CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

# EPBD implementation in Sweden

## Status in December 2016


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NATIONAL WEBSITES

**www.boverket.se, www.energimyndigheten.se**

## 1. Introduction

Sweden had most elements of the EPBD in place in 2014. Since then, Sweden has been working hard on defining the Nearly Zero Energy regulations, i.e., establishing the NZEB levels and a numerical indicator for energy performance. The *Planning and Building Ordinance* (2011:338) was altered in December 2016 and put into force on 1 April 2017; additional regulations are expected to come into force during 2017. The supervision of the EPC system has developed further, resulting in better compliance. A new and updated building regulation for determining energy performance of buildings is also in place since December 2016 (BFS 2016:13 and "*Boverket[1]s föreskrifter och allmänna råd om fastställande av byggnadens energianvädning vid normalt brukandeunder ett normalår,* BFS 2016:12 - BEN[2]).

# 2. Current Status of Implementation of the EPBD

## 2.I. Energy performance requirements: NEW BUILDINGS

### *2.I.i. Progress and current status of new buildings*

The energy performance requirements were tightened in 2015 (BFS 2015:3) and concerned the following:

#### Climate Correction

Sweden was divided in four climatic zones, as shown in Figure 1.

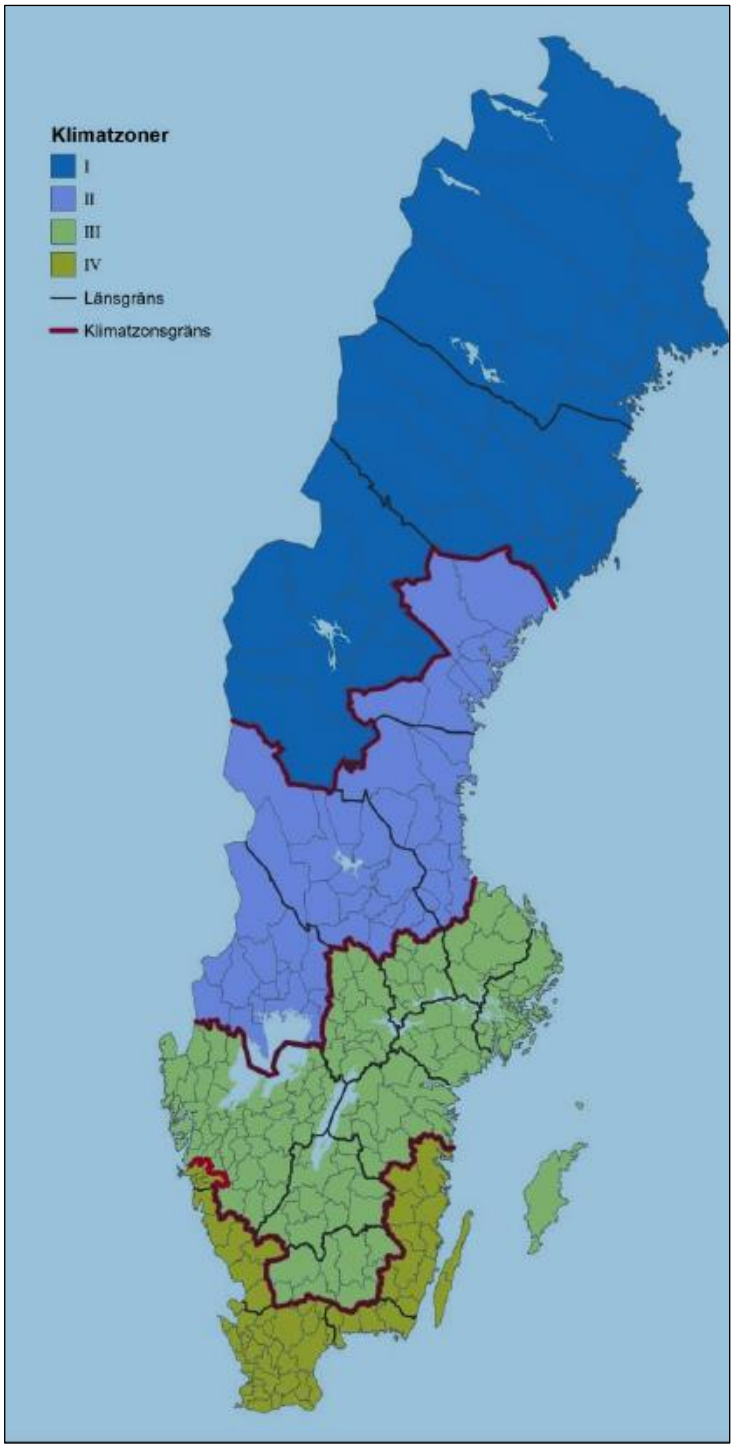


*Figure 1. Swedish climatic zones I-IV from north to south (länsgränser = county limits).*

The new climatic zone IV includes municipalities in southern and western Sweden. The new zone tightened requirements by about 10% compared to the new levels that were adjusted for climatic zone III.

### Non-residential buildings

Requirements were tightened by:

- 15 kWh/m$^2$ per year for spaces with heating other than electric in climatic zones I and IV;
- 10 kWh/m$^2$ per year for spaces with heating other than electric in climatic zones II and III;
- 10 kWh/m$^2$ per year for electrically heated premises in climatic zones I and II;
- 5 kWh/m$^2$ per year for electrically heated premises in climatic zone III.

The requirements for premises smaller than 50 m$^2$ remain unchanged.

### Residential buildings

Residential buildings are divided into two new categories: single-family homes and apartment buildings.

Requirements for apartment buildings were tightened by:

- 15 kWh/m$^2$ per year for apartment buildings with heating means other than electric heating in climatic zones I and IV;
- 10 kWh/m$^2$ per year for apartment buildings with heating means other than electric heating in climatic zones II and III;
- 10 kWh/m$^2$ per year for electrically heated apartment buildings in climatic zones I and II;
- 5 kWh/m$^2$ per year for electrically heated apartment buildings in climatic zone III.

The requirements for single-family homes remain unchanged in all zones, except in the new climatic zone IV where requirements are tightened by about 10%.

A new method for adjusting to normal use was developed and came into force in December 2016.

## *2.I.ii. Format of national transposition and implementation of existing regulations*

The Swedish energy performance regulations are based on measured delivered energy, including energy performance requirements for heating, cooling, hot water and other general uses of the building (pumps, fans and lighting for all buildings), known in Sweden as "*estate energy*", divided by the area intended to be heated to more than 10 °C ($A_{temp}$).

According to the building regulations (BFS 2011:6), new buildings must be designed in such a way that energy use is limited by low heat losses, low cooling demands, efficient use of heating and cooling, and efficient use of electricity.

Buildings must be designed so as to comply with:

- the building's specific energy performance requirements; e.g., for climatic zone III, where the majority of the Swedish population lives, the requirements are listed in Table 1 for residential buildings, and in Table 2 for non-residential buildings;
- the installed maximum electric power rating for heating devices, as in Table 1, applicable to electric resistance, electric boilers or heat pumps;
- the average thermal transmittance ($U_m$) of the building envelope ($A_{om}$) displayed in Table 3.

| **Energy use requirements for new[5] residential buildings [kWh/m²] $A_{temp}$** | **2006** | **2009** | **2012** | **2015** | | | | | **2017** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | **Single-family houses** | | **Multi-family houses:** | | | |
| | | | | 1-2 apartments | PE-ratio[4] | >2 apartments | more than 50% of the heated floor area, $A_{temp,}$ consists of dwellings < 35 m² | PE-ratio[4] | |
| Electrically heated[1,2] | 75[3] | 55 | 55 | 55 | 90/55=1.64 | 50 | 55 | 80/50=1.60 | NZEB planned for all buildings for July 2017 |
| Not electrically heated | 110 | 110 | 90 | 90 | | 80 | 90 | 90/55=1.64 | |
| 1. Electrically heated defined as more than 10 W/m² installed power. | | | | | | | | | |
| 2. Electrical heating devices shouldcomply with a maximum power limit. $P_{max}$= 4.5 + 0.025*($A_{temp}$-130)[kW] | | | | | | | | | |
| 3. Only for electrical panels in single-family houses. | | | | | | | | | |
| 4. Primary Energy (PE)-ratio is the ratio between the value for non-electrically heated and electrically heated buildings. | | | | | | | | | |
| 5. When altered, aim at the above with regard to the size of the alteration and the possibility of the building. Recommended but not required target. Target is defined by the possibilities of the building, for example, no change to the cultural values should be made. Owners cannot alter the look of the window and because of this it might not be possible to reach the exact requirement. | | | | | | | | | |

*Table 1. Building code since 2006 - residential buildings, electrically / not electrically heated climatic zone III.*

| Energy use requirements for new[6] non-residential (including public) buildings [kWh/m$^2$] $A_{temp}$ | 2006 | 2009 | 2012 | 2015 | PE-ratio | 2017 |
|---|---|---|---|---|---|---|
| Electrically heated[1,2] | 100[3] | 55[5] | 55[5] | 50[5] | 70/50= 1.40 | NZEB planned for all buildings July 2017 |
| Not electrically heated | | 100[4] | 80[4] | 70[4] | | |
| 1. Electrically heated defined as more than 10 W/m$^2$ installed power | | | | | | |
| 2. Electrical heating devices should comply with a maximum power limit | | | | | | |
| Addendum if the $q_{hygiene}$ is between 0.35 and 1.0 l/s, m$^2$ | | | | | | |
| 3. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m$^2$. +110*(q-0.35) [kWh/m$^2$] | | | | | | |
| 4. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m$^2$. +70*(q-0.35) [kWh/m$^2$] | | | | | | |
| 5. Addendum if $q_{hygiene}$ is between 0.35 and 1.0 l/s, m$^2$. +45*(q-0.35) [kWh/m$^2$] | | | | | | |
| 6. Existing buildings: When altered, aim at the above with regard to the size of the alteration and the possibility of the building. | | | | | | |
| $q_{hygiene}$ is the extra air flow needed to fulfil the special hygiene demand in certain non- residential buildings. | | | | | | |

*Table 2. Building code since 2006 - non-residential buildings with and without electrical heating, climate zone III.*

| | | 2006 | 2008 | 2011 | 2015 |
|---|---|---|---|---|---|
| Residential buildings | Not electrically heated | 0.5 | 0.5 | 0.4 | 0.4 |
| | Electrically heated | | 0.4 | | |
| Non-residential buildings | Not electrically heated | 0.7 | 0.7 | 0.6 | 0.6 |
| | Electrically heated | | 0.6 | | |
| For buildings < 50m$^2$ | | | | | 0.33 |
| Airtightness for buildings < 50 m$^2$ | | | | | 0.6 l/s.m$^2$ |

*Table 3. Evolution of maximum average building U-value [W/m2,K].*

Technical guidance documents[3] are developed and will be available online in 2017.

A new regulation on how to determine the building's energy performance connected to normal use was developed during 2016 and came into force in December 2016. The primary energy factor is defined as a factor that takes into account the difference of primary energy in electrically heated buildings and buildings heated with other energy sources.

*Boverket* is continuously monitoring the results of the cost-optimal calculation requirements. It also examines the possible effect of a further tightening of requirements on the cost-optimal calculations for the three building categories, i.e., single-family houses, multi-family houses and non-residential buildings, according to the latest revision of the regulations. In case of favourable economic conditions, the regulations are tightened.

The latest revision of the building requirements (following cost-optimal calculations) occurred in 2015.

Responsible parties for building compliance comprise the developer and its representative, the certified person responsible for inspections and verification, and the local municipal building council. In case the mandatory requirements are not met, the municipality can prohibit the use of the building or fine the developer until compliance is reached.

### *2.I.iii. Action plan for progression to NZEB for new buildings*

#### Key elements and milestones, including national application of the definition of NZEB for new buildings

Alterations in the *Planning and Building Ordinance (2011:338)* and the *Building Regulation (BFS2011:6)* specify the definition and levels of the NZEB requirement. The alteration included, e.g., the definition of energy performance. The Swedish Energy Agency[4] has launched a training initiative called "*Energilyftet*"[5] .

#### Actions towards the implementation of NZEB public buildings. Plans for the implementation of this as standard from 31st of December 2018

The NZEB definition has been fully implemented in 2017. The levels were set in 2015.

### *2.I.iv. Requirements for systems and / or building components for new buildings*

Sweden uses functional, instead of detailed requirements. This means that the developers are free to choose which areas they will focus their efforts on. As a result, there are no qualitative figures on specific parts of systems (e.g., boiler efficiency). As long as the total measured energy consumption value measured is lower than the requirements, the building is regarded as compliant.

Small stand-alone buildings < 50 $m^2$ are exempted from energy performance requirements. The exemption will no longer be regulated in the building ordinance but will instead be part of the building regulation. Thus, in small buildings apply requirements for U-values and airtightness.

## 2.II. Energy performance requirements: EXISTING BUILDINGS

In existing buildings, the requirements only come into force when the building is altered, no matter how small the alteration. When a building is renovated or refurbished, it is the altered part of the building that should comply with the regulations for new buildings. Requirements are set in relation to the extent of the alteration, e.g., a window should meet the requirements for a new window, if possible according to "*the technical possibilities for changes in the building*", for example due to cultural values.

### *2.II.i. Progress, current status and plans to improve the existing building stock*

Each time the regulation for new buildings is tightened, a tightening of the regulation for existing buildings follows, as they are closely connected. Energy performance requirements apply when an existing building is altered (major renovation or an alteration of a small part of the building). The levels of the requirements are the same as for new buildings but are adapted to the extent of the alteration and the technical and cultural possibilities of the buildings. For existing buildings, U-values requirements apply when alterations in the building envelope are made. For alterations in the technical building systems certain requirements apply, e.g., specific fan power for inhaust/exhaust systems with heat retention should currently not be higher than 2 kWh/$m^3$.s.

## *2.II.ii. Plans for implementation of renovation in national plans according to EED articles 4 and 5*

In the analysis of the first national plan for renovation, Sweden identified the lack of knowledge in the area of energy efficiency renovations as an important obstacle. The government has therefore proposed that a national information centre for sustainable buildings should be established in 2017. In the analysis of the second renovation strategy, Sweden identifies further areas that need to be developed in order to achieve a higher rate of energy efficient renovations. These areas comprise further development of the EPCs, developing guidance documents for all actors taking part in the renovation process, with specific emphasis on the relation between landlord and tenants, and a broadened scope for the existing governmental insurance for banks.

## *2.II.iii. Regulation of system performance, distinct from whole building performance*

Sweden has got requirements on U-values and specific fan power for the altered part of a building.

See the Swedish building regulation Section 9:9[6].

## *2.II.iv. Encouragement of intelligent metering*

The Swedish Energy Agency provides information on smart meters. For example, a test of eight (8) different smart meters has been made[7].

## *2.II.v. Financial instruments and incentives for existing buildings*

Sweden provides different types of incentives, e.g., administrative, economic, informational, research and market introduction of efficient technologies. Examples are subsidies for multi-family houses in areas with challenging socio-economic circumstances and poor energy performance[8]. The subsidies amount to about 100 million €. For single-family houses there is a tax deduction system[9] in place to stimulate renovation. Schools can also apply for subsidies to improve poor indoor conditions and thereby also improve the energy performance[10]. These school subsidies amount to about 50 million € between 2017 and 2019.

## *2.II.vi. Information campaigns / complementary policies*

The government has budgeted a "*national information centre for sustainable buildings*" and the framework of this is under development. *Boverket* has been instructed to perform a procurement to establish and run the national information centre. Focus will be on improving the energy efficiency while performing renovation works, and on energy-efficient construction with the use of sustainable materials with low environmental impact from a life-cycle perspective.

To fulfill these purposes, the information centre shall collect and review data, ensure quality and disseminate information to target groups within the building industry. The information shall be distributed free of charge. The first procurement will be done for a period of two years and this procurement is currently in process.

# 2.III. Energy performance certificate requirements

## *2.III.i. Progress and current status on sale or rental of buildings and EPCs*

Since 2009, all new buildings, as well as all existing buildings sold or rented, shall have an EPC. The *National Board of Housing, Building and Planning* administer and supervise the EPCs scheme and the national register of EPCs. This is regulated in Law 2006:985, Ordinance 2006:1592 and *Regulation by the National Board of Housing, Building and Planning* BFS 2007:4 on EPCs for buildings. The latest changes concerned amendments in the definition of energy performance and normal use in the regulation regarding EPCs. As of May 2017, over 660,000 buildings have been certified and registered in the national register of EPCs.

The *National Board of Housing, Building and Planning* enforce conditional fines in case a building owner has not obtained and registered an EPC. The first fine is at the level of the cost of an EPC, followed by further fines if the EPC is still not obtained. More information is available in the relevant country report of the "Book: 2016 – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports"[11].

## *2.III.ii. Quality Assessment of EPCs*

Quality assurance is made through automatic controls in the electronic certification system for all EPCs. These controls include, e.g., the level of energy performance, the heated area, the real-estate information and the climate-data. Controls are complemented with analyses of the EPCs database. If a certified energy expert does not meet the requirements concerning competence, access to the register and the EPCs issuing permit can be withdrawn.

## *2.III.iii. Progress and current status of EPCs on public and large buildings visited by the public*

Public buildings have been included in the certification system since 2008. The regulation follows the area limits provided in the EPBD Directive 2010/31/EU.

## *2.III.iv. Implementation of mandatory advertising requirement – status*

Requirements for advertising have been implemented since 2012 and *Boverket* regularly carries out advertisement controls. The most recent control is mainly focusing on the information given by real-estate agents during sales. If the requirements are not met, the supervisory authority can make an order for correction, which can be combined with a conditional fine.

# 2.IV. Inspection requirements – heating systems, air conditioning

For heating and AC systems, Sweden has chosen alternative measures (advice) in response to Articles 14 and 15 of the EPBD.

## *2.IV.i. Report on equivalence of model A and B for Heating Systems*

Article 14 of the EPBD targets locally fired boilers. These types of boilers represent a small proportion of heating systems for buildings in Sweden. For instance, 95% of the energy used for heating of premises and apartment buildings is covered by district heating and electricity. Efforts directed only at heating and AC systems are proven to be expensive compared to earnings. Therefore, Sweden has chosen to use and to develop already existing information channels, e.g., use energy and climate advisors and other professionals so as to disseminate information in order to fulfil the obligations. Specific measures to develop and customise information activities for each target group have been implemented.

By educating and supporting established professionals and developing existing activities, knowledge about energy efficiency measures can be spread to yet more actors. Through these actions, the Swedish strategy gives more property owners the opportunity to receive advice, which would not be the case, if only inspections took place.

## *2.IV.ii. Progress and current status on heating systems*

Sweden has chosen three different alternative measures:

### Personal advice focusing on energy efficiency

Municipal energy advisors provide free of charge advice to individuals, companies and organisations on how to reduce the total energy use. To ensure that proper focus is given on advice to building owners with large heating and/or AC systems, a special task has been assigned to the advisors by the National Energy Agency. The agency ensures the quality of advice given, by educating the energy advisors and by collecting reports of their work. The agency produces brochures and leaflets as well as information material for the internet. Support is also given by identifying those building owners who are affected by the directive so that they can be easily contacted by the advisors.

As a result of the cooperation between different authorities, an attachment with information about energy saving measures is distributed together with the EPCs.

### Personal advice carried out by professionals not focusing on energy efficiency

Accredited EPC assessors, chimneysweepers and service personnel for heating systems meet regularly with building owners and are encouraged to give information about energy efficient measures. Customised information material has been developed by the National Energy Agency in order to support these meetings. See the relevant country report in the “Book: 2016 – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports”.

### Other dissemination of information

Information material tailored for owners of large heating systems has been produced and is offered free of charge (Figure 2).


*Figure 2. Information material for owners of large heating systems.*

## Impact and equivalence assessment

Due to the lack of data at a system level, Sweden has chosen to use the top-down method to describe the impact from the measures mentioned above on heating systems according to the EU framework.

The impact of advice has been estimated based on reports submitted by the energy advisors. Several studies have been carried out in Sweden during the last years on the effect of the advice given by energy advisors, and also a system has been developed for collecting data from visits. These efforts will lead to better estimates of future energy savings. Table 4 shows the assessment of energy saved in heating systems. The assessment comprises advice given by energy advisors and during on-site inspections by energy experts issuing EPCs, via a mandatory survey, but data from chimneysweepers was not available at the time of the assessment.

| | Calculation of outcome of final energy savings (MWh) | | |
|---|---|---|---|
| **Source of advice** | **2014** | **2015** | **2016** |
| On-site inspections by municipal energy advisors | 0 | 780 | 810 |
| On-site inspections by other skilled professionals | 2470 | 2590 | 2290 |
| Written information (websites, brochures, leaflets etc.) | 0 | 970 | 660 |
| *Total* | 2470 | 4340 | 3760 |

*Table 4. The assessment of energy saved in heating systems.*

Preliminary results indicate that the number of companies that have been assessed is fewer than estimated. At the same time, the number of large individual heating systems fired with fossil fuels has decreased by 14% from 2011 to 2015. National statistics show that the use of energy for heating of apartment buildings and facilities has decreased between 2003 and 2015, from 398 TWh in 2003 to 370 TWh in 2015, although the building stock has increased (Figure 3).

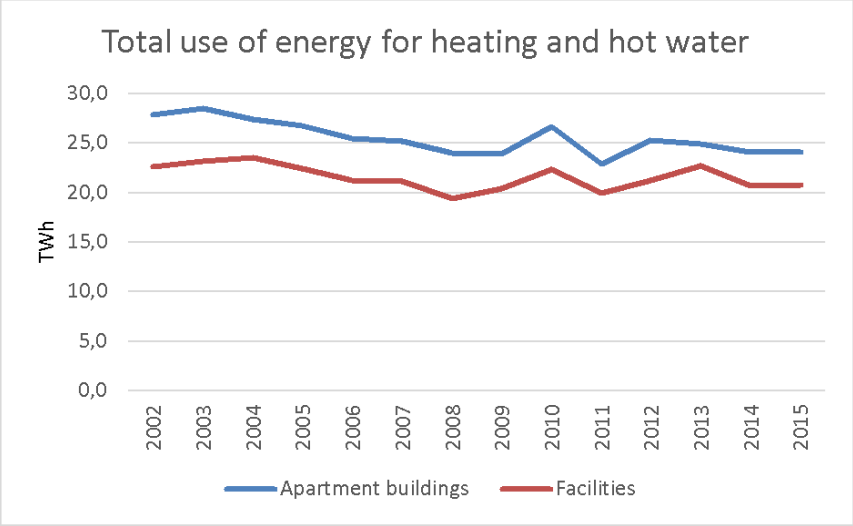


*Figure 3. National statistics show that the use of energy for heating of apartment buildings and facilities is decreasing.*

## *2.IV.iii. Progress and current status on AC systems*

The methods to improve energy performance of AC systems overlap with those for the heating systems, and the activities are similar.

### Personal advice focusing on energy efficiency

Municipal energy advisors are also offering advice to building owners with large AC systems, and the support from the National Energy Agency also includes AC systems.

### Personal advice carried out by professionals not focusing on energy efficiency

Within the procedures of compulsory control of ventilations systems, the assessors are obliged to give suitable advice on how to reduce the use of energy.

Service engineers working with cooling systems are also encouraged to provide information about energy efficient measures.

### Other dissemination of information

Information material tailored for owners of large AC systems has been produced and is offered free of charge.

### Impact and equivalence assessment

Cooling systems are almost always powered by electricity and it is hard to separate the energy used for cooling from electricity used for other purposes. Due to this lack of data, Sweden has chosen to use the bottom-up method to describe the impact of advice on cooling systems according to the EU framework. Assessments on the number of AC systems and the potential for energy savings have been made based on information from the EPC protocols. Table 5 shows the assessment of energy saved in AC systems. The assessment only comprises advice given by energy advisors and on-site inspections by experts performing EPC and ventilation control, but data from service engineers was not available at the time of the assessment.

| | **Calculation of outcome of final energy savings (MWh)** | | |
|---|---|---|---|
| **Source of advice** | **2014** | **2015** | **2016** |
| On-site inspections by municipal energy advisors | 0 | 210 | 230 |
| On-site inspections by other skilled professionals | 2260 | 2370 | 2380 |
| Written information (websites, brochures, leaflets etc.) | 30 | 160 | 90 |
| *Total* | 2290 | 2740 | 2700 |

*Table 5. The assessment of energy saved in AC systems.*

The Swedish climate is generally favourable for avoiding or reducing the need for cooling. In order to make AC systems more efficient, it is essential to control heating and cooling together to ensure that the building is neither over-heated nor over-cooled. The main benefit of the chosen alternative measures is that the energy advisor gives advice on both aspects.

# 3. A success story in EPBD implementation

## The database for EPCs

Sweden has used a national database for EPCs since its implementation in 2006/2007. The database holds, up to this date, approximately 660,000 EPCs.

The database contains a unique set of information concerning the energy consumption in the Swedish building stock. The EPCs are mainly based on measured energy consumption, and the quality is ensured by the fact that the EPCs are issued by certified assessors. The EPC is, in most cases, preceded by an on-site inspection of the building. This makes the database and the information therein valuable for statistics and research, as well as for monitoring and evaluation of the energy use in the building stock.

In addition to these areas of use, the database is also the foundation in making information on energy performance of buildings available to the general public and to potential building buyers or tenants. Furthermore, the database is also used for supervision activities, and for the development of regulations.

## Actual energy consumption

The use of actual energy consumption as the basis of buildings' energy performance assessment has been important for achieving better energy efficiency for buildings.

Among others, this approach contributed to the construction and real estate industry focussing on construction quality, efficient building management and efficient operation of technical building systems, and provided incentives to increased measurement of the energy consumption, thus raising awareness and knowledge, which, in turn, contributed to the application of further measures to reduce the actual energy use. For the above reasons, the use of actual energy consumption for the building energy performance assessment has the strong support of the construction and real estate industry. Further regulation has been developed on how to determine the energy performance based on actual energy consumption connected to normal use of the building.

# 4. Conclusions, future plans

As the EPC energy classes are dynamic and evolving over time, Sweden is working on further developing the NZEB-levels in the energy classes of the EPCs. Energy classes are, in the near future, going to be adapted to primary energy factors. Regulations for NZEB will come into effect in July 2017, and further sharpening of the requirements will take place in 2021.

Sweden is also investigating the possibilities of implementing a life-cycle assessment of the building requirements.

# Endnotes

1. Boverket is the Swedish National Board of Housing, Building and Planning
2. Boverket´s regulation and general advice about determination of the normal energy use of a building during a normal year
3. www.boverket.se/sv/PBL-kunskapsbanken/regler-om-byggande/boverkets-byggregler/energihushallning
4. Energimyndigheten
5. http://energilyftet.learnways.com
6. www.boverket.se/sv/lag--ratt/forfattningssamling/gallande/bbr---bfs-20116/
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8. www.boverket.se/sv/bidrag--garantier/hyreshus/stod-for-renovering-och-energieffektivisering-i-vissa-bostadsomraden
9. www.skatteverket.se/privat/fastigheterochbostad/rotochrutarbete/villkorforattfarotavdrag.4.5947400c11f47f7f9dd80004014.html
10. www.boverket.se/contentassets/1fc456aa2c514a4fb7c3dd84a78a0299/2017-06-01-trend--energideklarationer.pdf
11. www.epbd-ca.eu/ca-outcomes/2011-2015

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