different points of view to avoid future failure.

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