CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

EPBD implementation in Norway

Status in December 2016

AUTHORS

Tor Brekke, *Enova*; Olav Karstad Isachsen, *Norwegian Water Resources and Energy Directorate (NVE)*; Martin Strand, *Norwegian Building Authority (DIBK)*

NATIONAL WEBSITES

www.enova.no, www.nve.no, www.dibk.no

1. Introduction

Directive 2002/91/EC has been fully implemented in Norway since 2010. Energy performance requirements for new buildings were revised in 2010 and most recently in 2015, coming to full effect as of 1 January 2017. By the end of 2016, approximately 650,000 EPCs had been issued. The majority of these concern houses and apartments, while 24,000 concern non-residential buildings.

Directive 2010/31/EU has not been included in the EEA Agreement[1] yet, and is thus not implemented in Norway. The Norwegian Government has decided to incorporate the directive into the EEA Agreement with necessary adaptations.

In 2016, the state-owned energy administration Enova took over as operator of the EPC scheme. An evaluation of the scheme is ongoing and may lead to changes in 2017. The Norwegian Water Resources and Energy Administration remains responsible for the control and use of sanctions related to EPCs.

This report presents an overview of the current status of implementation, as well as of further plans for improvement of the schemes available under the EPBD in Norway, among others minimum requirements, certification (EPCs) and inspection systems including the status of quality control mechanisms, the status of qualified experts in the market, information campaigns, and incentives and subsidies.

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

In 2012, a broad agreement in the Norwegian Parliament stated that all new buildings should be at "*Passive House*" level in 2015, and NZEB by 2020.

The two Norwegian standards for passive houses and low-energy buildings are already in place. These are the NS 3700 for residential buildings, and the NS 3701 for non-residential buildings[2]. The definition of the "*Passive House level"* from the political agreement was to be implemented in the building regulations in 2015. In November 2015, the new requirements were published and have been effective since January 2017. The requirements of 2015 do not fully meet the Norwegian passive house standards, but are set at a more cost-optimal level.

The requirements for 2020 shall be set so as to comply with the EPBD, but they are yet to be defined.

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

The Norwegian building regulation, mandatory since 2017, includes two options to fulfil the requirements. For non-residential buildings, only the first option is allowed.

- The first option contains specific energy limits for different building types. The requirements are set in kWh/m^2 useful energy demand per year within the building envelope, considering heat recovery from ventilation systems but not considering system losses and energy export. If this option is chosen, a set of absolute minimum requirements must also be fulfilled.

- The second option (only for residential buildings) addresses different components of the building envelope as well as requirements for technical installations and solutions. The requirements will be considered fulfilled, if it is proven that 9 specific energy measures are applied. In addition to requirements concerning insulation and envelope airtightness, there are specific requirements for the heat recovery of ventilation air in the ventilation apparatus (yearly mean heat recovery rate) and the specific fan power (SFP) factor. These are the requirements shown in Table 1.

In order to ensure flexibility in heating systems and to facilitate systems based on renewable energy, all buildings larger than 1,000 m^2 shall have flexible heating systems, normally waterborne, and must be able to utilise low-temperature heating distribution systems. Single-family houses need to have a chimney flue, unless flexible heat distribution is installed. Installation of heating systems prepared for fossil fuels is not allowed. As Norwegian electricity production is almost exclusively based on renewable energy and fossil fuels are to be phased- out from buildings, primary energy factors are not used in the regulations. To stimulate local renewable production when electricity is produced on the property (more than 20 kWh/m^2 per year), the specific energy limit can be exceeded by 10 kWh/m^2 per year.

The Norwegian energy requirements are set for 13 different building categories. Indicatively, Table 1 shows the progress over time of certain aspects necessary to fulfil the Norwegian minimum energy requirements for commercial buildings, single-family houses and apartment buildings.

Requirement	1997	2007	2010 (after Directive 2002/91/EC)	2015 Specific requirements only applicable for residential buildings
Net energy demand (kWh/m^2 per year)	-	Single-family house: 125 + 1,600/m^2 heated floor area	Single- family house: 120 + 1,600/m^2 heated floor area	Single-family house: 100 + 1,600/m^2 heated floor area
		Apartment: 120	Apartment: 115	Apartment: 95
		Commercial building: 165	Commercial building: 150	Commercial building: 115
Maximum area of glass plus doors	20% of heated floor area	20% of heated floor area	20% of heated floor area	25% of heated floor area
Max U-value: exterior wall W/(m^{2}K)	0.22	0.18	0.18	0.18
Max U-value: roof W/(m^{2}K)	0.15	0.13	0.13	0.13
Max U-value: exposed floors W/(m^{2}K)	0.15	0.15	0.15	0.1
Max U-value: glass/doors W/(m^{2}K)	1.6	1.2	1.2	0.8
Thermal bridges (max linear U-value) W/(m^{2}K)	-	Single-family house: 0.03	Single-family house: 0.03	Single-family house: 0.05
		Other buildings: 0.06	Other buildings: 0.06	Apartment buildings: 0,07
Minimum efficiency of heat recovery in ventilation air	60%	70%	Single-family house: 70%	80%
			Commercial building: 80%	
Minimum airtightness (Max air changes/hour at 50 Pa pressure difference)	Single-family house: 4.0	Single-family house: 2.5	Single-family house: 2.5	0.6
	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5	Other buildings (with more than two floors): 1.5	
Max SFP factor kW/(m^3/s)	-	Single-family houses: 2.5	Single-family houses: 2.5	Single-family houses: 1.5
		Non-residential building: 2.0	Non-residential building: 2.0	
Max screening factor for glass/window (gt)	-	-	0.15 (all buildings)	

Table 1. Minimum energy requirements for buildings in Norway.

Table 2 shows the absolute minimum requirements that must be fulfilled if using the option of net energy demand limit.

U-value exterior wall W/(m²K)	U-value roof W/(m²K)	U-value exposed floors W/(m²K)	U-value glass/doors W/(m²K)	Airtightness (air changes/hour at 50 Pa pressure difference)
≤ 0.22	≤ 0.18	≤ 0.18	≤ 1.2	≤ 1.5

Table 2. Minimum requirements under the "specific energy limits" option.

Since 1 January 2013, all new buildings are required to be controlled by an independent expert at the end of the construction process. For larger residential buildings and for non-residential buildings, the control will be more extensive than for single-family houses. Air leakage testing is mandatory for all building types and must be documented according to the current standard.

As the requirements regulate the net energy demand, no primary energy factors are available.

The Norwegian standard for the calculation of the energy performance of buildings is NS 3031, which is derived from EN 15603. The regulation of 2015 is based on the 2014 version of NS 3031.

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

The 2012 agreement on climate issues in the Norwegian Parliament stated that the building requirements in 2020 will correspond to NZEB level. This was again stated by the government in 2015, when the new requirements were presented. However, the concept of NZEB in a Norwegian context has not yet been defined. Up until now, the national support scheme for buildings has been more ambitious than the energy performance requirements, and regional programmes have worked well to increase the amount of very energy efficient buildings. The Norwegian support scheme for new buildings meeting the criteria of the "*Passive House*" standards has therefore been replaced by a new programme for even more ambitious projects. Support is given in particular to innovative solutions to improve technical systems and heating systems. A first suggestion for the NZEB requirements and a roadmap for the work towards a NZEB definition including necessary assessments were delivered by the Norwegian Building Authority to the responsible ministry in March 2017.

Actions towards the implementation of NZEB public buildings are not applicable in Norway.

Figure 1 shows one of the first residential NZEB houses in Norway, which is a good example of what can be achieved.

Heating	12.9 kWh/m² year
Hot water	29.8 kWh/m² year
Ventilation fans	4.4 kWh/m² year
Cooling	0.0 kWh/m² year
Technical equipment	17.5 kWh/m² year
Pumps	0.8 kWh/m² year
Lighting	11.4 kWh/m² year
Others	0.8 kWh/m² year
Total	76.8 kWh/m² year

Figure 1. Norway´s first NZEB, a single-family house, was completed in 2012 and has since been in operation. The table shows the specified calculated energy need.

After the first full calendar year in use, the actual energy used for the operation of the house (excluding outdoor pool and other consumption not related to the building operation) was about 6,500 kWh, and the produced electricity from the solar panels was 7,126 kWh.

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

Pipes, ducts and equipment used for the building´s heating system must be insulated. The thickness of the thermal insulation must be cost-optimal and calculated according to a European standard, e.g., the EN 12828:2012+A1:2014 or the DS 452:2013.

2.II. Energy performance requirements: EXISTING BUILDINGS

2.II.i. Progress and current status of existing buildings

In general, the measures applicable to renovation of existing buildings are the same as the requirements for new buildings. The local authorities can give exemptions from the requirements under certain conditions. This applies to necessary remodelling, renovation and change of use, and in cases when, for example, the requirements will be unreasonable compared to the energy savings the measures will provide. For extensions, additions, underpinning and change of use, the requirements only apply to the new part of the building.

Heating	5.9 kWh/m^2 year
Hot water	1.4 kWh/m^2 year
Ventilation	2.3 kWh/m^2 year
Cooling	1.3 kWh/m^2 year
Lighting	7.7 kWh/m^2 year
Others	0.8 kWh/m^2 year
Total	19.4 kWh/m^2 year

Figure 2. 'Powerhouse Kjørbo' with the specified calculated energy need during operation.

The renovated office building "*Powerhouse Kjørbo*" demonstrates the possibility of transforming a typical 1980s office building into a plus-energy building, generating more energy during its lifetime since renovation than what will be consumed in that period for production of materials, construction and operation and demolition. The project was completed in 2014 and was awarded the BREEAM-NOR "*Outstanding*" classification, the highest classification in BREEAM-NOR (http://ngbc.no/breeam-nor/). The project also fulfils all requirements in the Norwegian passive house standard for non-residential buildings, NS 3701. The building produces energy using tilted solar panels on the flat roofs.

2.II.ii. Plans to improve the existing building stock

As for new buildings, the concept of NZEB in a Norwegian context has not yet been defined. The requirements in force from 2017 are considered as a step towards NZEB requirements, which are scheduled for 2020. A first suggestion and a roadmap for the work towards a NZEB definition including necessary assessments was delivered from the Norwegian Building Authority to the responsible ministry in March 2017. There are also financial and technical support schemes available through a government-financed agency as described below.

Plans for renovating the existing building stock towards NZEB are not applicable in Norway. But through Enova, grants are given to renovation projects, capacity building, etc. Many research projects are also working towards cost-efficient renovation methods. In 2017, the Parliament approved a proposal to prohibit the use of fossil oil for heating in all buildings from 2020. State owned buildings have already replaced all heating boilers that were running on fossil oil.

Directive 2012/27/EU (EED) is not implemented in Norway, and thus national renovation plans are not applicable. However, there is a political intention to incorporate the directive into the EEA Agreement with necessary adaptations.

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

For residential buildings, there is a set of requirements on component level, whereas for non-residential buildings the requirements apply to the building as a whole. As these requirements can be very difficult to fulfil for existing buildings, designers and builders might argue that they have performed a cost-optimal calculation and found that the requirements would be too costly to fulfil, and therefore build less energy efficiently. Still, constructors will have to build as energy efficiently as economically and technically feasible.

2.II.iv. Encouragement of intelligent metering

By 2019, all customers of electricity will have an advanced consumption meter. This will allow for automatic reading and will facilitate further installation of various intelligent systems for management and control.

For heating and cooling, there are requirements to measure the heat energy for space heating and domestic hot water in non-residential buildings and apartment blocks. The purpose of these measurements is to encourage energy management.

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

For small residential buildings, incentives are established to motivate owners to upgrade their building, when renovating, so as to approach the standard for new buildings. Subsidies are offered to develop a thorough plan for the upgrade and to cover some of the investment. The support scheme is connected to the EPC, and is also coordinated with preferential loans. There are also subsidies for single technologies, like heat pumps, bio-solutions for heat, solar energy, etc.

For multi-family residential buildings and non-residential buildings, there is financial support for mapping building portfolios as a basis for larger energy upgrading projects covering all parts of a portfolio. Upgrading projects are able to access subsidies. For buildings owned by municipalities, there are in addition preferential loans available. The use of energy performance contracting for buildings owned by municipalities has in recent years increased, taking advantage of the described incentives. This has initiated large energy projects with 25 – 35%[3] reduction of energy consumption in existing buildings.

2.II.vi. Information campaigns / complementary policies

Information campaigns generally work in synergy with financial incentives when directed towards the building owners, motivating them to make use of the incentives. There have also been information campaigns targeting the supplier side of the market, informing about new building codes, an upcoming ban on fossil fuel heating and the importance of advising the home-owner on energy upgrading when renovating.

A national information centre on energy in buildings answers approximately 60,000 questions annually via telephone, webchat, social media and e-mail. The centre also contributes to certain web based discussion forums, offering expert advice to homeowners regarding renovation of private homes, certification, subsidies, technical issues, etc.

2.III. Energy Performance Certificate requirements

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

The legislation regarding energy performance certification has been in place since 1 January 2010 under the Energy Act, but following a political discussion, the regulation was revised as of 1 July 2010.

The EPC for both residential and non-residential buildings is valid for 10 years, or until major changes are implemented in the building. EPCs are issued by Enova after on-line registration of building data. The registered data are stored in the database at Enova premises.

The owner of a building or apartment is responsible for the registration and presentation of an EPC at the point of sale or rent. The EPC shall be part of the marketing material to inform interested parties about the energy performance. The majority of the registered EPCs concern houses. Each apartment needs to have an EPC, whereas for non-residential buildings the EPC is normally issued for the building as a whole. Of a total number of 670,000 EPCs as of December 2016, 96% concern houses. Table 3 shows the building stock and the corresponding number of EPCs in 2016. The data is extracted from Statistics Norway and Enova's register of EPCs, and estimates are based on these statistics.

Experience shows that most of the EPCs for residential buildings relate to permanent houses; only a small proportion concerns holiday houses. Likewise, registration is well-advanced at the point of sale, and much less at the point of rent. The number of new EPCs in 2015 fits well to the sum of new and sold houses. Of the total number of approximately 3 million dwellings, 20% had an EPC by 2016. This number is growing year by year.

Building type	Existing stock in 2016	Newly built in 2015	Sold in 2015	Rented in 2015	Total with EPC	EPCs issued in 2015
House or apartment	2.5 mil.	31,000	86,000	n.a.	600,000 (estimation)	100,000
Holiday house	0.45 mil.	10,000 (estimation)	27,000	n.a.		
Non-residential buildings in total	2.6 mil.	80,000 (estimation)	n.a.	n.a.		
Non-residential with EPC-obligation	0.25 mil.	7,500 (estimation)	6,000 (estimation)	n.a.	20,000	2,000

Table 3. Total building stock and number of EPCs.

Figure 3. Two examples of EPCs or energy labels on the entry wall of non-residential buildings.

In the non-residential sector, approximately 8% of the buildings which have the obligation of certification, already have an EPC. Experience shows that most of the certifications concern buildings above 1,000 m^2 (obligation for EPC display; see III ii). The market for sale and rent is not as uniform as the market in the residential sector, and energy certification is in practice much less developed.

2.III.ii. Quality Assurance of EPCs

Quality assurance of EPCs takes place at three different levels:

- During registration, the energy certification system performs data validity checks and there are strong restrictions on what data are eligible. Normally, the data has to be within a certain range, thus excluding typing errors and misunderstandings. Also, there are restrictions to avoid false values. Most important is that the energy grade A cannot be achieved unless a leakage test of the building has been done according to standard procedures, and the date of the test has been registered.
  For simple registration of houses or apartments, there are even stronger restrictions as to what types of data are allowed to be registered. Only experts, who typically have the required professional knowledge and competence, are allowed to insert data.

- The most important quality assurance is the control performed by the buyer who reads the EPC and demands that data be correct. The EPC is designed to enable the reader to understand the main input data used. Sellers are in general well-aware of the obligation to give correct information to the market.

- Independent control. The first controls by NVE (2011-2012) concentrated on the existence of the EPC and, if relevant, whether the EPC was presented to potential buyers, or in the case of large non-residential buildings, to the users of the building. In the control carried out in 2016, the sample in question was also controlled for input values to the calculation of the energy label.

The first sanctions were issued in 2015 based on the lack of valid EPCs or inspection reports. Of a sample of 81 non-residential buildings, 61 building owners were addressed with warning of sanctions. In this first round, the owners were given ample time to conform to the requirements. A decision of compulsory fine was decided for 8 companies concerning 13 buildings. All the cases were finalised in December 2015 with fines for 5 companies (7 buildings).

A new round of controls with another sample is in process and planned to be finalised in early 2017. This round has also served as basis for Enova's evaluation of the present scheme to identify possible improvements to the system.

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

The directive's requirements for public buildings in Norway relate to all non-residential buildings. Thus, the regulation does not distinguish between public and private buildings above 1,000 m^2.

Since these buildings have an ongoing obligation to obtain and display the EPC, the task of informing the building owner on the EPC obligation has been simpler than for non-residential buildings being sold or rented. The understanding among developers of new building projects seems to be well developed – in particular among owners who want to demonstrate high quality buildings. A typical example is office buildings with headquarters for well-known companies. The knowledge and practical experience is less developed among owners of existing buildings.

A general impression is that a number of municipalities are lagging behind in certification due to budget constraints.

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

Since Norway has only implemented Directive 2002/91/EC and not Directive 2010/31/EU, building owners are not required to include energy labels in all advertisements, for instance in newspapers.

The regulation does, however, require building owners to use the EPC or a summary of it, in the marketing of the building for sale or rent. The label and certificate must thus be included in the total amount of documents being presented to the potential buyer.

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

The Norwegian regulation requires inspections of both heating systems and AC systems.

2.IV.i. Progress and current status on heating systems

Since 2010, owners of heating systems based on fossil fuels are obliged to have the boiler inspected every four years. For systems older than 15 years, an inspection of the whole heating system is required.

There are no trustworthy statistics available on the number of systems actually in use, although an estimate by NVE is 100,000 systems. Most of these are considered to have the obligation of inspection. In Enova's registry, only around 1,000 reports can be found. This is obviously not a success for this scheme of inspections.

Parallel to establishing the inspection scheme, more attention has been given to the political wish of phasing-out fossil oil from the heating of buildings. This has led to a steep decline in the use of fossil fuels in buildings, and a number of systems are already dismantled. In the building regulation it is already decided that the installation of fossil oil based systems in new buildings is illegal as of 1 January 2017. New boilers using petroleum for base load have been banned since 2011. The use of fossil oil for heating in existing buildings is banned as of 2020.

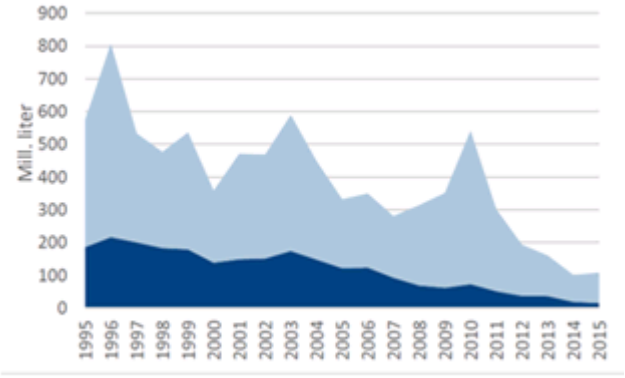

Figure 4. Decline in the use of heating oil (light blue) and kerosene (dark blue) in households and non-residential buildings, 1995 – 2015 (Norwegian Institute of Petroleum).

2.IV.ii. Progress and current status on AC systems

Since 2010 it has also been mandatory to have an inspection of AC systems. Most AC systems in Norway are for ventilation purposes only, possibly with cooling integrated in the system. The regulation thus requires that systems with a nominal effect above 12 kW, or systems that serve in total a heated area above 500 m^2, must be inspected every four years.

There are no trustworthy statistics available on the number of systems covered by this regulation, but an estimate would be 100,000 systems. As of December 2016, 4,000 systems for cooling and 18,000 ventilation systems have been inspected. Although far from all systems are inspected, this scheme has

been well-introduced in the market. For the system owner it is common practice to order an inspection as part of the regular maintenance, and in turn use the report as basis for further action. The industry organisations for maintenance and installation have undertaken an important role in providing information on the scheme, and this has proven to be vital for the results.

2.IV.iii. Enforcement and impact assessment of inspections

The same procedures for control and sanctions are in place for inspections as for energy certification. The sample of buildings, which was controlled in 2014, was controlled for the existence of both. Most compulsory fines were related to negligence of the obligation for both certification and inspection.

In Enova's current evaluation, the schemes for inspection of boilers, heating systems and AC systems are also under scrutiny.

3. A success story in EPBD implementation

Preparing the market for stricter energy performance requirements

On 1 January 2016, new and stricter energy performance requirements came into force in Norway. A one-year period of voluntary use, which has been in place before they became mandatory in January 2017, has helped all parts of the construction market to implement the new regulations. This implementation requires a change of the way buildings are constructed, though. Better planning and more cooperation between different technical professions would lead to an increase in the production of compact, airtight and well-insulated buildings, with well adapted technical installations.

The work of preparing the market for the new regulations started in 2010. Several concepts of energy efficient buildings had been tested out. Based on this, the German concept of *Passivhaus* was selected and adapted to Norwegian circumstances. A strategy was developed to share building knowledge among planners and contractors and to lift the concept into the Norwegian market for new buildings. The most important measures were:

- developing standards which describe the concept in detail for various building categories (as described under 2.I.i);
- guidelines and support to develop pre-studies establishing frontrunner-projects;
- substantial economic support to frontrunner-projects demonstrating the concept in all building categories, covering large parts of the country;
- access for planners to a highly professional team of *passive house* experts to mentor the planning of each project;
- communication about the concept and about front-runner projects;
- access to passive house training at different levels for various stakeholders.

The Norwegian programme[4], including the abovementioned elements as well as some other measures, was established in 2010. The programme ran for a period of three years. In some building categories, more than 10% of new buildings were built as *passive houses*.

Evaluations (see endnote 4) show that the programme has led to innovation and increased knowledge about building energy efficient buildings. An important key to success was the cooperation between several governmental organisations, research institutions, property developers and trade organisations in the building sector.

The evaluation documented that the most ambitious part of the market for buildings was changed, as a result of the process, but it was an open question if the rest of the market would follow. Now, almost two years later, new performance requirements were set close to the standards established in the programme. This is securing the spread of knowledge and techniques for building energy efficient buildings in a new way, which will soon be seen as the normal way.

4. Conclusions, future plans

Although Norway has only implemented Directive 2002/91/EC, Directive 2010/31/EU is also actively pursued, as there is a political decision by the government in Norway of its implementation with necessary adaptations. The result of current negotiations on the proposed revisions to the EPBD will also be considered for implementation.

The requirements for new buildings have recently been revised, and they are up for a new revision by 2020. The new requirements will be in line with a national definition of NZEB.

The energy certification and inspection schemes are currently under evaluation and possible revision to ensure the best effect in the market. By transferring the responsibility from NVE to Enova, the conditions are in place for a better coordination of these schemes with the considerable sum of programmes for information, technology dissemination and subsidies of measures for efficiency. Whereas the EPC until now has, to a large extent, been an isolated issue, there will now be options for the EPC to be integrated in the evaluation of applications and recommendations for good building owner practice.

NVE remains responsible for control and use of sanctions. This activity is scaled up to become an intrinsic part of the schemes, underlining the obligation to building owners.

Endnotes

1. The Agreement on the European Economic Area.
2. *NS 3700: 2013 Kriterier for passivhus og lavenergibygninger – Boligbygninger, NS 3701: 2012 Kriterier for passivhus og lavenergibygninger – Yrkesbygninger* (www.standards.no).
3. Experiences from approximately 50 EPC-projects in Norwegian municipalities in 2010. See also report "EPC in the Nordic countries"
4. See the evaluation report *"Evaluering av Enovas passivhusprogram"* for a presentation and evaluation of the programme (In Norwegian).

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